Test method for ballast power consumption versus light output

Objectives

The objective of this test is to determine the performance of comparable 600W lighting ballasts, from different manufacturers, under the same test conditions. The data obtained will be accurate enough to compare the performance of these ballasts relatively to each other.

Test Conditions

- All tests will be carried out in as similar conditions as follows.
- All tests will be carried out using the same test equipment.
- To eliminate any variation in results caused by supply voltage fluctuations a Variac will be used to supply all equipment.
- All lighting equipment will be plugged into the Variac via a calibrated energy power meter. This meter is then used to measure the voltage, current, power and power-factor values of the equipment being tested.
- The lamp used will have been run continuously for 100 hours, from new, before being used for testing.
- The lamp output will be measured by the use of an independently calibrated PAR meter and sensor and recorded in units of $W/m^{2.}$
- The lamp, reflector and PAR sensor will remain in a fixed position throughout the testing.
- To minimise external lighting and temperature influences, the lamp, reflector and sensor will be housed in a fully enclosed lightproof tent.
- The lightproof tent will be fixed and fully sealed during each series of tests.

Test Equipment

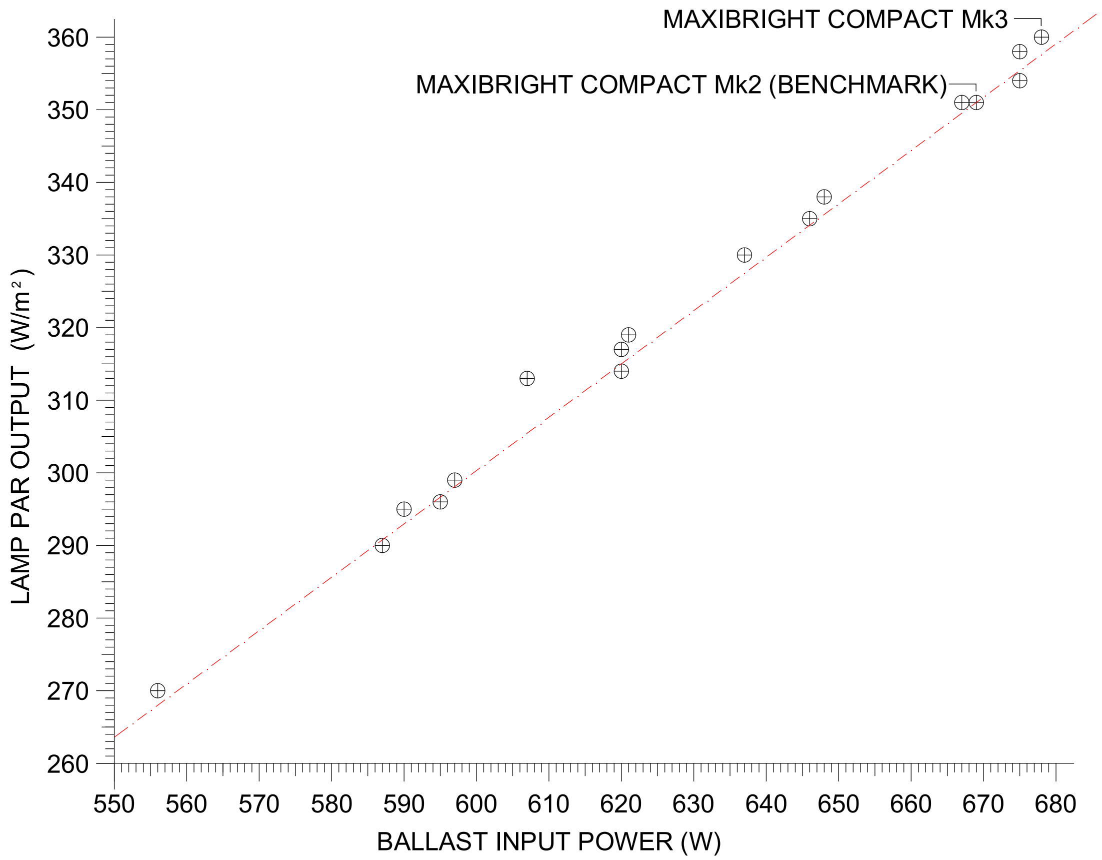
Equipment	Manufacture	Product Code
Variac	Claude Lyons	Variac 715-ED DIG VA
Energy Meter	Prodigit Electronics	2000MU
Reflector	Maxibright	Maxibright Deluxe (MBDR)
Lamps	Sunmaster Dual Spectrum	SL600W
Dark Room Tent	Secret Jardin	DR40
PAR Meter	Skye	SKE 500 0200 20405
PAR Sensor	Skye	SKE 510 0200 20404

Test method

1. The ballast to be tested will be fitted and wired as per manufacturer’s instructions.
2. The power will be switched on and the voltage set using the Variac at 240V.
3. The system will be left on for a minimum 30 minutes to allow lamp to warm up.
4. The voltage output from the Variac will be rechecked and adjusted if necessary to 240V. A current reading in amps will also be taken on the Variac.
5. Using the energy meter, readings for volts, amps, power and power-factor will be taken.
6. Using the PAR meter a reading will be taken to measure the lamp output.
7. The system will then be switched off and left for at least 15 minutes for the lamp to cool.
8. The ballast will then be changed, leaving all other equipment fixed and unchanged.
9. Steps 1 to 7 are then repeated until all ballasts of the same rating have been tested.
10. The test cycle will be repeated a minimum of 3 times for each ballast type.
11. At the end of the tests, the original ballast will be tested again to ensure that the current readings are within 1% of the original ones.

Results

When all testing was complete an arithmetic mean for the ballast input power and the lamp PAR output was calculated for each ballast type. The results can be seen in graph form below.



Observations

From our test results, we found the following:

1. The highest reading obtained was 678W giving 360 PAR W/m^2.
2. The lowest reading obtained was 556W giving 270 PAR W/m^2.
3. The mean power consumed of our benchmark Compact Mk2 600W power pack was 669W. The mean output from the lamp was 351 PAR W/m^2.
4. The mean power consumed overall was 635W.
5. The mean light output overall was 326 PAR W/m^2.
6. The mean power overall was 5% less than the Compact Mk2 600W benchmark.
7. The mean light output overall was 7% less the Compact Mk2 600W benchmark.
8. This ratio of (6) to (7) above is 1:1.4. This is our power loss to light loss ratio, which is described by the red line in the results graph above.

Conclusions

There was a surprising amount of difference between the ballast results, when you consider they are all labelled as “600W”.

Test method for establishing power correction for changes in voltage

Objectives

The previous tests will be carried out at 240V. However, officially the supply voltage in the UK can vary from 240V by -10% \ +6%. This means that anyone trying to replicate the above tests without a stabilised power supply, could encounter voltages anywhere between 215V and 255V.

Therefore, the objectives of this set of tests is to determine how much the mean power readings must be adjusted by to compensate for changes in supply voltage.

Test Conditions

- All tests will be carried out in as similar conditions as follows.
- All tests will be carried out using the same test equipment.
- To eliminate any variation in results caused by supply voltage fluctuations a Variac will be used to supply all equipment.
- All lighting equipment will be plugged into the Variac via a calibrated energy meter. This meter is then used to measure the voltage and power.
- The lamp used will have been run continuously for 100 hours, from new, before being used for testing.

Test Equipment

Equipment	Manufacture	Product Code
Variac	Claude Lyons	Variac 715-ED DIG VA
Energy Meter	Prodigit Electronics	2000MU
Reflector	Maxibright	Maxibright Deluxe (MBDR)
Lamps	Sunmaster Dual Spectrum	SL600W

Test method

1. The ballast to be tested will be fitted and wired as per manufacturer's instructions.
2. The power will be switched on and the voltage set using the Variac, so as the energy meter initially reads 240V.
3. The system will be left on for a minimum 30 minutes to allow lamp to warm up.
4. The voltage output will be adjusted on the Variac so as the energy meter reads 215V.
5. The system will be left for 10 minutes to allow it to stabilise.
6. The voltage reading will be checked on the energy meter and Variac adjusted as necessary.
7. Using the energy meter, a reading for volts and power will be taken.
8. Repeat steps 5 to 7, adjusting the Variac so as the energy meter reads 220V, 225V, 230V, 235V, 240V, 245V, 250V and 255V.
9. Adjust the Variac again so as energy meter reads 240V again. Repeat steps 5 to 7 to check that the original values are still within 1% of the original ones.
10. Repeat steps 2 onwards for all ballasts in the test group.
11. For each voltage setting, mean values for percentage increase\decrease in power consumption needed to achieve the power values recorded at 240V will then be calculated. E.g. if the mean power reading was 640W at 240V, and at 235V the mean power reading was 610W, any other power readings taken at 235V would need to be increased by approximately 4.9% for comparison with our data.
12. The maximum uncertainty of these results will be calculated by:
    a) finding the minimum percentages from the results
    b) finding the maximum percentage from the results
    c) pick whichever of these two values (i.e. minimum or maximum) is furthest from the mean

d) Find the difference between the value obtained in c) above and the mean. This becomes our value for maximum uncertainty.

Results

The following data was obtained from our testing:

Volts	Mean % increase of power per 5V increase
215	N.A
220	3.61%
225	5.89%
230	6.81%
235	6.08%
240	5.14%
245	5.73%
250	4.40%
255	4.53%
Minimum	3.61%
Maximum	6.81%
Mean	**5.27%**

According to our test method, as the minimum percentage is further away from the mean than the maximum, the maximum uncertainty calculated for the above results is (5.27% - 3.61%) = +\- 1.66%.

Comments

It was noted that the power readings taken for lower voltages on poorer quality ballasts (ones that consume less than 640W) introduced significantly more error to the data, than others closer to the normal power specification. This error has been preserved in our results below.

Conclusions

The change in power consumed as the voltage increases from 215V to 255V is reasonably linear. For every 5V increase in voltage, the power consumed increases approximately by 5%. Therefore, as a rule of thumb, for every 1V increase in voltage, the power should increase by 1%.