



# ATON SIGNALS QUICK GUIDE

to equipment selection for  
fairway managers and  
port authorities

# ATON SIGNALS QUICK GUIDE

## to equipment selection for fairway managers and port authorities

### About this guide

Fairway managers and port authorities rely on various types of aids-to-navigation (AtoN) marine signals to ensure the safety and security of vessels while navigating fairways and for port entry and exit. With a range of options available on the market, it can often be challenging to select the right type of signal for your specific requirements – particularly when dealing with new ports and fairways or projects to upgrade existing solutions.

The type of visual AtoN that is most suitable for each application will depend on a variety of factors, including the size of the port, the width of the fairway, and the types of vessel served, as well as the local geography and prevailing weather conditions.

This guide aims to provide you with an overview of the issues that should be considered before making an investment decision and to help you select the AtoN signal lights that best meet your needs.

### LEADING LIGHTS

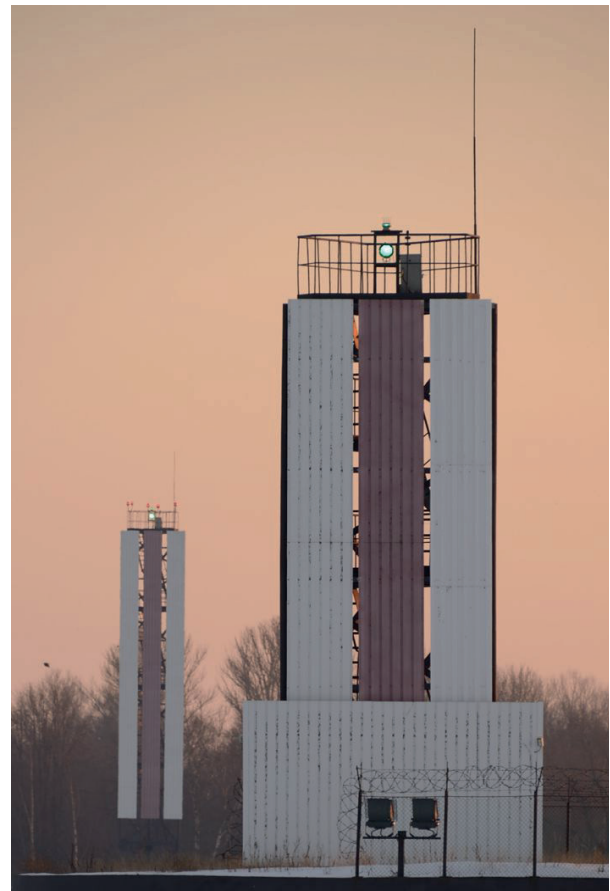
Leading lights, also referred to as range lights, are beacons that are used both day and night to mark safe passage for vessels along a fairway, through a shallow or dangerous channel, or when entering ports. They provide precise analog visual feedback to determine the vessel's location relative to the center of the channel.

Leading lights are defined by IALA as “A group of two lights, or of several lights in the same vertical plane, such that the navigator can follow the leading line by keeping the lights on the same bearing.”

The lights are typically spaced hundreds of meters apart, and in pairs, to form a continuous series of straight lines to guide vessels. The light nearest to the observer is the “front” light and the one furthest from the observer is the “rear” light, with the front light being at a lower elevation than the rear.

#### Things to consider

While leading lights offer a reliable and simple aid to navigation, geographical limitations can often make finding exactly the right installation location challenging. The lights must be installed precisely in line with the center of the fairway or port entrance, at exactly the right height and distance apart, which may not always be physically possible or economically feasible. For example, the location may not be available, or it may be deemed too expensive to construct new underwater foundations for lattice towers or other required infrastructure. It may also not be possible to rent the land, or the space on a building, needed for the correct positioning of the lights.



Leading lights in St. Petersburg, Russia

LO 200

Furthermore, leading lights likely cannot offer the level of accuracy required for safe navigation or port entry and exit on extremely tight fairways.

### Power consumption and maintenance

Modern leading lights have low power consumption requirements and can easily be powered by solar energy. In order to maintain visibility, it is important to have a robust maintenance schedule in place, including lamp cleaning as well as regular checks of the batteries and, where installed, the solar panels.

#### PROS

- Precise analog visual feedback to determine vessel location relative to center of channel
- Suitable for providing daytime and nighttime visual feedback
- The signal itself requires low capital expenditure (if it is a replacement and the structure is already in place)

### Choosing the right solution

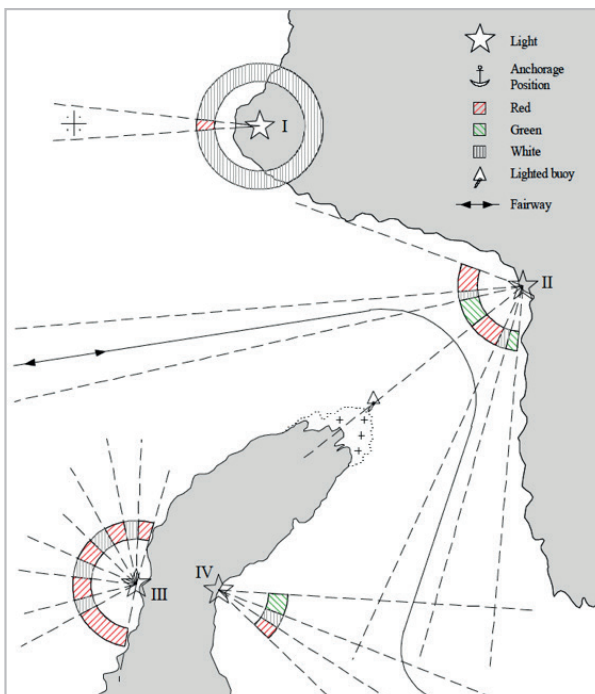
There are several factors to take into consideration when selecting a leading-light solution:

- The required visibility range – the correct intensity of light source needs to be selected depending on the required range of the light.
- The width of the fairway – narrow fairways may only require a single pair of lights covering three to four degrees; in wider channels it may be necessary to have several lights in a cluster to get the required horizontal divergence. In such cases, a more cost-effective option is to look for a solution that employs spreader-lens technology to extend the horizontal divergence with one light source.

#### CONS

- Installation costs can be high (e.g. for new lattice towers and underwater foundations)
- Placing the installation in the correct location may incur land rental charges
- The height difference required between the front and rear in each pair of lights may not always be possible

## OMNIDIRECTIONAL SECTOR LIGHTS



Omnidirectional lights are used exclusively in fairways as an aid to navigation. The different sectors in these types of lights can mark things such as a fairway, a turning point, a junction where one channel meets another, or a hazard.

Source IALA SECTOR LIGHTS 1041  
[www.iala-aism.org/product/sector-lights-1041/](http://www.iala-aism.org/product/sector-lights-1041/)

Sector lights are a tried and tested aid to navigation that have been in use since the 1800s. They are typically only used for nighttime navigation and provide directional information by displaying different colors and sometimes flash rhythms.

The IALA recommendations for sector lights state the following: “When a fairway is covered by a white sector, the convention to a vessel approaching the light from the seaward side must be a green sector to starboard and a red sector to port as per IALA Maritime Buoyage System colour convention for Region A; for Region B the colours are reversed. The white sector indicates safe passage.”

Omnidirectional sector lights are a cost-effective way to cover multiple fairways with a single installation and are a more affordable solution than leading lights for marking fairways. They can also be used to mark out very wide sectors.

However, standard omnidirectional sector lights do not offer the same level of light intensity, and therefore range, as solutions such as leading lights. Furthermore, if you need to mark out very narrow sectors on a fairway with a very small angle of uncertainty, look for the most precise omnidirectional sector lights, which allow a horizontal divergence of 0.5–1 degrees to be set. If even more precise sectors are needed, a projector sector light, which we look at in the next section, is the best choice. Their angle of uncertainty is only around 1-15 minutes of arc (0.02 – 0.25 degrees).

### Things to consider

With omnidirectional lights, it is important to consider what is known as the angle of uncertainty – the part of the arc where the color and/or the flash rhythm of the light changes and the observer is unable to distinguish between two sectors. Put simply, to ensure safe and accurate navigation, the smaller this angle is, the better.

Given the weather conditions that these lights are exposed to, they are susceptible to damage from lightning strikes or other events, meaning that it is not uncommon to have to replace them. With traditional sector lights, when this happens the correct setup should be redetermined, which can be challenging, time consuming, and costly as there are many factors to bear in mind, including things like tidal flow, currents, and background lighting.

This is why modularity is an important factor to take into account. Choosing a solution with a modular design with an easily replaceable lighting unit that is separate from the components that provide the sector divisions is recommended. This way, the light source alone can be replaced rather than having to rebuild the entire device from scratch onsite and then manually calibrating.

#### PROS

- A cost-effective way to cover multiple fairways with a single installation
- More affordable solution than leading lights for marking fairways
- Can be used to mark out very wide sectors
- Extremely low power consumption

### Power consumption and maintenance

Thanks to modern LED technology omnidirectional sector lights offer extremely low power consumption and require minimal maintenance. Like other modern marine lanterns, omnidirectional sector lights also support remote monitoring, although periodic cleaning is highly recommended to ensure correct functioning.



*New omni-directional sector light ODSL 200 installed on top of an old sector lighthouse in Pori, Finland*

**ODSL 200**

### Choosing the right solution

There are two main factors to take into consideration when selecting an omnidirectional sector light solution:

- The required angle of uncertainty – make sure the light's angle of uncertainty is precise enough to ensure safe and accurate navigation for your particular application
- Serviceability – a signal with a light source that can be changed without having to reconfigure the sector definitions will save a lot of time, effort, and money

#### CONS

- Higher angle of uncertainty compared to high-precision projector sector lights
- Lower light intensity – and therefore range – than other solutions such as leading lights
- Can be costly and time-consuming to install and calibrate correctly compared to leading lights
- Not suitable for locations with strong background light or for daytime use

## HIGH-PRECISION PROJECTOR SECTOR LIGHTS

When AtoN lighting needs to provide extremely precise guidance – for example when navigating into, within, or out of a busy port or along very narrow channels – only projector sector lights, commonly known as PEL lights, can deliver the required accuracy. Projector sector lights use a high-intensity light source that is clearly visible day and night, even against bright background lighting in ports. The visual range is up to six nautical miles (11 km) by day and 24 nautical miles (44 km) by night (at 0.74% transmissivity).

These types of lights guide traffic using the same principle as standard sector lights – by projecting a colored sector to help the observer determine their position within a fairway. However, they provide a much higher degree of accuracy – with color changes typically happening within one to 15 minutes of an arc. This results in an extremely small angle of uncertainty.

While projector sector lights are not the most economical solution in terms of capital expenditure, the cost must be balanced against the high degree of accuracy and corresponding contribution to safe navigation that they enable. In narrow or otherwise challenging channels, safety must always be the number-one priority and there is currently no other technological solution that can provide the level of visual feedback of projector sector lights.

### Providing highly accurate guidance using oscillating boundary technology

Some models of projector sector light can include an [oscillating boundary](#) system, where the entire filter assembly oscillates at a set number of cycles per minute. This causes the projected signal to rotate back and forth through an arc, meaning the observer sees only the color of the light coming directly towards them. The effect is to

see fixed colored sectors as with a standard omnidirectional sector light and new sectors where the color alternates between the colors of the fixed sectors on either side.

### Typical applications

This technology can be useful for helping a vessel pilot to set up a difficult turning maneuver by marking points on the approach to the turn.

#### 1. Early warning of lateral deviation

In channels where the intention is to help a vessel accurately maintain course on a desired track, an oscillating boundary makes any lateral movement obvious to the observer within a few seconds. The oscillating boundary gives immediate and accurate warning of a lateral deviation as small as six feet (two meters) at a distance of three nautical miles (six kilometers) from the light. The warning comes as the fixed white light is interrupted by a brief flash of color every three seconds. The duration of the flash increases as the vessel moves further from the center line.

#### 2. Proportional indication of lateral movement

As the observer moves across an oscillating sector, the duration of one color flash relative to the other changes continuously. As one color increases, the other decreases, but one cycle is always three seconds.

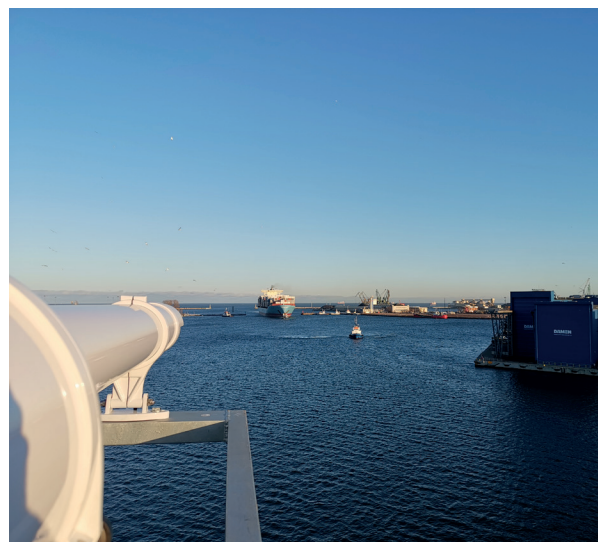
Projector sector lights are typically divided into three sectors, although five and seven are also possible, and the “safe” white sector can be extremely narrow, often less than the width of the ship’s bridge at the most distant point from the light. Where the intention is to keep a vessel accurately located on a desired track, a five or seven-sector configuration is normally used.

### Things to consider

Projector sector lights are installed on lattice towers at precisely the right angle to provide the required sector coverage. Because of the extremely sharp boundaries between the color sectors, it is critical to ensure that the installation height is accurate to provide the correct vertical divergence of the light. A projector sector light that is installed too low or too high could mean that the critical visual feedback it provides is not available just when the observer needs it most. It is important to specify a sector light that

#### PROS

- Extremely precise guidance
- Visible day and night
- Optional oscillating boundary system gives immediate warning of lateral deviation
- Single structure required for mounting



*Precision sector light PEL-4 guiding the way in Gdynia port, Poland*

#### PEL-4

meets your design criteria rather than a “good enough” solution limited by what a certain manufacturer’s technology can deliver. Choose a lantern with sufficient vertical divergence and where the width of the sectors can be adjusted freely, not only in certain increments, for example in 0.5 or 1.0-degree steps.

### Power consumption and maintenance

Modern projector sector lights use highly energy-efficient LED technology and are virtually maintenance free, which minimizes the need for costly lamp replacement. Their low power consumption also means they can easily run on solar energy.

### Choosing the right solution

Some of the most important things to consider when choosing a projector sector light are:

- Vertical divergence – choose a light that has a high enough vertical divergence to provide full visual feedback for all vessel sizes and bridge heights
- Prevention of lateral deviation – in narrow channels lights with oscillating boundaries provide an early warning if a vessel is straying off course
- Horizontal divergence – for the most accurate guidance, choose a light that allows full flexibility in terms of setting the lateral divergence along the whole navigable channel

#### CONS

- Relatively high CAPEX
- The very precise tower location and highly stable structure require a high level of expertise to design and install



## Summary

*Any decision to invest in visual AtoN should be based on a thorough risk assessment and understanding of the unique characteristics of the location in which it will be installed. A reputable equipment manufacturer or supplier will be able to advise you on the right solution for your needs.*

### Sabik Marine offers a range of visual AtoN products, including:

**VRL-74**, a modular medium to high-intensity light designed for applications requiring medium and long-range directional light, such as leading lights and port entry signals. It offers the possibility to cost-effectively adjust the horizontal and vertical divergence using spreader lenses

**ODSL 200**, a compact omnidirectional LED sector light with very accurate borders, this modular light unit also provides unprecedented serviceability

**PEL-4 and PEL-6**, precision projector sector light products with oscillating boundaries that provide very sharp sector boundaries and impressive range day or night

Sabik experts will be happy to help you define and select the equipment that best meets your needs.

**For more information, help, and advice please get in touch with your local Sabik representative**

**[sales@sabik-marine.com](mailto:sales@sabik-marine.com)**