

## T5 Versus T8 Lamps: Which Is the Winner?

### Key Points

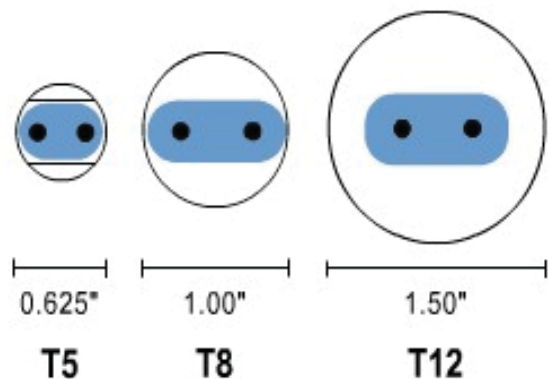
- T5s are slightly shorter than T8s—the T5’s miniature bi-pin does not fit in T8 sockets.
- The higher surface luminance of T5s, without any shields or diffusers, results in more glare and discomfort for room occupants.
- The higher light output of T5 high output (T5HO) lamps may reduce the number of luminaires per project.

The T8 is a 1” diameter fluorescent that has improved efficacy, higher ballast factor, longer operating life, and higher color rendering index (CRI) compared to a T12. It is a higher cost, higher performance tubular fluorescent almost exclusively equipped with electronic ballasts. Higher CRI is achieved by using combinations of rare earth phosphors in the T8, which produce high concentrations of light at the peak sensitivity regions of the human eye (red, green, and blue). This good color rendering and high-efficacy is achieved by using a blend of rare earth phosphors and halo-phosphates.

The T5 is more energy efficient than the T8, but can be limited in lumen output and may not be appropriate for some applications that require more light from fixtures that are at ceiling height and higher. The T5 is a 5/8” diameter lamp and is 7% to 15% more efficient than the standard T8 (a 1” diameter lamp, see graphic). The T5 was initially used for cove lighting because it operates more efficiently at higher temperatures (peak light output at 95°F). They are suited for office and new construction applications with ceiling heights over 10’ due to possible glare problems. The higher surface luminance of T5s, without any shields or diffusers, results in more glare and discomfort for room occupants. Unless the lamps are properly shielded, these high-luminance light sources may also annoy workers by reflecting off of computer screens or other visual display units.

The T5HO (high output) was developed to produce more light—about twice the light output of standard T5s. However, the T5HO is about 10% to 15% less efficacious than the standard T5. The T5 and T5HO are also more expensive compared to the T8, so efficiency versus cost is an important consideration. They are best suited for industrial manufacturing and warehouse applications as replacements for high intensity discharge (HID) lighting like metal halides and mercury vapor lamps.

If you are retrofitting T8s with T5s, the ballasts and fixtures will need to be changed out, due to a different connector (socket) for the T5s and the fact that T5s are slightly shorter than T8s. The T5 fluorescent lamps use a smaller connector, called a Miniature Bi-Pin, which is not interchangeable with the Medium Bi-Pin connector used for T8 or T12 lamps. Also, the ballast must be specifically designed for T5 technology.



The following table provides a general comparison between these three types of lights. Note that there are variations in efficiency, lumen output, and other factors within each class.

	<b>T5</b>	<b>T5/HO</b>	<b>T8</b>
Initial Rated Light Output	2900 lumens	5000 lumens	2950 lumens
Nominal Lamp Watts	28 watts	54 watts	32 watts
Initial Lamp Efficacy <sup>1</sup>	104 lpw	93 lpw	92 lpw
Initial System Efficacy <sup>2</sup>	89 lpw	85 lpw	90 lpw
Lumen Maintenance <sup>1</sup>	97%	95%	93%
Maintained System Efficacy <sup>2</sup>	86 lpw	81 lpw	84 plw
Rated Life <sup>3</sup>	16,000 hrs	16,000 hrs	20,000 hrs
Optimum Operating Temperature	95°F	95°F	77°F
<p><i>1: Based on 4 ft nominal lamp length, 85CRI lamps (lumens per watt or lpw)</i>  <i>2: Based on 4 ft nominal lamp length, 85CRI, 2-lamp rapid-start electronic ballast</i>  <i>3: This value varies, depending on manufacturer and phosphor coating technology used in the manufacturing process</i></p>			

Because the T5HO fixtures output significantly more lumens, you should compare a 4-lamp T5HO fixture with a 6-lamp T8 fixture.

<b>Fixture Type</b>	<b>CRI</b>	<b>Initial Lumens</b>	<b>EOL Lumen Maintenance</b>	<b>EOL Lamp Lumens</b>	<b>Luminaire Lumens</b>	<b>System Watts</b>	<b>EOL Lum/Watt</b>	<b>Average Life Hr.</b>
4 F54T5HO lamps, program start electronic ballasts, enhanced Al reflector	85	20,000	93%	18,600	17,112	234	73	20,000
6 F32T8 lamps, IS electronic ballasts, enhanced Al reflector	85	21,390	92%	19,680	17,909	220	81	15,000

It takes about the same amount of system watts to achieve the same lumen output in both cases.

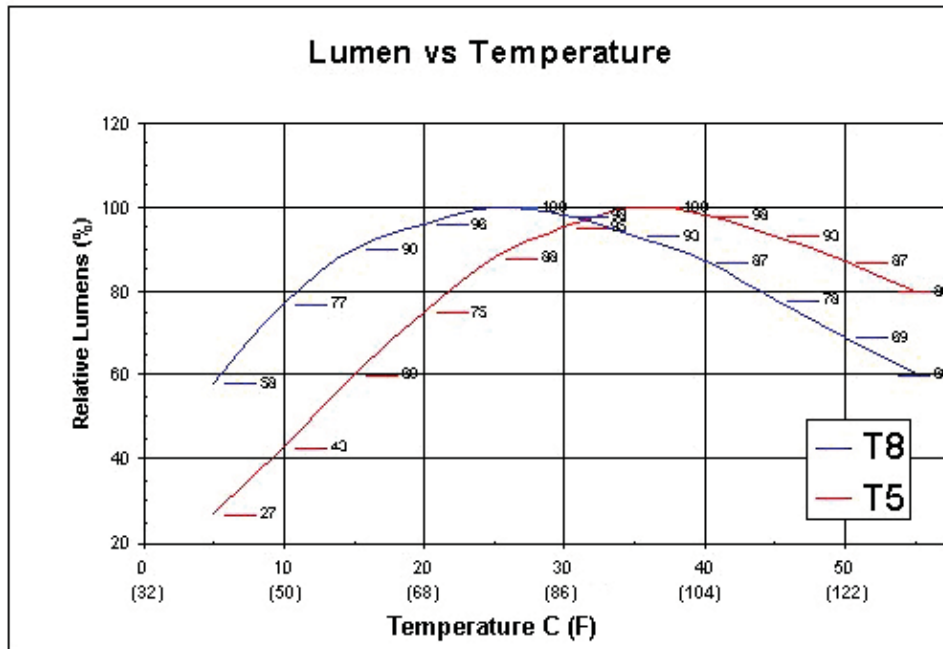
With regard to pricing, it really depends on the type of T5 or T8 chosen. As an example, a Philips 28 W T5 Silhouette 46" length bulb (2,750 lumens, 3,000°K color temperature) can be purchased for \$10.99 from www.bulbs.com. The Philips 25 W T8 48" length bulb (2,280 lumens, 5,000°K color temperature) can be purchased for \$5.49. Though the bulbs are not exactly the same specification, it is likely that the T5s will be more expensive than the T8s for similar performance.

T5 lamps are slimmer and can only be operated on electronic ballasts, which must be exclusively designed for the T5 technology. Due to their slim diameter, the T5 lamps can help increase luminaire efficiency by about 5%. This is because a thinner light source allows the light to be directed more exactly to where it is needed, and the thinner the lamp, the less it blocks its own light within the luminaire.

Finally, another important advantage with the T5 lamp is its low mercury content. T5 lamps have a coating on the inside of the glass wall

that stops mercury from being absorbed into the glass and the phosphors. This drastically reduces the need for mercury from around 15 to 3 milligrams per lamp. Since mercury absorption causes the lamp's light output to depreciate over its life, the coating helps to keep light levels much closer to initial ones (only 5% depreciation after 12,000 hours, compared with 15% with the older lamp types).

T5s maintain their lumen output better than T8s at higher temperatures, but worse at lower temperatures. The optimum lamp operating temperature limit is typically 77°F (25°C) for T8s and 95°F (35°C) for T5s. This gives the T5s an advantage over T8s for enclosed luminaires or high ceiling applications where temperatures are higher. Above these limits, the efficacy of fluorescent lamps falls by approximately 1% for every centigrade degree the temperature rises. Below this limit, the efficacy decreases by approximately 5% for every degree the temperature falls, as illustrated in the following graph.



T5 lamps are increasingly used to meet a variety of lighting applications, including commercial, hospitality, and retail. Typical applications include print shops, medical and laboratory facilities, jewelry manufacturing, hairdressing salons, color inspection areas in factories, hospital treatment rooms, and art classrooms. Their initial niche in the market was for applications where high color rendering was required.

### The key advantages of T5 lamps over T8 lamps are summarized as follows:

- The smaller size of T5 lamps allows for smaller luminaires, allowing them to fit in smaller spaces and be hidden from view, for example, indirect lighting for cove, cabinet, and display applications.
- The smaller lamp diameter of T5 lamps makes it easier to design optical systems that distribute light in the intended directions, for example, suspended indirect lighting.
- The higher light output of T5 high output (T5HO) lamps may reduce the number of luminaires per project.
- Lower mercury content.
- Lumen maintenance at higher ambient temperatures.

## There are also disadvantages of T5 lamps, as compared to T8 lamps:

- If they are inappropriately used, they can create glare. Glare can be prevented, though, by choosing luminaires that shield the light sources from view.
- Higher cost per lamp.
- Lower lumen output at colder temperatures.
- T5 lamps are only available in metric lengths and are, therefore, not a good retrofit option, but they can be an effective choice in new construction or major renovations. For instance, a nominal four-foot T5 lamp is about 2" (50 mm) shorter than its T8 counterpart.

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