IALA GUIDELINE

G1064
INTEGRATED POWER SYSTEM LANTERNS (SOLAR LED LANTERNS)

Edition 1.1

December 2009

urn: mrn:iala:pub:g1064:ed1.1

10, rue des Gaudines – 78100 Saint Germain en Laye, France
Tél. +33 (0)1 34 51 70 01 – contact@iala-aism.org
www.iala-aism.org
International Association of Marine Aids to Navigation and Lighthouse Authorities
Association Internationale de Signalisation Maritime

DOCUMENT REVISION

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

Date	Details	Approval
December 2009	First issue	Council 46
July 2022	Edition 1.1 Editorial corrections.	

CONTENTS

List of Figures

1. PURPOSE

This Guideline provides an overview and guidance for the use of integrated power system lanterns.

2. DEFINITION

An integrated power system lantern (IPSL) is defined by a device that includes:

- A photovoltaic power source
- Power storage
- Charge regulation
- A lens focussed LED light source
- Rhythmic character coding
- Day/night switching capability
- Ability to accept external programming commands
- Ability to isolate the light to facilitate shipping & storage
- Options of the inclusion of GPS and communication modules (possibly to indicate battery status etc.).

All the above are housed together in a single unit.

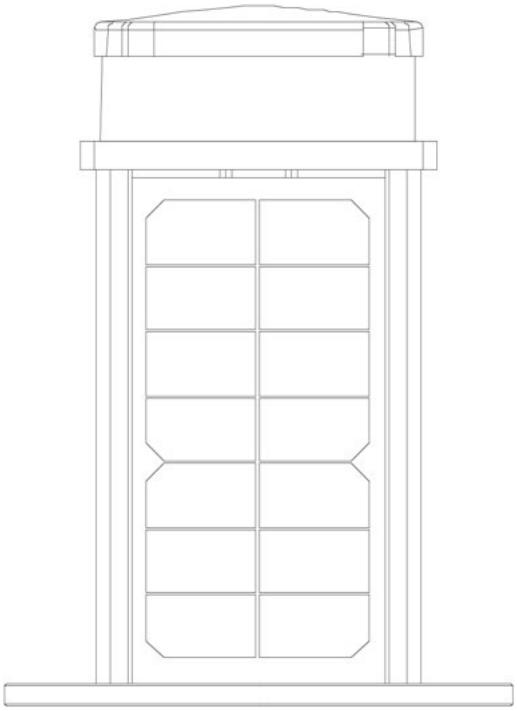

Figure 1 Generic impression of an IPSL

3. OVERVIEW

IPSL has application advantages for certain situations. By incorporating modern technologies, they can be small, durable, reliable, cost effective and fully self-contained. Technological advances in light emitting diodes (LEDs), photovoltaics (Solar Panels), and batteries complement each other and facilitate a compact lantern. In order to operate efficiently, these lanterns must be designed for a wide range of solar conditions (i.e., sunlight available to charge the lantern) while maintaining a specified optical output over the expected operating lifetime. These lanterns must match the application to ensure reliable operation.

4. APPLICATION CRITERIA

- Nominal range up to 5 NM
- Areas with good solar insolation (solar irradiation)
- Seasonal AtoN
- Areas that suffer from vandalism or theft
- Small buoys with limited weight carrying ability
- Emergency Wreck Marking Buoys.

5. LIMITATIONS OF APPLICATION

- Not in areas suffering from ice
- Not where nominal ranges greater than 5 NM are required
- Not in areas of poor solar insolation and shadowing by mountains
- Not where high duty cycle rhythmic characters are required.

6. SPECIFICATION TO INFORM A SUPPLIER

- Luminous range
- Vertical divergence
- Worst case geographical position
- Rhythmic character
- Mounting criteria
- Exact navigational application, e.g., port lateral
- Expected lifetime of unit (replacement period)
- Additional requirements e.g., GPS, Synchronization of units, monitoring etc.

7. OPTIONS

Some lanterns offer a means of interfacing with status communication modules. These modules may be fitted to provide remote monitoring of important parameters with wireless communications. These parameters include:

- GPS measured position and off-position alarm
- Battery voltage or health
- Lantern status.

These systems consume power and will affect the lantern's power balance. A larger lantern may be required to support this extra load while providing power for the AtoN.

- A limitation may be requested for the number of rhythmic characters available to simplify the programming procedure.
- Definition of a fixed luminous intensity can be made to ensure that programming errors are limited.

The common wireless communication methods include mobile phone networks such as GSM, Satellite communications and the Automatic Information System (AIS). Use of GSM is restricted to regions with reliable GSM coverage and will be subject to wireless fees. Satellite communications operate worldwide but the systems are typically expensive to both purchase and operate. The use of AIS for monitoring requires AIS base-stations to receive the messages.

8. CONSTRUCTION AND DESIGN

As the marine environment is very harsh on lanterns, it is important that they be of a strong construction and resistant to damage by passing ships, accidental sinking and other mishaps. UV stabilized Polycarbonate construction has the advantage of lower manufacturing cost over machined, cast, or extruded metal IPSL will need to be sealed and resistant to water ingress according to standards such as IP67. The possibility of battery replacement should be considered when specifying an IPSL.

The following IALA guidelines should be considered when designing:

- *G1067-0 Selection of Power Systems for Aids to Navigation*
- *G1067-1 Total Electrical Loads for Aids to Navigation*
- *G1067-2 Power Sources*
- *G1067-3 Energy Storage for Aids to Navigation*
- *G1043 Light Sources Used in Visual Aids to Navigation.*

9. VENTING

As rechargeable batteries can generate flammable hydrogen gas while charging, the possibility of a build-up of hydrogen gas must be considered when exchanging the old battery for a new one.

10. INTENSITY, RANGE AND POWER CONSUMPTION

Users need to specify the minimum intensity that is required for specific applications, consistent with IALA recommendations.

Desirable features, including creating consistency of autonomy across various rhythmic character duty cycles, while another design approach is to engineer the lantern so that its range is consistent across different rhythmic characters and pulse durations. Due to a human perceptual effect, there is a non-linear relationship between the durations of light flashes and the perceived intensity to an observer. Intelligent electronic control can account for these differences by employing effective intensity equations and ensure that any particular lantern will have the same range (i.e., a given intensity at a given distance) for all rhythmic characters.

11. PRODUCT SPECIFICATIONS

Every manufacturer of ISPL publishes specification sheets and will include some, or all, the following parameters.

11.1. LIGHT INTENSITY

Light intensity should be measured and published according to IALA Recommendation *R0203 (E200-3) Marine Signal Lights Part 3 - Measurement.*

11.2. RANGE

Luminous range should be calculated and published according to IALA Recommendation *R0202 (E200-2) on Marine Signal Lights Part 3 – Calculation, Definition, and Notation of Luminous Range*.

11.3. VERTICAL BEAM DIVERGENCE

Vertical beam divergence should be measured and published according to IALA Recommendation *R0203 (E200-3) on Marine Signal Lights Part 3 - Measurement.*

11.4. HORIZONTAL OUTPUT

Usually “360 degrees or omnidirectional”, this is simply the azimuthal range over which horizontal output is measured while rotating the lantern.

11.5. AUTONOMY

As detailed in IALA Guideline *G1067-0 Annex1*.

11.6. LATITUDE RANGE

Expressed as a range of degrees latitude (e.g., +50° to -50°), this is a rule-of-thumb range in which the IPSL can be expected to operate normally. In actual practice, local insolation (sunlight) data is required to conclusively determine whether a lantern will have continuous normal operation.

11.7. TEMPERATURE RANGE

Expressed as a temperature range in Celsius and Fahrenheit within which the lantern is capable of operating normally or possibly at minimal function. Solar panel, battery, LED and electronic performance all degrade to varying degrees with high temperatures.

11.8. ON/OFF LEVEL

Expressed in lux, this is the ambient light levels at which the lantern will turn on or off and should be in accordance with IALA Guideline *G1038 Methods and Ambient Light Levels for the Activation of AtoN Lights*. Manufacturers will frequently use solar panel voltages to estimate lux levels, while advanced designs will use dedicated photosensors.

11.9. LIGHT SOURCE

A brief description of the number, type and possibly the arrangement of LEDs providing the optical output of the lantern.

11.10. CHROMATICITY

Colour is usually expressed as being within certain general or preferred regions in the IALA Recommendation *R0201 (E200-1) Marine Signals Lights - Colours*.

11.11. RHYTHMIC CHARACTERS

Expressed as the number of rhythmic characters the lantern can be programmed for. This should include a steady state. Some manufacturers offer user configurable or custom rhythmic characters.

11.12. POWER MANAGEMENT

Provides information on the electronic control module and its methods/technology for managing the lantern's power balance (to maintain energy in = energy out). Care must be taken to ensure that the power management system does not adversely affect the desired light output intensity in operational conditions.

11.13. ADDITIONAL IMPORTANT SPECIFICATIONS

- Solar Panels – type, number, arrangement, wattage, UV protection
- Battery – type, number, amp-hours capacity, brand
- Lens Material – UV protection
- Battery venting – number, locations, type of seal (e.g., Gortex)
- Sealing – type of seals, waterproof standards (e.g., IP67, Nema 6)
- Weight – kilograms and pounds
- Construction – materials and grade
- Mounting – number and bolt patterns
- Lifetimes - serviceable lifetimes in years
- Environmental – compliance with environmental protections standards
- Weight
- Dimensions
- Vibration and Shock
- EMC/ESD - electromagnetic interference from sources such as VHF/UHF transmitters and discharge from lighting (25kv)
- Resistance to icing, wind, salt spray
- Method of programming by the user
- User replaceable parts and limitations

- Method of switching off the light when not in use

12. POWER SYSTEM MODELLING

Power system modelling should be carried out as detailed in IALA Guideline *1067-2*.

13. MAINTENANCE

While IPSL is designed as integrated units with a goal to be maintenance-free, certain maintenance events such as battery replacement may be necessary. Battery life depends primarily on ambient temperature and the type of battery. As a result, battery life can range from 2 to 8 years.

Manufacturers will have different approaches in their designs and methods. Replacement gaskets should always be included when the seals on a lantern need to be broken for maintenance. Wiring connectors should only connect one way, and the system should be protected against reverse polarity if accidental battery voltage reversal does occur. No special tool sets should be required, and the design should use simple conveniences such as battery handles.

The plastic or polycarbonate construction of the lenses, body and other parts should not require special cleaning materials and should be chemically inert as much as possible. Periodic cleaning of the solar panels and lens will ensure maximum power collection and light output.

14. DEFINITIONS

The definitions of terms used in this 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.

15. ABBREVIATIONS

AIS	Automatic Information System
cm	centimetre
EMC	Electromagnetic Compatibility
ESD	Electrostatic discharge
GHz	Gigahertz
GPS	Global Positioning System
IPSL	Integrated Power System Lantern
IP67	A seal protected against dust and immersion in water to a depth between 15cm and 1m
kV	kilovolt(s)
LED	Light-emitting diode
m	metre
MHz	Megahertz
NM	nautical mile
nm	nanometre(s)
Nema 6	National Electrical Manufacturers Association equivalent to IP67

UHF	Ultra high frequency (300 MHz and 3 GHz)
UV	Ultraviolet (light) (10 – 380 nm)
VHF	Very high frequency (30 MHz to 300 MHz)