

February 8, 2011

White Paper:

Retrofitting T8 Instant Start Electronic Ballasts into Rapid Start T12 fixtures

Purpose

Although linear fluorescent T12 lamps have been used in general lighting for many years, recent legislation has set efficacy standards that are bringing the days of the T12 to an end. Environmentally friendly legislation is forcing consumers to switch to newer fluorescent technologies with far superior efficacy and color quality. Considering the ever-increasing focus on energy and resource conservation, extended life, high efficiency products make quite a bit of sense.

T12 lamps were originally designed for use with magnetic (electromagnetic) ballasts. For many years, T12 linear fluorescent lamps - paired with magnetic ballasts - were a very efficient lighting option compared to incandescent types. Now that most T12 lamps face extinction due to upcoming legislation, the fixtures that operate them must be retrofitted with ballasts that are compatible with lamps that meet specified energy efficiency standards.

T8 lamps and T12 lamps have identical lamp lengths and both have medium bi-pin (G13) bases. T8 lamps, however, are much more efficient at producing light and are subject to less self absorption in a fixture than T12 lamps. These qualities make T8 retrofits a cost effective way of replacing T12 lamps with a system that exceeds energy efficiency standards.

Differences between Instant Start and Rapid Start Configurations

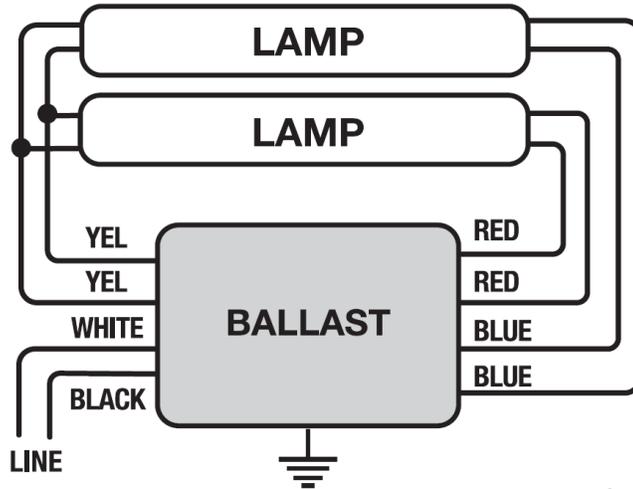
Over the years, the primary method of operating T12 lamps has been magnetic ballasts using **rapid start** technology. Rapid start configurations have two wires connected to each side of the lamp. There is a small voltage between the two wires that is used to provide heat to the lamp's *cathodes*. An arc forms between the electrical connections in the cathodes, which produces light. When heated, the cathodes release *emitter*, which is a substance that helps strike the arc across the lamp between the two cathodes. The voltage between each side of the lamp is required to maintain an arc over the length of the lamp tube. Rapid starting is relatively gentle on the cathodes and - when operated on short lighting cycles - the lamp doesn't sacrifice life. However, due to cathode heating, rapid start systems require several extra watts per lamp more than instant start systems.

T8 lamps are designed as rapid-start lamps, as are T12 lamps, and they are capable of being operated on rapid start, programmed rapid start or instant start ballasts. Electronic T8 ballasts are most commonly *instant-start configurations*, where there is no cathode heating. With an instant start configuration, a high voltage pulse is used to start the arc between the lamp's cathodes. The primary advantage of instant start systems is the energy saved since no power is required to heat the cathodes. The main disadvantage is reduced life when instant start systems are installed in applications that are frequently turned on and off.

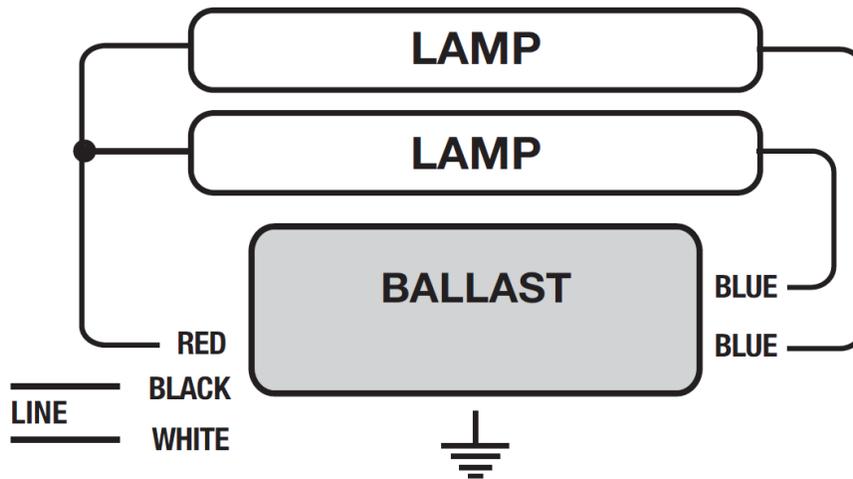


Wiring requirements

Because of the power required to heat the cathodes, ballasts used in rapid start operations have four connections with each lamp (although two lamp ballasts often share the “return”). A typical two lamp rapid start configuration has two red wires going to lamp one, two blue wires going to lamp two, and a pair of yellow wires that act as “returns” back to the ballast that are shared by the lamps. In addition to the lamp circuit, the ballast has a black wire and a white wire and the ballast is grounded through the case fastened to the fixture.



Instant start systems are wired slightly differently than rapid start systems. Fewer wires exit the instant start ballasts and they have different color arrangements. One line connects to each lamp and a return line runs back to the ballast. Like rapid start ballasts, there is a white and a black wire entering the ballast, which is grounded through the case being fastened to the fixture.



When comparing the wiring diagrams, the rapid start to instant start system retrofit is relatively simple, although the colors may not match up.

Grounding Requirements:

Grounding is important to ensure proper operation and life of any lamp/ballast system. Grounding is important not only to the lighting system as a whole, but it is vital to the individual lamps and the ballast.

Per the ANSI standard, all fluorescent lamps must be operated within a specified distance from a *grounded metal plane*. The distance between the lamps and a grounded metal plane depends on the fluorescent lamp type (see table 1). The grounded metal plane also acts as a starting aid for the lamp by helping the arc travel from one end of the tube to the other.

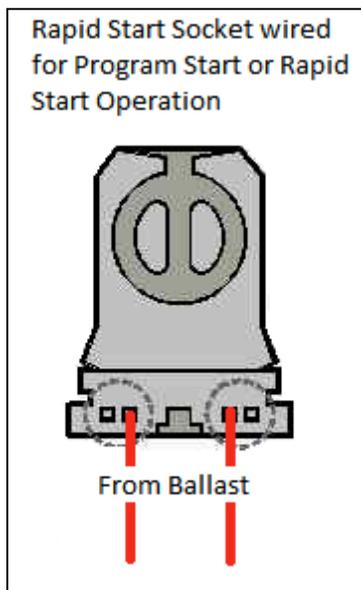
Type of Fluorescent Lamp	Maximum Distance	
	Inch	Mm
T5 Linear Lamps	¼ (0.25)	6
T8 Linear Lamps	¾ (0.75)	19
Other 500mA or less	½ (0.5)	13
Other greater than 500mA	1	25

Table 1: Distance from Lamp to Grounded Plane

The grounded metal plane is typically provided by the fixture, assuming that the fixture is properly grounded and the lamp-holders are within the specified distance. Electronic ballasts are more sensitive to the grounding plane, so it is important when performing a retrofit to verify that the lamps are the proper distance and that the fixture provides a grounded plane.

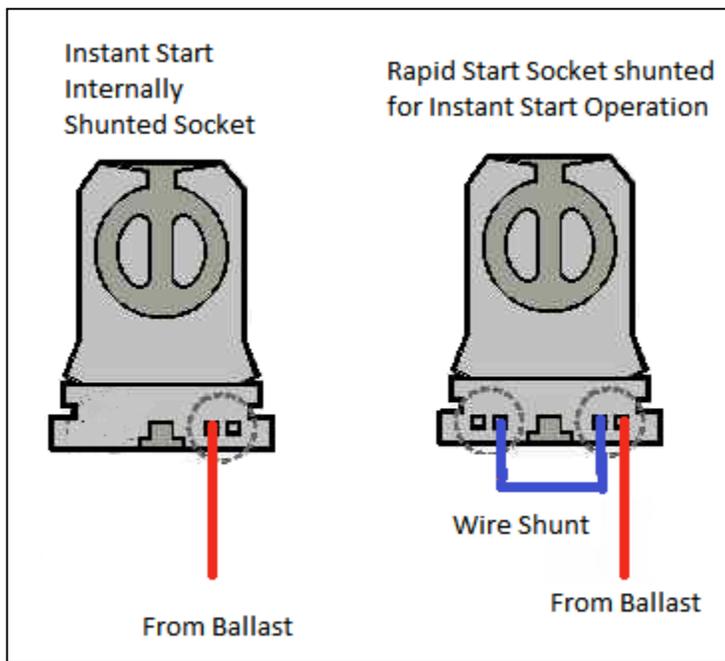
The ballast also requires good grounding so it will operate properly and safely. Ballast mounting is frequently accomplished through the mounting screws that connect the ballast to the fixture. This is typically a reliable method of grounding the ballast, but it is important to verify that the fixture is properly grounded for optimal ballast operation.

Socket Connections:



The existing sockets can be utilized when retrofitting a T8 lamp into a T12 fixture, but it is generally a good idea to replace them. Oftentimes, the lamp/ballast system needs to be re-wired and the true condition of the sockets is difficult to determine when they are in the fixture.

Both T12 and T8 lamps use a G13 socket. T12 lamps use an unshunted socket. There are two wires connected to each lamp end. The voltage between the two wires provides cathode heating, which is required for lamp starting when using a *rapid start* or *programmed rapid start* ballast. Without cathode heating, the reduced starting pulse is unable to strike a voltage across the lamp and initiate the arc.



T8 lamps are rapid-start design lamps with two pins. They are capable of operating on rapid start, programmed rapid start and instant start ballasts. The majority of commercial ballasts in the market that operate T8 lamps are instant start. Because of this, when retrofitting a rapid start system to an instant start system, some alterations to the socket wiring are required in order for it to work optimally. When using an instant start ballast, the fixture should make use of a shunted socket (which internally connects both pins of the lamp), or it should use a jumper wire to tie the two lamp pins together. The pin separation is not used because instant start ballasts do not heat the cathodes. Leaving the two pins unconnected may cause a hot spot on the cathode and will reduce lamp life.

Summary:

Instant start T8 retrofits are an excellent way to reduce energy usage in applications with T12 fixtures. Additionally, instant-start T8 systems allow existing fixtures to be utilized after 48" T12 lamps have been completely legislated out of general lighting applications. The wiring is slightly different, but with proper considerations and attention to detail, it can be accomplished easily and safely.

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