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Xenon vs. LED Strobes

While Xenon bulb based stroboscopes have been the standard for decades in the non-contact measurement of RPM and "freeze motion" inspections and studies; LED based Stroboscopes have entered the market.

This discussion is going to concentrate on the measurement of RPM and "freeze motion" applications since they comprise most of the applications of Monarch Instrument Strobes.

Why does a stroboscope make an object appear motionless?

It all has to do with the persistance of the image to the person's eye; or simply called the eye's "memory". If an object is illuminated by a brief, repetitive high intensity light source that matches the RPM of a rotating object or the repetitive rate of linear objects such as the images on a moving printing press, the eye will remember that image and be fooled into thinking that the object is not moving at all. (note: The eye is not easily fooled below about 300 flashes per minute. However, by doubling or tripling the flash rate, the object will still appear to be motionless, even though you are seeing every second or third object as it pases by.)

(While actual flash duration times may vary from model to model, the numbers in the discussion below are typical for illustration purposes.)

Xenon based strobe's flash duration runs from about 5 to 20 microseconds and is typically not user adjustable; and it may vary in that range with the actual flashes per minute that the strobe is producing.

LED based strobes gave us the ability to adjust the flash duration from less than one microsecond to 3000 microseconds (also can be expressed in degrees of rotation, 0.5 to 14 degrees). The actual upper limit is limited by the circuits automatically so as no circuit or LED damage will occur.

From about 20 microseconds on up, the LEDs always go to their peak light output before shutting off for the next flash. (below 20 microseconds, the peak output starts dropping off below 100%. At 5 microseconds the peak output is about 85%.

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Because of the eye's "memory" mentioned above, longer flash durations make the LED strobes appear brighter to the human eye; so much so that they appear much brighter than a Xenon Strobe at the same flash rate.

If an LED strobe is set to the same 5 to 20 microsecond flash range as a Xenon strobe, the LED strobe, at the very least, appears to have the same brightness as a Xenon strobe. (LED output and efficiency is improving all the time so LED strobes are getting "brighter and brighter"

What impact does flash duration have in the real world?

Let's take the two prime applications, RPM measurement and "freeze motion" inspection.

First, for measuring RPM, the technique for measuring RPM calls for having a single unique reference mark; be it a bolt head, shaft key, paint mark, piece of reflective tape or even a scratch. Since the aim for RPM measurement is to see that mark appear stopped, it does not matter if that mark appears as a sharp image or as a fuzzy or blurry image, just as long as it appears "stopped". With the longer flash duration possible in the LED strobes, RPM can be measured at longer distances and under higher ambient light conditions than a Xenon strobe.

Second, for inspection applications where a sharp image is desired, the LED strobe can be adjusted down to the 5 to 20 microsecond range of the Xenon strobe so that the item is sharp and clear. In this case, the strobes may appear to be of the same light intensity; but the LED has a bit of an edge and getting better all the time.

In summary:

Longer flash duration (more degrees of rotation) = higher apparent brightness = fuzzy image

Shorter flash duration (less degrees of rotation) = lower apparent brightness = sharper image.

Other differences between Xenon and LED strobes:

LED strobes have no bulbs to replace while xenon strobe bulbs last about 100 million flashes.

LED strobes can have between 3 to 5 times the operating life between charges as the equivalent Xenon strobe, depending on model.

LED strobes have a more uniform light pattern than Xenon.

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