▼ LIGHT READING™

The Newsletter of The Light Edge, Inc.

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**TECHNICAL DATA ISSUE:**

**HARMONIC DISTORTION**

## Harmonic Distortion/The Light Edge fixtures by David M. Gerton

We have had several recent inquires regarding this subject. This information should help somewhat to explain the magnitude of the harmonics generated by HID versus our T5/HO fixtures.

For most people, the word "harmonics" brings to mind something musical. My wife, who is a symphony violinist, explains it this way. If you could look at a bowed violin string in slow motion, you would see that it vibrates in several ways. First, it vibrates end to end, anchored at the scroll of the violin and at the bridge. This vibration is called the ‘fundamental frequency’. If you touch the string between the scroll and the bridge, the string also vibrates at a different frequency along another portion of the string. Depending on where you touch the string the frequency will vary, but it will be some multiple of the fundamental. This vibration, a multiple of the fundamental vibration, is called a ‘harmonic’. The frequency of a third harmonic, for instance, is three times the fundamental, etc. The fundamental frequency and it’s harmonics produce the sound we hear.

The translation to electricity is almost direct. Harmonic distortion is caused by any current switching device, which can be as simple as a transformer or as complicated as a solid state power supply. Some examples are computers, fax machines, variable speed solid-state motor drives, magnetic ballasts and electronic ballasts.

When electricity is produced, it is delivered in its fundamental form as a 60 cycles per second (Hertz) sine wave. Once delivered to a facility, certain types of equipment can superimpose harmonics on the basic sine wave. Remember, harmonics are multiples of the 60 Hertz wave. For example, the second harmonic is at 120 Hertz, the third is at 180 Hertz, etc. TOTAL HARMONIC DISTORTION is calculated by adding the square of each harmonic present and taking the square root of the sum of the squares. The higher this figure the more total harmonic distortion is on the system.

This THD then imposes a current back onto the neutral conductor as a percentage of the current being drawn on each hot leg. For instance, if the hot leg is carrying 10 Amps and the THD is 20%, then the neutral is carrying 2 Amps. For this to become a problem the neutral would have to see current in excess of its current carrying capacity or, put another way, THD in excess of 100%. However, this applies only to single-phase circuits with one hot and one full-size neutral. In the case of three-phase circuits there are 3 hot legs and one common neutral, so each hot leg cannot carry more than a total of 33.3% THD before the neutral would be carrying its full capacity.

The bottom line is this. A perfect electrical system has no current on the neutral so **the lower the THD the better.**

Now let’s compare a typical 400 watt HID fixture with a typical 4 lamp T5/HO fixture, like our MONSOON™ or RAPTOR™ series, which are powered by high-performance electronic ballasts. Assuming perfect power factor, or 1.0, for the HID (a virtual impossibility but good for the purposes of this calculation) the 400 watt HID fixture consumes 465 Watts and generates a minimum THD of 20% (or 93 Volt-Amps) per fixture. Most HID ballasts have a power factor of between .70 and .90 with very few above .90 and many as low as .50. Our 4 lamp products consume 220 Watts at a power factor of .999 and a THD of less than 10%, so our systems produce a maximum of 22 VA.

When you compare the two on this basis, the actual THD of our product is 76% less than the 400 watt HID. If the power factor of the HID fixture is .70, which many are, then the 93 VA needs to be divided by .7 and thus the actual current back on the neutral becomes 133 VA.

**It should be noted that low THD/high power factor ballasts we use actually become part of the solution instead of part of the problem.**