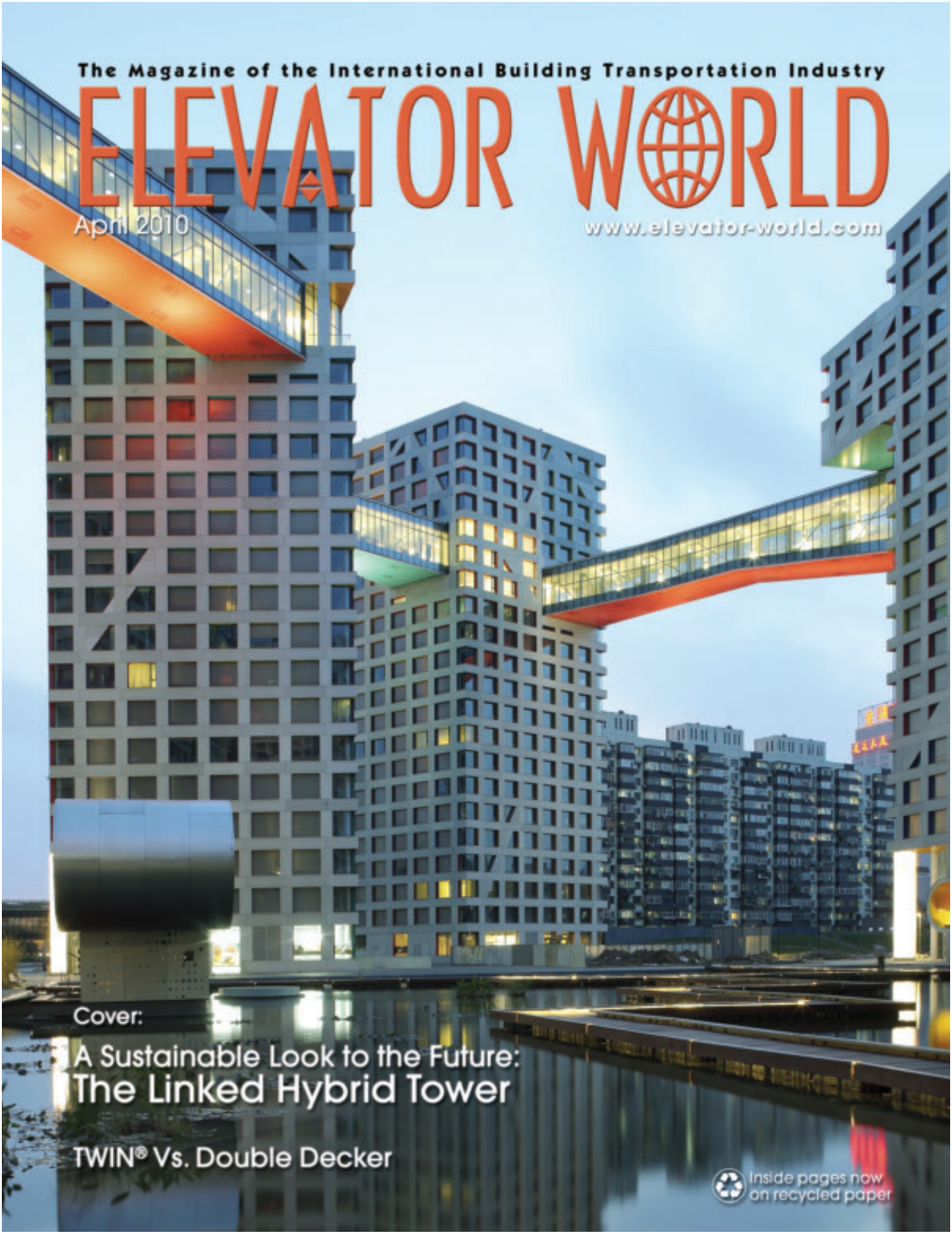


The Magazine of the International Building Transportation Industry

ELEVATOR WORLD

April 2010

www.elevator-world.com

Cover:

A Sustainable Look to the Future: The Linked Hybrid Tower

TWIN® Vs. Double Decker

Inside pages now on recycled paper

The Green Cab Lighting Guide

by Jed Shapiro

Introduction

Many types of lighting have been used in elevator cabs over the years. Among the latest are LEDs, which consume little energy, run cool, may provide increased life expectancy and are environmentally friendly. We're in the "Wild West" period for new LED lighting technologies. Many claims are exaggerated and results still unproven.

Following is a discussion of various lighting alternatives, potential energy savings, lamp life expectations, replacement cycles and costs, waste heat, environmental considerations and end-of-life waste stream contribution.

What Is an LED?

LED stands for light emitting diode, a type of semiconductor that generates light when electricity is applied. The "power on" indicator on your computer, flat screen TV, radio, cellular phone and a host of electronics have employed LEDs for years. More recently, LEDs have started replacing standard incandescent traffic lights on city streets. They've also started to appear on commercial trucks and in taillights on newer cars.



LED device

Recent advances have improved the color rendition of LEDs so that they are now an acceptable replacement for other, less efficient light sources. As LEDs move to the mainstream for a variety of lighting needs, they have become more recognized for their potential to improve lighting energy efficiency.

Global Lighting Industry Betting on LEDs

Presently there's an international campaign to replace incandescent

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Installed LED downlight system

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bulbs with compact fluorescents (CFLs). This is driven by the inherent inefficiency of incandescent bulbs, where up to 98% of the energy they use produces heat, not light. So it's no surprise that "Edison"-type bulbs will be phased out in the next few years.

Even as CFLs replace less efficient sources, the lighting industry sees them as an interim solution at best. Of the big three bulb manufacturers – Philips, Osram/Sylvania and General Electric – Philips has already shifted the vast majority of its R&D budget (reported at 5.2% of its global lighting revenue) from fluorescents to LEDs.

Utilities Advocate Fluorescents; Mercury a Concern

The electric utility industry continues to champion the ability of fluorescents to reduce the amount of power we consume. However, responsible property managers, parents and just about everyone else is less enthusiastic once they realize that even cutting-edge fluorescent bulbs contain 1.4 milligrams of mercury, and standard bulbs contain 4 milligrams or more.

A so-called heavy metal, mercury is a widely recognized health and environmental hazard. While an individual bulb represents a small risk, the aggregate impact of bulbs flowing into the waste stream has potential to do serious environmental damage, including groundwater contamination.

Meanwhile, at home or in the office, accidental breakage of fluorescent bulbs creates an environmental microhazard when it occurs. The U.S. Environmental Protection Agency (EPA) recommends evacuating the room, airing it out for 15 minutes, then carefully following a cleanup procedure intended to isolate, capture and remove as much of the mercury as possible. More on this can be found at website: www.epa.gov/mercury/spills/index.htm#fluorescent.

Keeping Their Cool

LEDs have a limited temperature tolerance – they work best within a narrow temperature range. As operating temperature rises, efficiency falls, and life expectancy is diminished – so the major challenge for design engineers is keeping them cool. Some manufacturers have been experimenting with liquid cooling to remove damaging heat from the LEDs light-generating semiconductor material.

Lighting Alternatives Comparison at a Glance

Lighting Type	Power Efficiency	Light Quality	Waste Heat	Bulb Replacement
ECI CabLite	A	A-	A	A
Screw-in LEDs	B	C	B	F
Fluorescent Tube	B	F	C	B
CFLs	C	F	C	C
Halogen	D	B	F	B
Incandescent	F	A	F	F

To date, these are still experimental, high cost solutions.



Screw-in LED – CREE LRP-38

Screw-in replacement LED "bulbs" must pack a tiny power supply into the lamp base, since they run on low voltage. Due to power conversion inefficiencies, the power supplies themselves are a secondary heat source, making it even more difficult to keep LEDs cool. For this reason, screw-in replacements typically employ a massive external heat sink in an attempt to regulate operating temperatures.

The challenge of keeping screw-in LEDs cool limits the amount of power that can be packed into a standard size lamp to substitute for inefficient halogen and other bulbs. Theoretical life expectancy claims have not been proven to translate into realized service life for these devices.

Cool Design Breakthrough

One manufacturer of LED lighting specifically developed for use in elevator cabs has taken a different approach. ECI America's CabLite® system combines high-powered LED downlights in a heat-dissipating aluminum housing and a remote external power supply and controller. With this design, power supply heat is isolated, so there is no contribution to LED overheating. The result is that these LEDs run cool on power from a compact control unit providing precisely regulated current to each individual downlight.



ECI CabLite downlight

Service life expectation claims for CabLite are double those claimed for screw-in LED replacements – 100,000 hours or 11.4 years of continuous service. ECI guarantees service life of at least 60,000 hours.

Elevator Safety Code Light Level Requirements

The ANSI A17.1-2007 code requires that a minimum 50 Lux light level be provided at the cab threshold (Table 1). In most cases, a single ECI CabLite downlight will provide sufficient illumination to meet the safety code – although a typical cab will have six to nine downlights or more.

The color of light is defined by temperature measured in Kelvin units. A typical daylight bulb equivalent is 6,300 Kelvin; warm white color rendition is 3,000 Kelvin. An intermediate color temperature, favored increasingly in government specifications, is 4,100 Kelvin. ECI CabLite offers some of the most color accurate luminaries available, and any of the three color temperatures are available without any upcharge.

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Energy Savings: Consumption Compared

The most widely accepted method for comparing energy consumption for various lighting sources is to measure the amount of light in lumens produced by a watt of electric power, or comparison based on lumens per watt.

LEDs are among the most efficient lighting sources, capable to produce in the range of 50 or more lumens per watt, and these figures continue to improve. By using a regulated power supply matched to the LED arrays in each downlight, ECI's CabLite delivers 105 lumens per watt. Each downlight consumes only 3.7 watts.

Fluorescent tubes are theoretically as efficient, producing 50-100 lumens per watt, while their CFL siblings are less efficient, at 35-60 lumens per watt. Halogen lighting produces only 15-20 lumens per watt, while incandescent bulbs produce only 9. Most industry sources show lumens per watt as ranges, which have been averaged in Table 2.

Power savings can be dramatic, depending on the inefficiency of the existing lighting method compared to a system like ECI CabLite. Conservative 10 year power consumption savings per cab with CabLite replacing incandescent bulbs is estimated at US$4,380.

Theoretical Vs. Actual Usable Lumens per Watt

Additional factors affect the actual usable lumens per watt including:

(1) power supply conversion efficiency
(2) directionality of light produced
(3) lighting losses resulting from use of a diffuser panel.

LEDs, fluorescent tubes, CFLs and many halogen lights are low voltage devices, so they require use of a power supply to step down 120 VAC line voltage. Conversion inefficiencies erode lumens-per-watt delivered.

LEDs produce highly directional light, ideal for use in ceiling downlight applications. A standard fluorescent tube, on the other hand, is non-directional, radiating light in all directions at right angles to the tube. Fluorescent tubes are typically installed in fixtures with a reflector of white-painted metal, which redirects very little light energy. Perhaps only 30-60° out of a fluorescent tube's 360° of light output is directed where useful, for an efficiency factor of 8.3% to 16.6%. This would also be essentially true of CFLs, which are non-directional.

Lighting Type	Power Supply Efficiency
ECI CabLite	80%
Screw-in LEDs	65%
Fluorescent Tube	94%
CFLs	80%
Halogen	80%
Incandescent	N/A

Sealed halogen lamps are directional. They typically incorporate a highly polished parabolic reflector that efficiently directs light energy out of the customary fixture with a 30-60° spread angle.

Last but not least, fluorescent tubes used in elevator cabs are mounted in a fixture that either has an integrated diffuser or in a fixture above a dropped ceiling either partly or completely comprised of a plastic diffuser material. These plastic materials both absorb and reflect some light energy toward the cartop, reducing system efficiency.

Lamp Life Expectations

Lamp life data is readily available for traditional lighting types, where rated lamp life is determined by subjecting a statistical sample of bulbs to continuous operation – including several starts per day – until 50% of the samples burn out. The lighting industry defines the time for this to occur as rated lamp life.

Unlike other types of lighting, LEDs do not burn out, but instead gradually lose brightness over time. Their life expectancy is defined as the length of time it takes for luminary performance to degrade to 70% of initial brightness.

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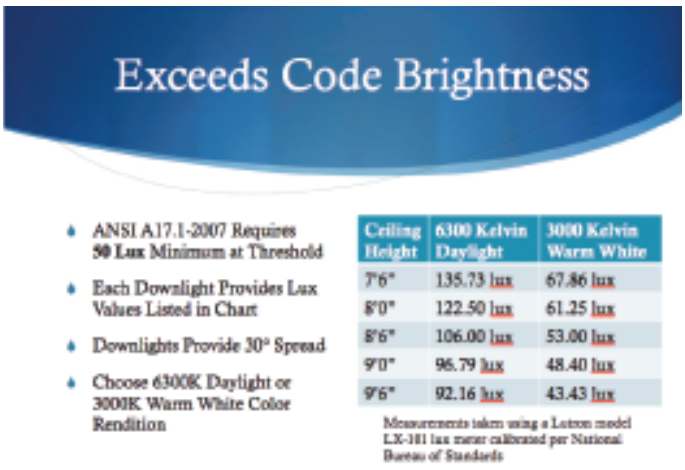


Table 1

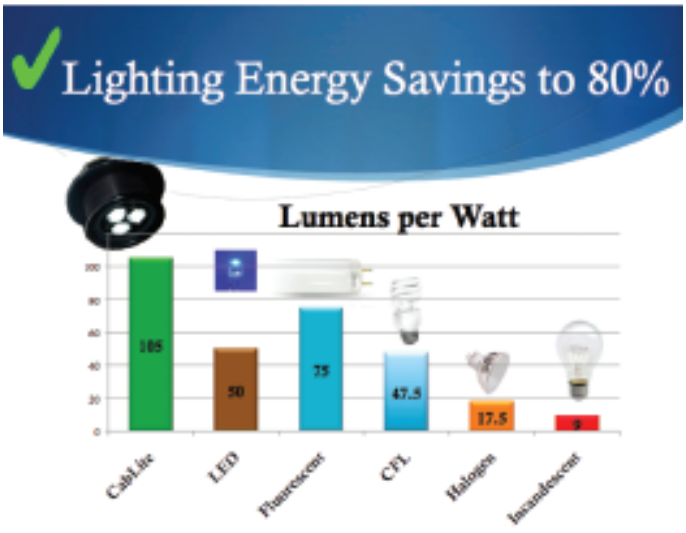


Table 2

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Lighting industry information suggests the following theoretical lamp life expectations:

Lighting Type	Lamp Life Hours	Lamp Life Years
ECI CabLite	100,000	11.42
Screw-in LEDs	50,000	5.71
Fluorescent Tube	15,500	1.77
CFLs	6,000	0.68
Halogen	10,000	1.14
Incandescent	1,000	0.11

As theoretical life expectations extend to be measured in decades, rated lamp life is increasingly difficult to confirm based on aging tests.

However, preliminary statistical tests on screw-in LEDs, conducted by the consumer products testing agency Stiftung Warentest in Germany, suggest that manufacturers have unrealistically inflated life span claims. LEDs labeled at 50,000 hours failed after less than 1,000 hours in tests. Some screw-in LEDs available in the U.S. are cryptically labeled with lamp life rated "up to 50,000 hours." Others are not recommended for downlight applications where heat is trapped in the fixture, which is typical of elevator ceiling applications.

Standardized testing for screw-in LED lighting has been proposed by the U.S. Department of Energy, along with a "Lighting Facts Label," much like the now familiar food labels in the U.S. that show calories, fat grams, etc. Still voluntary, the labeling standard is backed by a uniform testing standard identified as IESNA LM-79. Few manufacturers of screw-in LEDs have complied so far.

Lamp Replacement Cycles

Based on a hypothetical 5.7-year operating period, the number of re-lamps for various lighting types is as follows:

Lighting Type	Lamp Life Hours	Re-lamping Cycles
ECI CabLite	100,000	0
Screw-in LEDs	50,000	1.0
Fluorescent Tube	15,500	3.2
CFLs	6,000	8.3
Halogen	10,000	5.0
Incandescent	1,000	50.0

Considering realistic lamp life expectations, re-lamping cycles, lamp replacement costs (materials plus labor), and the number of lamps in a typical cab, 10-year re-lamping cost savings with a system like ECI CabLite could range from as little as US$1,156 for a cab lit with fluorescent tubes to a stunning US$26,280 for a cab lit with screw-in LEDs (presuming a realized 3,000 hour service life).

Waste Heat Cost and Removal

Aside from energy cost and lamp replacement savings, there is another factor that may be the most significant of all – waste heat. As previously mentioned, a standard incandescent lamp converts only 2% of the electrical energy into light, which means that up to 98% of the energy used produces heat. This nuisance heating effect is particularly troublesome for elevator cab lighting, because these British thermal units (BTUs) of heat energy need to be removed from the cab interior to prevent overheating.

Essentially, the building owner pays twice: once for the electric power to generate the heat, then again to remove it. Secondary cost impacts include putting cooling equipment or added capacity in place to transfer unwanted heat from inside the elevator cab to outside the conditioned building envelope where it is exhausted.

Environmental Considerations

Reducing electric power consumption has emerged as a popular public policy and must-do mandate as we continue to better understand the nature and implications of global warming. Selection of efficient lighting alternatives, whether as a retrofit project or during building/elevator construction, just makes good sense. Operating costs are reduced, replacement cycles are minimized, and reasonable return on investment (ROI) can be demonstrated.

Reductions in waste-heat generation eliminate electrical energy used to generate waste heat and the additional energy and equipment required to exhaust heat outside the building. The aggregate impact of limiting the amount of waste BTU's released into cities and the lower atmosphere is unknown, but beneficial.

Finally, every lighting type discussed – with the exception of LEDs – contains some mercury. Accidental breakage and end-of-life disposal are both issues in terms of air quality and groundwater contamination.

End-of-Life Waste Stream Contribution

The ECI CabLite system has been designed with a regulated power supply controller separate from the individual downlights. This power supply has an indefinite life, unlike the integrated power supply embedded in screw-in LEDs, CFLs and low-voltage halogen bulbs, which are discarded with the lamp at end of life. Further, ECI has established a program to return, harvest and recycle all downlight materials and components to the extent possible including aluminum housings and plastic parts. As such, ECI CabLite will have a zero waste stream contribution.

Energy Calculator

A calculator to determine potential energy savings, re-lamping cycle cost savings, and ROI years is available from ECI.

The ECI CabLite system is available with standard black or silver downlight bezels. Other colors can be provided. Adaptor plates are available for quick and easy retrofit of existing cab ceilings with 6-inch can cutouts. The CabLite system provides integrated emergency lighting, which illuminates up to two downlights exceeding code required operating hours. Downlights are dimmable, and maximum light level and dim level are easily reset.