Energy-Efficient Track Lights

Track lights provide directable beams of high-quality light for use in retail displays, galleries, museums, and residences. They are useful in locations where lights need to be aimed at different angles and where the position of the light may be changed frequently. Until recently, the only light sources that could provide the right kind of illumination for track lighting were inefficient halogen lamps. However, newer light sources now provide a wider array of options.

Low-wattage metal halide (MH) lamps introduced in the mid-1990s gave designers and specifiers the first energy-efficient alternative. Today, compact fluorescent lamps (CFLs) are available for some types of track lighting, and light-emitting diodes (LEDs) are also becoming a viable light source for many applications. These lamps reduce energy use and last several times longer than halogen lamps, leading to reduced lamp-replacement costs. However, the costs for energy-efficient lamps and fixtures are significantly higher than those for halogen units, so these newer technologies are most likely to be cost-effective in applications with long burn hours and where changing lamps is difficult. Advanced halogen lamps that will meet new federal regulations are also now available and will keep halogens in the game for a while longer.

WHAT ARE THE OPTIONS?

this section

Lamp Types

Halogen lamps, CFLs, MH lamps, and LEDs are all used in track lighting (**Table 1**). Each has strengths and weaknesses.

Table 1: Choosing the right lamp type

When choosing track lighting, it’s important to consider how you’re going to use it—each type of lamp is appropriate in different applications (A). Lamp types—halogen,

compact fluorescent, metal halide, and light-emitting diode—also differ in efficacy, life, and color quality (B).

A. Track lighting applications

Application	Halogen	CFL	MH	LED
Office—wall-washing, wall accent	■	■	■	■
Schools—wallboard, hall display board		■		■
Hospitality—wall display, perimeter accent	■	■	■	■
Retail—display, accent lighting	■		■	■
Retail—wall display		■		■
Industrial—task lighting	■		■	■

B. Light source comparison

Light source	Mean efficacy (lumens/watt)[a]	Lumen maintenance (%)	Life (hours)	Color rendering index
Halogen	15–25[b]	95	2,000–4,000	100
CFL	40–70[b]	86	6,000–15,000	80–85
MH	60–80[b]	65–75 (quartz); 80 (CMH)	7,500–20,000	60–75 (quartz); 85–94 (CMH)
LED	15–70[c]	70	25,000–50,000	80–90[d]

Notes: CFL = compact fluorescent lamp; CMH = ceramic metal halide; MH = metal halide; LED = light-emitting diode.
a. Mean lumens per input watts; mean lumens = average quantity of light output over the life of the lamp.
b. Higher efficacy correlates with higher wattage for halogen, CFL, and MH.
c. Most of the variation is due to LED product quality.
d. Color rendering index for LEDs can vary widely in practice and may not be a good indicator of the color quality for a particular application, so try before you buy.

Advanced halogen lamps. Advanced halogen lamps use advanced halogen infrared (IR) technology. IR coatings redirect wasted heat energy emitted by the lamp filament back to the filament to increase its temperature and thus increase light output without increasing wattage. These products provide a 20 to 30 percent increase in efficacy but cost 2 to 3 times more than standard halogen products. More-efficient versions are in the works.

Metal halide lamps. MH lamps, especially ceramic metal halide (CMH) units, have improved greatly in recent years and can compete with halogen lamps in most applications except those where deep dimming is called for—MH lamps suffer from an undesirable color shift when they are dimmed; they are generally not dimmable below about 50 percent of initial output. CMH lamps offer better color quality and exhibit less color shifting than conventional quartz MH lamps, and their light output degrades more slowly. CMH lamps provide good color quality, long life, and a widening variety of lamp shapes and sizes, including MR16, PAR20, PAR30, PAR38, T-6 single-ended, and T-6 double-ended, all of which have been incorporated into track lighting designs. Newer CMH lamps that draw as little as 20 watts have enabled the technology to compete with halogen lamps and CFLs in a wider range of applications. Some of the low-wattage, self-ballasted CMH products may have low power factors, so harmonic distortion and high neutral currents could be a concern if they are deployed in high concentrations (check the lamp specifications for

power factor).

Compact fluorescent lamps. CFLs are not a good choice for track lighting applications where concentrated beams of light are needed, but these lamps are suitable for track lights used for flood-type light distributions and wall-washing. CFLs are also of limited value where dimming is required—dimmable CFLs cost more, and they generally don't dim as deeply or as smoothly as halogen lamps. Fluorescent lamp track heads often require baffles to reduce glare for shoppers or room occupants.

Light-emitting diodes. LEDs have a number of properties that make them good candidates for track lighting applications. Their light output is directional, so the lamps can theoretically be designed to match any of the light distributions of conventional lamps and even provide new distributions. However, it's important to test products to make sure that they provide the desired light spread. LEDs emit neither ultraviolet (UV) nor IR radiation, so they can be used in museums and other areas with UV-sensitive objects as well as in grocery stores and other applications where objects are sensitive to heat.

LEDs are not quite ready to replace small, high-wattage halogen lamps. The challenge for smaller-sized LEDs, such as those aiming to replace halogen MR16 lamps, is that LEDs require large heat sinks to dissipate the waste heat they generate. In addition, it has proved difficult so far to pack enough LEDs into a small space to replace small, higher-wattage lamps.

Fixture Types

Track lights for energy-efficient lamps are similar to track lights for halogen lamps (**Figure 1**). The track can be recessed into the ceiling, mounted to the surface of the ceiling, or suspended from the ceiling in a configuration known as a pendant mount. The track head—which includes the lamp housing, lamp, socket, and a reflector cone—moves along the track and may be integrated into the track or suspended in a pendant mount. In addition, some individual track lights can be connected directly to a junction box. Ballasts are typically housed in the track head, although they may also be recessed into the ceiling plenum. Track lights also offer options for switching individual lamps or groups of lamps.

Figure 1: LED track lighting fixture

Track lights for energy-efficient lamps are similar to those for halogen lamps. This light-

emitting diode (LED) fixture was a prizewinner at the Next Generation Luminaires competition.

Courtesy: Amerlux

Accessories available for track lights include lenses that alter the beam shape, louvers and tubular shields that cut down on glare, and filters that change the color of the light. Some products also offer a ballast fuse that prevents damage from voltage surges.

HOW TO MAKE THE BEST CHOICE

this section

Compare the cost-effectiveness of halogen with other energy-efficient alternatives. The cost-effectiveness of energy-efficient options depends on the intensity of their use and on local electricity costs. Energy efficiency and long life make up for higher first costs most quickly in areas where electricity costs are highest and in applications where maintenance costs are high and usage is most intense. Use the online calculator below as a screening tool to compare the costs and savings of halogen with energy-efficient alternatives for a given application.

Energy-Efficient Track Lighting Savings Calculator

Try before you buy. Alternative light sources produce different color effects than halogen lamps, so test the lighting before any major conversion to be sure that the results are acceptable. In addition, because ballasted fixtures (unlike halogen fixtures) are designed to work with only one lamp wattage, it is important to determine the right lamp size before you purchase any fixtures.

Account for lumen depreciation. Halogen lamps lose less than 5 percent of their light from the time that they are new to the time that they fail. MH lamps lose 10 to 40 percent of their rated output after 40 percent of their rated life. LED lamps don't generally fail outright, but their output fades over time and the generally accepted definition of the end of lamp life is the time at which output has degraded to 70 percent of its initial value. This phenomenon can shorten the lamp's effective life if output becomes too dim for the application, or it can force designers to overlight the application when it is first installed.

Avoid halogen lamps where heat can cause problems. LED lamps reject most of their waste heat by conduction and therefore keep illuminated objects cooler. MH lamps and CFLs also emit less IR radiation than halogen lamps do. This feature can reduce fading and drying of objects and may increase the lifetimes of some displayed objects, such as food.

Use long-life sources to minimize disruptions. In applications such as retail display lighting in windows and areas tightly packed with products, long-life sources such as LEDs will reduce the frequency of relamping and therefore reduce maintenance disruptions.

Look for Energy Star–qualified LEDs. With LEDs, one way to ensure that products have been designed with adequate heat-dissipation capability is to choose Energy Star–qualified products. Some manufacturers are also participating in the Lighting Facts Program, a voluntary program run by the U.S. Department of Energy that uses the Lighting Facts Label to report data in a uniform, useful way based on established standards.

Don't use MH lamps where warm-up and restrike delays could cause problems. MH lamps require a warm-up period, which can be troublesome after power interruptions or in applications where lights are frequently turned on and off. CMH lamps on electronic ballasts take 1 to 3 minutes to reach full output and as much as 10 to 20 minutes to restrike after a shutdown or power interruption.

Be sure the track can handle the weight in a retrofit. MH track lights can fit into existing tracks that were designed for halogen fixtures. However, magnetically ballasted MH track lights weigh considerably more than halogen units and could exceed the weight capacity of the

track. Electronically ballasted fixtures weigh considerably less and may not present such a hazard.

WHAT'S ON THE HORIZON?

this section

All of the energy-efficient lamp types are improving. Halogen IR lamps may provide as much as 45 lumens per watt before 2020, manufacturers are improving the dimming capabilities of CFLs and decreasing the time it takes them to reach full brightness, and LEDs continue to come down in cost as their performance improves.

WHO ARE THE MANUFACTURERS?

this section

Following is a partial listing of companies that offer metal halide lamps and track-lighting fixtures.

General

- Amerlux
- Inlite
- Lithonia Lighting
- Philips Lightolier
- Times Square Lighting
- Zumtobel

Light-emitting diodes (LEDs)

- Cooper Lighting: Halo Stasis
- enLux
- Kichler Lighting

- EcoSense Lighting

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