Guidelines: 
Indirect Viewing Performance of Visual 
Emergency Notification Technologies
Determination of light output in ANSI/UL 1971, Standard for Signaling Devices for the Hearing Impaired, performance standard for emergency visual signaling appliances has long been based on a calculation called effective intensity, an estimate of the intensity of a flashing light versus a steady-burning light.

This estimate has worked well to predict viewing effectiveness as long as the emergency notification appliances tested, such as the predominant xenon strobe technology, have similar, short pulse durations that produce similar peak intensities.\textsuperscript{i}

However, a recent review of research and follow-up human behavior laboratory study provided for the Fire Protection Research Foundation (FPRF) of the National Fire Protection Association (NFPA) finds that other light sources (such as LEDs) that use a longer pulse duration to achieve the same effective intensities as xenon strobes are not detected as reliably when viewed indirectly (as a reflection on room surfaces).\textsuperscript{iii}

This white paper summarizes some key findings of this study and provides recommendations for choosing visual emergency notification devices based on these results.\textsuperscript{viii}

**Industry Challenges**

As with all life safety systems, designers and installers of emergency notification systems are first concerned with never compromising the safety of the individuals that their systems protect. In practice, this requires fire and emergency system professionals to use their experience and knowledge to design and install systems that meet the unique requirements and challenges of each individual application. It also requires choosing notification devices that meet both application requirements and UL and NFPA 72\textsuperscript{®} standards.

Designers must accomplish both of these goals while staying within budget and managing system costs. One way to do this is by choosing devices for the system that require the least amount of current draw. This enables the designer to lay out a system that can include more devices on each fire alarm control panel (FACP) notification appliance circuit (NAC), which potentially translates into fewer panels/power sources and lower costs for the overall system.

For visual signaling devices, light emitting diode (LED) technology has recently entered the market. The LED strobes available today appear to meet minimum NFPA and UL standards, while in some limited applications (depending on candela setting) providing increased power efficiency over the predominant xenon strobe technology.

Effective intensity, an estimate of the luminous intensity of a flashing light that has equivalent visual effectiveness as a steady-burning light,\textsuperscript{iv} is a calculation that has served as the test criteria for the current NFPA 72 and ANSI/UL 1971 performance standard for visual signaling appliances.

Although LED strobe technology on the market meets the current performance standard, in order to do so, the pulse duration of these devices must be increased over the time required for the predominant xenon strobe technology. This increase in pulse duration, while enabling these newer technologies to meet the performance standard, may result in lower real-world detection performance versus xenon strobe technology, thus limiting the predictive power of the current performance standard.
As a recent review of research performed by the RPI Lighting Research Center on behalf of NFPA’s Fire Protection Research Foundation suggests, “effective intensity may not be predictive of visual detection of signal lights when these are viewed indirectly [reflected on room surfaces].”

As a result, the Fire Protection Research Foundation commissioned a human factors laboratory study to test the viewing performance of different lighting technologies, including commercially available emergency notification visual signals. What this study shows is that “effective intensity…was not a useful predictive metric for the performance of visual signals having different durations.”

This result begs the question, “Does meeting the current performance standard duration, with LED technologies protect the public as effectively as the predominant xenon strobe technologies?”

The remainder of this white paper will summarize the methods of the human factors research study as it relates to emergency notification appliances, provide an overview of some of the key results, and provide our recommendations based on those results.

**Indirect Viewing Study: Setup**

Test subjects for the human factors study were seated at a table in a large rectangular classroom facing a white painted wall. White painted walls were also on either side of the subject. The test light source was mounted from the ceiling about one foot away from the wall behind the test subject.

Some experiments had subjects look directly at the wall in front of them. In other experiments, the subjects were asked to perform “numerical verification tasks” (NVTs) on the table in front of them in order to test how well they detected the flashing light with their peripheral vision.

The study included 7 total experiments with 10 subjects in each experiment. Two experiments (4 and 5) used a commercially available emergency notification visual signal (xenon strobe) set to the nominal 15 cd setting and standard pulse duration, along with LED light sources. In each of these experiments, light sources were flashed at different intensities and rates. The ambient illuminance was also varied.

Subjects were exposed to each experimental condition (flashing light at different rates and intensities) in a random order for 10 seconds each. They were then asked to report if they detected the flashing light. They were also asked to rate the ease of detection and level of perceived urgency of each signal (if detected).

Of interest for indirect viewing performance, experiment 4 had subjects performing the NVT. The results of experiment 4 are summarized in the following section.

**Results for Experiments 4**

In experiment 4, subjects were asked to perform the NVT (a number task on the table in front of them) in order to test peripheral detection of light sources.
Detection Performance

Overall, detection of LED light sources as shown in the table in this experiment was lower. However, the xenon strobe light source was detected 100 percent of the time. In fact, the highest performing LED light source pulse durations (100 ms and 25 ms) were only detected 70 percent of the time – even at higher effective intensities than the xenon strobe.

The LED sources similarly underperformed the xenon strobe technology in ease of detection and urgency of the signal (see the full report for complete results).

Recommendations/Conclusions

Based on the NFPA research report report, notification appliances using a longer pulse duration might not alert individuals as effectively as xenon-based products. UL has created a Task Group to work on updating the standard to address the performance differences.

In the future, using new light sources capable of a shorter pulse duration and complying with the new (as yet undefined) standard will make new notification appliances with alternate light sources, such as LEDs, a viable option. Until then, the research has demonstrated that xenon bulbs are the best technology to use for alerting people.

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AVWP96402 • 5/14