Federal Aviation Administration

Research Highlights

LED Airfield Fixture Lighting System Life

Background

Sample LED lighting systems used in airport runways and taxiways.

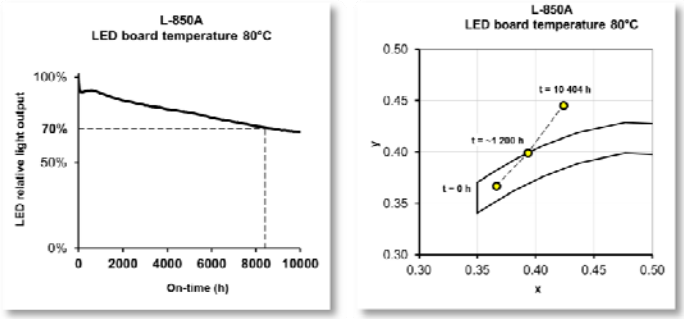
Long service life is a commonly claimed benefit for LED-based lighting systems used on airport runways and taxiways. Unlike the life definition used for incandescent light sources (the time for the light source to cease producing light), manufacturers quote the expected number of hours for the LEDs in a light fixture to reach a 30 percent reduction in light output when tested continuously. However, with this definition maintenance professionals do not know when to change light fixtures, and as a result they wait until no light is produced by the system. One potential drawback of this approach is that even when the light is operational, its intensity may not be sufficient for pilots to clearly identify runway lights.

Study Goals

To better understand the performance of airfield lighting systems and develop a suitable definition for system lifetime, researchers from the Lighting Research Center (LRC) at Rensselaer Polytechnic Institute conducted long-term testing of in-ground runway fixtures.

Research Activities

Several runway edge, centerline, and touchdown zone fixtures were subjected to long-term aging tests in the laboratory that included continuous and on and off switching operation. A set of sample data is shown in the following two graphs. For the systems tested, the time to reach a 30% light output depreciation (parametric failure) was nearly 9000 hours at an LED test temperature of 80°C, and the chromaticity values fell outside the designated color boundary after approximately 1200 hours. System catastrophic failures occurred between 560 and 10,000 hours due to failure of the electronic driver. It is worth noting that the LED system lifetime depends on the operating temperature and the on-off switching pattern. At higher temperatures, the system lifetime will be shorter.



Light output depreciation (left) as a function of time for one of the L-850A products tested and chromaticity shift (right) of the white side of the same system showing its initial and final chromaticities. The fixture's chromaticity fell outside the FAA white color boundary at approximately 1200 hours.

An LED lighting system life definition should be based on the number of hours that the lighting system maintains the light level within a prescribed range, where the lower end is the minimum light level required for pilots to clearly see the light and the upper end is the limit for the light to not cause disability glare. Within this time, the chromaticity values must remain within the designated color boundaries. The LED system life test procedure must include on-off switching and determine the times for lumen depreciation, color shift, and catastrophic failure, selecting the shortest of these as the reported useful lifetime.

For More Information

- http://www.airporttech.tc.faa.gov/DesktopModules/FlexNews/DownloadHandler.ashx?id=bac0e5da-7fb3-43fe-bd2d-35c4a6d84d51&f=S10106-Narendran_Freyssinier.pdf
- http://www.iesalc.org/?wpfb_dl=442

This project was conducted by the Lighting Research Center at Rensselaer Polytechnic Institute (www.lrc.rpi.edu) under FAA contract 10-G-013 and 13-G-009. This summary was prepared by the Lighting Research Center on behalf of the FAA.

Further details: Don Gallagher, donald.gallagher@faa.gov; http://www.lrc.rpi.edu/programs/solidstate/aviation.asp.

Lighting Research Center