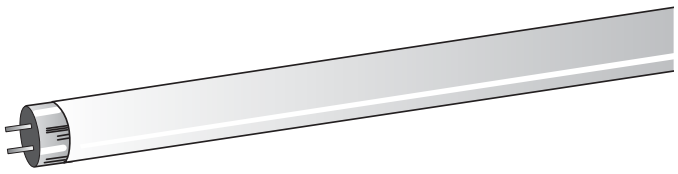
Shining a Light on Lighting Maintenance

You've done your lighting upgrade and your facility looks great, energy bills are down, and morale is up. But beware—all those benefits can literally fade away if the new lighting systems are not well maintained. Maintenance is not complicated—light-reflecting surfaces and lenses must be periodically cleaned and lamps replaced—but it does require attention to detail. Those details vary depending on the types of lighting used. Most facilities employ a mix of incandescent, full-size fluorescent, compact fluorescent, and high-intensity discharge (HID) lamps. Here's a look at the important considerations and potential pitfalls for each type.



Incandescent lamps. In lighting upgrades where halogen or halogen infrared-reflecting lamps replace standard incandescent lamps, there is a risk that relampers will use standard incandescent lamps if halogen stocks run out. That step would degrade the installation and eliminate any savings. To minimize that risk, it is best if every incandescent lamp in the facility is changed out and any remaining standard stock is removed from the premises.

Bare halogen lamps—those lacking a lens or protective outer glass bulb—require special handling because they can shatter if spattered by water or spotted with dirt or oil from fingers. Relampers should handle the lamps with clean gloves and reinstall protective glass covers after each relamping. Clean gloves can be stored with the lamp inventory to make them readily available.

Fluorescent lamps. After an upgrade from T12 to T8 fluorescent lamps, relampers or maintenance staff may be tempted to "finish up" existing T12 stocks in a new T8 installation, so those stocks should be removed *before* this mistake is made. Failure to do so will result in a shoddy appearance and a major drop in light levels. Also, if a standard or energy-saving T12 lamp is operated on a T8 ballast, it will likely fail after operating for only a fraction of its rated life.

Conversely, T8s can mistakenly be installed in T12-ballasted fixtures. In this case, one of two things may happen: The lamps will put out greater light but will fail long before their rated life (because the cathodes will be rapidly damaged by the T12 ballast's higher current), or the lamps will fail to start because T8 lamps require a higher starting voltage than T12 lamps.

Now that some lighting upgrades take a facility from earlier generations of T8 lamps to newer, more efficient T8s, steps must be taken to ensure that the high-performance T8s are not replaced with lower-performing lamps when they burn out. Make sure that stocks of the old lamps are removed and that purchasing policies require that only high-efficiency lamps be purchased.

Fluorescent ballasts. Ballasts last longer than lamps, and their performance does not deteriorate over time, but they will eventually need to be replaced. The challenge is that there is a wide variety of similar-looking ballasts available, and an incorrect replacement can make the lamp difficult or impossible to start, reduce light output, increase power draw, and damage the lamp. Even when the ballast used is designed for the lamp in question, it is important to check that the replacement ballast has the right ballast factor (BF), a measure of the percentage of a lamp's rated lumen output that is provided by a given ballast. To avoid confusion, the BF of each ballast used should be

clearly marked inside each fixture. This step will increase the probability that maintenance staff will replace a defective ballast with a ballast that has the same BF.

Compact fluorescent lamps. Maintenance issues with CFLs differ with the type of CFL in question. For screw-in CFLs, the biggest concerns are the chance of replacement with incandescent lamps and theft because of the high value of a CFL compared to an incandescent bulb. Fortunately, theft-resistant options are now available that limit "disappearances." Theft is also becoming less of a problem as the cost of CFLs comes down.

Maintenance considerations for pin-base CFLs are similar to those for linear fluorescent lamps and ballasts. It is important to maintain lamp and ballast compatibility. Even though screw-in CFLs and adapters for pin-base lamps are stock items in most electrical supply houses, users should keep their own supply so that no incentive is created to "temporarily" replace such devices with an incandescent lamp.

High-intensity discharge lamps. HID lamps present their own set of maintenance considerations. The main issues for metal halide lamps are lamp/ballast compatibility, proper orientation of the lamp (vertical or horizontal), and hazard avoidance.

If a metal halide lamp is used with the wrong ballast, an early arc tube failure is likely. To avoid this problem, the proper American National Standards Institute (ANSI) ballast designation for each lamp is listed on the lamp sleeve or on the insert included with the lamp.

If the lamps are not oriented properly, lamp life will suffer. One way to eliminate this problem is to use lamps that are designated to have universal orientation; however, such lamps are less efficient. The use of compact metal halide fixtures also eliminates this problem because it makes incorrect orientation impossible. However, there are still lots of fixtures available that can accommodate any metal halide lamp with a mogul base in any orientation, regardless of its designed orientation. The best solution is to avoid mixing differently oriented metal halide fixtures in the same building.

Although the probability is small, some metal halide lamps will rupture at the end of their life, creating a potential for injuries or fire. This hazard can be avoided through the use of enclosed fixtures or through the use of lamps designed to contain the fragments of a failed arc tube. To help users avoid this problem, ANSI has established three classifications for metal halide lamps:

- E-type lamps must be used only in enclosed luminaires.
- S-type lamps may be used in open luminaires as long as they are operated in a near-vertical position, as specified in the lamp data sheet.
- O-type lamps are designed to prevent fragments of an exploding arc tube from rupturing the outer glass bulb and can be operated in open luminaires.

The newest open luminaires feature a special "exclusionary" socket designed to operate only with O-type lamps. Although E- and S-type metal halide lamps can fit into these exclusionary sockets, they will not operate. O-type lamps will also work when installed in standard metal halide sockets. This new socket prevents misapplication of metal halide lamps, but there are millions of open luminaires still in the field that use the older standard socket. Therefore, it is essential that maintenance personnel be trained to use only O-type lamps in open metal halide luminaires.

The risk of lamp rupture can also be reduced by following manufacturers' recommendations for cycling lamps that would otherwise run continuously—typically at least 15 minutes of off time is required after each week of continuous operation. (For more information on metal halide lamp ruptures, download the National Electrical Manufacturers Association white paper "Best Practices for Metal Halide Lighting Systems, Plus Questions and Answers about Lamp Ruptures in Metal

Halide Lighting Systems," LSD 25-2004, available for no charge at www.nema.org.)

HID lamps, especially metal halide lamps, shift in color as they age, making group relamping essential where color constancy is important. Although the color change may not noticeably affect the look of a space, the differences can be distracting when you are looking at a fixture or a white ceiling above an indirect HID fixture (see sidebar on group relamping).

High-pressure sodium (HPS) lamps exhibit another unique phenomenon that can affect maintenance: They naturally cycle on and off at the end of their useful life. This phenomenon is sometimes mistakenly perceived as a signal to lamp maintenance personnel that the lamp needs to be replaced. Although the cycling is visually distracting, it occurs so slowly that it can actually prevent timely lamp replacement because even in the cycling phase the lamp may appear to be operating normally when observed for a short period of time. To solve

Group Relamping

With fluorescent and high-density discharge lamps, it is usually cost-effective to practice *group relamping*, in which all lamps are replaced in the same operation, rather than *spot relamping*, in which lamps are replaced only when they burn out.

- On a per-lamp basis, group relamping requires much less labor than spot relamping because the maintenance workers have all the required materials on hand and can move systematically from one fixture to the next. In addition, group relamping is normally done outside working hours, which reduces disruptions of normal activities.
- Group relamping is an easy task to schedule and to delegate to outside contractors who have special equipment and training.
- Group relamping provides brighter and more uniform lighting because it gets rid of lamps before they are at the end of their lumen depreciation curve.
- Group relamping offers increased control over the replacement lamps, reducing the probability of mixing incompatible lamps, such as those with different color temperatures.
- Other maintenance activities can be combined with group relamping, such as ballast and reflector inspection and lens cleaning. Group relamping also provides an opportunity for retrofitting reflectors, lamps, ballasts, or lenses as necessary.

Group relamping is normally done at about 60 to 80 percent of rated lamp life, depending on variables such as labor costs, requirements for fixture cleaning, and the cost and mortality curves of the lamps.

Economic comparisons typically show that group relamping has higher lamp costs but lower labor costs than spot relamping. One such comparison (**Table 1**) shows a substantial overall savings from group relamping.

Table 1: Economics of group versus spot relamping

Group relamping has higher lamp costs but much lower labor costs, providing, in this case, a 43 percent overall savings. Group relamping also provides additional benefits in lighting quality and facility management.

	Relamp cycle (hours)	Average lamps replaced per year	Average material cost per year	Average labor cost per year	Total average cost per year
Spot relamping on burnout[a]	20,000	525	$945	$3,938	$4,883
Group relamping at 70 percent of rated life[b]	14,000	750	$1,350	$1,425	$2,775
Difference	6,000	225	$405	–$2,513	–$2,108

Notes: Money amounts are in U.S. dollars. Assumes 1,000 three-lamp T8 lensed troffers.
a. Assumes labor costs of $7.50 for relamping and cleaning, material cost of $1.80 per lamp, and 3,500 hours per year operation.
b. Assumes labor costs of $1.90 for relamping and cleaning, material cost of $1.80 per lamp, and 3,500 hours per year operation.

Source: E SOURCE

this problem, some manufacturers offer HPS lamps designed to fail without cycling at the end of their life.

HPS lamps and pulse-start metal halide lamps are started by igniters (also called "starters"). Delays in lamp replacement can lead to damage to an igniter, which may then shorten the life of the next lamp installed. To get around this problem, some magnetic and nearly all electronic HID ballasts are available with an automatic starter cutoff, which kicks in when a lamp fails to start after a short period of time, usually less than three minutes. Though these ballasts can initially be more expensive, they can quickly recoup the extra cost in saved labor and lamp costs. Tester kits are available for HID fixtures to determine whether igniters or ballasts are defective.

Mercury vapor lamps, the third type of HID lamp, burn almost indefinitely with ever-diminishing output rather than failing outright. To avoid complaints of low light levels, group relamping is recommended. Better yet, replace mercury vapor lamps with a more efficient light source.

Plan for maintenance of your lighting systems as outlined here, and you'll keep things running efficiently for years to come.

Proper Lamp and Ballast Disposal

Fluorescent and HID lamps and some ballasts contain hazardous materials and should be properly disposed of. For information on lamp recycling, visit www.lamprecycle.org; for information on ballast disposal, visit www.epa.gov/pcb.