Federal Aviation Administration

Research Highlights

Effective Intensity for Flashing Lights

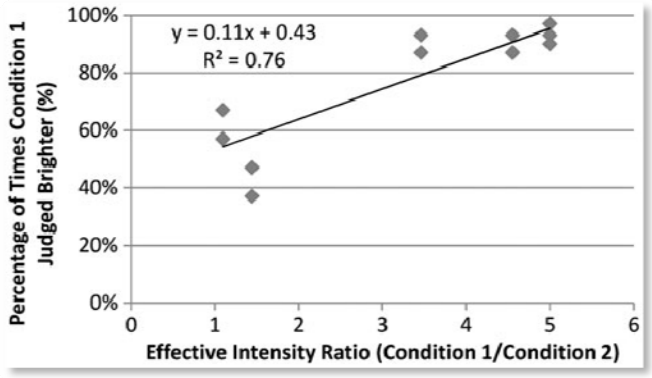
Study Goals

Flashing lights, such as runway end identifier lights (shown), are often used at airports to help avoid collisions. The FAA uses a concept known as effective intensity as the metric for quantifying the intensity of such flashing light. It is defined as the luminous intensity of a steady-burning light that has the same visual range as the flashing light. It is a measure of effectiveness at the visual threshold, although many airfield lights are designed to be seen well above threshold conditions. Further, the equation used by FAA to define effective intensity for signals using multiple pulses of light that may appear like a single flash of light, differs from that used by the Illuminating Engineering Society (IES). The goals of the Lighting Research Center's studies were to validate the suitability of effective intensity as a metric for above-threshold visibility and to test the suitability of the FAA's effective intensity equation for multiple-pulse flashing lights.

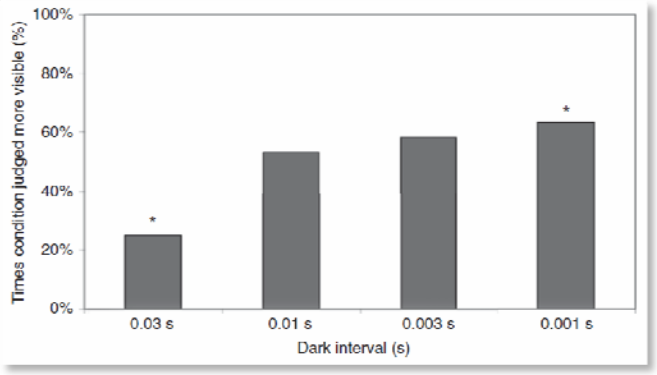
Runway end identifier light

Research Activities

In the first study, experimental subjects viewed flashes of light varying in duration and in intensity (but always well above the visual threshold), and were asked which flash of light appeared to be brighter. Brightness judgments were consistently related to the relative effective intensities of the flashes, indicating that effective intensity can be a useful metric for characterizing the visual effectiveness of a flashing light. In the second study, four different sequences of light pulses separated by different dark intervals were displayed to experimental subjects. The FAA effective intensity equation for multiple-pulse flashes of light predicted all of the sequences to have the same effective intensity; the IES equation predicted that the pulses separated by shorter dark intervals would be more effective. When asked to judge which one of a pair of multiple-pulse flashes was more visible, subjects consistently judged the pulse sequences with the shorter dark intervals as most visible.



Judgments of flashing signal light brightness were correlated with the relative effective intensities of the lights.



Multiple-pulse flashes of light were most visible when the dark intervals between pulses were shortest.

The recommended equation for effective intensity (I_e, in candelas) of multiple-pulse flashing lights in FAA guidance documents is:

$$I_e = \int_{t1}^{t2} I \, dt / (0.2 + t_2 - t_1)$$

Where t_1 is the start of the first pulse of light and t_2 is the end of the last pulse of light (in seconds), and I is the instantaneous luminous intensity (in candelas) between times t_1 & t_2.

For More Information

- http://dx.doi.org/10.1080/09500340.2013.831497
- http://dx.doi.org/10.1177/1477153512444494
- http://www.airporttech.tc.faa.gov/Download/Airport-Safety-Papers-Publications/Airport-Safety-Detail/ArtMID/3682/ArticleID/114/Effective-Intensity-of-Multiple-Pulse-Flashing-Signal-Lights

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

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Lighting Research Center