NOT YOUR AVERAGE T8

If you think you’ve done it all when it comes to lighting retrofits, think again! For years, the mantra of the lighting retrofit industry has been, “Replace your T12 fluorescent lighting with T8 lamps and electronic ballasts.” However, fluorescent lighting technology has achieved new levels of efficiency, color quality, and longevity in a class of products that have been unofficially dubbed “super T8s.” (This pamphlet is a condensed version of Robert Sardinsky and James Benya, “Super T8s: Super Lamps, Super Ballasts,” E SOURCE Report, ER-03-16 [September 2003], Platts Research & Consulting.)

Super T8s are more efficient, last longer, and provide better color quality than earlier T8 technologies. Even so, demand for the new systems isn’t surging. One reason is cost — a super-T8 lamp/ballast system generally costs more than comparable T12 and commodity T8 systems, but that cost differential is shrinking. Today, the main challenge for facility owners and managers is sorting through the confusing array of available T8 options. Lighting manufacturers are competing fiercely for their share of the new, replacement, and retrofit markets by introducing a stream of innovative super- and “not-so-super”-T8 products. Diligent scrutiny of manufacturers’ product literature, performance specifications, and fine print is necessary to sort out the relative performance of these competing products.

The new generation of 4-foot T8 lamps and electronic ballasts available from several manufacturers has been evolving since the mid-1990s through incremental improvements in lamp barrier coatings, phosphors, cathodes, and gas fills, as well as in ballast circuitry and components. Super T8s primarily use rare earth (RE) phosphors instead of the less-costly halophosphors typically used in the standard T12. RE phosphors convert ultraviolet energy to light more efficiently, provide higher lumen maintenance, and offer superior color rendering. Today’s super-T8 lamp and ballast combinations can improve system performance significantly (see Table 1), with payback periods ranging from less than one year to several years, depending on the electricity price and capital expenditure.

Table 1: Super-T8 system efficacy compared with the most popular standard lamps and ballasts

<table>
<thead>
<tr>
<th>Technology</th>
<th>Light output (mean lumens/watt)</th>
<th>Over original T12</th>
<th>Over generic T8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetic T12, with original magnetic ballast and 40-watt halophosphor lamps</td>
<td>54</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Magnetic T12, with energy-saving ballast and 34-watt halophosphor lamps</td>
<td>54</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Generic T8, with instant-start ballast and commodity 32-watt 700 series CRI lamps</td>
<td>75</td>
<td>39</td>
<td>None</td>
</tr>
<tr>
<td>Super T8, with programmed-start ballast and 32-watt 800+ series CRI lamps</td>
<td>92</td>
<td>70</td>
<td>23</td>
</tr>
<tr>
<td>Super T8, with instant-start ballast and 32-watt 800+ series CRI lamps</td>
<td>98</td>
<td>81</td>
<td>31</td>
</tr>
</tbody>
</table>

Note: CRI = color rendering index. Courtesy: Benya Lighting Design and Rising Sun Enterprises

DEFINING SUPER LAMPS AND BALLASTS

Given that super-T8 technology is available in both lamps and ballasts, and that numerous variations are available for both, a simple definition of the super-T8 system is elusive. Further complicating matters, super-T8 lamps can be used with conventional electronic ballasts and super-T8 ballasts can be used with conventional T8 lamps, although the highest efficiencies are realized by using super-T8 lamps and ballasts together.

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Other types of low-wattage lamps have been evolving in parallel with super-T8s but do not meet the defining criteria (see sidebar, “What Are Super-T8 Lamps?”). These are the 28- and 30-watt reduced-light-output/energy-saver T8s, some of which operate almost as efficiently as the 32-watt super T8. However, some low-wattage lamps are not recommended where ambient temperatures fall below 60°F, in drafty locations, or for use with low ballast factor, rapid-start, or dimming ballasts. Given those constraints, one can argue that these lamps are not “super,” even though they may offer the most energy savings in some situations.

ARE SUPER T8S COST-EFFECTIVE?

Super T8s may be super in performance, but at what price and under what circumstances are they cost-effective? Most, but not all, of the new options carry a price premium, though the premiums are rapidly diminishing. In 2002, super-T8 instant-start ballasts cost about 40 percent more than commodity ballasts, but the premium is now less than 15 percent in competitive markets and for larger projects. For super-T8 lamps, the cost difference depends on the product, quantity, project, distribution channel, and competition. Today, the cost for super-T8 lamps is commonly more than twice that of commodity T8 lamps with color rendering index (CRI) ratings in the 70s. In many areas, super T8s have to be special-ordered, increasing the cost.

Although super-T8 lamps and ballasts can cost significantly more than their commodity cousins, the difference can be made up through higher efficiencies and longer lamp life. The net result can be lower lifecycle costs for super T8s — overall, about $2.40 less per lamp per year than for generic T8s. In present-value terms, this works out to a savings of about $29.00 per fixture over 20 years, or approximately 10 percent lower life-cycle costs. This calculation conservatively assumes that the super-T8 system costs twice as much as the commodity system, but the differential will be less than that in many cases, making the life-cycle costs for the super T8s look even better. In addition, the use of super T8s in combination with other measures — such as improved fixtures — can enable delamping, which could yield even greater savings.

In practice, savings and paybacks will vary by installation. In one example, substantial savings were gained by switching from commodity T8s to super T8s in new modular classrooms in California. The new classrooms came equipped with 2-foot x 4-foot, four-lamp fixtures. With all four lamps operating, the fixtures drew 116 watts and produced excessive light levels — more than 100 foot-candles. The power draw was reduced to 74 watts by simply removing the four factory-issue lamps, capping off one lead from each of the two existing ballasts and installing two super-T8 lamps. This delivered lower, more appropriate lighting levels. The retrofit preserved the original fixtures’ step-dimming capability with side-by-side switching and reduced the building’s air-conditioning load, because the new lamps put off less heat. The retrofits are projected to pay for themselves in less than a year.
APPLICATION NOTES

The payback from super-T8 systems can be rapid, especially in new construction (because there is no incremental labor cost) and in retrofits where fixtures with standard-T8 ballasts can be reused, partially delamped, and reloaded with super-T8 lamps.

New construction. When planning new construction, select super-T8 lamps and ballasts. Higher-CRI lamps make super T8s a good choice in applications where color quality is important, such as high-end retail spaces, the hospitality industry, healthcare facilities, and schools. Consider using a super-T8 ballast with a low ballast factor instead of a generic T8 ballast with a normal ballast factor. That way, you can drop the luminaire wattage while maintaining the same mean light level. This is what Symantec did at its Research Center in Springfield, Oregon. In this new building, the company also equipped private offices with T8 uplights containing three super-T8 lamps and low ballast factor “super” programmed-start ballasts. Including additional task lights, power density in these spaces is 1 watt per square foot (W/ft²); without task lights, the power density is 0.6 W/ft². If generic T8 equipment had been used, the power density would have been about 25 percent higher.

Retrofitting lamp for lamp. Replacing commodity T8 lamps with 32-watt super-T8 lamps and low ballast factor ballasts can deliver savings of at least 6 watts per lamp while maintaining existing light levels. Replacing T12s with super T8s, lamp for lamp, can save even more.

Retrofitting overlit space. For spaces that are slightly overlit, 30- or 28-watt energy-saver lamps might be a good choice when paired with a super-T8 ballast, saving a watt or two per lamp. Alternatively, greater energy savings may be realized by delamping the fixtures and retrofitting them with 32-watt super-T8 lamps paired with the appropriate ballast factor ballasts to achieve the desired lighting level. Overlit spaces represent gold mines for energy-savings opportunities, particularly by delamping and upgrading to super-T8 lamps and ballasts.
Dimming. Even with a super-T8 lamp, today’s dimming electronic ballasts are less efficient than commodity instant-start electronic ballasts. This is principally due to the added power burden of dimming circuits. At full output, a lamp with a dimming ballast will require 10 to 17 percent more power to produce the same amount of light as would be produced with a super-T8 ballast. Unless this penalty is considered when applying advanced strategies (such as daylighting), the expected savings won’t be realized. Another way to provide some “step-dimming” capability is to configure the fixtures with independent inboard and outboard switching or to wire the fixtures in zones so that they can be switched in groups in response to changing light conditions.

WHAT ABOUT T5S?

T5 fluorescent lamp systems are creating some confusion in the marketplace. To the casual observer, if smaller is better (T12s versus T8s) then T5s must be best. This was actually true until the super T8 came along, and the standard T5 comes close enough in efficacy that it warrants serious consideration. The T5’s smaller diameter permits downsized fixtures and reduces fixture light losses, but it’s not suitable for retrofitting — the T5 is shorter, uses different sockets, and has other limitations as well. Although super T8s represent a significant technological advance, because T5 systems have been so highly publicized, often even the most sophisticated designers don’t realize that super T8s can be superior in many applications.