



## **Lamp Life: Factors That Influence and Proper Selection**

*by David North, ETC Technical Services Manager*



*Lamp life is defined as the number of hours that pass when reaching the point that half of the lamps are still burning and half have burned out.*

### **My lamps are burning out too soon. Why are your dimmers doing this to them?**

Yes, as dimmer manufacturers, the controller of all that is power to lamps, we are blamed for a number of things from time to time. In this day and age of warranties, guarantees, customer service and lawsuits, a lot of people expect a minimum certified performance from each part of any product they buy and use. Lamps are expensive, especially to cash-strapped non-profits, and labor to keep them replaced is even more costly. In fact, think about the church who has added a new complex lighting system to their alternative worship service and has to remove pews and rent a lift to get to the fixtures in the ceiling. By the time they get to the second round of lamp replacement you get the first phone call asking why the lamps are failing.

### **So let's first talk about lamp life**

Lamp life is a median performance measure. More specifically, within a large sampling of lamps, lamp life is defined as the number of hours that pass when reaching the point that half of the lamps are still burning and half have burned out. When you decide to install 300 hour lamps into fixtures for houselights so that you get the maximum amount of lumens per fixture and the facility has them on for 12 hours a day at full intensity, only half the lamps will be lit after 25 days. Now keep in mind this is a median measure so you could end up with half burning out in the first couple of hours and the rest at 301 hours. Does that really happen? Not usually. In fact they typically will run to around the 300 hour mark for the majority as long as several items are kept in mind.

### **Contact Surface**

The lamps need to be fully seated to maximize contact surface area. Otherwise, passing the required current through a smaller contact increases resistance and eventually the contact burns, arcs, and fails taking the lamp out as well. If the sockets show heat damage, arcing or carbon build up they should be replaced for the same reason. So the lamp and socket combination is important to maintain in good health.

### **RMS Voltage**

RMS voltage still eludes a few people. Make sure that the meter says RMS or True RMS on it or review the data sheet for specs. Since phase control dimmers regulate output voltage by altering the waveform in the time axis, a non-RMS or averaging meter can not accurately reflect the voltage the lamp is seeing. With an 115V dimmer output I've seen averaging meters show anywhere from 83V to 156V depending on make and model.

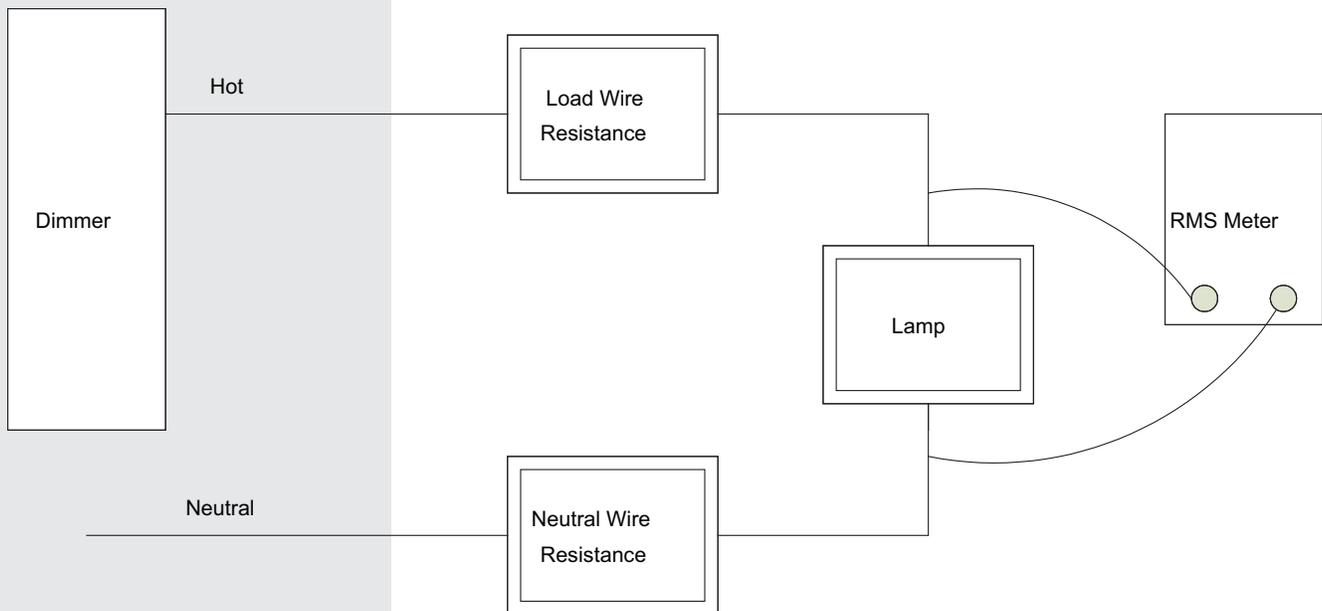


Root mean square (abbreviated *RMS* or *rms*), also known as the *quadratic mean*, is a statistical measure of the magnitude of a varying quantity, in this case voltage.

You must make the measurement at the fixture as there are several factors that influence your voltage reading; presence of load, amount of load and load circuit length and size.

Make sure the all the fixtures are plugged in and the lamps are good. Without a load on most dimmers, there is the possibility that you will read a floating level that is close to line level. SCR and triac dimmers have output chokes that act as series resistor and create a voltage drop but only when there is a real load on the output.

Load circuit length and size on both the hot and neutral create another source of resistance resulting in additional voltage drop. These factors will change the RMS voltage at the fixture. Refer to the figure below which shows a basic voltage divider circuit built with three resistors; hot wire, load, and neutral wire. With 200' of 12-gauge wire and a 750W lamp on the circuit, the voltage drop on each of the hot and neutral wires is about 2V. Therefore, your measured RMS voltage across the lamp is now 4V less than what the dimmer is set to deliver. A large load will create a greater voltage drop in the circuit since the voltage drop across each conductor is based on the current the lamp draws and the resistance in the wire.



All these matter because lamps, and more especially high performance tungsten lamps, have a greatly reduced lamp life when faced with voltage past their rating. According to some sources, feeding an 115V lamp with 120V can drop its life to 40% of rated lamp life which then means that your 300 hour lamp may be lucky to last to 120 hours. I have seen this in fact be even shorter. Of course if you are using 120V lamps and your power feed is less than that then you never reach the full brightness of the lamps which is great for lamp life but may be hard to read by.



*These are all the lamps available for the Source Four Family and their lamp life.*

<b>ETC Part #</b>	<b>Lamp Code</b>	<b>Average Rated Life</b>
RT116	HPL 750/115**	300
RT196	HPL 750/115X	1,500
RT113	HPL 575/115**	300
RT114	HPL 575/115X	2,000
RT142	HPL 375/115	300
RT143	HPL 375/115X	1,000
N/A	HPL 750/120	300
N/A	HPL 750/120X	1,500
RT115	HPL 575/120	300
RT171	HPL 575/120X	2,000
RT112	HPL 550/77*	300
RT117	HPL 550/77X*	2,000
RT160	HPL 750/230**	300
N/A	HPL 750/230X	1,500
RT129	HPL 575/230**	400
RT138	HPL 575/230X	1,500
RT154	HPL 375/230X	1,000
N/A	HPL 750/240	300
N/A	HPL 750/240X	1,500
RT130	HPL 575/240	400
RT139	HPL 575/240X	1,500
RT155	HPL 375/240X	1,000

## So how do we increase lamp life?

### Use longer life lamps

The first is obvious. Choose a 2000 hour lamp for use in facilities where the fixtures are going to be on for a significant part of the day. There may be some design choices along with the use choices to make with the customer. Longer life lamps typically have a different color temperature and less lumen output which may not be desirable in some cases. For high school auditorium house lights where the facility will be used for daytime classes and lights are on all day, combine longer life lamps with a small increase in the number of fixtures to get the lumen coverage and service life of the system. On stage, do the same for worklights but for show lighting used only occasionally, you may want to go to a higher output lamp especially in a professional theatre. For the stage lights at the local gymnasium, longer life lamps will work very well.

### Change the regulation setting on the dimmer

A number of dimming systems available allow you to set the high end trim level or maximum output of each dimmer which is part of the function called dimmer regulation. If you do not have a dimming system with programmable regulation then this could lead to shortened lamp life depending on the feed voltage to those same dimmers. What happens is that increases in line voltage will not be compensated for by the dimmers and they will pass those increases on to the lamps and at full the lamps could be subjected to higher than rated voltage. A dimming system that regulates is the ideal choice. Such systems should be programmed with loading and load wiring loss in mind to end up with voltage at the end of the circuit to match the lamp. However there's also a neat little trick here.

Lamp life can be extended by lowering the top end the dimmer reaches when at full. On dimmer systems without this level of control, the lighting console or architectural processor may have a configurable top end in its channel patch but this can get overridden in some products or when a different controller is introduced to the system. So try to set a top end limit in the dimming system itself. The results on lamp life can be dramatic.

Just a 5% drop in output voltage (from 120V to 115V for a 120V lamp) can double the lamp life but your lumens drop by about 18%. A 10% drop in output voltage may increase lamp life to 350% but will drop lumen output about 30%. Of course these are rough numbers and are for tungsten light sources. Still the idea here is that even if you drop the top end regulation by a few volts, the results are great.

### Make the right choices

The main idea here from all this information is that there are design and use choices to be made that help determine performance versus life and serviceability. It is important to know and share this information not only on new installations but with fixture and replacement lamp sales as well.