Color Identification of LED Aviation Signal Lights

With the expected growth of LEDs in airfield (runway and taxiway) signaling applications, it is important to ensure that pilots, including those with color-vision deficiencies, can adequately identify these signals. Commercially available LED sources used in aviation signal lights have chromaticities within the permissible color boundaries, but they can look perceptibly different than lights using incandescent sources. The luminous efficacies of several different colors of LEDs are all very similar, which could result in signal lights that have similar luminous intensities. If such signals are used, a color-deficient pilot's ability to discriminate among colored signal lights could be reduced because the pilot can no longer differentiate between colors by comparing intensities as they could with filtered incandescent signal lights.

Adequate color discrimination is important for pilots to identify runway and taxiway signal lights.

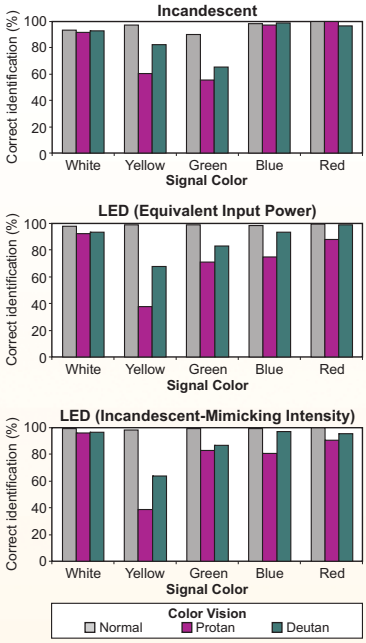
The LRC, in collaboration with the Federal Aviation Administration's Civil Aerospace Medical Institute, conducted a study to assess the ability of color-normal and color-deficient observers to identify the colors of incandescent and LED signal lights, presented alone and in the presence of signal lights of different colors, and to discern the extent to which observers might use intensity differences in combination with color differences to identify correct colors.

Sponsor

Federal Aviation Administration (FAA/05-C-AT-RPI)

Experiment

Twenty-nine subjects with normal color vision, eight with protan (red) color deficiency, and thirteen with deutan (green) color deficiency viewed a signal light display that presented five different colored lights in singles or in pairs. The presentations included incandescent, LED with equivalent input power, or LED with incandescent-mimicking intensities. Each of 180 presentations was shown for five seconds and then switched off, at which time subjects responded as to which colors they saw.



Correct identification percentages to each color and for each color-vision group for incandescent, LED with equivalent input power, and LED with incandescent-mimicking intensity signal lights.

Results

In general, LED signal lights resulted in improved color identification performance for color-normal observers. The results for protan and deutan observers were mixed, with white and green LEDs resulting in improved identification performance relative to incandescent signals; however, other colors showed no difference or worse identification performance for LEDs. The results suggest that limiting the chromaticity of yellow and green LEDs to certain regions within the allowable color boundaries could help maximize color identification of LED signals of these colors.

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