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April 14, 2010

To: Will Reed
Evluma

From: Patrick André

Re: Possible Reliability Numbers for Clearlight with Legacy Ballast

Overview

Upon review of the data obtained by Evluma, the calculation of mean time between failures (MTBF) is difficult to assess without a great deal more information or testing. Commonly, a number of products are sent through a testing regiment which includes temperature cycling, mechanical vibration, and other environmental influences on the equipment. Since the ballast is typically located outdoors, water and humidity, corrosion and corrosive atmospheres (such as salt fog), and other such issues come into consideration.

It will not be possible to account for all of these influences. However, certain information and data can be obtained from existing sources to allow us to use a rough order of magnitude value in determining MTBF. It appears that a value of 20 years, or about 100,000 hours, may be used.

Variables

Ballast Age

First consideration has to be the existing age of the ballast. Since the concept is to replace a light and allow the existing ballast to remain in place, the life of the ballast is already partially used. Common HID ballasts have MTBF ratings of 10,000 to 15,000 hours. Digital versions are found to be 30,000 to 40,000 hours. If a lamp is replaced at a normal interval, about 3000 hours, but the ballast is not, the remaining life on the ballast may be down to about 70%. If this is a second bulb replacement on this ballast, then only 20-40% of the life may be left. Also, a possibility exists that the bulb is replaced at the ballast end of life.

Environmental Issue

External temperature extremes and moisture related issues can create significant loss of life, even without use. Solder fatigue is caused by the cycling of temperature, among other issues. Corrosion can occur in connectors, windings of transformers, or where ever dissimilar materials meet. Capacitors, if used in the electronics, can leak and fail with time.

Photo-Control Switch

With the extended life there comes a higher number of on-off cycles. Some ballasts were not designed with long life photo-control switches, instead used inexpensive devices which were not intended to last much longer than the ballast. Although the electrical contacts will not fail due to the lower current draw, the mechanical aspects of the switch (if any mechanical mechanisms are used) can fail with extended use.

Recommended Calculations

To deal with all of these issues, it may be useful to give values for new and used ballasts. For example, if a region decides to replace all lamps with Clearlight LED lamps, and the area has used these lamps for extended time, the likelihood is that the ballasts will be fairly evenly distributed in age. It may be safe to assume the ballast has 50% of its life left.

For electronics, transformers can last over 100,000 hours of use, or about 23 years, assuming use is 12 hours a day on average. Capacitors likewise have 100,000 hour life expectancy with proper environmental seals. The unknown is the number of cycles the switch will withstand.

Using the I^2R calculations from the Evluma paper, a life increase of 88 times was calculated. What is not known is if this relationship was linear over temperature, or if with decreased temperature, the benefit also decreases. Taking a conservative value of about half the calculated life increase still allows for over 40 times increase of life. So assuming a standard ballast life is about 10,000 hours, and half the life is gone, then the expected life would be about 5,000 hours. If there was a 40 times increase in life, this still accounts for 200,000 hours of possible life.

Conclusion

It is believed that the failure of the ballast will not be due to the I^2R issue, but more likely due to environmental issues. It is recommended that the maximum stated MTBF is 100,000 on used ballasts, or over 20 years of daily use.

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