1. LISTING REQUIREMENTS

1.1. The Luminaire shall be listed by a National Recognized Testing Laboratory (NRTL) as defined by the U.S. Department of Labor. The testing laboratory must be listed by OSHA in its scope of recognition for the applicable tests being conducted as required by this specification. A list of recognized testing labs for products sold in the United States may be found on the U.S. Department of Labor’s web site: http://www.osha.gov/

1.2. The Luminaire shall be listed and labeled by a NRTL as being in compliance with UL 1598 and suitable for use in wet locations.

1.3. Light source and drivers shall be RoHS compliant.

1.4. Shall have an International Electrotechnical Commission (IEC) 529 Ingress Protection (IP) rating of IP 65 or greater.

1.5. Shall be in compliance with Electro Magnetic Interference (EMI) requirements as defined by FCC 47 Sub Part 15; CISPR15, CISPR22 Class A (120Vmin), EN61000-3-2, -3-3, -4-4, -4-5.

1.6. Shall be tested according to the most current version of Illuminating Engineering Society of North America (IESNA) LM-79 See section 6 below.

1.7. Shall have lumen maintenance measured in accordance the most current version of Illuminating Engineering Society of North America (IESNA) LM-80 See section 8 below.

1.8. Shall have long term lumen maintenance documented according to the most current version of Illuminating Engineering Society of North America (IESNA) TM-21 See section 6 below.


1.10. Shall meet the light level performance requirements as listed in section 4 of this specification.
2. **HOUSING:**

2.1. Shall have an aluminum housing.

2.2. Shall be painted gray or bronze to increase corrosion resistance.

2.3. All hardware on the exterior of the housing including cover and latch shall be stainless steel, zinc or steel with zinc alloy electroplate and chromate top coat.

2.4. Shall be easy to open when properly mounted.

2.5. Shall be easy to open when sitting on its top side when placed on the ground.

2.6. Shall have readily accessible internal parts.

2.7. Shall have provisions for a 4-bolt slip fitter type mounting on nominal 2 inch (2 3/8 OD) pipe brackets.

2.8. Slip fitter mount shall allow 4 inches of the pole bracket to be inserted in the luminaire mounting assembly.

2.8.1. The mounting assembly shall permit any necessary adjustment to orient the luminaire with the roadway for proper light distribution.

2.9. Shall have a clamping assembly with 4 bolts for securing the assembly to the light pole.

2.10. Shall not weigh more than 75 pounds when fully assembled.

2.11. Shall have an effective projected area of no more than 3.2 square feet (when viewed from either side or either end).

2.12. Shall be compliant with American National Standard (ANSI) IEEE C136.31, Table 2 Roadway Lighting Equipment -Luminaire Vibration for both normal applications and bridge and overpass applications.

2.13. Shall have area on the top of the housing to allow for a level to be used for proper orientation of the Luminaire.

2.14. Luminaire shall be designed to accommodate photo-electric control receptacle (PECR). PECR shall be rotatable up to 359 degrees without the use of tools. Housing shall provide 360 degree stop to prevent the internal twisting of PECR wire assemblies resulting in potential electrical short.

2.15. Housing shall be designed to allow water shedding.

2.16. Passive cooling method shall be employed to manage thermal output of LED light engine and power supply.
3. **ELECTRICAL REQUIREMENTS:**

3.1. Shall fully operate in a temperature range -40º C to 54.4º C (-40º F to 130º F).

3.2. Shall consume an AC line input power of 240 watts maximum.

3.3. Shall have an integral power supply.

3.4. Shall have a power supply that will operate within the following voltage range (105 to 277 VAC (rms)) ±10% at 60 hertz ± 3Hz.

3.5. Shall have a power supply that has a power factor of .90 or greater at full load.

3.6. Shall have a power supply that has total harmonic distortion of 20% or less at full load.

3.7. Shall have load regulation of ± 1% from no load to full load.

3.8. Shall have power supply output ripple of less than 10%.

3.9. Shall have an isolated power supply output.

3.10. Shall have a power supply that has thermal overload protection.

3.11. Shall have a power supply that is self-limited short circuit protected and over load protected.

3.12. Shall have a power supply that is fully incased and potted.

3.13. Shall have a power supply that is terminated with quick disconnect wire harnesses for easy maintenance. Wire nut termination is not acceptable.

3.14. Shall have a terminal block for terminating pole wiring to the Luminaire. The terminal block shall be a 3 station, tunnel lug terminal board that will accommodate #6 thru #18 AWG pole wire.

3.15. Shall have life rating on all electrical components of 70,000 hours or greater.

   3.15.1. All electrical components shall be L70 rated at 25 º C (77 º F).

3.16. Electrical components shall be protected per ANSI/IEEE standard C62.41, for Class C applications.

   3.16.1. The transient suppressor is not required to be RoHS compliant.
4. LED PERFORMANCE REQUIREMENTS:

4.1. Shall fully operate in a temperature range -40º C to 54.4º C (-40º F to 130º F).

4.2. Shall lose no more than a 15% optical intensity of initial delivered lumens due to thermal loading when operated at 25º C (77º F).

4.3. Shall deliver an average 70% of initial delivered lumens after 70,000 hours of operation.

4.4. Shall have a rated life of 70,000 hours when operated at 25 º C (77º F).

4.5. Shall have Luminaire efficacy of a minimum of 70 lumens/watt.

4.6. Shall meet the Chromaticity requirements as follows:

The standard color for the LED Luminaire shall be White. The colors shall conform to the following color regions based on the 1931 CIE chromaticity diagram.

**Nominal Correlated Color Temperature**

CCT = 4000K or 4500K

<table>
<thead>
<tr>
<th>Manufacturer-Rated Nominal CCT (K)</th>
<th>Allowable LM-79 Chromaticity Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Measured CCT (K)</td>
</tr>
<tr>
<td>4000</td>
<td>3710 to 4260</td>
</tr>
<tr>
<td>4500</td>
<td>4260 to 4746</td>
</tr>
</tbody>
</table>

Adapted from NEMA C78.377

**Color Rendering Index**

Shall have a minimum Color Rendering Index (CRI) of 60

4.7. Intensity and Chromaticity as stated above must be confirmed by an Independent test lab.
5. OPTICAL REQUIREMENTS:

5.1. Shall have a completely sealed optical system.

5.1.1. Shall have a (IEC) (IP) rating of 65 or greater

5.2. Shall have Cut-Off requirements as follows:

5.2.1. The luminaire shall not allow more than 10 percent of the rated lumens to project above 80 degrees from vertical.

5.2.2. The luminaire shall not allow more than 2.5 percent of the rated lumens to project above 90 degrees from vertical.

5.3. Shall have a light distribution pattern at the road surface that has an evenly dispersed appearance.

5.3.1. A 250 Watt HPS luminaire shall meet the required light levels at the following mounting and setback requirements when:

- It would be mounted at a height of 40 ft.
- It would be mounted on one side of the roadway.
- It would light 2 lanes that are each twelve feet wide.
- It would have a 23 foot set back from the right lane fog line (right edge of driving lane).
- It would be mounted on a davit extending 9 feet from the pole towards the roadway.
- It would be mounted on poles spaced at 250 feet.
- No light from luminaires placed on the opposite side of the roadway shall be included in any light level calculations.
- Using a 10 foot by 10 foot grid points of analysis for the entire area.

With the mounting requirements stated above the lighting unit shall provide light levels as follows:

5.3.1.1. Shall have average maintained illuminance in the range of 0.6 to 1.1 foot candles using a roadway classification of R2 & R3. These light levels must be documented using lighting support software utilizing a Light Loss Factor (LLF) = 0.70.

5.3.1.2. Shall have an average to minimum uniformity of 3.00:1 not to exceed 4.00:1

5.3.1.3. Shall have veiling luminance of ratio \( \frac{L_{\text{Vmax}}}{L_{\text{Vave}}} \) not to exceed 0.4:1

5.4. Shall provide independent test laboratories IES photometrics which verify light levels.

5.5. Product submittal shall be accompanied by IES TM-21 compliant test reports from a CALiPER qualified or NVLAP accredited testing laboratory for the specific model being submitted.
6. **LUMINAIRE PERFORMANCE:**

6.1. The vendor must submit TM-21 calculations based on LM-79 photometric test data for no less than three samples of the entire luminaire.

6.2. Duration of operation and interval between photometric tests shall conform to the TM-21 criteria for LED light sources. For example, testing solely at 0 and 6000 hours of operation would not be adequate for the purposes of extrapolation.

6.3. Between LM-79 tests, the luminaire test samples must be operated long-term in the appropriate application as defined by ANSI/UL 1598 (hardwired luminaires).

6.4. The test laboratory must hold NVLAP accreditation for the LM-79 test procedure or must be qualified, verified, and recognized through the U.S. Department of Energy (DOE)’s CALiPER program.


6.5. The extent of allowable extrapolation (either 5.5 or 6 times the test duration) depends on the total number of LED light sources (no less than 10 and preferably more than 19) installed in the luminaire samples, as per TM-21.

6.6. Values used for extrapolation shall be summarized per TM-21 Tables 1 and 2.

   6.6.1. Submitted values for lumen maintenance lifetime and the associated percentage lumen maintenance shall be “reported” rather than “projected” as defined by TM-21.

   6.6.2. Supporting diagrams are requested to facilitate interpretation by Owner.

7. **WARRANTY:**

7.1. The entire Luminaire assembly including material, workmanship, photometrics, labor, power supply and LED modules shall have a minimum of five (5) year warranty from the date of installation.

   7.1.1. If more than 5% of the individual LED’s fail within the warranty period the luminaire must be repaired and replaced.

   7.1.2. The department will remove the unit from the field and ship it to the manufacturer for repair or replacement.

7.2. Shall have a 5 year warranty on the paint finish.
8. **MINIMUM REQUIRED SUBMITTALS:**

8.1. Luminaire specification sheet.

8.2. LED driver specification sheet.

8.3. LM-79 Luminaire photometric report.

8.4. LM-80 Lumen maintenance report.

8.5. TM-21 calculations as defined in section 6.

8.6. Backlight, Uplight, Glare (BUG) rating of the luminaire.

8.7. Computer generated point by point photometric analysis.

8.8. Lighting facts label as defined by the DOE LED lighting facts program.

8.9. Written product warranty.

8.10. Independent test lab IES photometric reports.

   8.10.1. Including IES electronic file.

   8.10.2. Including intensity and chromaticity data.

8.11. Instructions for installation and maintenance.

9. **MN/DOT ACCEPTANCE TESTING:**

9.1. Luminaire will be reviewed against each item listed on this specification. If the fixture is not in compliance with each item on this specification it will not be placed on the Lighting Approved Products List (APL).

9.2. Shall be installed by MN/DOT on a 40 foot pole to verify light levels and light pattern.

9.3. The Minnesota Department of Transportation will verify light levels using the independent test laboratories photometrics.

9.4. The Minnesota Department of Transportation reserves the right to perform random sample testing on all shipments at its own expense. Random sample testing will be completed within 60 days, and as soon as possible, after delivery. Mn/DOT shall determine the sampling parameters to be used for the random testing. If the units tested fail random testing the units will be removed from the MN/DOT Approved Products list for Lighting.
9.5. Once the Luminaire has been placed on the MN/DOT APL for Lighting no substitution of materials will be allowed unless the manufacturer has received written permission in advance from MN/DOT allowing the substitution.

9.6. MN/DOT must be notified of any change to the catalog number. This notification must include the reason for the change in catalog number. Failure to meet this requirement may cause the luminaire to be eliminated from the MN/DOT Approved Products List (APL).