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Programmed Start: The New Way to Start a Fluorescent Lamp

By Greg Bennorth, Manager-Market Specifications,
Universal Lighting Technologies

Fluorescent lamp and electronic ballast systems are widely used today because of the energy they save. However, when they are used in applications where they are cycled on and off frequently, lamp life can be reduced, no matter what type of ballast is installed – instant or rapid start. Now there is a new ballast technology that can extend fluorescent lamp life by more than 50 percent in these application scenarios, reducing energy and replacement costs.

The programmed start ballast incorporates a starting method which is gentler on the lamp than either the rapid or instant start ballasts. For frequent-start applications, rapid start ballasts are traditionally specified with the promise of minimal lamp life reduction compared to instant start ballasts. Rapid start ballasts consume more energy than instant start, so there is a tradeoff in using them. Also, rapid start ballasts provide longer lamp life. The wide variety of design methodologies of rapid start ballasts among manufacturers, can actually lead to a reduction in lamp life as compared to instant start ballasts.

Let's review the various types of ballasts and their associated starting methods to better understand the need for programmed start ballasts in today's lighting applications.

Rapid Start

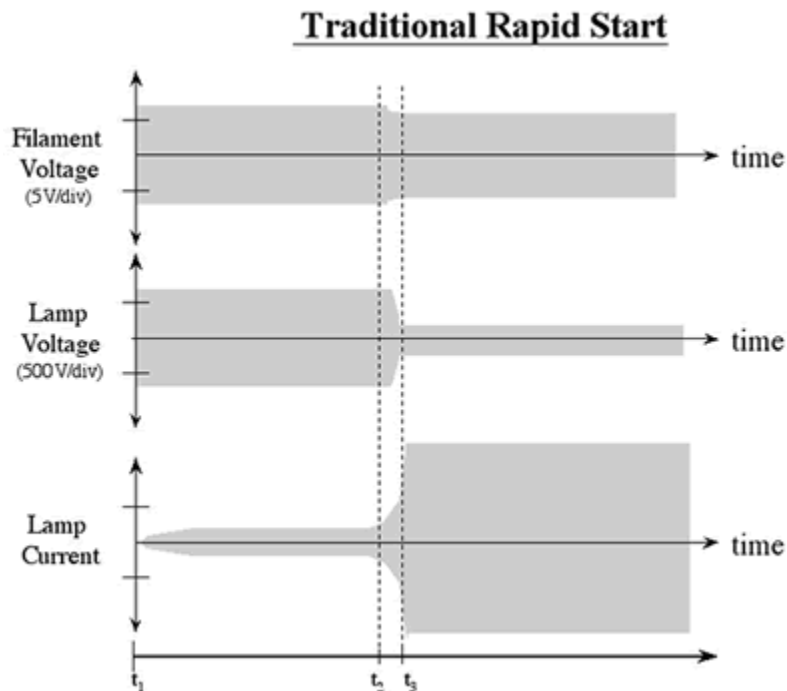
Rapid start ballasts ignite lamps by providing cathode voltage (heat) and voltage across the lamp simultaneously (Figure 1). As the cathodes heat, the voltage required to ignite the lamp is reduced. At some time after both voltages are applied, the cathodes reach a temperature sufficient for the applied voltage to ignite the lamps. During this starting scenario, voltage across the lamps creates a glow current that damages the lamp by sputtering off the cathode's emissive material. The sputtering results in end blackening and a reduction in lamp life. After all of this material is depleted from the cathode, the lamp ultimately fails.

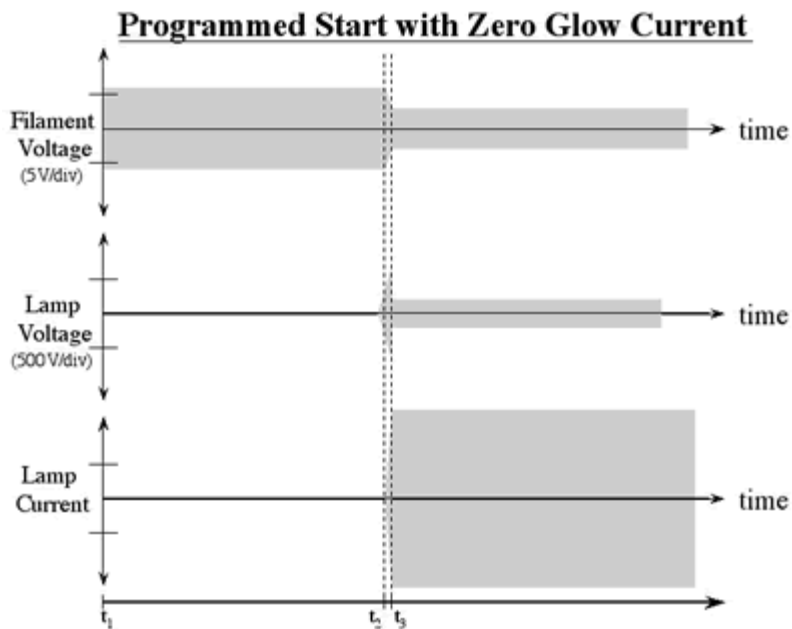
Instant Start

Instant start ballasts ignite lamps by applying a significant voltage across the lamp during starting. However, no cathode heating is applied before or after the lamps are ignited. The high voltage applied across the lamps typically ignites them within 50 milliseconds. Since the cathodes are not heated with instant start ballasts, emissive material is also released during this type of scenario.

Programmed Start

Programmed start ballasts incorporate a precise starting scenario which breaks the process into unique and well defined steps that eliminate the pitfalls of the other starting methods (Figure 2).





The first step in the series is the application of cathode heat. While this heat is being applied (preheat interval), voltage across the lamp is reduced to a level that reduces damaging glow current. Glow current is actual lamp current that flows during this preheat interval and causes end blackening and degradation in lamp life. It is important during this step that sufficient voltage is applied to the cathodes for a long enough duration so the cathode's temperature is at least 700°C. The duration of this step is pre-programmed into the ballast circuitry. Since the lamp voltage is kept very low, the lamps cannot ignite until the cathodes are heated to optimal temperature and the ballast program moves to the second step.

The second step of the starting process is the application of lamp voltage. After the programmed time of step one has been reached, a voltage is applied across the lamps, igniting them with minimal loss of the emissive material. Minimal loss of the emissive material equates to gentle treatment of and prolonged life for the lamp.

Cathode Heating

Rapid starting does not guarantee that the cathodes are at their proper temperatures prior to lamp ignition. If applied voltage across the lamp is too high, the lamps will ignite before the cathodes are at their proper temperature. This will also cause sputtering of the emissive material. The programmed start ballasts's combination of pre-heating time and voltage are set at a level to assure that the cathodes have reached the desired temperature before starting.

Glow Current

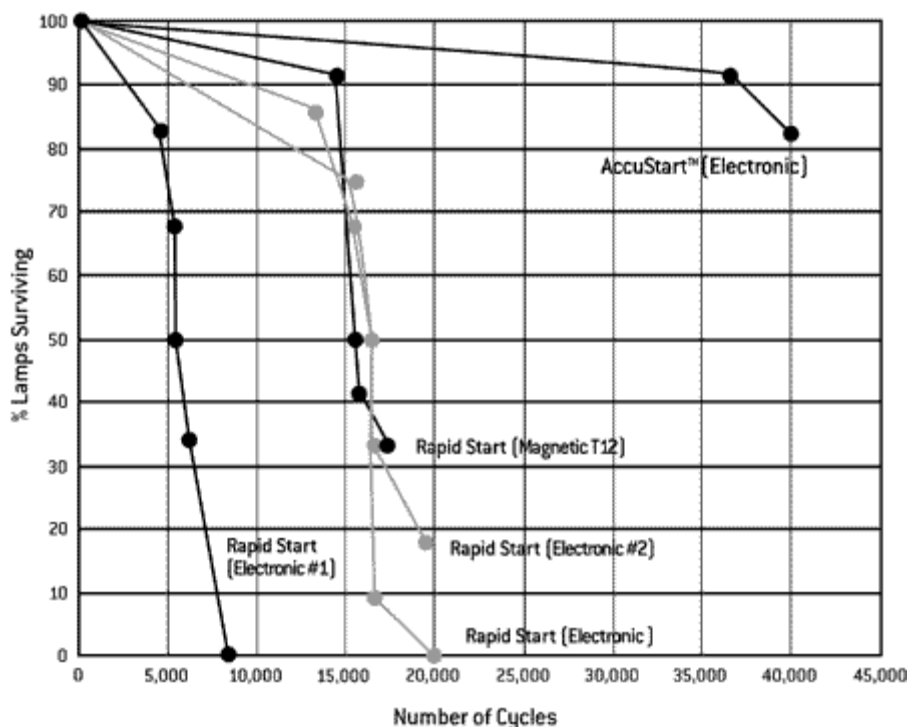
As mentioned earlier, glow current is the actual lamp current that flows across the cathode during a preheat interval and causes end blackening and degradation in lamp life. As the amount of glow current increases, the cathode emissive material also increases which is further detrimental to the lamp. Programmed start ballasts are able to keep sputtering to a minimum by reducing voltage across the lamps during the first phase. Some, but not all, programmed start ballasts have the capability to eliminate glow current completely by not applying any voltage across the lamps during this first step.

Transition Phase

The time required for the lamp to move from the cathode heating stage to the full arc current stage is called the transition time. The longer this process is, the more emissive mix is being removed from the cathodes. Most rapid start ballasts have a transition time of about 80 to 100 milliseconds. The length of this transition is based upon the cathode's temperature and the voltage across the lamp. However, for programmed start ballasts, the transition time to fully ignite the lamps is fast – as little as 30 milliseconds. This fast transition time in addition to the pre-heated cathodes, prevents any significant loss of emissive material from the cathodes in comparison to rapid or instant start ballasts.

Normal Operating Efficiency

Once the lamps have ignited, the cathode heat remains on with rapid start ballasts even though it does not provide any additional benefits. This has been demonstrated in lamp manufacturer's rated lamp life graphs. These graphs indicate instant and rapid start ballasts provide the same lamp life in continuous burn applications. This cathode heating does use power and increases the input wattage of the lighting system. Some program start ballasts have the ability to reduce the power supplied to the cathodes, saving additional energy. This is the only phase where instant start has an advantage with no cathode heating applied so the systems efficiency is at its highest.



Accelerated Life Testing

Accelerated cycle testing of the instant, rapid, and programmed starting methods has yielded surprising results (Figure 3). In 15 minute on / 5 minute off cycles, most rapid and instant start ballasts supply about 16,000 starts with a 50 percent lamp survival rate. The programmed start ballasts, however, exceed 40,000 starts. Additionally, the instant start ballasts were equivalent to or better than the rapid start models tested.

Lamp Applications Flexibility

Most electronic ballasts operate a variety of lamps. With many electronic rapid start ballasts, other lamps listed for use are usually shorter in length, requiring less voltage to ignite them. Often what occurs is the lamps are instant started due to the voltage potential required for longer lamps. With many programmed start ballasts, the voltage across the lamp during step one can be kept low enough so that shorter lamps will not ignite until their cathodes have been properly heated and the ballast has transitioned to step two of starting.

Lamp Configuration

Parallel lamp operation can be incorporated with this new technology. When one lamp fails, the other lamp(s) will remain functional. With series lamp operation, when one lamp fails, the other lamp(s) will not provide any significant amount of light.

In summary, programmed start ballasts are ideal for applications where lights are turned off and on frequently. These applications include classrooms, copy rooms, restrooms, storage rooms or any location an occupancy sensor may be installed. The programmed start ballast provides the efficiencies expected from a T8 electronic system, utilizes new technology to maximize lamp life, reduce lamp maintenance costs and provides an optimal environment in which we work and live.

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