TraStar, Inc.

Company Overview

July 15, 2016

TexITE Presentation

Presented by: Beau Davis, Outside Sales Manager
• Incorporated in Richardson, Texas in 2002
• Recognized Minority Business Enterprise by the NCTRCA
• Duralight® LED Products are Approved and Installed by Many DOT’s, Municipalities, Commercial and Industrial Locations
• Our LED Luminaires are approved by the Texas Department of Transportation (TxDOT)
January 2015
TxDOT finalizes the official specification for LED Roadway Luminaires

February 1, 2015
TraStar is the first manufacturer listed on the TxDOT Material Producer List

March 7, 2016
TraStar is awarded the TxSmartBuy LED luminaire contract
Duralight JXM-ST Luminaires

Cobra Heads
- JXM-ST140-3 (150W HPS Replacement)
- JXM-ST180-3 (250W HPS Replacement)
- JXM-ST180-4 (400W HPS Replacement)

<table>
<thead>
<tr>
<th>Model Number:</th>
<th>JXM-ST140-3</th>
<th>JXM-ST180-3</th>
<th>JXM-ST180-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wattage Level:</td>
<td>70W</td>
<td>135W</td>
<td>205W</td>
</tr>
<tr>
<td>Lumen Output:</td>
<td>≈ 6990</td>
<td>≈ 12600</td>
<td>≈ 19400</td>
</tr>
<tr>
<td>CRI:</td>
<td>&gt; 70</td>
<td>&gt; 70</td>
<td>&gt; 70</td>
</tr>
<tr>
<td>Power Factor:</td>
<td>0.99</td>
<td>0.99</td>
<td>0.99</td>
</tr>
<tr>
<td>Weight</td>
<td>≤ 27lbs</td>
<td>≤ 35lbs</td>
<td>≤ 35lbs</td>
</tr>
<tr>
<td>EPA</td>
<td>0.543 sqft</td>
<td>0.805 sqft</td>
<td>0.805 sqft</td>
</tr>
</tbody>
</table>
Duralight JXM-ST Luminaires

Key Characteristics

• Flexible mounting adjustment (tilt angle)
• Fits various tenon sizes
• Driver Compartment is completely enclosed
• Heat Sink designed for easy debris run-off
• Dark-Sky Certified
• Special Optic design for Type II & Type III distributions
• Easy one-person installation
• Tool-less Entry for convenient maintenance
General Lighting Information

Distribution / Shooting Patterns

- Typical Patterns: Type I, Type II, Type III, Type IV & Type V

- LED lights are very directional which maximizes the amount of light being used and minimizes the amount of light being wasted or lost.

- Most Roadway applications will call for a Type II or III Distribution Pattern

- Most Parking lot applications will call for a Type IV or V Distribution Pattern
JXM-ST140-3  
Underpass / 150W Equivalent Photometric Analysis

- **Fixture Spacing:** 90 ft  
- **Mounting Height:** 16 ft  
- **Setback:** 10 ft

Minimum > 0.35 footcandle  
Average > 1.1 footcandle  
Average/minimum ratio < 3.0:1  
Zero Uplight

<table>
<thead>
<tr>
<th>Calculation Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Label</td>
</tr>
<tr>
<td>RoadOpt_Illum</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Qty</th>
<th>Label</th>
<th>Arrangement</th>
<th>Total Lamp Lumens</th>
<th>LLF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18</td>
<td>1409241306-001B</td>
<td>SINGLE</td>
<td>N.A.</td>
<td>0.860</td>
</tr>
</tbody>
</table>

Luminaire Schedule
JXM-ST180-3
250W Equivalent Photometric Analysis

Pole Spacing: 220 ft  
Mounting Height: 40 ft  
Setback: 15 ft

Minimum > 0.20 footcandle  
Average > .60 footcandle  
Average/minimum ratio < 3.0:1  
Zero Uplight

```
0.86  0.75  0.66  0.59  0.52  0.47  0.42  0.38  0.42  0.47  0.52  0.59  0.66  0.75  0.86
1.13  0.98  0.85  0.73  0.64  0.57  0.50  0.44  0.44  0.50  0.64  0.73  0.85  0.98  1.13
1.25  1.10  0.92  0.78  0.69  0.63  0.52  0.46  0.46  0.52  0.63  0.69  0.78  0.92  1.10  1.25
1.28  1.15  0.94  0.74  0.67  0.60  0.50  0.42  0.42  0.50  0.60  0.67  0.74  0.94  1.15  1.28
1.33  1.20  0.96  0.70  0.62  0.54  0.44  0.36  0.36  0.44  0.54  0.62  0.70  0.96  1.20  1.33
1.29  1.17  0.98  0.65  0.55  0.46  0.36  0.30  0.30  0.36  0.46  0.55  0.65  0.98  1.17  1.29
```

Luminaire Schedule

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Qty</th>
<th>Label</th>
<th>Arrangement</th>
<th>Total Lamp Lumens</th>
<th>LLF</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>JXM-ST180-3</td>
<td>7</td>
<td>JXM-ST180-3</td>
<td>SINGLE</td>
<td>N.A.</td>
<td>0.860</td>
<td>JXM-ST180-3</td>
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Calculation Summary

<table>
<thead>
<tr>
<th>Label</th>
<th>CalcType</th>
<th>Units</th>
<th>Avg</th>
<th>Max</th>
<th>Min</th>
<th>Avg/Min</th>
<th>Max/Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>RoadOpt_Illum</td>
<td>Illuminance</td>
<td>Pc</td>
<td>0.73</td>
<td>1.33</td>
<td>0.30</td>
<td>2.43</td>
<td>4.43</td>
</tr>
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</table>
JXM-ST180-4
400W Equivalent Photometric Analysis

Pole Spacing: 270 ft  
Minimum > 0.20 footcandle
Mounting Height: 50 ft  
Average > .60 footcandle
Setback: 15 ft  
Average/minimum ratio < 3.0:1
Zero Uplight

<table>
<thead>
<tr>
<th>Footcandle Values</th>
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<tbody>
<tr>
<td>0.49</td>
</tr>
<tr>
<td>0.59</td>
</tr>
<tr>
<td>0.69</td>
</tr>
<tr>
<td>0.73</td>
</tr>
<tr>
<td>0.77</td>
</tr>
<tr>
<td>0.82</td>
</tr>
<tr>
<td>0.92</td>
</tr>
<tr>
<td>0.97</td>
</tr>
<tr>
<td>1.07</td>
</tr>
<tr>
<td>1.11</td>
</tr>
<tr>
<td>1.12</td>
</tr>
</tbody>
</table>

Luminaire Schedule

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Qty</th>
<th>Label</th>
<th>Arrangement</th>
<th>Total Lamp Lumens</th>
<th>LLF</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7</td>
<td>1400241300 001A</td>
<td>CIRCLE</td>
<td>N.A.</td>
<td>0.000</td>
<td>1400241300 001A, MOD#: JK</td>
</tr>
</tbody>
</table>

Calculation Summary

<table>
<thead>
<tr>
<th>Label</th>
<th>CalcType</th>
<th>Units</th>
<th>Avg</th>
<th>Max</th>
<th>Min</th>
<th>Avg/Min</th>
<th>Max/Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eave_xPkt_Illum</td>
<td>Illuminance</td>
<td>fc</td>
<td>0.68</td>
<td>1.20</td>
<td>0.30</td>
<td>2.27</td>
<td>4.00</td>
</tr>
</tbody>
</table>
DURALIGHT LED
High Mast Lighting

July 15, 2016
TexITE Presentation
# Duralight JXM-ST High Mast

## High Mast
- JXM-ST-HM6
- JXM-ST-HM4

<table>
<thead>
<tr>
<th>Model Number:</th>
<th>JXM-ST-HM6-A</th>
<th>JXM-ST-HM6-B</th>
<th>JXM-ST-HM4-S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wattage Level:</td>
<td>490W</td>
<td>490W</td>
<td>300W</td>
</tr>
<tr>
<td>Lumen Output:</td>
<td>≈ 42650</td>
<td>≈ 42650</td>
<td>≈ 30030</td>
</tr>
<tr>
<td>CRI:</td>
<td>&gt; 70</td>
<td>&gt; 70</td>
<td>&gt; 70</td>
</tr>
<tr>
<td>Power Factor:</td>
<td>0.99</td>
<td>0.99</td>
<td>0.99</td>
</tr>
<tr>
<td>Weight</td>
<td>≤ 68 lbs</td>
<td>≤ 68 lbs</td>
<td>≤ 52 lbs</td>
</tr>
<tr>
<td>EPA</td>
<td>1.29 sqft</td>
<td>1.29 sqft</td>
<td>1.29 sqft</td>
</tr>
</tbody>
</table>
Duralight JXM-ST High Mast

Key Characteristics

• ± 5º mounting angle adjustability
• Easy field-rotatable optics to ensure proper orientation of luminaire
• Fits various tenon sizes
• Tool-less entry power supply compartment for convenient maintenance
• Heat Sink designed for easy debris run-off
• Special Optic design for Type A, B & S distributions Easy installation
Photometric Analysis

Replacement: 400W Replacement (12 per ring)
Model: JXM-ST HM6-A
Fixtures per ring: 6 (replacing 2 for 1)
Pole Spacing: 920 ft

Mounting Height: 150 ft
Roadway Width: 8 lane x 12.5 ft wide = 100 ft
Setback: 30 ft

Illuminance (Fc)
Average = .84
Maximum = 1.88
Minimum = 0.30
Avg/Min Ratio = 2.8
Max/Min Ratio = 6.27
Max/Avg Ratio = 2.24

Fixture Orientation:
Photometric Analysis

Replacement: 400W Replacement (12 per ring)
Model: JXM-ST-HM6-B
Fixtures per ring: 6 (replacing 2 for 1)
Pole Spacing: 800 ft

Mounting Height: 150 ft
Roadway Width: 14 lane x 12.5 ft wide = 175 ft
Setback: 30 ft

Illuminance (Fc)
Average = .81
Maximum = 1.88
Minimum = 0.32
Avg/Min Ratio = 2.53
Max/Min Ratio = 5.88
Max/Avg Ratio = 2.32

Fixture Orientation:
Photometric Analysis

Replacement: 400W Replacement
(12 per ring)
Model: JXM-ST-HM4-S
Fixtures per ring: 6 (replacing 2 for 1)
Pole Spacing: 450 ft

Fixture Orientation:

<table>
<thead>
<tr>
<th>Calculation Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Label</td>
</tr>
<tr>
<td>CalcPis</td>
</tr>
</tbody>
</table>
Technical Requirements

1) Compliance
   - ANSI/UL 1598/CSA C22.2
   - Design Lights Consortium Listed
   - RoHS Compliant
   - Buy American Compliant
   - Dark-Sky Compliant

2) Testing and Standards
   ✓ IESNA LM-79-08 (IESNA Approved Method for the Electrical and Photometric measurements of Solid State Lighting Products)
   ✓ IESNA LM-80-08 (IESNA Approved Method for Measuring Lumen Maintenance of LED Lighting Source)
   ✓ IESNA TM-15 – Luminaire Classification (BUG Rating)
   ✓ IES File – IESNA Photometric File
   ✓ TM-21 – Lumen Maintenance Projection
   ✓ In-Situ Temperature Measurement Test (ISTMT)

3) Testing and Standards, Cont.
   ✓ ANSI C136.25 – IP Rating for Optical Assembly
   ✓ ANSI C136.31 – 3G Vibration Testing
   ✓ ASTM D 1654, ASTM B117, ASTM D 523 - Paint & Gloss rating
   ✓ ANSI/IEEE C62.45 per ANSI/IEEE C62.41.2 – Electrical Fast Transit (EFT) and Surge Immunity
   ✓ ANSI/UL 1598/CSA C22.2
## Technical Requirements

- **LM-79 Testing** = Testing procedures for integrating sphere and goniophotometric testing of SSL Luminaires and lamps.
  - Must be preformed by a DOE CALiPER Independent laboratory with NVLAP accreditation
  - Total Luminous Flux
  - Luminous Intensity Distribution
  - Electrical Power
  - Luminous Efficacy (calculation)
  - Color Characteristics (Chromaticity, CCT, CRI)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Factor</td>
<td>0.995</td>
</tr>
<tr>
<td>Current ATHD %</td>
<td>5.60</td>
</tr>
<tr>
<td>Correlated Color Temperature (CCT - K)</td>
<td>4218</td>
</tr>
<tr>
<td>Color Rendering Index (CRI - Ra)</td>
<td>74.3</td>
</tr>
<tr>
<td>Color Rendering Index (CRI - R9)</td>
<td>-12.8</td>
</tr>
<tr>
<td>CRI</td>
<td>0.001</td>
</tr>
<tr>
<td>Chromaticity Coordinate (x)</td>
<td>0.372</td>
</tr>
<tr>
<td>Chromaticity Coordinate (y)</td>
<td>0.375</td>
</tr>
<tr>
<td>Chromaticity Coordinate (u)</td>
<td>0.220</td>
</tr>
<tr>
<td>Chromaticity Coordinate (v)</td>
<td>0.500</td>
</tr>
<tr>
<td>Backlight Rating (B)</td>
<td>3</td>
</tr>
<tr>
<td>Uplight Rating (U)</td>
<td>0</td>
</tr>
<tr>
<td>Glare Rating (G)</td>
<td>3</td>
</tr>
</tbody>
</table>
Technical Requirements

- **In-Situ Testing**
  - Combines test data from the LM-80 to simulate real-world applications by testing the highest temp. LED in the luminaire while the power supply is measured at a steady state.
Technical Requirements

- **TM-21 Data**
  - Uses the LM-80 & In-Situ results to project the expected lumen output over time of the source as part of the system (fixture)

### Results

<table>
<thead>
<tr>
<th>Time (t) at which to estimate lumen maintenance</th>
<th>70,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumen maintenance at time (t) (%)</td>
<td>9 / 40%</td>
</tr>
<tr>
<td>Calculated L70 (hours)</td>
<td>1,098,000</td>
</tr>
<tr>
<td>Reported L70 (hours)</td>
<td>&gt;=60,000</td>
</tr>
</tbody>
</table>
Technical Requirements

  - Resistance to Dust, Solid Objects and Moisture
  - DURALIGHT Luminaires are rated IP 66
  - First digit “6” = Dust Tight (No ingress of dust)
  - Second digit “6” = protected against powerful water jets = (water projected in powerful water jet against enclosure from any direction shall have no harmful effects
Technical Requirements

  - 3G Vibration Testing

  - SPD protection against common mode transient peak voltages
  - 20kV/10kA

- **ASTM D 1654, ASTM B117, ASTM D 523 Testing**
  - WV Weathering/QUV Testing = Testing after 500 hrs
  - Salt Spray = Exceeds rating of 6 after 1000 hours
Technical Requirements

- **LM-80 Testing** = Measurement of lumen maintenance for LED-based packages, arrays, and modules only
  - LEDs tested for 10,000 hours, non-stop continuous testing
  - Tested under 3 case temperatures (55°C, 85°C, 105°C)
  - Observation of failed LEDs
  - Lumen Maintenance data under test temperatures over testing time period

<table>
<thead>
<tr>
<th>Data Set</th>
<th>Case Temperature [Ta]</th>
<th>Ambient Temperature [Ta]</th>
<th>Drive Current [I]</th>
<th>Lumen Maintenance at 10,000 hours</th>
<th>Chromaticity Shift (Δu/Δv) at 10,000 hours</th>
<th>TM-21 Projection L80(10K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>55°C</td>
<td>&gt; 50°C</td>
<td>700 mA</td>
<td>97.7%</td>
<td>0.0020</td>
<td>&gt; 60300 hours</td>
</tr>
<tr>
<td>2</td>
<td>55°C</td>
<td>&gt; 50°C</td>
<td>1000 mA</td>
<td>97.2%</td>
<td>0.0021</td>
<td>&gt; 60300 hours</td>
</tr>
<tr>
<td>3</td>
<td>85°C</td>
<td>&gt; 80°C</td>
<td>700 mA</td>
<td>95.9%</td>
<td>0.0021</td>
<td>&gt; 60300 hours</td>
</tr>
<tr>
<td>4</td>
<td>85°C</td>
<td>&gt; 80°C</td>
<td>1000 mA</td>
<td>95.8%</td>
<td>0.0026</td>
<td>&gt; 60300 hours</td>
</tr>
<tr>
<td>5</td>
<td>105°C</td>
<td>&gt; 100°C</td>
<td>550 mA</td>
<td>95.2%</td>
<td>0.0022</td>
<td>&gt; 60300 hours</td>
</tr>
<tr>
<td>6</td>
<td>105°C</td>
<td>&gt; 100°C</td>
<td>700 mA</td>
<td>95.8%</td>
<td>0.0025</td>
<td>&gt; 60300 hours</td>
</tr>
</tbody>
</table>

Average L70 Extrapolation

\[
L = L_{max}e^{\frac{t}{\alpha}} \\
L_{70} = \ln(0.7/L_{max})/\alpha
\]

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>L_{max}</td>
<td>0.9948</td>
<td></td>
<td></td>
</tr>
<tr>
<td>\alpha</td>
<td>-1.4156E-06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L_{70}</td>
<td>248303</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R^2</td>
<td>0.4922</td>
<td></td>
<td></td>
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</tbody>
</table>
Duralight JXM-ST Luminaires Projects

City of Waco, TX
Initial Installation 2012

City of Coppell, TX
Initial Installation 2015
Duralight JXM-ST Luminaires Projects

City of McKinney, TX
Initial Installation 2014

Custer Rd between Stonebridge and US 380
Duralight JXM-ST Luminaires Projects

Harris County Toll Road Authority, TX
Initial Installation 2015

City of Frisco, TX
Initial Installation 2015 (Main St between Custer and Preston)
League City, TX
Initial Installation 2014

State Hwy in Austin, TX
Initial Installation 2015
IES Files can be found at www.trastarusa.com

Please call us if you can’t find what you need.

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Thank You!

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