

LED Aviation Signal Light Brightness

As light-emitting diode (LED) technologies continue to advance, signal lights using LEDs are increasingly used to replace incandescent signals. Generally, LED signal lights have narrower spectral distributions than incandescent (filtered and unfiltered) signals, resulting in more saturated colors. Since color saturation increases the perception of brightness, the Federal Aviation Administration (FAA) asked the LRC to develop a set of “brightness correction factors” for white, green, and blue signal lights.

Experiment

The LRC conducted a study to identify the brightness/luminous intensity (B/L) ratio values for white, green, and blue LED signals (and in different LED color bins) relative to incandescent signals of the same nominal color. In a dark laboratory, subjects viewed pairs of signal lights: one LED and one incandescent. Subjects judged which appeared brighter while adjusting the intensity of the LED to randomly selected values.



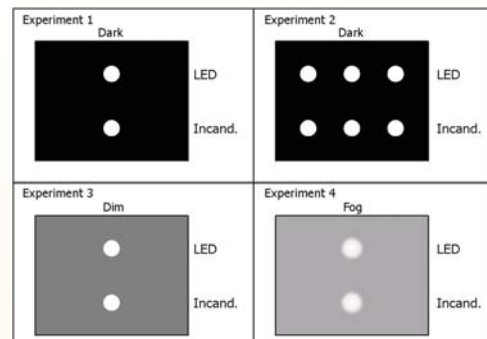
View of apparatus showing LED (top) and filtered incandescent (bottom) signal lights

Sponsors

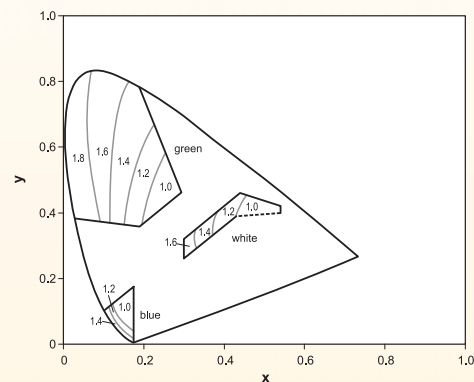
Federal Aviation Administration (FAA)
Center of Excellence for Airport Technologies (CEAT)

Additional experiments determined if the following factors affected B/L values:

- Arrays of signal lights (rather than single lights)
- Dim (rather than dark) conditions
- Simulated fog conditions



A total of four experiments were conducted - using single lights in dark backgrounds, arrays in dark backgrounds, single lights in dim backgrounds, and single lights in simulated fog conditions.



Chromaticity regions of equal B/L values for white, green, and blue signal lights

Results

- Generally, LED signals were judged brighter than incandescent signals of the same nominal color
- Only the simulated fog had reliable effects on B/L values, reducing the relative brightness differences between LED and incandescent signal lights.
- The results were used to develop a general model with which signal lights of any chromaticity within the FAA color boundaries could be assessed for their B/L characteristics.