



# GUIDELINE

1140

## COMMISSIONING OF AtoN EQUIPMENT AND SYSTEMS

**Edition 1.0**

**December 2017**



# DOCUMENT HISTORY

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Revisions to this IALA document are to be noted in the table prior to the issue of a revised document.

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## 1. INTRODUCTION

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In very general terms, the process to manufacture and/or supply a product/system is based upon the following sequence of activities, with commissioning generally taking place in a number of forms across the final three activities:

- Requirements and specification development;
- Design (preliminary and detailed);
- Manufacture/assembly;
- Testing (Factory Acceptance Tests or FAT);
- Delivery;
- Integration/installation/deployment.

It is fundamental in providing effective Aids to Navigation (AtoN) that their performance and reliability meet the operational needs. To ensure this is achieved, it is important that components, equipment and systems are checked before implementation, fitment and use. The impact of ineffective AtoN equipment verification can extend far beyond the inconvenience and additional costs of having to undertake an unplanned repair. The delivery of these important services could have a direct impact on safe navigation.

A specific form of commissioning is often undertaken during a Factory Acceptance Test (FAT) where a supplier of equipment or a system must demonstrate to the purchaser that the requirements and specifications have been successfully implemented and met. Any defects or issues noted at the FAT that do not conform to the requirements and specifications need to be corrected before the equipment leaves the factory. The responsibility for ensuring the equipment conforms to the requirements and specifications therefore remains with the supplier at this time. It is cheaper to correct defects at the factory rather than in the field. A staged payment for the equipment is often linked to successful passing of the FAT.

## 2. SCOPE

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The concept of commissioning can be applied to a wide range of equipment and systems, such as the fit of mooring components, through to the commissioning of remote monitoring and control systems. Often the phases of commissioning develop from the smaller discrete items, built up to complete assemblies and systems.

This can extend to the complete supply and checking of parts, equipment, tools and instruction to ensure efficient and effective implementation of an AtoN installation. This is critical at remote and difficult to access locations.

Commissioning should be considered a key part of any quality system in ensuring no defective parts or systems are employed on operational AtoN.

The extent or scale of these tasks need to reflect the size, complexity or criticality of the equipment or system being deployed. Additionally, the scope of these tasks may be applied to a first of type production solution, but significantly reduced to the production product.

## 3. CONCEPT OF COMMISSIONING

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Commissioning is often thought of as the act of getting something working and confirming its correct operation in service. It can range in complexity from a simple visual verification such as an AtoN character, through to an elaborate process dependant on measurement and / or historical data. More elaborate commissioning procedures are essential for the ever more complex systems that are required for AtoN and e-navigation.



Commissioning especially needs to be focused on those aspects that impact on the effective performance on the AtoN and as such, every component that contributes to this needs to be identified and commissioned.

Some examples of those aspects, in relation to AtoN, are provided in Section 4.3 of this guideline.

The key purpose of commissioning is to ensure that the correctly specified components are used. These may then be built up to form assemblies, which assemble and function as designed and specified. Records of all measurements and functions need to be recorded to allow the process to be repeated if necessary and to inform others of what is correct.

The extent of testing that should be done needs to be reflective of the importance and size of the product or system that is being replaced.

## **4. THE IDENTIFICATION OF CRITICAL FACTORS**

### **4.1. WHAT NEEDS TO BE CAPTURED?**

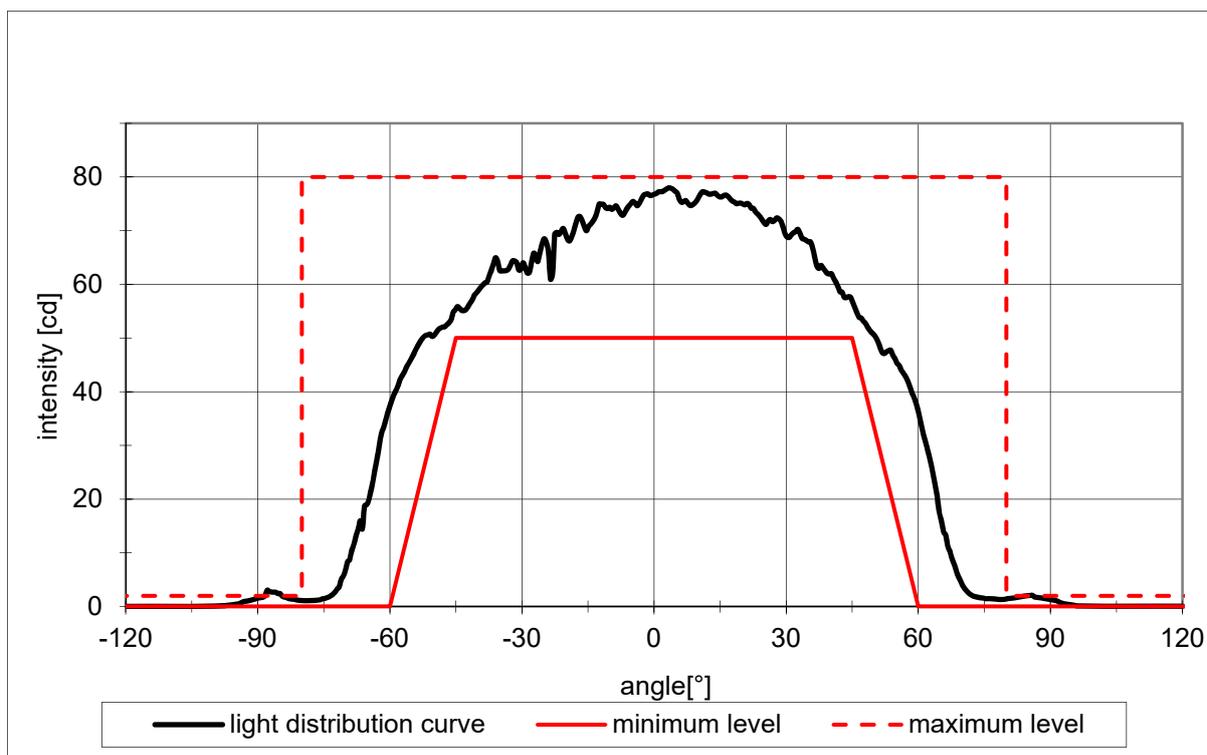
Throughout the design phase, the design engineer should identify the critical factors that need to be measured, checked or functionality tested. Some of this information may be supplied by manufacturers of equipment or materials and may be presented in the form of certification of performance.

In addition to the requirement for final operational performance, there can also be critical limits for transporting hazardous goods or equipment such as batteries in order to comply with statutory regulations. The early identification of such constraints is important to avoid unplanned difficulties in the delivery of AtoN equipment to a depot and the subsequent onward delivery to the AtoN site.

### **4.2. MEASUREMENT AND VISUAL CHECKS**

The identification of critical factors will also determine the manner in which such factors are to be checked. This is usually in the form of either measurement or visual. Examples of each of these could be:

- lantern optical performance – measurement within tolerance (see Figure 1);
- battery connectivity – visual;
- battery state of charge – operational measurement;



**Figure 1** *Light distribution curve showing tolerances*

### 4.3. EXAMPLES OF KEY COMMISSIONING CHECKS FOR VARIOUS ATON TYPES

Some examples of key commissioning checks for AtoN are provided in the following sections. This list is not exhaustive and is meant to provide general guidance. A more detailed commissioning process can be developed, based on the equipment, the system and the navigational and operational requirements.

An example of a more detailed commissioning procedure is provided as Appendix 1.

In all cases, the inclusion of relevant photographs should be considered as they are a useful addition to any commissioning process and provide good visual records of the process.

#### 4.3.1. BUOY COMMISSIONING

- Colour
- Top mark
- Light character
- Position
- Size and integrity of mooring and attachments.
- Any equipment attached.

#### 4.3.2. LANTERN

- Intensity<sup>1</sup>
- Colour
- Environmental rating
- Character
- Current draw

<sup>1</sup>The peak intensity is normally stated by the supplier. The effective intensity (and therefore range) can be calculated based on the flash length as per IALA guidelines.



- Input voltage – Load & No Load
- Levelling of the lantern
- Position
- Main / Stand by operation
- All LEDs working (if appropriate)
- Mariner's viewing
- Connection to power supply
- Physical attributes: size, weight, material etc.
- Reference number (manufacturers serial number)

#### 4.3.3. SECTOR LIGHTS

- Intensity
- Character
- Colour
- Environmental rating
- Current draw
- Input voltage – Load & No Load
- Levelling of the lantern
- Position
- Main / Stand by operation
- All LEDs working (if appropriate)
- Sector angle
- Sector cut off
- Mariner's viewing
- Connection to power supply.
- Physical attributes: size, weight, material etc.
- Reference number (manufacturers serial number)

#### 4.3.4. LIGHT SOURCES

- Focussing
- Intensity
- Colour
- Mariner's viewing
- Character
- Current draw
- Input voltage – Load & No Load
- Main / Stand by operation

#### 4.3.5. POWER SUPPLIES

- Size and suitability
- Terminal integrity
- Voltage – Load & No Load
- Current draw on load
- Ventilation
- Physical security
- Hot spots
- Reference number (manufacturers serial number)

#### 4.3.6. CONTROL SYSTEMS

- Functionality as per requirements and specifications:



- Control (e.g. Nav Light ON/OFF; Main / Standby operation, switch to Emergency Lights on Main Light failure etc.)
- Rotation sensing (if appropriate)
- Monitoring (e.g. interface to telemetry system for Status of AtoN, Alarms, analogs such as Battery Voltage etc.)
- Local indications of Status and Alarms
- Local testing (e.g. test Main to Standby operation etc.)
- Size and suitability
- Terminal integrity
- Surge protection devices / lightning protection
- Voltage – operating range
- Current draw on load
- Ventilation
- Physical security
- Hot spots
- Relevant drawings and Operating Handbooks available

#### 4.3.7. AIS AtoN

- See Guideline 1098

#### 4.3.8. RACON

- Position
- Morse code character
- S&X band working from ships report
- Voltage – Load & No Load
- Current draw
- Physical security
- Reference number (manufacturers serial number)

## 5. RESPONSIBILITIES FOR COMMISSIONING

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The responsibility for commissioning lies with the competent authority deploying the aid. For the FAT, the responsibility remains with the supplier until the equipment or system is handed over, however, it is the responsibility of the AtoN authority to ensure the FAT commissioning is carried out in a complete and appropriate manner.

Commissioning or testing prior to deployment is the responsibility of the AtoN authority as is commissioning after installation or deployment. It is important that any commissioning is carried out by competent personnel, either within the AtoN authority or out-sourced to a third party. There may often be number of options for third party testing and indeed this is sometimes a regulatory or specification-driven requirement.

It is preferable that commissioning is carried out by personnel who have not been directly involved in the installation or deployment, especially with more complex equipment or systems. This allows a “fresh look” at all the relevant requirements and specifications to ensure they conform. It may be that the Design Engineer or specifier is best placed to carry out the commissioning as that person has the best overview of the requirements and specifications. However, it is accepted that this may not always be practical due to time or resource limitations and that installation personnel will carry out the commissioning. There may also be a mix of both internal and external responsibilities in the commissioning process.

Commissioning responsibilities should be clearly stated in the commissioning procedure or checklist.

## 6. MEASUREMENTS AND RECORDS OF PARAMETERS

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It is important throughout the commissioning or during each commissioning phase, that records of any measurements and tests are captured. This provides a historical record for the future and confirmation of performance, leading to a level of confidence to proceed to the next stage.

Such records allow a baseline of operation to be captured for future comparison and assessment. A repeat of these tests through a product life will inform of any degradation and hence allow a prediction of end of service life.

One of the most essential measurements is the verification of performance, usually against a reference or standard. An example could be the material of chain to a relevant standard or the measurement of a lantern intensity and character or sectors to an IALA Recommendation.

Alternatively, it could be confirmation of the correct operation of a diesel generator set following a mains failure. Either way, it is important that the steps taken are recorded to allow this operation to be repeated in the future.

Whatever it is, the method of verification should be identified in the commissioning procedure or checklist.

As already noted, the inclusion of relevant photographs in the Commissioning Report is also a very useful addition.

All the tests and measurements should be compiled into a Commissioning Report and distributed and archived as appropriate.

## 7. FUNCTIONALITY

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The functionality of individual items need to be proven in isolation and then slowly built up into more complete and complex systems. Proving at each stage will ensure the predicted operation is achieved. This process should always be undertaken where full facilities are available to remedy any issues encountered.

Such testing, allows confirmation of functionality, both during correct and adverse operating conditions. This is applicable to both hardware and software.

This highlights the importance of both positive and negative testing which proves the correct operation and simulates faults and failure modes in line with the designed operation. It is important to conduct Negative Testing to prove how the AtoN will perform in a fault condition and that it performs as it is designed to do. While most testing can be envisaged before the testing or commissioning commences, further tests may become obvious when the tester is in front of the equipment or system. Such additional tests should be carried out and results recorded. Any subsequent tests on similar equipment or systems can then have these additional tests included.

## 8. LINK TO FUTURE MAINTENANCE

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The measurements taken at the time of commissioning allow comparison to the original baseline giving the opportunity to evaluate performance and assess or predict service life. Such information is useful in planning for replacement before having to react to a failure. This ensures continuity of service to the mariner as well as ensuring the availability of the aid conforms to IALA requirements.

Occasionally, for critical factors, certain parameters are monitored remotely to ensure a failure or deviation of such a parameter against the baseline, can be responded to. An example of such a parameter could be the system battery voltage.

Naturally, a record of functional checks and how these were achieved, allows confirmation of correct operation of a system throughout its life. In order to avoid maintenance induced failures, such a test should be non-intrusive, otherwise the frequency of such a test should be balanced against the benefit they bring.



It is also important to capture setting, configuration and measurements during commissioning as such information provides a useful reference when replacing equipment. More complex systems may include a software or firmware version which should be noted. This ensures that any replacement equipment is configured the same as the original and allows a repeat of identical tests to confirm correct operations. Spare units can then be configured if required to be sent to a site.

Consistent configuration, setup and testing of common equipment can aid in the early identification of common faults, aiding in the adoption of a proactive approach to rectification before unplanned failure.

## 9. VALIDATION

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Although it is important to capture, measure and record all factors that can influence the effective performance of an AtoN, it should also not be overlooked that validation by the customer or key stakeholders is also a critical factor in concluding commissioning.

Such validation may be achieved through observation by the customer or stakeholder, but could also be achieved through evidence of how the mariner uses the new AtoN.

## 10. MONITORING

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As part of assessing effective unattended operation in line with the expected functionality, a period of normal operation 'soak test'<sup>2</sup> should be monitored and recorded. This is ideally done prior to deployment where additional parameters can be monitored that may not be available when remotely monitored. An example is temperature of certain components e.g. LED units.

To determine the longer term effectiveness of the systems, user feedback can be captured and used as evidence to support any further changes or as further validation to the design.

Over the long term, monitoring of the performance of systems and equipment is important and can provide useful information such as trends e.g, seasonal battery voltage. Such information informs designers, engineers and organisations alike for improvements and optimisation of future design. This leads to the elimination of common failures connected to a historical design solution and returns a cost saving to organisations as well as continuity of service to the mariner

## 11. REFERENCES

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- [1] IALA Guideline G1008 on Remote Control & Monitoring.
- [2] IALA Guideline G1077 on Maintenance of Aids to Navigation.

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<sup>2</sup> Soak testing involves testing a system with a typical production load, over a continuous availability period, to validate system behaviour under typical use



## ANNEX A    AN EXAMPLE OF A TEST SHEET

### Checking, installation and commissioning PROCEDURE RESULTS

The following instructions shall be followed for the checking, installation and commissioning of SABIK ODSL-200 Sectored 6 and 12 tier LED lantern. Tests and checks show the outcome of the Commissioning of the equipment and peripherals.

Contact xxxx.

Completed document is to be forwarded to Project Manager.

**Site ID:** .....                      **Site Name :** .....

#### CHECKING AND SETUP OF LIGHT – IN THE DEPOT

**Date:** .....                      **Completed by:** .....

Item	Checking/ Setup step	Checking / Setup Procedure	Expected Results	Result	Comments
1	Confirm all equipment has arrived safely and is clearly identified.	a. Identify and check all components of the light.	All components present.	Yes/No	
		b. Inspect for any physical damage.	No visible damage.	Yes/No	
		c. Confirm all units are clearly identified with Maximo numbers (where applicable).	All applicable equipment have Maximo labels.	Yes/No	



Item	Checking/ Setup step	Checking / Setup Procedure	Expected Results	Result	Comments
2	Check Current draw	a. Connect lantern and confirm current draw.	Current draw is available and polarity is correct.	Amps: Day: <hr/> Night off: <hr/> Night on: <hr/> Amps Pass/Fail	
3	Confirm lantern photocell is operating	a. Power up lantern with adequate light on photocell.	Lantern does not come on.	Yes/No	
		b. Power up lantern and cover photocell.	Lantern comes on.	Yes/No	
4	Confirm Character Setting	a. Confirm character setting matches with ANS attached. (ANS may be draft copy only for new installations)	Character setting matches ANS.	Yes/No	
5a	Confirm sector plate Cutouts	a. Setup light on flat level surface approximately 5m from clear wall space. Remove weather cover (if fitted) and affix sector bearing check plate with arrow and string line to top of LED lantern.	Lantern setup with sector bearing check plate and arrow affixed	Yes/No	
5b		b. Sector Cutout 1 check bearing (from seaward) <hr/> Secure string line to wall, setup the first sector cut out and rotate the sector bearing plate to match the bearing as per ANS. Rotate the Lantern until the string line lines up with the other side of the sector, check angle on sector bearing plate. Do not adjust sector bearing plate	Sector cutout 1 1 <sup>st</sup> bearing edge <hr/> Sector cutout 1 2 <sup>nd</sup> bearing edge <hr/>	Sector matches ANS Yes/No	



Item	Checking/ Setup step	Checking / Setup Procedure	Expected Results	Result	Comments
5c		<p>c. Sector Cutout 2 check bearing (from seaward)</p> <hr/> <p>Check angles on sector bearing plate for the second sector cut out. Do not adjust sector bearing plate.</p>	<p>Sector cutout 2 1<sup>st</sup> bearing edge</p> <hr/> <p>Sector cutout 2 2<sup>nd</sup> bearing edge</p> <hr/>	Sector matches ANS	
5d		<p>d. Sector Cutout 3 check bearing (from seaward)</p> <hr/> <p>Check angles on sector bearing plate for the third sector cut out. Do not adjust sector bearing plate.</p>	<p>Sector cutout 3 1<sup>st</sup> bearing edge</p> <hr/> <p>Sector cutout 3 2<sup>nd</sup> bearing edge</p> <hr/>	Sector matches ANS	
5e		<p>b. Sector Cutout 4 check bearing (from seaward)</p> <hr/> <p>Check angles on sector bearing plate for the fourth sector cut out. Do not adjust sector bearing plate.</p>	<p>Sector cutout 4 1<sup>st</sup> bearing edge</p> <hr/> <p>Sector cutout 4 2<sup>nd</sup> bearing edge</p> <hr/>	Sector matches ANS	
6	Confirmation Sectors match ANS	Check sector angles match ANS attached	Sector match ANS	Yes/No	If Yes – proceed to 7 If No – recheck sectors and if still wrong quarantine the light and contact supplier



Item	Checking/ Setup step	Checking / Setup Procedure	Expected Results	Result	Comments
7	Record Intensity Setting	Read and Record Intensity setting. (No setting available to confirm against for new installations)	Intensity setting recorded.	Intensity: _____	
8	Prepare light for mobilisation	a. Secure sector bearing plate with tek screw to handle to stop from rotating.	Sector bearing plate secure	Yes/No	
		b. Roll up and leave string attached to sector bearing plate and affix weather cover.	String attached to sector bearing plate, weather cover affixed	Yes/No	
		c. Place light back into box, ensuring the name on the box matches the name on the light	Name on box matches light	Yes/No	
		d. This document to be completed and packed with the light	Completed document scanned and packed with light	Yes/No	



## INSTALLATION OF LIGHT – ON SITE

Date: .....

Completed by: .....

Item	Installation step	Installation / Commissioning Procedure	Expected Results	Result	Comments
1	Confirm all equipment has arrived safely and is clearly identified.	a. Identify all equipment by checking off against checklist.	All equipment present and labelled.	Yes/No	
		b. Inspect for any physical damage.	No visible damage.	Yes/No	
		c. Confirm all units are clearly identified with Maximo numbers (where applicable).	All applicable equipment have Maximo labels.	Yes/No	
2	Inspection of existing lantern stand.	a. Identify the mounting position and confirm the mounting requirements for the new lantern as per the drawings.	All equipment can be installed as per drawings.	Yes/No	
		b. Identify the mounting position and confirm mounting requirements for the lantern junction box as per the drawings.	All equipment can be installed as per the drawings.	Yes/No	
		c. Inspect for any physical damage or corrosion to existing lantern stand	No visible damage.	Yes/No	
3	At the regulator board, confirm input and output of circuit breaker and that the polarity is correct.	a. With the circuit breaker in the off position, measure the input voltage.	12VDC is available and polarity is correct.	_____ Volts Pass/Fail	
		b. With the circuit breaker in the off position, measure the output voltage.	0VDC is available.	_____ Volts Pass/Fail	
4	Confirm existing lantern is isolated from regulator board	a. Remove lantern cover/ existing junction box and test for voltage.	0VDC (lantern is isolated).	_____ Volts Pass/Fail	



Item	Installation step	Installation / Commissioning Procedure	Expected Results	Result	Comments
5	Remove existing lantern	Disconnect cable from lantern and remove lantern and any other mounting equipment associated with the existing lantern. Existing cable to be re-used and connected to new junction box.	All equipment removed from lantern stand.	Yes/No	
6	Bearing setup	a. Attach theodolite mounting stand to theodolite using the theodolite mounting bolt. Fix the mounting stand with theodolite to the existing lantern stand. Level Theodolite.	Theodolite mounted to lantern stand and level	Yes/No	
		b. Locate true north and mark on site for future reference (eg handrail) other positions can also be used as reference/check	True north and/or other positions marked on site for future reference	Yes/No	
		c. Remove theodolite mounting stand from lantern stand	Theodolite stand removed.	Yes/No	
7	Installation of new Sectored LED lantern.	a. Determine whether installed height of the lantern (base of the lens) is greater than 50mm above the horizontal plane of any obstructions.	Lantern lens base is installed greater than 50mm above the horizontal plane of any obstructions.	Yes / No	If no go to 7b If yes go to 7c
		b. Install extension stand as per the drawing to raise height of lantern to clear obstructions.	Extension stand installed. Lantern lens base is installed greater than 50mm above the horizontal plane of any obstructions.	Yes / No	
		c. Ensure all dissimilar metals are isolated with the use of nylon sleeves and washers as per the drawings.	Nylon sleeves and washers are installed and dissimilar metals are isolated.	Yes / No	



Item	Installation step	Installation / Commissioning Procedure	Expected Results	Result	Comments
		d. Remove weather cover to expose sector bearing plate. Do not adjust sector bearing plate. Position light to align the sector bearing plate to the correct orientation.		Yes / No	
		e. Ensure Lantern is level	Lantern level	Yes / No	
8	Install new lantern junction box.	a. Install junction box as per the drawing ensuring that the LED lantern cable can be installed. If there is an existing junction box, and the cables are not sufficient in length, the new junction box is to be installed between the existing junction box and new LED lantern	Junction box installed as per drawing and cable can be terminated.	Yes / No	
		b. Ensure all dissimilar metals are isolated with the use of nylon sleeves and washers as per the drawings.	Nylon sleeves and washers are installed and dissimilar metals are isolated.	Yes / No	
		c. Remove all sharp burrs and edges from junction box mounting rails.	No sharp burrs or edges exist.	Yes / No	
9	Installation Complete	a. As built dimensions taken of lantern installation, including wiring diagram/s.	As built comments completed	Yes / No	To be sent to PM
		b. Take photos of the complete site including cabling and terminations.	Photos of site taken	Yes / No	



## COMMISSIONING OF LIGHT – ON SITE

Date: .....

Completed by: .....

Item	Commissioning step	Installation / Commissioning Procedure	Expected Results	Result	Comments
1	Connect cable from lantern to junction box.	a. Connect cable from LED lantern to new junction box via cable glands and ensure correct polarity	Cable connected to junction Box via cable glands and polarity correct.	Yes / No	
2	Connect existing cable into the new junction box.	a. Inspect existing cable to ascertain it is in good working condition and can be utilised for the new LED lantern.	Existing cable can be utilised for the new LED lantern.	Yes / No	
		b. Connect existing cable into new junction box via cable gland reducing the length as required and ensure correct polarity	Cable connected to junction Box via cable glands and polarity correct..	Yes / No	
		c. Cable is to be secured with stainless steel insulated cable ties to lantern stand and affixed along the existing path to the regulator board .	Cable is secured by insulated cable ties.	Yes / No	
		d. Remove disconnect pin from junction box.	Disconnect pin removed.	Yes / No	



Item	Commissioning step	Installation / Commissioning Procedure	Expected Results	Result	Comments
3	Confirm that the LED Lantern powers up.	a. Enable circuit breaker at the regulator board and apply power to the terminal connections.	Circuit breaker enabled.	Yes / No	
		b. Confirm 12VDC power is available and the polarity is correct.	12VDC is available and polarity is correct.	Volts Pass/Fail	
		c. Insert disconnect pin back into junction box.	Disconnect pin reinstalled	Yes / No	
4	Check LED lantern operation.	a. Cover photocell to confirm lantern comes on.	Lantern comes on when photocell covered.	Yes / No	
		b. Check character setting is correct as per Draft ANS	Character setting confirmed as per Draft ANS	Yes / No	
		c. Compare character setting on the Draft ANS to the current ANS.	Both settings are the same	Yes/No	
5	Commissioning Complete	a. Site clear of tools and spare parts. No rubbish left behind.	Site clean and clear of hazards	Yes / No	
		b. Confirm sector check from vessel. - Confirm and record angle of visibility of auxiliary light as per AMSA sector check procedure AtoN6-3 and AMSA1524 Sector check form;	Sectors confirmed and correct	Yes / No	