

General Lighting

What is the difference between power factor and ballast factor?

Power Factor

Power factor (pf) is a measure of how “efficiently” an electrical or electronic product uses its power. It usually expressed as a percentage from 0% to 100%. In a more technical format, power factor is the fraction of power actually used by a customer’s electrical equipment compared to the total power supplied by the utility or the ratio between watts (W) and volt-amperes (VA).

$$\mathbf{pf} = \frac{\mathbf{W}}{\mathbf{VA}}$$

In its most technical form, power factor is how far a customer's electrical equipment causes the electric current delivered at the customer's site to be out of phase with the voltage. This phase difference can take two basic forms. 1) The current can “lag” the voltage when an inductive load (i.e., motors, magnetic HID ballasts) is used or 2) the current can “lead” the voltage when a capacitive load (i.e., computers, electronic fluorescent ballasts) is used. When the current is out of phase with the voltage, the power utility has to supply more volt-amperes (VA) for a given wattage (W). Certain customers, such as industrial companies, may have to pay an additional charge if their power factor is too low which is why many industrial applications have banks of capacitors. These capacitors correct the poor power factor caused by the motors. This is also how manufacturers have been able to take a product that is inductive in nature, such as a magnetic HID ballast with a normal power factor, and include a “power factor correcting” capacitor to give the ballast a high power factor.

There is one last condition when there is no phase difference between the current and voltage. This happens in resistive loads (i.e., incandescent lamps, heating elements). Resistive loads typically have a power factor of 100%.

Ballast Factor

Ballast factor (BF) is the ratio of the lumen output of a lamp on commercial ballast (system lumens) as compared to the lumen output of the same lamp on a reference ballast (rated lumens). The reference ballast is set-up and calibrated according to ANSI test procedures (American National Standards Institute). The commercial ballast is a ballast that would be purchased through a ballast manufacturer or store such as an electrical distributor or home improvement warehouse.

$$\mathbf{BF} = \frac{\text{lamp lumens on commercial ballast}}{\text{lamp lumens on reference ballast}}$$

Let's work through an example. Let's determine what the ballast factor is for a QTP 1x32T8/UNV PSN ballast. Using the SYLVANIA Ballast Technology and Specification Guide, we can get the information we need. The following is a piece of that guide.

Item Number	Description	Input Voltage (VAC)	Input Current (AMPS)	Lamp Type	Rated Lumens (lm)	No. of Lamps	Ballast Factor (BF)	System Lumens	Input Wattage (W)	System Efficacy (lm/W)
51400	QTP 1x32T8/UNV PSN-TC	120-277	0.26/0.11	F032/XP(32W)	3000	1	0.88	2640	31/30	85/88
			0.24/0.10	F030/SS(30W)	2850	1	0.88	2510	29/28	87/90
			0.23/0.09	F028/SS(28W)	2725	1	0.88	2400	27/26	89/92

To find the ballast factor for this ballast, we need the system lumens and the rated lumens. The ballast factor is equal to the system lumens divided by the rated lumens. $BF = 2640 / 3000 = 0.88$ which matches the ballast factor column.

Currently, ballast factors range from 0.70 and 1.20. A low ballast factor has a value between 0.70 to 0.80. A normal or "standard" power factor is between 0.85 and 1.00. A high ballast factor is between 1.13 and 1.20. Ballast factor is used in lumen method lighting calculations and is a component of the light loss factors (LLF). Different ballast factors may be used to tailor different spaces in the same building with different light level while using the same lamp thus reducing the risk of using the wrong lamp in the wrong application.

Power Factor and Ballast Factor

Where the power factor relates the power utility to the ballast, ballast factor relates the ballast to the lamp(s). The following diagram better shows the relationship between power factor and ballast factor.

