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Title
LIFE TESTING ON DURO-TEST LAMPS

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MEMORANDUM

DATE: July 7, 1982
TO: Lighting Systems Research Group
FROM: Greg Ward
RE: Life Testing on Duro-Test Lamps

Introduction

This memorandum describes the electrical, photometric and chromatic performance of the Duro-Test incandescent lamps after 520 hours of burning time. Initial performance of these lamps was described in a previous memorandum dated May 4, 1982.

Test Procedure

Before taking any measurements, each lamp was placed in the integrating sphere base up and burned at 115 VAC for 20 minutes. The sphere was then closed, and photometric and electrical data were taken. In accordance with the manufacturer's recommendations, lamps were operated and tested at 115 VAC rather than 120 VAC.

Spectral power distributions were measured with the spectroradiometer.

Color temperature and color-rendering indices were computed from the spectral power distribution data.

Luminous flux values were calculated using an NBS-calibrated incandescent lamp as the transfer standard.

The equipment used for all measurements is listed below:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Parameter Measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clarke-Hess 255 watt-meter</td>
<td>Power, input voltage, current</td>
</tr>
<tr>
<td>Tektronix J-16 photometer</td>
<td>Luminous flux</td>
</tr>
<tr>
<td>EG&amp;G Electro-Optics 555</td>
<td>Spectral power distribution</td>
</tr>
</tbody>
</table>
Test Results

Major test results are shown in Table 1. Initial lamp performance data (from previous memorandum) is included in this table to show the relative change in lamp performance over time. Also, the average value for each measured parameter is calculated with the standard deviation of the sample. The percent change in light output and efficacy are given for each lamp in columns 10 and 13, respectively.

It should be noted that lamp #479 burned out after 280 hours of operation and could not be included in the measurements taken at 520 hours. The averages taken to make graphs 1, 2, and 4 did not include lamp #479 but the initial averages given in Table 1 did.

The most significant result in the life test measurements is the unusually rapid decline in light output. The average loss in output after 520 hours (roughly 1/5 of the total rated life) was 24%. Two lamps (#497 & #486) had lost near forty percent of their initial luminous flux. These results were not expected because the average decrease in output at the equivalent point in the life of a standard incandescent is about 8%, and there is no obvious reason why light output would decline so much faster in this design.

Discussion

To a large degree, the depreciation in light output appears to be caused by the deposition of tungsten on the bulb wall, as in most incandescent designs. However, bulbs #497 and #486 showed signs of deterioration in the reflective coating which has assumed a brownish clouded appearance. Also, leakage in the seals of the bulbs could be causing oxidation of the filament and the early burnout of #479 and since then #460 and #476.

Although these measurements are not conclusive, they do suggest that further tests should be made on the envelope seal under operating conditions and the stability of the reflective coating.

Acknowledgement

This work was supported by the Assistant Secretary for Conservation and Renewable Energy, Office of Building Energy Research and Development, Building Equipment Division of the U.S. Department of Energy under Contract No. DE-AC03-76SF00098.
<table>
<thead>
<tr>
<th>Lamp #</th>
<th>Input Power (watts)</th>
<th>Current Factor (%)</th>
<th>Power Factor (%)</th>
<th>Luminous Flux (lumens)</th>
<th>Change in Output (%)</th>
<th>Efficacy (lumens/watt)</th>
<th>Change in Efficacy (%)</th>
<th>Color Temperature (°C)</th>
<th>C.R.I. (°)</th>
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<tbody>
<tr>
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<td>54.2</td>
<td>677.4</td>
<td>682.0</td>
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<td>69.4</td>
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<td>441</td>
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<td>54.9</td>
<td>672.0</td>
<td>682.0</td>
<td>70.9</td>
<td>71.0</td>
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<td>457</td>
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<td>55.4</td>
<td>666.1</td>
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<td>682.0</td>
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<td>----</td>
<td>672.0</td>
<td>----</td>
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<td>----</td>
<td>----</td>
<td>31.6</td>
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<td>450</td>
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<td>54.9</td>
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<td>676.0</td>
<td>71.8</td>
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<td>-18</td>
<td>27.7</td>
<td>22.1</td>
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<td>476</td>
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<td>660.0</td>
<td>666.0</td>
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<td></td>
<td><strong>Average</strong></td>
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<td>54.7</td>
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<td>1.13</td>
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*Burned out @280 hrs.
DURO-TEST LIFE TEST DATA
TOTAL FLUX vs HOURS BURNED

GRAPH 1

Lamps Not Included:
# 479

Bars represent Standard Deviation
DURO-TEST LIFE TEST DATA

EFFICACY vs HOURS BURNED

Lamps Not Included:
# 479

Bars represent Standard Deviation
DURO-TEST LIFE TEST DATA
EFFECTIVENESS VS HOURS BURNED

GRAPH 3

Efficacy (lm/watt)

Lamp #479
Burned out @ 280

Hours Burned (hrs)
DURO-TEST LIFE TEST DATA
INPUT POWER vs HOURS BURNED

GRAPH 4

Lamps Not Included:
# 479

Bars represent Standard Deviation

Input Power (watts)

Hours Burned (hrs)
<table>
<thead>
<tr>
<th>Lamp No</th>
<th>Lamp Current (mA)</th>
<th>Power Rating (W)</th>
<th>Power Factor (%)</th>
<th>Lux (lx)</th>
<th>Total Flux (lm)</th>
<th>Efficiency (lm/w)</th>
<th>Color Temp (°K)</th>
<th>CRI</th>
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</thead>
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</table>

**AVG:** 698 56.2 69.9 829 941 16.8 2743 93.1 1.6
DURO-TEST LIFE TEST DATA
TOTAL FLUX vs HOURS BURNED

Lamps Not Included:
- #460
- #476
- #479
DURO-TEST LIFE TEST DATA
EFFICACY vs HOURS BURNED

Lamps Not Included:
# 458
# 476
# 479
DURO-TEST LIFE TEST DATA
TOTAL FLUX vs HOURS BURNED

Total Flux (lm)

Hours Burned (hrs)
DURO-TEST LIFE TEST DATA
Efficacy vs Hours Burned

Efficacy (lm/watt)

Hours Burned (hrs)
Duro-Test Life Curve

Number of Lamps Burning

Time (hrs.)

442, 450, 486 still on after 1600
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