# TECHNICAL DATA SHEET 08-01
# VEGA VLB-44 LED LANTERN

## General Information

The Vega VLB-44 LED lantern is a versatile lantern capable of being installed on buoys, fixed structures and lighthouses. It is generally used when a self-contained LED lantern is not feasible or cost effective to operate. The lantern is available in white, yellow (except 2.5 degree), red and green, and three vertical divergences; 10 degrees (total to 50% peak intensity) for use on buoys, 5 degrees for fixed structures and 2.5 degrees for lighthouses. The narrow divergence (2.5 degrees) concentrates light in the horizontal plane, but requires a stable platform to remain level. This regulates the 2.5 degree lantern to lighthouses.

The VLB-44 is available with up to 8 tiers of LEDs to increase intensity. This lantern requires an external 12 VDC power source from a DC power supply or a legacy solar power system consisting of solar panels and rechargeable lead-acid batteries. Note: due to the nature of LED lanterns this signal can not be used with a color sector.

Vega VLB-44 5-Tier LED Lantern

## Selection Criteria

Intensity selection should be based on the operational requirements of the aid. To determine the intensity requirements for any aid, Districts shall use the standard procedures for selecting an AtoN light signal as prescribed in the AtoN Technical Manual (Chapter 6, Section 6.B, page 6-1)

and the Visual Signal Design Manual (Chapter 3). These references describe how operational range, luminous range, light color, light characteristic, background lighting, and meteorological visibility are used to calculate intensity needs.

The VLB-44 has a feature that allows the lantern to produce the same effective intensity regardless of flash rhythm. The intensities cannot be tabulated because the operating current and peak intensity capabilities are different for each flash rhythm. Use one of the solar design spreadsheets to select the lantern, number of tiers, color and flash rhythm, available at: http://www.uscg.mil/hq/cg4/cg432/publications.asp.

For most desired effective intensity settings, the user has the option of picking lanterns with different numbers of tiers. For a desired effective intensity, the greater number of tiers will lower the overall power draw. However, more tiers than necessary will significantly increase the cost of the lantern and the height. Unless there is a compelling reason, pick the lantern with the fewest number of tiers.

LED Version – The capabilities of LEDs are changing very rapidly. Periodically Vega uses new LEDs in a specific lantern (or group of lanterns). This impacts the lantern's intensity values, current draw and solar sizing. In order to identify the LEDs used in a lantern, Vega uses a 3-digit number to identify the "LED version." For example, the white LEDs available in late 2007 and early 2008 are designated version 421. LEDs available in mid 2008 are designated version 422. Consult with the manufacturer and the solar sizing spreadsheet to determine which LEDs will be available when the lantern is purchased. Lanterns will be labeled with the LED version, the LED version can be retrieved from the lantern using the IR programmer and solar sizing spreadsheets will contain all LED version information to determine the intensity and power requirements of older lanterns.

## Purchase

The VLB-44 is purchased from Vega Industries, Ltd, located in New Zealand. Some lanterns will be stocked at the ELC. Due to the time difference (generally 16 hours ahead of EST), correspondence with Vega is limited to FAX or email. Contact COMDT (CG-432A) for assistance when purchasing directly from Vega. Mailing address is: 21 Heriot Drive, Porirua, New Zealand, FAX: +64 4 237 4392, email: sales@vega.co.nz.

The following VLB-44 lanterns will be stocked at the ELC in project 98A (free-issue) for approved buoy, fixed aid and lighthouse projects (contact Son Nguyen: Son.T.Nguyen@uscg.mil).

| | |
|---|---|
| VLB-44-10 | Single tier buoy lanterns, white with a high base (all lanterns include bird spikes) |
| VLB-44-5 | Single tier fixed aid lanterns, red, white and green |
| VLB-44-2.5 | Eight tier lighthouse lanterns, white |
| Remote 1 | Vega infrared remote control |

If demand is sufficient, the buoy and fixed aid lanterns will be moved to Commodity 5 stock (MILSTRIP) in 2010.

Lanterns not listed above must be purchased directly from Vega using the following format:

VLB-44-(Color)-(Divergence)-(Tiers)-(Base Mount)

| | | |
|---|---|---|
| Where: | Color = | WHT, RED, GRN, YEL |
| | Divergence = | 2.5, 05, 10 for lighthouses, structures or buoys, respectively |
| | Tiers = | 1T, 2T…..8T for 1 through 8 tiers. |
| | Base Mount = | 3H (for 3 hole mount, regular base; if replacing a 250mm, you can order a 4-hole mount; 4H), use 3HH for high base on buoys. |

Example: VLB-44-WHT-2.5-6T-3H 6 Tier, White, 2.5 degrees, 3-hole mount.

*Additional Notes:*

- If ordering directly from Vega, you can specify the desired intensity setting and flash rhythm (preprogrammed).
- A high base **is required** for buoy installations to prevent obstruction by the lantern ring when viewed at low heights-of-eye.
- VLB-44 High Base; change the suffix from 3H to 3HH in the VLB-44 item description.
- Bird spikes are included. Replacement bird spikes are available; order part number 138-800, Bird Spikes.
- Standard cable length is 1.5 meters for VLB-44 2.5 and 10 degree versions. Specify 3 meter cable for 5 degree versions (structures) when purchasing lanterns (longer cables are available).
- Pricing is available from Vega and will include freight to the destination, including customs fees. Orders can be placed by fax using a credit card or purchase order.

# Programming - Overview

The lantern must be programmed to the proper flash rhythm and intensity before deployment.

The lantern is programmed using the Vega Infrared (IR) Remote Control or any Carmanah or RCA TV remote. There are about 30 different RCA TV Universal Remote Controls. The remote must be **initialized** so that the remote can communicate with the lantern. Different models have different initialization procedures. If the remote purchased uses a 3-digit code use code 0 3 9. If the remote uses a 4-digit code, then use code 1 0 3 9. **Consult the instructions that come with the remote**. Follow the "Direct Entry Method" for programming a TV as shown in the instructions. Initialization will likely take one of the following two forms (use the first one for the Carmanah remote):

| | | |
|---|---|---|
| Press and hold | **CODE SEARCH** | until red light on remote turns on |
| Press | **TV** | red light on remote will blink once |
| Enter | **0 3 9** | red light will blink once after each entry |
| | **or** | |
| Press and hold | **TV** | keep holding TV button! |
| Enter | **1 0 3 9** | **while still holding TV button** |
| Release TV button | | |

You are now ready to program the Vega VLB-44 lantern.

Gather the information needed to program the lantern; intensity and flash rhythm code (note: if the lantern is purchased directly from Vega for a specific project it may come pre-programmed. You can check the entries; see Programming – Reading a Program Setting detailed later in this instruction.)

**Standard CG Flash Rhythms**

| Rhythm | Code | Rhythm | Code |
|---|---|---|---|
| FL2.5 (0.3) | **310** | Q | **601** |
| FL4 (0.4) | **321** | Mo(A) | **801** |
| FL6 (0.6) | **337** | Iso 2 | **100** |
| FL (2+1) 6 | **472** | Iso 6 | **104** |
| FL (2) 5 | **406** | Oc 4 | **205** |
| FL (2) 6 | **416** | Fixed | **000** |

For lighthouses, the VLB-44 is intended to mimic a rotating beacon or flash rhythm emitted from a classical lens. Note: the flash duration of a rotating beacon is very short; on the order of 0.05-0.2 seconds. It is not practical to flash a LED lantern this quickly, so the "ON" time of the flash is extended. Generally, a flash length that corresponds to minimum duty cycle of 10% will yield satisfactory results (the exception, below is FL15(1) which is 6.7%). Duty cycle is the sum of the ON times divided by the period x 100. As an example, a FL5 rotating beacon can be replaced by a LED lantern emitting a FL5(.5) rhythm; 0.5 sec / 5 sec x 100 = 10%. Some group flash rhythms may have 20% duty cycles. The following is a list of nonstandard, but common *flashed* lighthouse rhythms used at CG aids. Also posted is the actual flash (FL) and eclipse (EC) times of each rhythm. For rhythms not listed here, consult with Vega's IR Programmer Manual or contact COMDT (CG-432A) for the correct code and any assistance in determining a compatible rhythm.

**Non-Standard Flash Rhythms**

| Rhythm | Code | FL | EC | FL | EC |
|---|---|---|---|---|---|
| FL5 (0.5) | **329** | 0.5 | 4.5 | | |
| FL7.5 | **343** | 0.8 | 6.7 | | |
| FL10 | **350** | 1.0 | 9.0 | | |
| FL15 | **354** | 1.0 | 14.0 | | |
| FL (2) 10 | **428** | 1.0 | 1.0 | 1.0 | 7.0 |
| FL (2) 15 | **435** | 1.0 | 2.0 | 1.0 | 11.0 |
| FL (2) 20 | **436** | 1.0 | 3.0 | 1.0 | 15.0 |

Intensity Setting – The intensity setting or value can be found on the solar design spreadsheet. A value of 1390, for example in the effective intensity (cd) block refers to an effective intensity of 1390 candelas and the code for that intensity is 1390.

## Programming Notes:

- Lantern must be programmed with power applied in daytime conditions outside or in a lighted room (lantern commanded off by the daylight control).
- Programming entries must not lag by more than 10 seconds or the lantern will exit the programming mode. Write down the programming codes for each session to avoid delays.

- The Infrared Receiver (IR) is located in the base of the lantern through a window just above the label. Aim the remote control here 6-12" from the lantern.
- The lantern enters the programming mode by pressing the "red standby", "power" or "program" key on the remote for 5 seconds. The lantern will display 4 quick flashes (.1 sec on, 0.1 sec off) indicating that it is in the programming mode.
- Each successful numeric keypad entry will result in 1 flash for each key pressed.
- Wait for the lantern to flash before entering the next digit (don't rush programming).
- When the programming code is recognized, the lantern will display the 3 or 4 digit code with a series of quick flashes with a gap of 0.5 seconds between each "number" of the code. A zero (0) is displayed as a 2 second flash.
- If the programming code is not recognized, the lantern will display 3 quick flashes and the lantern will return to the programming mode (re-enter entire program code again).
- When exiting programming mode, the lantern will display 2 quick flashes, followed by a short pause and another 2 quick flashes, then display the flash rhythm for 16-20 seconds.

## Programming

Apply 12 VDC to the input leads of the lantern. Black is positive and white is negative. The green/yellow sync wire is left disconnected. If you are using a power supply, be sure that it is capable of providing enough power; approximately 1.25 amps per tier.

The lantern will power up in the default setting from the factory (or if it came pre-programmed). After 10 seconds it will monitor the ambient light level and if bright enough will turn off (the desired mode for programming). If, for some reason the voltage at the lantern is below 11.0 volts, the lantern will shut down to conserve energy and protect the battery and will not relight unless power is reapplied or the voltage exceeds 13.0 volts and at least one daytime cycle is detected (to prevent oscillation on and off at night).

The programming sequences are grouped together so that all codes are entered at one time. It is suggested and acceptable to perform the programming operation in two separate sessions (detailed **A** & **B**). The two programming operations required are: flash rhythm and intensity.

**A. Flash Rhythm.** To start a programming session, gather the data for each operation. For example, the following VLB-44 has a flash rhythm of FL6(.6) and an intensity setting of 7280 candelas. The code for FL6(.6) is **337** and the intensity value is **7280**. The remote is capable of many operations (more on that later). The programming **operation** is code **1**. The flash rhythm **feature** is code **0**.

Assemble the codes, as shown below for your flash rhythm programming sequence:

| | | Code |
|---|---|---|
| Operation | Programming | 1 |
| Feature | Flash Rhythm | 0 |
| Value | FL6(.6) | 337 |

The programming sequence for this example is **10337**.

With power applied to the lantern in a lighted room or outside, aim the remote at the window above the label and:

| | |
|---|---|
| 1. Press and hold the standby/program/power button for 5 seconds. | The lantern will give 4 quick flashes to indicate that it has entered the programming mode. |
| 2. Enter the programming sequence for the flash rhythm 10337 (wait for confirmation flash after each digit) | The lantern will flash once each time a key on the programmer is pressed. When the sequence is entered and accepted, the lantern will display the value 337 as a series of flashes as: 3 quick flashes followed by a 0.5 sec gap, 3 quick flashes followed by a 0.5 gap and finally 7 quick flashes. |
| 3. Leave the programmer idle for 10 seconds to exit the programming mode. | The light will give 2 quick flashes followed by a short pause, then another 2 quick flashes. After this it will flash on the programmed rhythm for 16-20 seconds. |

**Important Note: unsuccessful programming sessions will be followed by 3 quick flashes followed by the lantern returning to the programming mode (step 2). Try the code again, or wait at least 10 seconds to exit the programming mode and reenter the above sequence (step 1).**

**B. Intensity.** Next, assemble the codes, as shown below for your intensity setting programming sequence:

| | | Code |
|---|---|---|
| Operation | Programming | 1 |
| Feature | Nighttime Intensity | 1 |
| Value | Intensity, 7280 | 7280 |

The programming sequence for this example is 117280. **Important Note**: if you omit or fail to program the zero (0) in this code, the lantern will have an intensity of 728 candelas, not 7280 candelas.

With power applied to the lantern in a lighted room or outside, aim the remote at the window above the label and:

| | |
|---|---|
| 1. Press and hold the standby/program/program button for 5 seconds. | The lantern will give 4 quick flashes to indicate that it has entered the programming mode. |
| 2. Enter the programming sequence for the flash rhythm 117280 (wait for confirmation flash after each digit) | The lantern will flash once each time a key on the programmer is pressed. When the sequence is entered and accepted, the lantern will display the value 7280 as a series of flashes as: 7 quick flashes followed by a 0.5 sec gap, 2 quick flashes followed by a 0.5 gap, 8 quick flashes followed by a 0.5 sec gap and finally a 2 second flash representing zero (0). |
| 3. Leave the programmer idle for 10 seconds to exit the programming mode. | The light will give 2 quick flashes followed by a short pause, then another 2 quick flashes. After this it will flash on the programmed rhythm at the selected intensity for 16-20 seconds. |

**Important Note: unsuccessful programming sessions will be followed by 3 quick flashes followed by the lantern returning to the programming mode (step 2). Try the code again, or wait at least 10 seconds to exit the programming mode and reenter the above sequence (step 1).**

## Programming – Reading a Program Setting

The program settings can be deciphered by reading and recording (writing down) lantern flash sequences upon activation with the IR remote control. The flash rhythm and intensity are read as separate sequences and may be used to verify the setting(s) without reprogramming the lantern. To check a program setting, power the lantern from a 12 VDC source in daytime conditions, aim the programmer at the window above the label and enter the following codes:

To check flash rhythm:

| | | Code |
|---|---|---|
| Operation | Read Settings | 9 |
| Feature | Flash Rhythm | 0 |

To check intensity setting:

| | | Code |
|---|---|---|
| Operation | Read Settings | 9 |
| Feature | Intensity Setting | 1 |

To check LED version:

| | | Code | |
|---|---|---|---|
| Operation | System Check | 3 | |
| Feature | LED Version | 5 | (for example, will display **421** as a series of flashes) |

For example, to check if a lantern is programmed as a FL4(.4), look up the code on page 3 (code 321):

| | |
|---|---|
| 1. Press and hold the standby/program/power button for 5 seconds. | The lantern will give 4 quick flashes to indicate that it has entered the programming mode. |
| 2. Enter the programming sequence to determine the flash rhythm: **90** (wait for confirmation flash after each digit). *The sequence to determine intensity is **91** and the sequence to determine the LED version is **35.*** | The lantern will flash once each time a key on the programmer is pressed. When the sequence is entered and accepted, the lantern will display the value 321 as a series of flashes as: 3 quick flashes followed by a 0.5 sec gap, 2 quick flashes followed by a 0.5 gap, 1 quick flash. |
| 3. Leave the programmer idle for 10 seconds. | The lantern will display 2 quick flashes, a pause followed by 2 quick flashes, display the FL4(.4) rhythm for 16-20 seconds, then turn off (if daytime). |

## Bench Test

Bench test each beacon with a 12-volt DC power source to ensure proper operation. The recommended interval is 24 hours. Color coding: black is (+) and white is (-). The green/yellow sync wire is left disconnected. The daylight control in the Vega lantern is above the label through the window in the base and may be covered with black electrical tape to darken the lantern. Check to be sure that the lantern is flashing at the desired rhythm and that all LEDs are lit around the perimeter of the lantern.
The LED lanterns do not have provisions for terminating wires from the battery and solar panel like our current 155mm lantern using a CG series flasher and CG-6P lampchanger. Instead, they are equipped with a 1.5 meter power cable (3 meters for structures) that is terminated in a LED Junction Box on buoys (Figure 4), at the battery box on fixed aids (Figure 6) or at the battery box, Range Power Box (RPB), CAT V Load Center or Low Voltage Drop Box (LVDB) at lighthouses. The junction box provides a convenient place to terminate the solar panel, lantern and battery without excessive cable runs. Longer power cables may be specified upon purchase from Vega, or they can be replaced using the procedure on page 13. On multi-tiered lanterns use the wire sizing program available on our website to ensure that voltage drop is not excessive.

## Design Considerations

The lantern is mounted to the standard 200mm (7.875”) diameter three-hole mount. Additionally, a 3.5” hole through the center of the lantern allows other apparatus to be mounted above the lantern without obstructing the lens. Height will vary depending on the number of tiers, the base height and use of bird spikes. Figure 1 details the dimensions for the various configurations. A high base (optional) **is required** for buoy installations to prevent obstruction by the lantern ring when viewed at low heights-of-eye.

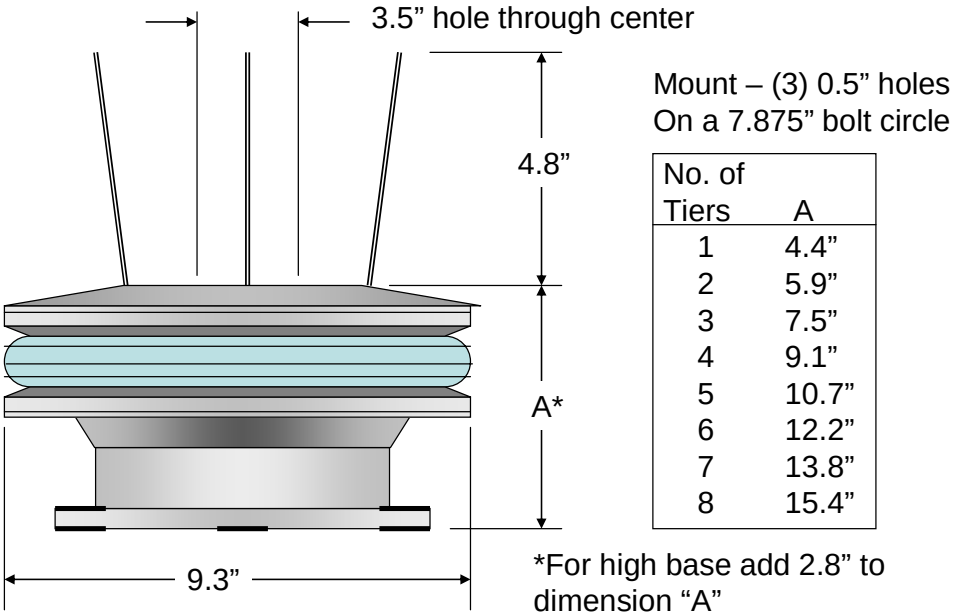



Figure 1.

## Installation – VLB-44-10 on a Buoy

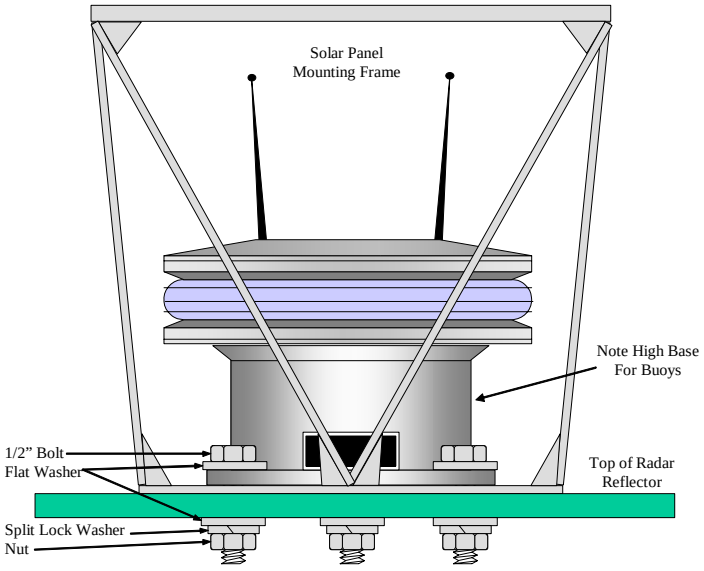



Figure 2.

Sandwich the panel stand between the lantern and buoy and attach with ½” threaded stainless steel bolts, flat washers, split lock washer and nuts, as shown in Figure 2. Do not lose the plastic inserts in the base or over tighten the fasteners, crushing the inserts as they prevent galvanic corrosion. Replacements are available from COMDT (CG-432A). Screw the four bird spikes into the top of the lantern.

Install the appropriate solar panel using the solar panel installation kit and the appropriate number of batteries, and connect as outlined in the Short Range Aids to Navigation Servicing Guide.

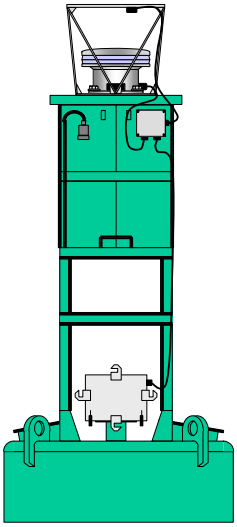


Figure 3.

The LED Lantern Junction Box should be mounted to one of the radar reflectors (preferably one of the closed sections) to protect it from rain and guano, as shown in Figure 3. Install using the template provided in the LED Lantern Junction Box; mark the four holes to be drilled on the radar reflector with a center punch. Be sure the area behind the radar reflector has room to install hardware (no cross ribs, vertical reflectors, etc.). Drill four 9/32" diameter holes through the reflector. Install the junction box using the provided hardware. Route the wires through the stuffing tubes, as shown in Figure 4. Tie the cables to adjacent support structures and cut off the excess in the box (keep the cable as short as possible). Strip the ends of the wire and insert into the Euro type terminal strips and secure with a 3/16" flat blade screwdriver. The terminals are labeled and color coded black for positive and white for negative. The box is gray and may be painted to match the buoy, if desired.

Note:
Cable sizes for the VLB-44 varies. Single tier lanterns use a 0.39" dia cable and multi tier lanterns use a 0.44" dia cable.
For multi tier lanterns, use the supplied 2E packing.
For single tier lanterns order 2D packings via MILSTRIP, NSN5330-00-202-2589

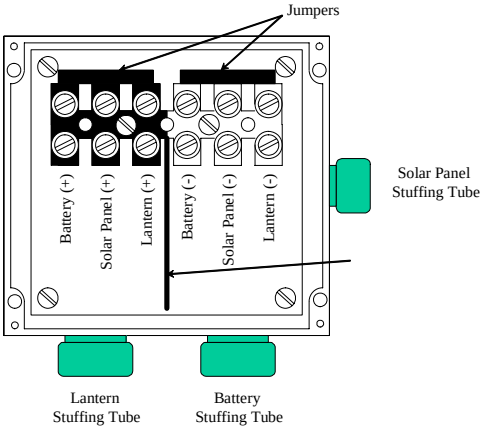



Figure 4.

Cover the window above the label accessing the daylight control to simulate nighttime and check for proper operation.

## Installation – VLB-44-05 on a Structure

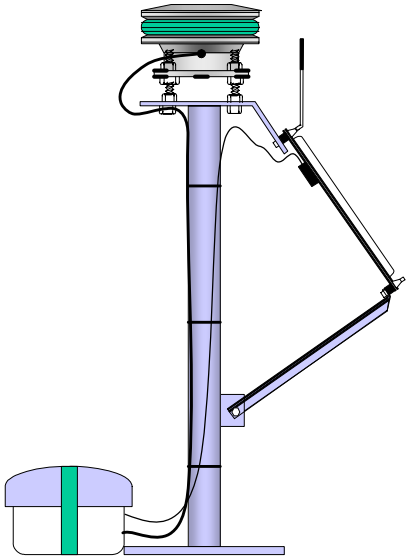


Figure 5.

Mount and level the lantern using three ½" stainless steel studs or bolts, as shown in Figure 5. Do not lose the plastic inserts in the base or over tighten the fasteners, crushing the inserts as they prevent galvanic corrosion. Replacements are available from COMDT (CG-432A). Place the level on top of the center hole. Use the "T" method as shown in Figure 6 and adjust the nuts until level. After tightening, recheck using the level in both directions.

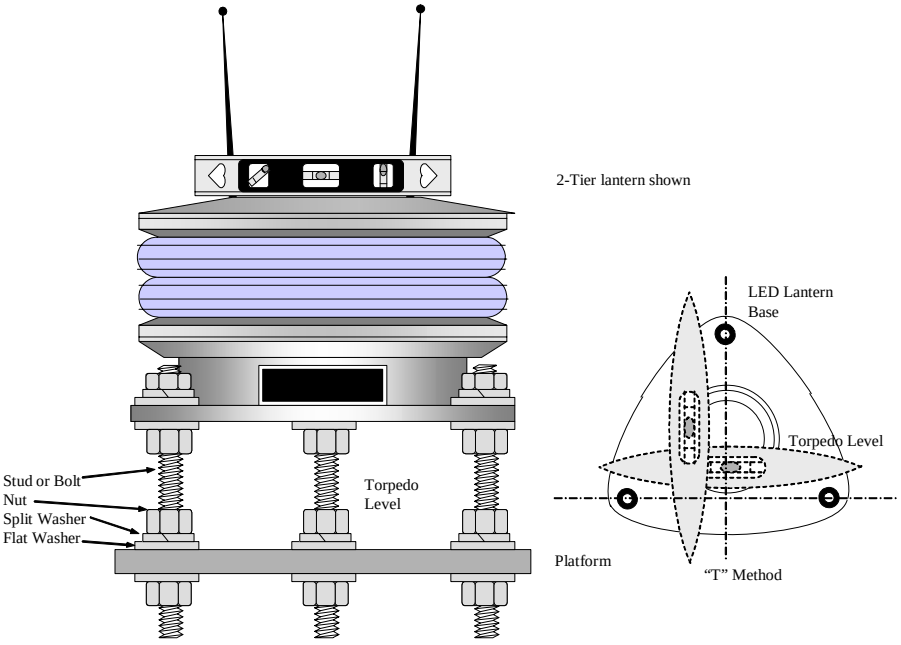



Figure 6.

Screw the four bird spikes into the top of the lantern if installed outside.
Install the appropriate solar panel using the solar panel installation kit and the appropriate number of batteries, and connect as outlined in the Short Range Aids to Navigation Servicing Guide. Be sure the tilt angle is appropriate for the area and that the panel is facing south.

The leads from the lantern and solar panel should be terminated in the battery box on structures, as shown in Figure 5. Route the wire and zip tie it along structural members then cut the excess inside the battery box. Crimp the proper ring lug onto each wire and attach the black leads to the (+) battery terminal and white leads to the (-) battery terminal. Apply No-ox grease or a suitable anticorrosion coating to the battery terminals. The lantern for structures (5 degree) is equipped with a 3 meter (approx 10 ft) cable. If the cable is not long enough, extend the wire with a waterproof, soldered splice, use the LED junction box or replace the cable (see page 13).

Cover the window above the label accessing the daylight control to simulate nighttime and check for proper operation.

## Installation - VLB-44-2.5 in a Lighthouse

The physical installation at a lighthouse is the same as for a structure. Leveling is especially critical as the vertical divergence (beam spread) is very narrow and the light may not project in the direction of the mariner (an out of level lantern will project the light beam into the sky or into the water). A “lighthouse” is defined as a rock-solid structure unaffected by wind and wave action. The VLB-44-2.5 is not suitable on single or multi-pile structures, or any structure with significant movement by wave or wind.

Wiring is critical to ensure adequate voltage at the lantern. Lighthouses generally use multi-tiered lanterns and will use a significant amount of current. Expect the VLB-44 to use up to 1.25 amps per tier. Therefore, an 8 tier lantern will have a maximum current consumption of 10 amps. Voltage drop between the battery and lantern shall not exceed 0.35 volts. Use of a low voltage drop kit to increase the wire size between the lantern and charge controller, CAT V Load Center or Solar Distribution Box may be necessary. To prevent excessive voltage drop, keep the wire run between the junction box and the lantern as short as possible (2-3 feet). Consult with the Solar Design Manual, COMDT M16500.24 or our website for wire sizing calculations, or contact COMDT (CG-432A) for assistance.

The operating current of the VLB-44 may be lower than the operating current of the lantern it replaced. If using a SACII or SACIII to monitor the main light, the SACII/SACIII will have to be adjusted if the operating current of the VLB-44 is below 1.5 amps. Technical Data Sheet 96-03 (http://www.uscg.mil/hq/cg4/cg432/2a_technicaldatasheets.asp) details the procedure to adjust the SAC. Note: 1.25 amps per tier is the maximum current consumed by the VLB-44. Selecting an intensity other than the maximum intensity for the number of tiers used will result in lantern current being lower than 1.25 amps per tier. Either measure the lantern current with a digital volt/amp meter, use the VLB-44 current calculator (available from CG-432A), or contact COMDT (CG-432A).
The VLB-44 can not be used with color sectors. White LED light does not contain as much red (or green) light as does white light from an incandescent source. Placing a red or green filter in front of a white LED light will result in an unacceptably low amount of colored light on the far side of the filter.

The effective intensity of any light signal in a lantern room is reduced by 12% when it passes through clear glass or acrylic. Be sure to account for this reduction when calculating the effective intensity, luminous and nominal ranges of the aid.

## Power System

Most VLB-44 installations will be wired as self-regulating systems (minor aids that don't use a Solar Charge Controller (SCC) or Range Power Box (RPB)). Lighthouses and some installations in northern latitudes and/or multiple tiers may require a more significant power system. Consult with the standard aid drawings to determine the proper layout and wiring of components: http://www.uscg.mil/hq/cg4/cg432/drawings_2a.asp. The power system shall be sized using the solar design spreadsheets available at http://www.uscg.mil/hq/cg4/cg432/publications.asp. Assistance is available from COMDT (CG-432A).

## Servicing

Servicing should be performed in accordance with the standard cycle established for the aid.

Ensure that the lens is clean. Wipe with a cloth dampened with mild soap and water, if necessary.

Cover the window above the label to ensure that the lantern flashes on rhythm. Check to be sure all LEDs are lit around the lantern. If more than 3 LEDs are out, it may create an area of reduced intensity or no coverage in that region. Do not open the lantern on station. Parts are not captive and will be easily lost. The lantern may still provide adequate service to the mariner, but a replacement should be procured as soon as possible.

Inspect the wiring and power system in accordance with the Short Range Aids to Navigation Servicing Guide. Replace, if necessary using the procedure listed below.

## Power Cable Replacement

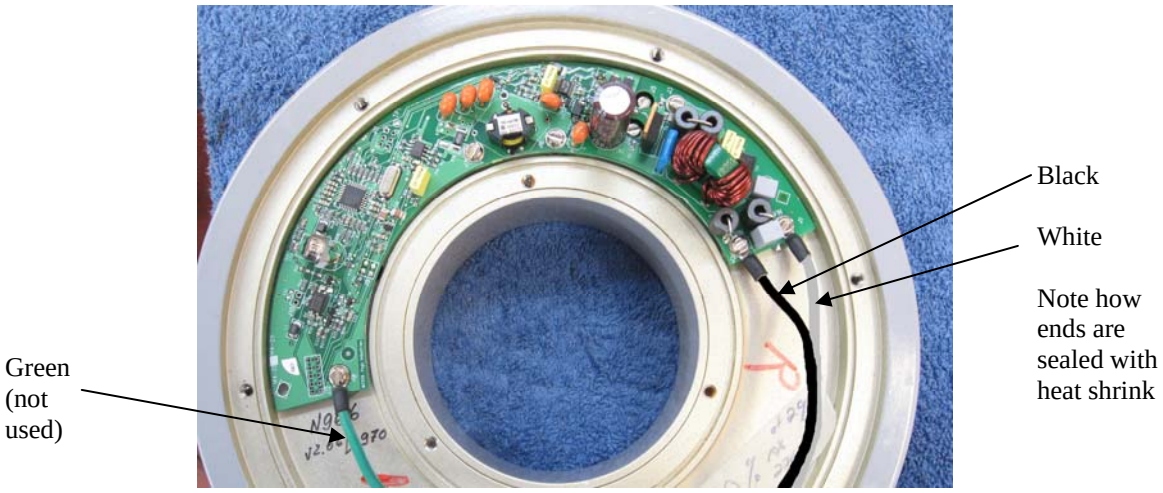
The power cable for the VLB-44 is wired to the circuit board inside the lantern through a stuffing tube. Replacement cable should be 12/2 SOW, SOOW, SJOW, SJOOW for 3-8 tier lanterns and 16/2 for 1-2 tier lanterns ("S" is 600 V insulation, "SJ" is 300 volt insulation, "O" is oil resistance, and "W" is for outdoor use). Jacket diameters should be approximately 0.385" for the 16/2 cable and 0.441" for the 12/2 cable. Note: the lantern is wired with 3 conductor cable. We do not use the 3rd conductor, so 2 conductor wire may be purchased. Sources are: http://www.delcowireus.com/, www.mcmaster.com, or any local supplier.

The ends of the wires terminating inside the lantern **must** be sealed as water will travel along the strands and exit in the lantern. After stripping back the appropriate length of outer jacket and conductor jacket, tin the ends of the wire with rosin core solder. Slide a ½" long piece of heat shrink tube on each conductor and crimp and solder a non-insulated ring lug for a number 6 stud (or M3 stud) onto each wire. After the terminations cool, slide the heat shrink tubing over the shoulder of the lug and shrink so that the insulation and lug are sealed (see next page).

Open the lantern using a 2.5mm Allen wrench to remove 9 fasteners from the bottom of the base including the three fasteners inside the center tube. Fasteners have a conical sealing washer on them (they may stick to the lantern). Do not lose these washers.

Unscrew the old cable from the circuit board. Screws are metric, so do not lose them. Remove the old cable by loosening the outer cap on the stuffing tube and pulling the cable from the lantern. Slide the bushing (packing) off the old cable, inspect for tears and replace, if necessary. Replace the stuffing tube, if necessary. 1-2 tier lanterns use a M16-1.5P stuffing tube and 3-8 tier lanterns use a M20-1.5P stuffing tube. These have metric threads and are available from http://www.lappusa.com/index.htm, SKINTOP SLM/SLRM series plastic dome cable connector part number S2509 and S2513, respectively.

Slide the stuffing tube cap and bushing on the new cable, feed it through the stuffing tube and connect to the circuit board, as shown below. Be sure that the cable is tight in the stuffing tube (give it a tug) to prevent water vapor from entering the lantern. Reassemble the lantern paying careful attention to the two O- rings that seal the base to the optic head. Insert the 9 metric fasteners with conical sealing washers and tighten in a crisscross pattern until they are snug. Do not over tighten. Test the lantern before redeployment.




## Questions/Comments

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