

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, per-

formance 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.

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

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

The best super-T8 lamp paired with a super-T8 instant-start ballast outperforms T12 systems by 81 percent and older T8 systems by 31 percent.

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

Note: CRI = color rendering index.

Courtesy: Benya Lighting Design and Rising Sun Enterprises

What Are Super-T8 Lamps?

Super-T8 technology is available for 2-, 3-, 4-, and 8-foot lamps, as well as for u-bent lamps. This discussion of super-T8 lamps is based on 32-watt, 4-foot F32T8 lamps that:

- Produce 3,100 or more initial lumens,
- Achieve 2,915 or higher mean lumens and 95 percent lumen maintenance at 8,000 hours of use,
- Have a color rendering index (CRI) of 82 or higher,
- Are rated for 24,000 hours or more (at 3 hours per start, on a rapid-start or programmed-start ballast),
- Will start at 0° Fahrenheit (F) on an instant-start ballast rated for 0°F starting,
- Will operate in rapid-start, programmed rapid-start, instant-start, or dimming modes, and
- Enable compliance with low-mercury/TCLP (toxic characteristic leaching procedure) requirements.

Some specific lamps that meet these criteria are:

- The High Lumen ECO from General Electric (F32T8/XL/SPXxx/HL/ECO) (where “xx” is equivalent to any color temperature in this CRI series of lamps)
- The Advantage ALTO from Philips (F32T8/ADV/8xx/ALTO)
- The Xtreme XPS EcoLogic from Sylvania (F032/8xx/XPS/ECO)

can be used with conventional T8 lamps, although the highest efficiencies are realized by using super-T8 lamps and ballasts together.

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 life-cycle 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

What Are Super-T8 Ballasts?

To determine if a ballast qualifies as super-T8, calculate the ballast efficiency factor (BEF)— $BEF = 100 \times (\text{ballast factor} / \text{ballast input power in watts})$ —and see if the result matches any of the options shown in **Table 2**.

Five manufacturers currently offer super-T8 ballasts in the U.S.:

- Advance: the Optanium
- General Electric: the Ultramax
- Howard Industries: the HEX
- Sylvania: the PSX, which has a ballast factor (BF) of 0.71, and the PSN (0.88 BF)
- Universal: the ULTim8 EL (0.77 BF), the HE (0.87 BF), and the AccuStart8

Table 2: Efficiency is key for super-T8 ballasts

To qualify as super-T8 technology, ballasts must have a ballast efficiency factor (BEF) at least as high as the ones shown in this table. The data provided here is for universal-input-voltage ballasts, because, although they are slightly less efficient than dedicated-voltage ballasts, they make retrofitting easier and reduce stocking requirements. However, dedicated-voltage, instant-start ballasts will maximize energy savings and should be used wherever it is practical.

Number of F32 T8 lamps per fixture	BEF with instant-start universal-input-voltage ballasts ^a			BEF with programmed-rapid start universal-input-voltage ballasts ^a		
	Low ballast factor (0.77)	Normal ballast factor (0.87)	High ballast factor (1.15)	Low ballast factor (0.71)	Low ballast factor (0.77)	Normal ballast factor (0.88)
1	3.08 / 3.08	3.11 / 3.11	NA	2.84 / 2.84	NA	2.84 / 2.93
2	1.60 / 1.60	1.61 / 1.64	1.55 / 1.58	1.51 / 1.54	1.60 / 1.60	1.47 / 1.52
3	1.05 / 1.07	1.06 / 1.09	1.04 / 1.06	0.97 / 1.00	1.04 / 1.05	1.00 / 1.04
4	0.79 / 0.80	0.80 / 0.81	0.77 / 0.78	0.76 / 0.78	0.79 / 0.80	0.75 / 0.78

Notes: NA = no applicable product available.
a. BEF at 120 volts / BEF at 277 volts.

Source: Platts; industry data

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.