Long-term Evaluation of LED Airfield Luminaires

LED luminaires for airfields offer the potential for energy savings, longer life, and more reliable operation than their incandescent predecessors. Knowing the useful life of LED luminaires allows airport authorities to make informed decisions about new installations, upgrades, and maintenance without disrupting airport operations. However, LED systems for airfields are relatively new and sufficient data about long-term performance are not readily available. Importantly, there are no standard criteria to determine the useful life of airfield lighting systems. Unlike general illumination where light output maintenance is generally not critical, safe airport operations depend on adequate luminaire intensity distribution and chromaticity performance at all times.

LRC researchers conducted a long-term performance evaluation of LED airfield luminaires under operating temperatures that covered a range of realistic conditions, as a first step toward establishing a functional definition of useful life for these lighting systems.

Laboratory study

Three red/white directional runway centerline luminaires (type L-850A) and three white touchdown zone in-ground luminaires (type L-850B) were operated continuously at three LED board temperatures: 55°C, 80°C, 100°C. LRC researchers monitored their relative light output and spectral power distribution for 10,000 hours.

Results

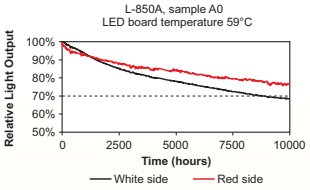
Complete failures

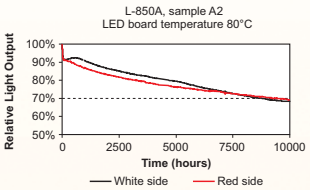
- Three luminaires failed before the end of the test because of driver malfunction: two touchdown zone luminaires at 560 hours (100°C condition) and at 3360 hours (80°C condition) of operation, and one runway centerline luminaire at 7630 hours of operation (100°C condition)

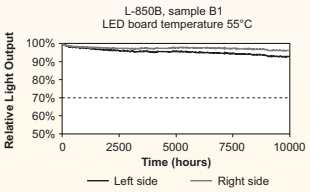
Light output and chromaticity maintenance

- Runway centerline luminaires (“A” samples)
  - Relative light output loss of 30–37%
  - Color shift between 32- and 52-step MacAdam ellipses
- Touchdown zone luminaires (“B” samples)
  - Relative light output loss of 5–11%
  - Color shift between 7- and 16-step MacAdam ellipses

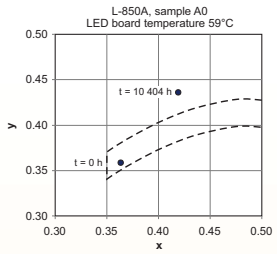
In all cases, the color shift brought the samples’ chromaticities outside the FAA’s specified color boundary for white light.

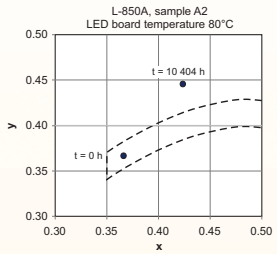


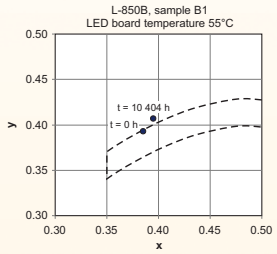




Relative light output over time of the three luminaires that completed the 10,000-hour test.







Initial and final chromaticity coordinates of the white light side of the three luminaires that completed the 10,000-hour test. The dashed line shows the FAA’s white light chromaticity boundary.

These results illustrate the need to include more than just LED lumen maintenance in a functional definition of useful life for LED systems. Clearly, LED systems perform very differently depending on how they are designed and used.

Future work

The second stage of this long-term performance evaluation is currently in progress to evaluate three new models of LED airfield luminaires under both continuous and cycled operations.

Publication

Freyssinier JP. 2014. Airfield lighting: The long-term performance of LEDs. *International Airport Review.* 18(2): 38–41. Available at www.lrc.rpi.edu/programs/solidstate/aviation.asp.

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