CML’s 7530 series Rigid Light Guide Applications Note

The even, linear light patterns emitted from fluorescent and neon tubes have long been desirable in applications where breakage and safety have prevented their use. Until recently, the technology to deliver them has lacked the durability and cost competitiveness required for widespread application. Recent developments in LED’s (Light Emitting Diodes) and acrylic optical structures have overcome these obstacles. The result is CML’s RLG (Rigid Light Guide) a safe, durable and economical means for distributing light in linear and curved patterns.

1. LED Light Engines’ attached to CML’s RLG create a sold-state light source which generates little heat and provides a long life.

2. Clear, UV-resistant, solid-core CML’s RLG is durable and safe for public contact and can be shaped.

3. Unique, integrated reflective strip focuses light in the required direction while eliminating stray light and glare.

CML’s RLG was originally introduced to the auto industry in 2000 for Ford and Toyota programs and can now be found in everything from office equipment and control panels to boats and coffee shops.

Design of CML’s RLG

The CML RLG is composed of three structures, as illustrated below. The outer (PMMA) cladding, an acrylic polymer core, and a proprietary reflector which causes light to radiate from the guide. All components are combined in a co-extrusion process, providing for consistent quality and competitive cost. CML’s RLG is available in 6.5mm, 10mm and 14mm sizes.

The light acceptance angle of the CML RLG is 55 degrees (27 degree half angle) and the guide has a numerical aperture of 0.46. CML’s RLG can withstand temperatures ranging from -40 to +80 degrees Celsius and exhibits good chemical resistance, making it suitable for installation in demanding applications, such as vehicles, marine environments and building exteriors.
Light Emission

The standard approach to getting light out of RLGs is to abrade or notch the material. Extracting light by use of an integrated reflective structure, as applied in CML’s RLG is unique.

The angular distribution of light emitted from the RLG is determined by the width of its integrated reflector. The reflector width should be selected to meet the needs of the application.

LED Light Engines

CML’s Light Engines are is optimized to work with various lengths of CML’s RLG. LED Light Engines provide for uniform illumination. The CML Light Engine is water resistant with it’s integral rubber O-ring. Light Engines are is designed to operate from 3 volts DC up to 12 volts DC. Current consumption ranges from less than 50 mA up to 420 mA depending on rod diameter and LED sizes and colors.
Cutting
There are several ways to cut RLG RLG.

A water-cooled abrasive (tile) saw produces the best cut. Tools such as hacksaws and scroll saws may also be used to cut RLG, but they will require additional treatment to get a smooth surface. Progressive sanding can be used to smooth out rough cuts. Begin with 240 sandpaper followed by 400 and finally 600 wet paper.

Shown: Use of a water cooled saw to cut RLG.

Tip: Keep CML’s RLG in its protective plastic sleeve, except during heating, to protect it from scratches.

WARNING: FOLLOW ALL SAFETY PRECAUTIONS PROVIDED WITH EQUIPMENT!

Heating
PVC heating blankets can be used for heating RLG. The blankets are portable, heat quickly to 250F and come in a variety of sizes. For best results cut three or four 3/4 inch diameter aluminum tubes slightly longer than the length of the blanket. Make sure any rough edges are removed from the aluminum tube to prevent scratching of the RLG. Finally, wrap the PVC heating blanket around the aluminum tubes.

WARNING: CML’S RLG IS HOT! WEAR GLOVES TO PROTECT YOUR HANDS.
Use the small heating blanket for heating short pieces of CML’s RLG or to heat a section of a long CML’s RLG where one specific bend is desired. Use the longer heating blanket to heat CML’s RLG where the entire rod is to be shaped.

* 6.5mm RLG will swell if overheated. Do not overheat!

PCV heaters can be found at electrical supply houses.

**WARNING! TEMPERATURE AND HEATING TIMES WILL VARY WITH DIFFERENT EQUIPMENT. OVERHEATING WILL DAMAGE C<L’s RLG.**

**Shaping**

**Template Shaping**

Push heated CML’s RLG against template and secure until cool.

**Freestyle Shaping**

Heat the CML’s RLG and place it against the contour you wish to copy.

Hold the CML’s RLG still until it cools completely.

**WARNING: BE SURE TO WATCH THE REFLECTOR ORIENTATION.**
Attachment of LED Light Engines

Be mindful of reflector orientation when attaching LED Light Engines. Short lengths of RLG RLG, up to approximately 2ft, can be illuminated with an LED module at one end and a reflective tape (adhesive aluminum tape), at the unlit end. Longer lengths of CML’s RLG should have LED modules at both ends.

Attachment of the 14mm LED Light Engines

14mm RLG LED Light Engines can be attached by tightening the integral nut and O-ring to the body of the Light Engine.

Light Engine Power Requirements

You must use a regulated DC power source. CML Light Engines must be wired in parallel. The total current consumption of the LED modules must not exceed the power supplies output.
Light Environment
CML RLG is recommended for use in areas of subdued light. High ambient light environments reduce the effectiveness of CML RLG.

THE LIGHT ENVIRONMENT AND DESIGN INTENTION MUST BE UNDERSTOOD BEFORE APPLYING CML RLG.

CML RLG Length
The length of CML’s RLG is determined by desired light output, the uniformity of output and the demands of the application. If the length is too long, the center of CML’s RLG will appear dim.

Short lengths of RLG, up to approximately 2ft, can be illuminated with an LED module at one end and a reflective tape at the unlit end. Longer lengths of CML RLG should have LED modules at both ends.

As a rule of thumb, a 3-4ft section of 14mm diameter RLG with wide reflector or a 4-6ft section with narrow reflector should provide satisfactory uniformity in low light environments.
CML RLG Reflector

Neon and fluorescent lighting sources radiate light from their entire circumference (360 degrees). RLG radiates light in a narrow angle. This angle of illumination is based on its reflector width. 14mm RLG is offered in both 5mm and the 8mm reflector widths; 10mm is available with a 6mm wide reflector, 6.5mm RLG comes with a reflector width of 3mm only.

CML RLG Reflector Orientation

CML RLG reflector orientation affects viewing angle. The reflector's orientation is critical in design placement decisions, as RLG creates a unidirectional output.

Orientation is important when mounting CML’s RLG. Other light sources striking the reflector may cause colors to appear faded.

PLEASE CONSIDER THE CONTEXT IN WHICH CML’s RLG WILL BE VIEWED.
LIGHT FROM OTHER SOURCES STRIKING ITS REFLECTOR MAY PRODUCE UNSATISFACTORY RESULTS.
**Mounting Method**

Mounting method may affect the RLG’s appearance. When viewing RLG within its angle of light output, it appears as a solid lit tube. When viewed outside its angle of output, it appears translucent and has little illumination. Whether this is desirable or not depends on the application and design intent. Mounting method must be determined by designer and materials sourced separately.

**Bending Radius**

The bending radius should be a minimum of 10 times the RLG diameter.

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BE AWARE OF REFLECTOR ORIENTATION WHEN BENDING CMLRLG.
**Application Checklist**

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>TASK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Environment</td>
<td>Ambient light level is suitable for CML’s RLG</td>
</tr>
<tr>
<td>Length</td>
<td>Length of RLG is within guidelines and appropriate for project.</td>
</tr>
<tr>
<td>Reflector Width</td>
<td>Suitable reflector width (5mm or 8mm) for 14mm diameter RLG has been established.</td>
</tr>
<tr>
<td></td>
<td>Light output angle is acceptable.</td>
</tr>
<tr>
<td>Reflector Orientation</td>
<td>Reflector orientation is established.</td>
</tr>
<tr>
<td>Mounting Method</td>
<td>Mounting method determined based on viewing angle. Suitable mounting method selected and hardware source identified.</td>
</tr>
<tr>
<td>Bending Radius</td>
<td>Application does not exceed bending limits of the RLG.</td>
</tr>
<tr>
<td>LED Module</td>
<td>LED module power requirements, method of attachment to the RLG and quantity are determined.</td>
</tr>
<tr>
<td>Power</td>
<td>Power requirements and routing established. Component source identified.</td>
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</table>

**Design Validation**

If CML’s RLG appears suitable to your application after consideration of these Guidelines, and items in the Application Checklist are confirmed, it is time to mockup the application. Design validation is the only way to determine if RLG will provide satisfactory results.
FAQs:

1. Where is RLG currently used?
RLG is used in many commercial applications. When used with an LED module, RLG is solid state and will not shatter like neon or florescent tubes. It is ideal for applications subject to vibration such as vehicles, aircraft, boats and machinery. RLG comes in three diameters: 6.5mm, 10mm and 14mm and is very compact, permitting installation in tight places. It can be placed within public reach. The low voltage LED light source generates little heat and the durable RLG will not break when handled.

2. What diameters of RLG are available?
6.5mm, 10mm and 14mm diameter RLG can be produced in diameters ranging from5mm to 14mm if ordered in large quantities.

3. How is RLG illuminated?
LED Light Engines are used to illuminate the RLG.

4. What determines the brightness of the RLG?
Brightness is determined primarily by the amount of light entering the RLG, the width of it's reflector and its length. Ambient light levels are also critical to the perceived brightness of the RLG.

5. What is the maximum length of RLG?
RLG can be illuminated in lengths ranging from 3-6ft, depending on light input and reflector width. RLG is sold in 6ft lengths.

6. Can RLG be cut?
RLG can be easily cut.

7. Can RLG be shaped?
RLG can be easily shaped.

8. Is RLG as bright as neon?
RLG is not as bright as neon. It should be used in areas of subdued ambient lighting.

9. Does RLG radiate light from its entire circumference (360 degrees) like neon?
No, RLG is unidirectional. The light output angle is a function of it's reflector width. Output is typically in the range of 50-90 degrees.