FLUKE®

# Lighting ballast evaluation

## Application Note

Power Quality **Case Study**

**Measuring tools:** Fluke 43B Power Quality Analyzer

**Operator:** Plant engineer or plant energy manager

**Features used:** Voltage, kW, PF, DPF, THD

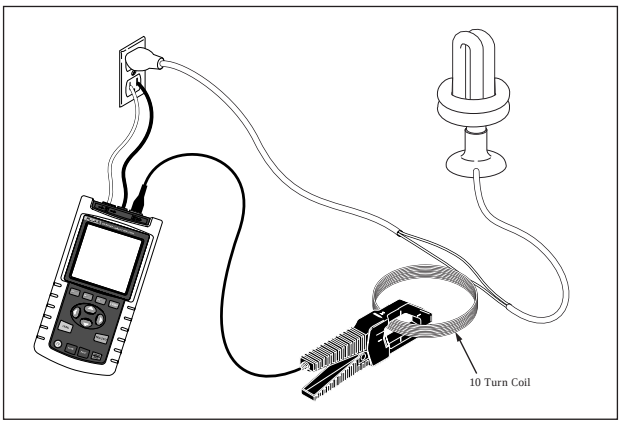


**Fig. 1** Example test set up for compact fluorescent lamps

### Problem description

In most facilities, lighting is a major element of operating cost. Part of that cost is due to energy, and part is due to maintenance. The maintenance costs can be significant. Light fixtures require periodic maintenance — for example, lamps burn out, ballasts fail and lenses need cleaning. The amount of maintenance required varies with the age and design of the lighting fixtures. The logistics of that maintenance (e.g., needing a personnel lift for high ceiling areas) can magnify "typical" cost estimates by an order of magnitude. It is sometimes cost-effective to replace an entire system with a more efficient one. In the case described here, the owner decided to replace the entire system.

While reducing the maintenance costs was the driving force in obtaining a replacement system, reducing energy costs was the driving force in selecting a replacement system. Determining the actual reduction in energy consumption required significant research. The research was difficult, because there was no common platform for comparing the widely varying performance claims from competing suppliers. Sometimes, critical specs were missing altogether.

The plant engineer decided to compare various units side-by-side, in the field. He began by asking each supplier to submit a sample for evaluation. Next, he worked on determining what to measure and how to make the measurements. The final measurement criteria included measurements of power consumption, power factor, displacement power factor and harmonic spectrum. Power consumption and displacement power factor would translate directly to operating cost. Harmonic distortion was of interest, because the plant engineer knew that high levels of harmonic current could cause problems for transformers, circuit breakers and other parts of the electrical distribution system.

To make these measurements easy, the plant engineer chose the Fluke 43B. The electrical team made measurements using a setup similar to Fig. 1. This is an experiment that you can easily duplicate on your workbench.

They recorded data in the matrix table shown here. From the table, you can see they were able to make comparisons of all the key electrical factors on a level playing field. This allowed them to select the most cost-effective approach.

It's worth noting that each manufacturer bases its performance claims on a specified set of operating conditions — these conditions may be ideal or they may be "typical." But, the conditions vary between manufacturers and the conditions differ from actual applications. Therefore, those claims, while made in good faith, can be a poor basis for a final product decision. When trying to make economic decisions on lighting or other electrical applications, measuring actual performance under actual conditions — with the right test equipment — is a sure way to arrive at the best decision.

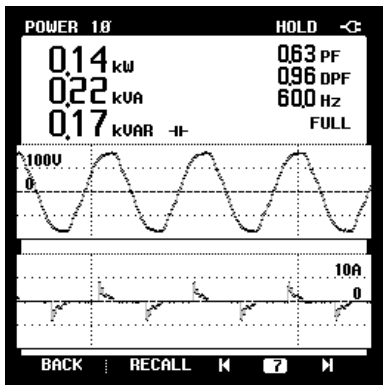


**Fig. 2** Compact fluorescent lamp power consumption and current waveform

Line voltage: 119.2 V ac
Line voltage THD: 2.7 %

| Ballast/lamp supplier | Power consumption | P.F. | D.P.F. | Current THD | Unit cost $ |
|---|---|---|---|---|---|
| Brand A | 14 W | 0.63 | 0.96 | 74.3 % | $6.50 |
| Brand B | 16 W | 0.59 | 0.98 | 77.1 % | $8.00 |
| Brand C | | | | | |
| Brand D | | | | | |

**Notes to table:**

1. The comparison test for compact fluorescents can easily be demonstrated using a desk lamp and a split extension cord with one conductor wrapped in a 10-turn coil. The 10-turn coil increases the range of current measurement. Power consumption for one unit would be the recorded value divided by 10.
2. To make a fair comparison, the line voltage should be the same for each unit tested.
3. The performance value of current THD will depend on the amount of harmonic distortion on the supply voltage and impedance of the voltage source. It may not be possible to duplicate the ballast suppliers' exact specification number — but, if all tests are made from the same supply source, the performance comparison will be valid.
4. Measurement values for the lamp tested in Fig. 2 and Fig. 3 are recorded as "Brand A." The remaining tests for brands C and D are left as an exercise for the reader.

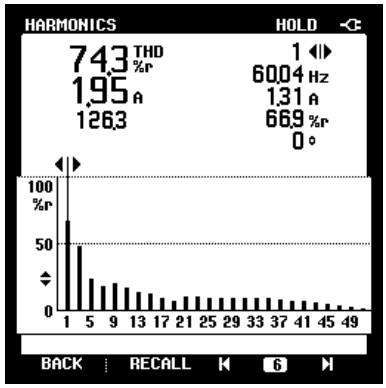


**Fig. 3** Compact fluorescent lamp current harmonic spectrum

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