

Life Expectancy and Replacement Schedule for LED Traffic Signals Studied

A research study by Organizational Results in cooperation with the Traffic Division

MoDOT Summary Statement

The goal of this study was to provide a repeatable methodology that can be used by the MoDOT and other DOTs to evaluate the life expectancy of LEDs based on real traffic flow, intersection geometrics in Missouri and the basic science of LED components, as well as provide guidelines for cost-effective replacement plans based on these findings.

- *Cross-sectional results suggest that useful life of LED traffic signals meets or exceeds useful life warranty expectations for most indicator types and manufacturers.*
- *Pending longitudinal evaluation, it is recommended an implementation strategy that replaces circular green and green arrow indicators at approximately eight years.*
- *Preliminary results suggest that circular red indicators hover below the ITE threshold for a lengthy period following a rapid drop-off after installation.*
- *Based on limited observed degradation patterns, it is suggested that circular red signal indicators should be evaluated when circular green and green arrow indicators are replaced. If the luminous intensity continues to hover near threshold, replacement is suggested at the 10-year mark.*

Background

Over the last two decades light-emitting diodes (LEDs) have replaced incandescent bulbs in traffic signals because of energy savings and much longer service life. Departments of transportation (DOTs) have gained sufficient experience with converting traffic signal indication. However, much of the initial phasing out of incandescent bulbs is complete and many of the first installments of LEDs now need replacement. The standard practices of maintaining and replacing incandescent lamps cannot be simply transferred and applied to LED signals. To ensure that LEDs aren't left in the field with light output below the recommended values, DOTs are still searching for a reliable method to monitor the light output of LEDs which degrade over time.



Approach

An original field testing instrument was developed by the research team for collecting illuminance readings from a driver's perspective at intersections across the state of Missouri. Data was collected over a time period of 11 weeks and readings were recorded in a computerized database program. Recommendations were based on:

1. Signal head intensity and ITE threshold compliance from the driver's perspective.
2. Differences by color, indicator type, and manufacturer.
3. Economic cost-benefit analysis of replacement of individual signal heads versus entire traffic signals.

Results

Circular Green:

Although limited statistical inferences can be drawn by manufacturer, differences were present. Based on the study results, Dialight circular green products outperform GE circular green signal heads and have several additional years of expected life. These conclusions are based on limited data. Results fall within confidence limits; however, high levels of variability per signal head suggest that these differences may not be present when comparable numbers of data records are studied for both manufacturers.

Green Arrow:

Dialight and GE green arrow products displayed a comparable useful life and similar degradation patterns.

Circular Yellow:

Additionally, this study's results strongly indicate the need for additional laboratory and field study of circular yellow LEDs. The ITE guidelines specify that circular yellow actually maintain the highest luminous intensity at a red to yellow to green ratio of (1: 2.5: 1.3). This means that the candela values for circular yellow LEDs should have been 2.5 times greater than those of circular red on average. This was not observed during this study in either the laboratory or in the field.

Yellow Arrow:

Comparable useful life degradation patterns were calculated for yellow arrow signal indicators irrespective of manufacturer. ITE ratio discrepancies were observed and further study is needed.

Circular Red:

Decisions regarding circular red indicators cannot be made at this time due to insufficient intersection identification by manufacturer and age variance. Red signal indicators quickly fall below ITE threshold, but do not degrade at a significant rate after the initial reduction in intensity. This suggests that their useful life may approach two to three times the manufacturer's warranty. This should be confirmed with a longitudinal study.