

T5 Lamps

By Craig DiLouie, Editor, LightNOW

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The T5 lamp was first unveiled at Hannover Fair in 1995 and introduced to North America in 1996. The T5HO, which produces twice the light output of a T5 lamp while being the same length, was introduced to Europe in 1997 and North America in 1998. Since then, T5 lamps have carved out a share of the lamp market due to a unique combination of advantages and disadvantages.

T5 and T5HO lamps are immediately distinguishable for their slim profile. The T means the lamp is tubular in shape; the number, divided by eight, is the lamp's diameter in inches. So the T12 lamp is 1-1/2 inches in diameter, the T8 lamp is one inch in diameter, and the T5 is 5/8 inches in diameter.

The lighting industry, in particular lighting designers and high-end fixture manufacturers, were quick to grasp the potential of T5 lamps to be used in slimmer and more compact fixtures and follow the popular trend of "smaller is better." Since the lamp is 40 percent smaller than T8 lamps, the fixture should be 40 percent smaller, went the reasoning. In addition, the slim diameter enables better photo-optic control of the light emitted in the fixture, increasing fixture efficiency and providing uniform light distribution.

Light output and efficacy. A 28W T5 lamp produces about the same light output as a 32W T8 lamp during system operation. The lamp, however, is more efficacious (initial lamp efficacy of 104 lumens per watt for a 28W T5 vs. 94 LPW for a 32W T8). T5 lamp-ballast systems also operate at a higher efficacy than T8 lamp-ballast systems (96 LPW at 8,000 hours of operation for a T5 system with a 28W T5 lamp vs. 89 LPW at 8,000 for a T8 system with a 32W T8 lamp). T5HO initial lamp and maintained system efficacy, meanwhile, is somewhat less than that for the T8. In addition, T5 lamps contain a very small amount of mercury (3mg), have good color rendering (82 CRI), and offer high lumen maintenance (about 95%).

With a thinner tube, more light is output from a smaller surface area, making the lamp brighter—brighter than a T8 lamp but less bright than compact fluorescents. This effect, of course, becomes pronounced when using T5HO lamps, which produce nearly twice the light output of T5 lamps (with the same surface area) and close to twice that of T8 and T12 lamps, and can result in discomfort glare.

"T5 lamps can be used anywhere T8 and T12 lamps are currently used," says Jeff Waymouth, LC, Senior Applications Engineer - Fluorescent Lamps, for OSRAM SYLVANIA, Inc., a lamp and ballast manufacturer. "Since the lamps are so much brighter, T5HO lamps should be used in applications where they are not directly visible."

Metric dimensions. While T5 lamps can be installed anywhere T8 or T12 lamps are used presently, T5 lamps were never intended for retrofit of T12 or T8 fixtures. The primary reason is that T5 lamps are not exactly the same length as T8 and T12 lamps are designed to metric dimensions. The four-foot T5 is 45.8 inches from end to end, 50mm shorter than the T8. This means that T5 lamps require dedicated fixtures.

Current use. Because T5 lamps and ballasts are more expensive than T8 lamps and ballasts, penetration of T5 lamps has been small overall. About 10 years ago, T12 lamps held about 95 percent of the linear fluorescent market and T8 lamps had made a small penetration of about five percent, while T5 lamps were not yet on the radar, according to SYLVANIA.

"The first T5s were the 28W lamps and were used in similar applications to T8s; 14, 21 and 35W sizes completed this family when different lengths were required," says Wymouth. "The next big step in the development of the T5 was the introduction of the 54W T5HO; 24, 39 and 80W sizes increased this family's utility. Recently, new colors such as 5000K and 6000K have been introduced."

Today, according to the National Electrical Manufacturers Association (NEMA), T12 lamps now make up about 65 percent of the market while T8 lamps account for 33 percent and T5 lamps make up the remaining two percent. However, while overall penetration is low, T5 and T5HO lamps have become popular for certain applications where their slim profile and high brightness are strengths, such as linear indirect, direct/indirect, recessed baskets, soffits, valences, cove, wall-mount and low-bay fixtures.

"T5 lamps currently comprise less than 10 percent of the linear fluorescent lamp market, but they are the fastest growing lamp in the linear fluorescent family," says Ted Simpson, Senior Manager of Field Marketing for the Professional Lighting Organization of Philips Lighting Company.

Indirect lighting. With their high intensity, T5-lamped indirect and direct/indirect pendants can be mounted as much as 12 to 15 ft. apart on ceilings as low as nine feet (although some manufacturers say they can go lower). In contrast, T8 fixtures generally should be mounted 10 to 12 ft. apart on ceilings at least 9.5 ft. high, which is higher than many office ceilings. With

fixtures that have optics designed specifically for T5 lamps, a uniform light pattern is produced on the ceiling.

In addition, T5HO lamps, which produce 5,000 lumens in the 54W 4-ft. model, have resulted in already slim T5 indirect fixtures becoming even slimmer by allowing them to use one lamp instead of two. This not only improves the fixture aesthetically and makes it less architecturally and visually obtrusive, but also improves application flexibility (by allowing indirect lighting into more spaces). The use of T5HO lamps may also result in the need for fewer fixtures in the design, resulting in cost savings.

Low-bay lighting. T5HO lamps have been incorporated into a new type of low-bay (>15 ft.) fixture. This 4- or 6-lamp, instant-on/restrike, high-lumen-maintenance, high-CRI, 20,000- or 28,440-lumen fluorescent fixture has become a popular energy-saving alternative to metal halide in industrial facilities, warehouses, gymnasias, etc.

All things being equal, the T5HO fluorescent is more efficient than metal halide, provides better color rendering and consistency, and has instant-on and instant-restrike, with the tradeoff that more lamps and fixtures would be required to light the space, and the fluorescent lamps may not perform as well in cold environments. An interesting side benefit of T5 low-bays is that they can double for emergency lighting.

“T5 lamps are ideal for high-bay applications,” says Simpson. “The fact that the lamps can shut on and off instantly means that T5 lamps can be used in conjunction with motion sensors in warehouses, contributing to energy savings.”

Light output and temperature. Ambient temperature affects the light output of all fluorescent lamps. Linear T5 and T5HO lamps are designed to emit peak output at 35°C (95°F) ambient temperature, while T8, T12 and circular T5 lamps provide peak output at 25°C (77°F) ambient temperature. As manufacturer Philips Lighting puts it, this is to provide better “real world performance,” as with a slimmer fixture it’s assumed that heat build-up would occur.

Lamp wattages, shapes and lengths. Standard T5 lamps are available in 14W, 21W, 28W and 35W in nominal lengths of two, three, four and five feet respectively, with the 28W four-foot length being most common; and in a circular shape in wattages of 22W and 40W. T5HO lamps are available in 24W, 39W, 54W and 80W in lengths of two, three, four and five feet respectively, again with the 54W four-foot length being most common; and in a circular shape in 55W.

Ballasts. T5 and T5HO lamps work most effectively with programmed start electronic ballasts, which provide the benefits of higher efficiency and long lamp life. T5 lamps operate at 170 mA and T5HO lamps operate at 288-533 mA, compared to T12 lamps (430 mA) and T8 lamps (265 mA), so the ballasts are not compatible. Universal-voltage (120-277V and at least one version of 347-480V) ballasts have been introduced along with ballasts capable of operating up to four lamps. Dimming ballasts are available for T5HO lamps.

“T5 and T5HO ballast technologies are trending towards higher case temperatures and expanded voltage range (to 480V), and the lighting systems themselves are increasingly being used with occupancy sensors, controls and switching applications,” says Rachelle Nono, Product Manager for Advance Transformer Company, a ballast manufacturer.

Properly applied, T5 and T5HO lamps can prove to be superior lighting solutions in a range of applications.

Table 1. Comparison of nominal four-foot lamp types. Based on data from OSRAM SYLVANIA.

	T5	T5HO	T8
Color temperature	3000/3500/4100K	3000/3500/4100/ 5000/6000K	3000/3500/4100/ 5000/6500K
Initial rated light output*	2900 lm @ 35°C ambient	5000 lm @ 35°C ambient	3000 lm @ 25°C ambient
Nominal lamp watts	28W	54W	32W
Initial lamp efficacy	103.6 LPW @ 35°C ambient	92.6 LPW @ 35°C ambient	93.8 LPW @ 25°C ambient
Lumen maintenance	93% @ 8000 hours	95% @ 8000 hours	95% @ 8000 hours
Maintained system efficacy	96.3 LPW @ 8000 hours and 35°C ambient	86.1 LPW @ 8000 hours and 35°C ambient	89.1 LPW @ 8000 hours and 25°C ambient
Rated life (3 hours/start)	20,000	20,000	24,000

**28W T5, 54W T5HO and 32W T8 light output values are for 3000K, 3500K and 4100K lamps, not 5000K, 6000K or 6500K, which will generally be slightly less.*