Sealite®

WHITE PAPER

Vertical Divergence of Long Range Lanterns

www.sealite.com

We believe technology improves navigation™

Viewing long range lights at short range

Long range LED lanterns are often available with 'narrow' vertical beam versions for use on fixed structures. Generally these structures are quite tall. Often end-user customers ask whether these lights are also suitable for viewing at shorter ranges where the mariner may be considerably below the level of the light. Is it possible to lose sight of the light "below the beam"? The answer is emphatically NO and this paper will explain why.

Why are lighthouses often so tall? - Geographical range

In order to achieve sufficient visible range, medium and long range lights are often installed on ground of high elevation or structure height such as a cliff or tall lighthouse. This has to be done because the earth's surface is curved. Provided that the intensity is sufficient, the higher the light is mounted, the further it can be seen by a mariner. This is known as the geographical range and according to IALA Guideline G1065 this can be calculated from the following equation, which also takes into account the curvature of the earth and atmospheric factors:

$Rg = 2.03 \times \sqrt{ho} + \sqrt{Hm}$

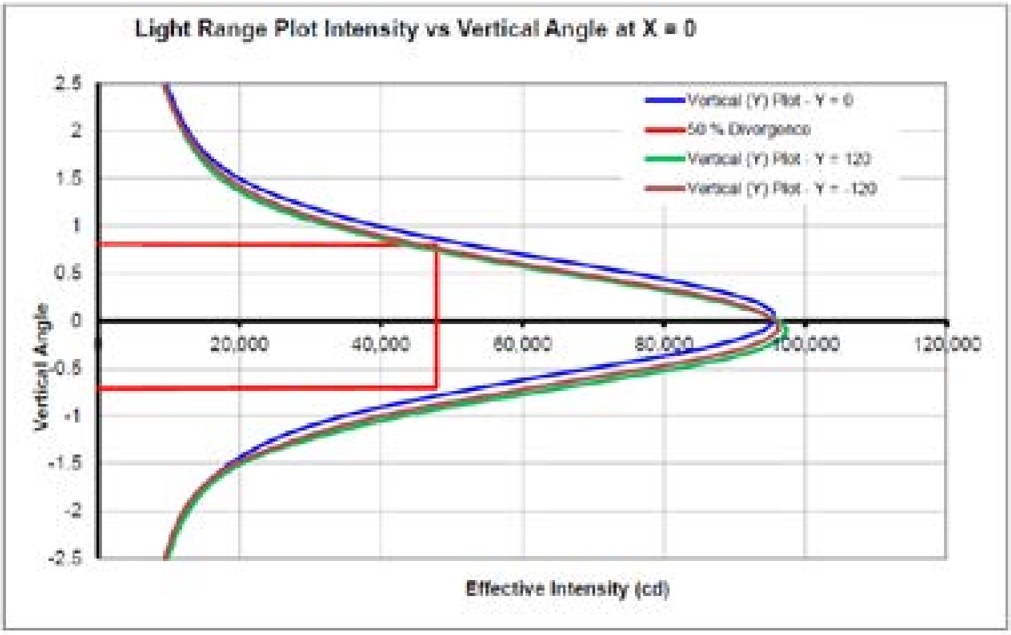
Where:

Rg is the geographical range in nautical miles, NM or M.
ho is the elevation of the observers eye in metres, m.
Hm is the elevation of the light above sea level, m.

Example 1: For an 18 mile light to be seen from a vessel with 10m bridge height it ideally needs to be at an elevation of 33m above sea level or more.

What is Vertical Divergence?

Lantern product datasheets specify product light output intensity in candelas (cd) and often display a graphical image showing how the intensity varies according to the vertical angle at which the light is viewed relative to the horizontal plane. For example see the Sealite SL-300-1D5 photometric plot below:



Example 1: SL-300-1D5 vertical photometric plot

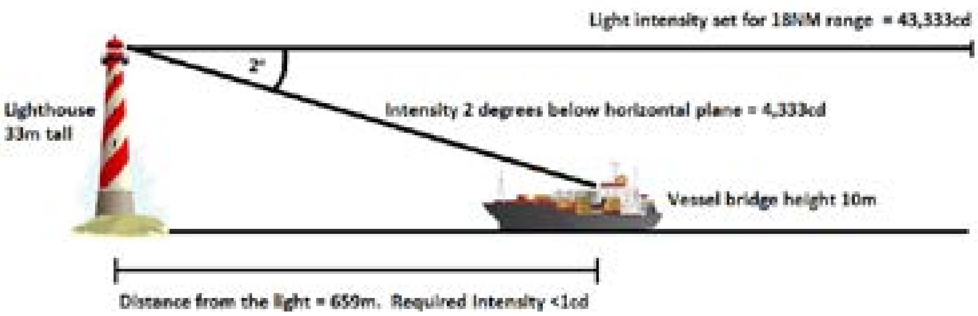
Since the vertical angle and intensity are both variables, it is normal practice to state a figure for vertical divergence based upon the angle above or below horizontal at which the intensity falls to 50% of the maximum. This is called Full Width Half Maximum (FWHM) shown in red on the plot above. Occasionally, the angle at which the intensity falls to 10% of maximum is used. This is known as Full Width Tenth Maximum (FWTM).

The published vertical divergence value on manufacturer's spec sheets does not represent the maximum vertical angle below which the light can be seen. The light can be seen at a much wider angle at close range below the level of the light, where less intensity is needed to achieve the same perceived brightness at the mariner's eye.

How much vertical divergence is needed for lights on fixed structures?

For a fixed structure and a lantern with a typical vertical divergence curve it can be shown that in theory a vertical divergence of only 0.5 degrees measured at FWHM (see IALA Guideline G1065) is sufficient to enable all observers to continue to be able to see the light from 1 mile up to the maximum viewing range. This means that the observer need not be concerned about the possibility of being 'below the beam' at short range.

This is true because as the observer approaches the light and the light is viewed from a progressively greater angle below the horizontal plane, the required intensity for the given distance decreases faster than the intensity output from the light.



Example 2: Using the SL-300-1D5 and the same lighthouse as Example 1

This shows that even at ranges of less than 1/2 mile, and even 23m below the level light, it will appear many times brighter than it did at 18NM - so it will not disappear.

At shorter ranges where only 1 candela or less is required to make the light visible at night the light will continue to greatly exceed the required output, ensuring it is visible. In fact the 'glow' of the lens would be visible even at angles of 45 degrees or more above or below the light due to internal reflections within the lens – see photo below:

The Sealite Advantage

The narrower vertical divergence versions of Sealite's SL-155 (2.5 degrees) and SL-300 (1.5 degrees) lanterns have been selected for fixed structures by many leading worldwide users including all three UK lighthouse authorities due to their outstanding efficiency, quality and technical suitability.

Because of the precisely engineered lenses, the beam is wide enough to cover all possible vessel heights at ranges from very close to the light up to the maximum visual range of the product without excessive loss of light where it is not needed.

The benefits of greater electrical efficiency include:

- Lower running cost.
- Less impact on the environment – lower carbon footprint.
- Possibility of solarisation, saving the cost of running diesel generators or maintaining a connection to the power grid.
- The lantern is smaller, lighter and therefore easier to install.

SL-155-2D5 Lantern, 2.5 degree lens enabling up to 14NM range from a self-contained SL-C600 solar system. Note the reflections from the narrow beam on the clothing of the technician.

SL-300-1D5 Lanterns, main and standby configuration, for an 18NM mile application at Sark Island for Trinity House Lighthouse Service, UK.

Further information about Sealite's class leading long range lantern products can be found using the follow links:

MARINE LANTERNS ➜

SL-300 ➜

SL-155 ➜