3.0G ANSI C136.31-2018 Vibration Testing of OSQ Large Luminaire with Direct Arm Mount

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B83 Project Number:
C013-3270

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Objective

One (1) OSQ Large Luminaire with a Direct Arm (DA) mount was to be subjected to vibration testing in accordance with ANSI C136.31-2018 at 3.0G. The luminaire assembly was to function normally and have no damage, or reduction of electrical spacing. The torque of the mounting fasteners was to be maintained above acceptable limits as specified by CREE during testing in all axes.

Executive Summary

<table>
<thead>
<tr>
<th>Vibration Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Date Performed</strong></td>
</tr>
<tr>
<td><strong>Test Article</strong></td>
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</tr>
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1.0 Introduction

1.1 Scope of Work
CREE Lighting (CREE) retained the services of B83 Testing & Engineering, Inc. (B83) to perform vibration testing in accordance with ANSI C136.31-2018 at 3.0G on one (1) OSQ Large luminaire with direct arm mount.

1.2 Description of Test Articles
On February 26, 2020, B83 received one (1) OSQ Large luminaire with direct arm (DA) mount and hardware. The results of the testing are applicable to the test article as received. The luminaire assembly was assigned B83 sample tracking number 203495. The details of the luminaire assembly are listed below. Photographs of the test article are shown in Figure 1, page 8.

<table>
<thead>
<tr>
<th>Part Description</th>
<th>Part Number</th>
<th>Hardware</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSQ Large Luminaire</td>
<td>NPI-OSQ-A-NM-5ME-T-40K-UL-SV-R</td>
<td>• Four (4) ⅜” Set Screws</td>
</tr>
<tr>
<td>Direct Arm Mount</td>
<td>OSQ-DASV</td>
<td>• Two (2) S30400 5/16”-18 x 1 ¾” Bolts with external tooth lock washers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Backing plate (1¼” x 3 ½” x ¼”)</td>
</tr>
</tbody>
</table>

1.3 Order of Report
The equipment used to perform the testing is listed in section 2.0. Requirements, procedures, and results of the tests performed can be found in section 3.0. Disposition of the test articles upon the completion of testing can be found in section 4.0. All figures referenced in the body of this document are located in Appendix A.

1.4 Referenced Documents
CREE Lighting
- Testing details provided by CREE personnel via email with subject line “RE: 3G Edge HO HV Mount and Spline Screws Backed Out”, email received by B83 on February 26, 2019

2.0 Test Equipment

The following table lists the equipment used to perform the vibration testing.

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Equipment No.</th>
<th>Cal. Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibration Research Model VR9500 Vibration Controller</td>
<td>S/N 95183540</td>
<td>6-24-2020</td>
</tr>
<tr>
<td>PCB Model 353B33 Accelerometer – Fixture</td>
<td>S/N 30523</td>
<td>11-06-2021</td>
</tr>
<tr>
<td>PCB Model 353B15 Accelerometer – Luminaire C.G.</td>
<td>S/N LW157860</td>
<td>4-10-2020</td>
</tr>
<tr>
<td>MTS Model 248.04 Hydraulic Actuator (Z-Axis)</td>
<td>S/N 282</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>MTS Model 407 Servo-Hydraulic Controller (Z-Axis)</td>
<td>S/N 0420260L</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>MTS Model 244.21 Hydraulic Actuator (X &amp; Y Axes)</td>
<td>S/N 1005265</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>MTS Model 407 Servo-Hydraulic Controller (X &amp; Y Axes)</td>
<td>S/N 04118911L</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>JETCO Model ED-250I 250in-lb Torque Wrench</td>
<td>S/N 06193030</td>
<td>7-2-2020</td>
</tr>
</tbody>
</table>

3.0 Vibration Testing of OSQ Large Luminaire with DA Mount

3.1 Test Requirements

Vibration testing was to be conducted on the luminaire assembly in accordance with the 3.0G requirement of ANSI C136.31-2018. The luminaire was to be dwell tested near the fundamental resonant frequency at 3.0G for 100,000 cycles in each of the three (3) mutually perpendicular axes (X, Y, and Z). Acceleration was to be measured at the luminaire’s center of gravity. The fundamental resonant frequency was to be determined for each test axis. The dwell frequency was to be no more than 2Hz below the fundamental resonant frequency.

The mounting fasteners were to be tightened to the levels shown in the following table:

<table>
<thead>
<tr>
<th>Fastener</th>
<th>Quantity</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/16” Mounting Bracket Hardware</td>
<td>2</td>
<td>132in-lbs</td>
</tr>
<tr>
<td>3/8” Luminaire Set Screws</td>
<td>4</td>
<td>85in-lbs</td>
</tr>
</tbody>
</table>

The luminaire was to be powered with 120VAC at the start and end of testing to verify operation. The luminaire was to function normally and have no damage, reduction of electrical spacing, or loosening of parts at the completion of testing.
3.2 Test Procedure

The DA mount and luminaire were installed on the test fixture and the mounting fasteners were tightened as required prior to the start of each test axis. The test fixture was secured to a vibration table. An accelerometer was bonded to the test fixture adjacent to the test article and a second accelerometer was mounted near the center of gravity of the test article, both mounted parallel to the direction of vibration.

The vibration controller was programmed to perform a sine sweep with an amplitude of 3G utilizing a sweep rate of 1 octave/minute to determine the fundamental resonant frequency. The required dwell testing was then conducted. The dwell frequency was selected based on suitable controllability and being no more than 2 Hz below the fundamental resonant frequency determined for that axis.

Testing started in the Z-Axis, followed by the Y-Axis, and concluded in the X-Axis. Photographs of the test fixture and test setups are shown in Figure 2, page 9 through Figure 4, page 10.

The luminaire was powered with 120VAC at the start and end of testing to verify operation.

3.3 Test Results

One (1) OSQ Large with DA mount (B83 SN 203495) completed the required testing on February 27, 2020 through February 28, 2020. The luminaire completed 100,000 cycles at 3.0G in each of the three mutually perpendicular axes for a total of 300,000 cycles. All testing was performed no more than 2Hz below the fundamental resonant frequency for each axis. The luminaire functioned normally and there was no damage, or reduction of electrical spacing. The torque of the mounting fasteners was maintained above acceptable limits as specified by CREE during testing in all axes.

Transmissibility plots for each axis are shown in Figure 5, page 10 through Figure 7, page 11. The dwell test levels are summarized in the table below:

<table>
<thead>
<tr>
<th>Axis</th>
<th>Time</th>
<th>Dwell Frequency (Hz)</th>
<th>Transmissibility</th>
<th>Test Fixture Acceleration (G)</th>
<th>Test Fixture Displacement* (inch p-p)</th>
<th>Luminaire CG Acceleration (G)</th>
<th>Luminaire CG Displacement* (inch p-p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>Start End</td>
<td>15.6</td>
<td>30.0</td>
<td>0.10</td>
<td>0.0080</td>
<td>3.0</td>
<td>0.2412</td>
</tr>
<tr>
<td></td>
<td>30.0</td>
<td>15.6</td>
<td>0.10</td>
<td>0.0080</td>
<td>3.0</td>
<td>0.2412</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>Start End</td>
<td>13.8</td>
<td>10.7</td>
<td>0.28</td>
<td>0.0288</td>
<td>3.0</td>
<td>0.3083</td>
</tr>
<tr>
<td></td>
<td>18.2</td>
<td>13.8</td>
<td>0.17</td>
<td>0.0170</td>
<td>3.0</td>
<td>0.3083</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>Start End</td>
<td>48.5</td>
<td>150.0</td>
<td>0.02</td>
<td>0.0002</td>
<td>3.0</td>
<td>0.0250</td>
</tr>
<tr>
<td></td>
<td>187.5</td>
<td>48.5</td>
<td>0.02</td>
<td>0.0001</td>
<td>3.0</td>
<td>0.0250</td>
<td></td>
</tr>
</tbody>
</table>

*calculated based upon acceleration and frequency

4.0 Disposition of Test Articles

Upon completion of testing, the OSQ Large luminaire with DA mount was disposed of by B83 personnel.
Appendix A – Referenced Figures
Figure 1: OSQ Large Luminaire, DA Mount, and Mounting Hardware – B83 SN 203495
Figure 2: Z-Axis Test Setup

Figure 3: Y-Axis Test Setup
Figure 4: X-Axis Test Setup

Figure 5: Z-Axis Transmissibility Plot
Figure 6: Y-Axis Transmissibility Plot

Frequency 13.79 Hz
CG/Fixture 37.03 G/G

Figure 7: X-Axis Transmissibility Plot

Frequency 48.54 Hz
CG/Fixture 211.8 G/G