



Light Pipe / LED Matching

Part 2 of 3 Part Series

Title

- *Light Pipe / LED Matching*

Purpose

- *Discuss maximizing lighting efficiency by optimized matching between light pipe and LED*

Objective

- *Why is light pipe / LED matching important*
- *4 key elements to effective light pipe / LED matching*

Content

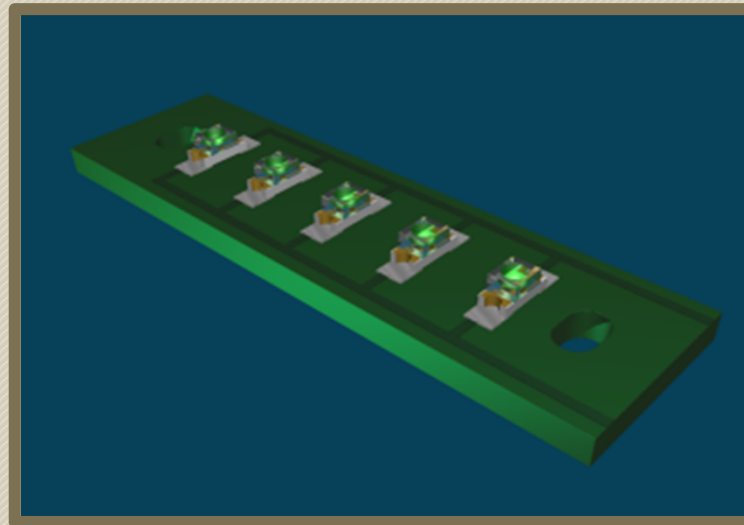
- *9 Pages*

Learning Time

- *5 Minutes*

Welcome to the Lumex training module on light pipe and LED matching. The objective of this training module is to discuss the role light pipe and LED matching plays in ensuring efficient lighting design with maximum possible light capture. This module will present an overview of why light pipe and LED matching is important as well as outline the four key steps to effective light pipe and LED matching.

Why Matching is Important?



An exact match between light pipe and LED technology is equivalent to finding two puzzle pieces that fit together perfectly to establish optimum performance.

Generally speaking, the brightness emitted from a light pipe will be dependent upon the LED utilized, as well as on the shape of the application. A properly matched light pipe will emit nearly the same brightness as the individual LED, minimizing the amount of light lost and ensuring good color performance.

Effective Light Pipe / LED Matching

Location

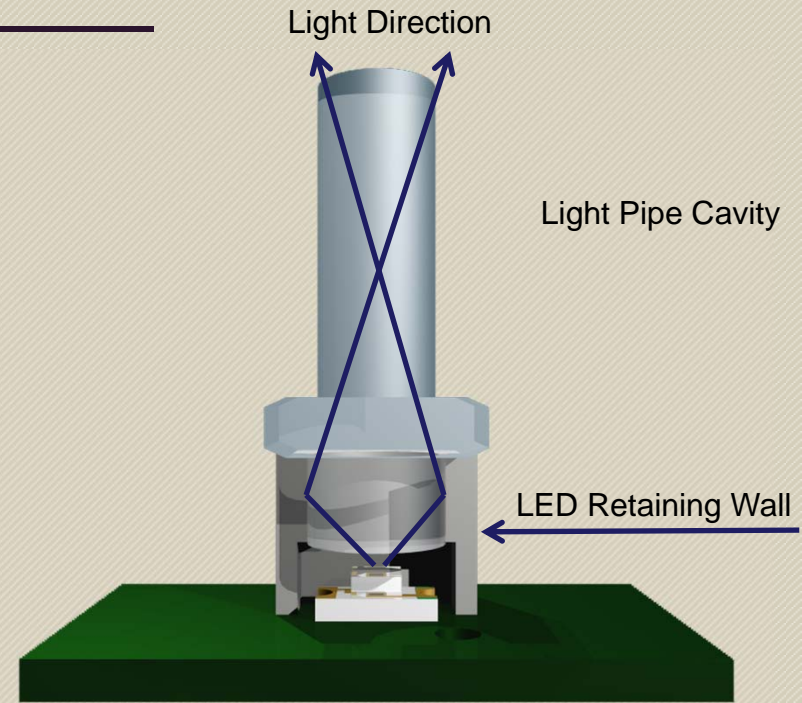
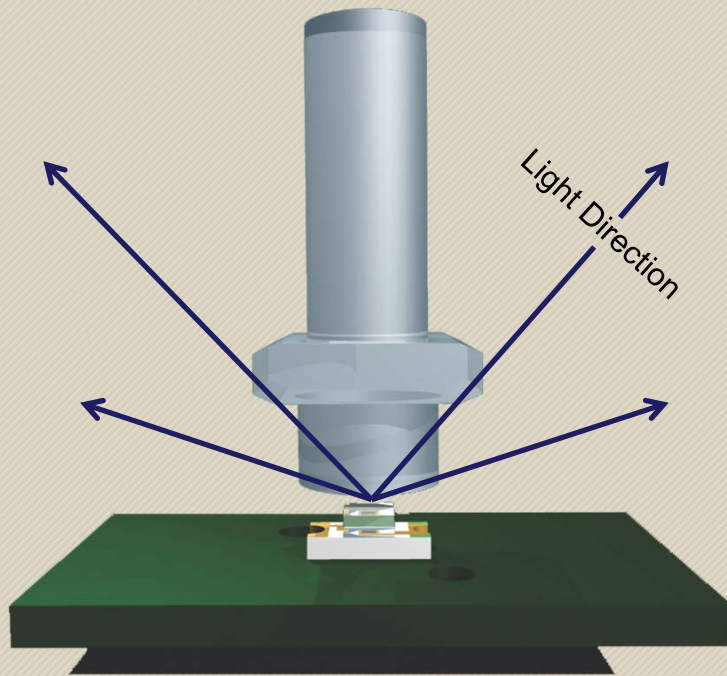
Size

**Viewing
Angle**

**Color
Binning**

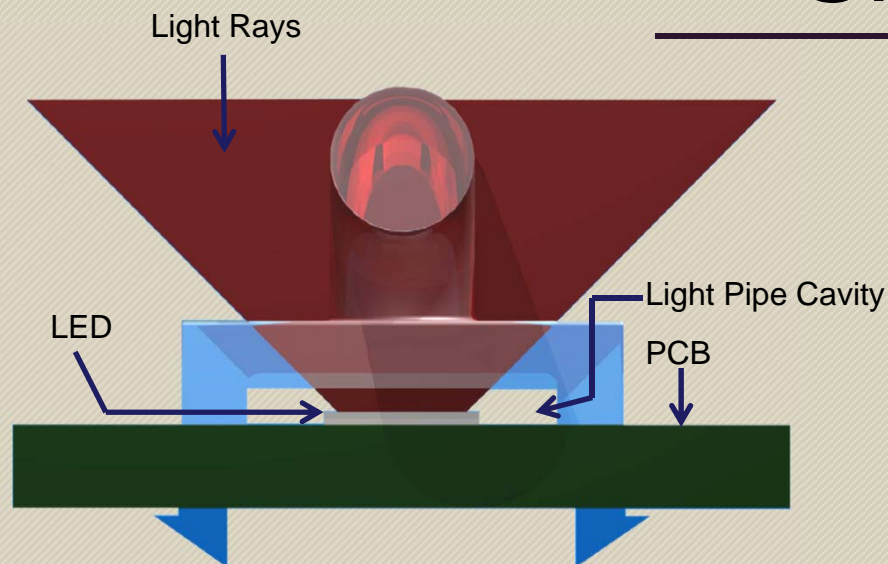
The four key elements to ensuring effective light pipe and LED matching are LED location, size, viewing angle and color binning. An overview of each of these elements is provided in the slides that follow.

Location

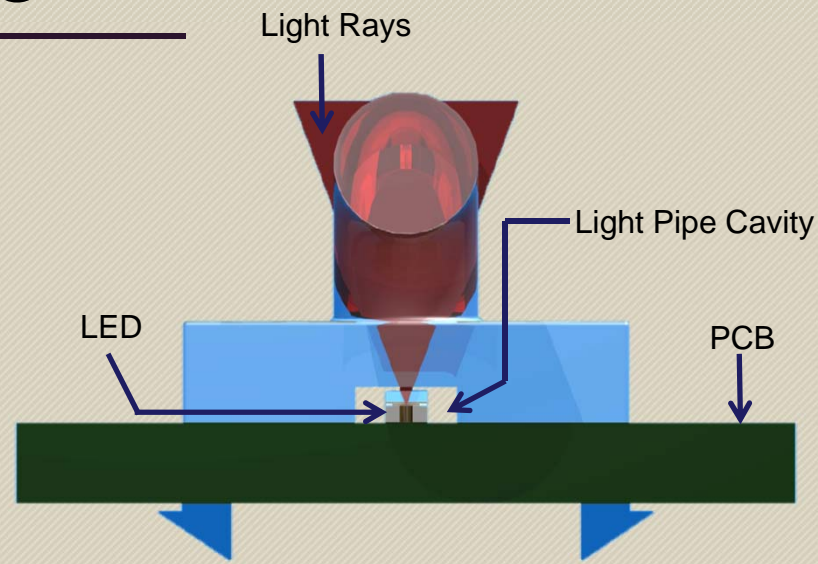


The most effective light pipe and LED matching is to have the top of the LED as close to the light pipe entry point as possible. When light goes from one medium to the next. For example, when light travels through air into a light pipe there is an automatic light loss of 8 percent. Therefore, in order to obtain greater than 92 percent efficiency, the LED should be surrounded by a retaining wall of the light pipe.

Size



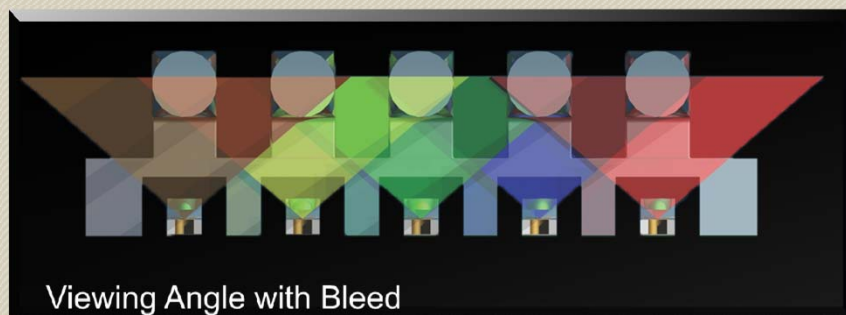
- The width of the light pipe cavity is too wide
- The height of the light pipe cavity is too tall



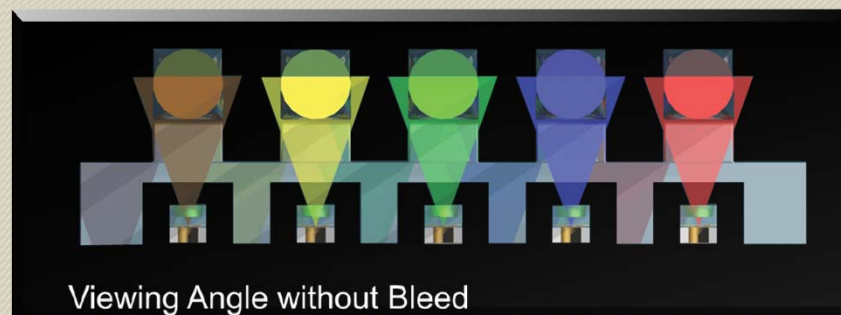
- The width and height of the light pipe cavity is ideal

To ensure light is effectively captured from the LED and delivered to the desired location, it is essential that the light pipe cavity is properly designed for the matching LED. This will ensure that all the light is trapped within the light pipe and travels down the light pipe rather than escaping out into the environment. LED size will vary on applications – though commonly the LED size will be about 1.6 millimeters by 3.2 millimeters (as in the Lumex 1206 LED series). Smaller size will typically be around 1.5 millimeters by 1 millimeter and larger sized are often about 3 millimeters by 3 millimeters.

Viewing Angle



- Improper color diffusion
- Different intensity levels



- Color diffusion uniformity
- Consistent intensity levels

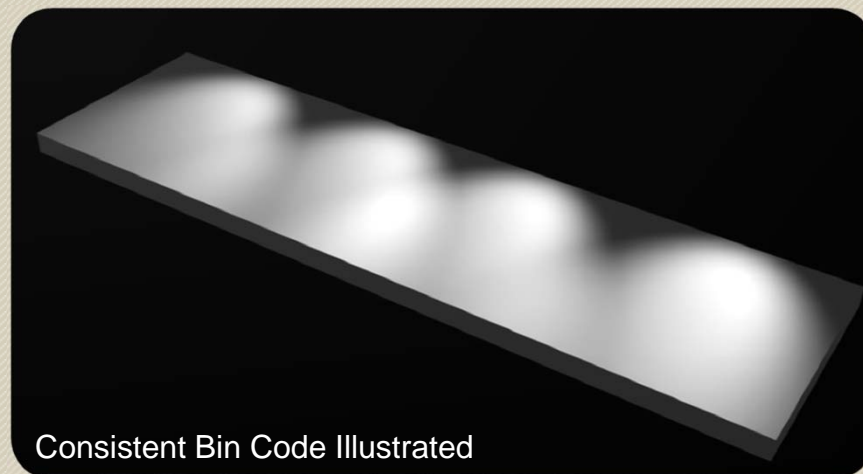
Once you know the desired LED size to fit a particular application, the next step is to select the LED of this size with the smallest possible viewing angle. Effective light pipe and LED matching occurs when the LED radiation pattern angle matches the acceptance pattern angle of the light pipe. This will help ensure that the light remains focused where needed and does not bleed into adjacent light pipes. Again, angle size will vary from application to application. However, LEDs matched with light pipes typically have viewing angles less than 30 degrees for surface mounted LEDs.

Color Binning



Inconsistent Bin Code Illustrated

- Multiple un-binned LEDs



Consistent Bin Code Illustrated

- Properly binned LEDs

For applications that require an array of light pipes of the same color, it is important to ensure that the LEDs that are mounted with each light pipe come from the same color bin. This ensures consistent color performance. In other words, binning makes it possible to ensure that the color of light coming from each light pipe is as closely matched as possible.



Thank You