City of Flagstaff
Specifications for Light Emitting Diode (LED) Luminaires

All new street lighting fixtures shall comply with the LED Luminaire Requirements of this section and in the *City of Flagstaff Specifications for Light Emitting Diode (LED) Luminaires* which is posted to the City webpage at www.flagstaffaz.gov . The City Traffic Engineer will maintain the *City of Flagstaff Specifications for Light Emitting Diode (LED) Luminaires* along with a list of acceptable luminaires. Luminaires that are not on this list will require submittal of technical information for review and approval by the City Traffic Engineer. In some special cases higher output luminaires with corresponding mast arm and pole combinations may be desirable, these special cases will be reviewed by the City Traffic Engineer for approval.

1. General Requirements:
    a. Each luminaire shall meet all parameters of these specifications throughout the minimum operational life when operated at an average nighttime temperature of 70 degrees F.
    b. Streetlights shall be fully shielded in such a manner that light emitted by the fixture, either directly from the lamp or indirectly from the luminaire, is projected below a horizontal plane. External shield or reflectors to prevent up-light are not allowed.
    c. Luminaires 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 the Occupational Safety and Health Administration (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.
    d. Luminaires shall be listed and labeled by a NRTL as being in compliance with UL 1598 and suitable for use in wet locations.
    e. The light source and drivers shall be Restriction of Hazardous Substance (RoHS) compliant
    f. Luminaires shall have an International Electrotechnical Commission (IEC) 529 Ingress Protection (IP) rating of IP 66 or greater for optical assemblies of the luminaire.
    g. The mounting assembly shall permit any necessary adjustment to orient the luminaire with the roadway for proper light distribution
    h. Luminaire shall have a built-in leveling indicator inside the housing to allow for proper orientation.
    i. The individual LEDs shall be connected such that a catastrophic loss or failure of one LED will not result in the loss of the entire luminaire.
    j. Lumen maintenance at 50,000 hours and 40 degrees C based on TM-21 testing shall be 90% or greater.
    k. Driver and LED modules shall be replaceable as separate units and have plug connections.
    l. Luminaire shall be tested and capable of operating in ambient temperature of -25 degrees C to 50 degrees C.
    m. Luminaires shall support installation of a future Electronic Control Module (ECM) for dimming and luminaire performance monitoring.
    n. Luminaires shall have a label that states operating voltage and current range. The label must be clearly visible on the inside of the housing.
    o. A limited system warranty must be provided for the replacement or repair of the luminaire due to any electrical failure (including light source and or power supplies/drivers) for ten (10) years.
    p. The power supply shall be rated for a minimum life expectancy equal to or greater than the minimum operation life of the luminaire.
    q. Luminaires shall have a 7-pin locking ANSI C136.41 photocell receptacle
    r. The power supply shall have two (2) leads with standard 0-10V dimming control and be prewired to the 7-pin photocell receptacle.
    s. Each luminaire shall include a photocell.
    t. Photocells shall:
        i. Local and Minor Collectors:
            1. Have a 10 year warranty and a rated life of 20 years
            2. Operate at nominal 120-277V
            3. Have surge protection arrestor to protect the luminaires and photocell from in rush surges
            4. fail with the fixture on

ii. Arterial and Major Collectors:
    1. The photocell shall be capable of dimming the fixture to 80% lumen output upon installation
    2. Utilizing either a programmable or preprogrammed routine the photocell shall ramp up output by 3% each year to compensate for depreciation.
    3. Have a 10 year warranty and a rated life of 20 years
    4. Operate at nominal 120-277V
    5. Have surge protection arrestor to protect the luminaires and photocell from in rush surges
    6. Fail with the fixture on

u. Compatibility – the luminaire shall be operationally compatible with currently used ANSI 7 pin receptacles (ANSI C136.41-2013), lighting control systems and photoelectric controls.
v. RF Interference – the luminaires and associated on-board circuitry shall meet Class A emission limits referred in Federal Communication Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.

2. Electrical - Power Consumption
    a. Power consumption efficacy allowed for NBA LED luminaire shall not exceed one (1) watt for 45 lumens of emissions.
    b. Maximum drive current for NBA LED shall not exceed 550 mA.
    c. Power consumption efficacy allowed for PCA LED luminaire shall not exceed one (1) watt for 80 lumens of emissions.
    d. Maximum drive current for PCA LED shall not exceed 700 mA
3. Electrical – Operating Voltage
    a. The luminaire shall operate from a 60 HZ +/- 3 HZ AC power source. The fluctuations of line voltage shall have no visible effect on the luminous output.
    b. The operating voltage may range from 120 VAC to 277 VAC.
4. Electrical – Power Factor
    a. The luminaire shall have a power factor of 0.90 or greater.
5. Electrical – Total Harmonic Distortion
    a. THD (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent
6. Electrical – Surge Suppression
    a. The luminaire on-board circuitry shall include surge protection devices (SPD) to withstand high repetition noise transients as a result of utility line switching, nearby lightning strikes, and other interference.
    b. The SPD shall protect the luminaire from damage and failure for transient voltages and currents as defined in ANSI/IEEE C64.41.2 (Tables 1 and 4) for Location Category C-High.
    c. The SPD shall conform to UL 1449, or UL 1283, depending on the components used in the design.
    d. SPD performance shall be tested per the procedures in ANSI/IEEE C62.45 based on ANSI/IEEE C62.41.2 definitions for standard and optional waveforms for Location Category C-High.
    e. The SPD shall be capable of withstanding 10kV/5kA of transient line surge.
    f. Operational Performance – the LED circuitry shall prevent perceptible flicker to the unaided eye over the voltage range specified above.
    g. The SPD shall fail in such a way as the luminaire will no longer operate. The SPD shall be field serviceable.
7. Lumen Maintenance
    a. Per Table 13-12-003-01 – Lumen Output shall be defined as initial fixture output for fixtures installed on Local and Minor Collector roadways. For fixtures installed on Major Arterial, Minor Arterial and Major Collector roadways a 20% fixture total depreciation shall be assumed for calculating initial required lumen output.
8. Photometric Requirements
    a. The direct Narrow Band Amber LED (NBA LED) luminaire does not have a CCT requirement.
    b. Narrow Band Amber luminaires do not have a Color Rendering Index (CRI) requirement.

c. Phosphor Converted Amber (PCA) LEDs shall have an S/P (Scotopic / Photopic) ratio of 0.50 or less.
d. Direct Narrow Band Amber (NBA) LEDs shall have a peak wavelength between 589 and 595 nm with no more than a 20nm width at 50% of peak output.

9. Thermal Management
   a. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the designed operational life.
   b. The drive current shall not exceed 550mA for NBA LEDs, 700 mA PCA.
   c. The LED manufacturer's maximum junction temperature for the minimum operational life shall not be exceeded.
   d. The designed maximum junction temperature shall not exceed 221 F.
   e. The junction to ambient thermal resistance shall be 58 F / Watt or less
   f. Thermal management shall be passive by design – the use of fans or other similar devices shall not be allowed.
   g. The heat sink material shall be aluminum or other material of equal or lower thermal resistance.
   h. The luminaire may contain circuitry that will automatically reduce the power to the LEDs to a level that will ensure that the maximum junction temperature is not exceeded.
10. Physical and Mechanical Requirements
   a. The luminaire shall be a single, self-contained device, not requiring on-site assembly for installation. The power supply for the luminaire shall be integral to the unit.
   b. The maximum weight and effective projected area are listed in Table 13-12-005-01 of the Engineering Standards
   c. The housing shall be constructed of aluminum and finished in a light to medium grey color.
   d. Each housing shall be provided with a slip-fitter capable of mounting on a two (2) inch pipe tenon.
   e. The slip-fitter shall fit on mast arms from 1-5/8 to 2-3/8 inch (O.D.)
   f. The slip-fitter shall be an integral part of the luminaire housing.
   g. The slip-fitter shall be capable of being adjusted a minimum of +/- 10 degrees from the axis of the tenon.
   h. The clamping brackets of the slip-fitter shall not bottom out on the housing bosses when adjusted within the designed angular range.
   i. No part of the slip-fitter mounting brackets on the luminaires shall develop a permanent set in excess of 1/32 inch when the two or four 3/8-inch diameter cap screws used for mounting are tightened to 10ft-lbs.
   j. Two (2) sets of cap screws may be supplied to allow for the slip-fitter to be mounted on any pipe tenon in the acceptable range without the cap screws bottoming out in the threaded holes.
   k. The cap screws and the clamping bracket(s) shall be made of corrosion resistant materials and be compatible with the luminaire housing and mast arm or treated to prevent galvanic reactions.
   l. The assembly and manufacturing process for the LED luminaire shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration from high winds and other sources.
   m. The housing shall be designed to allow water, snow and ice shedding.
   n. Exposed heat sink fins shall be oriented so that water can freely run off the luminaire and carry dust and other accumulated debris away from the unit.
   o. The optical assembly of the luminaire shall be protected against dust and moisture intrusion per IP66.
   p. When the components are mounted on a down opening door, the door shall be hinged and secured to the luminaire housing separately from the refractor or lens frame. The door shall be secured to the housing with captive hardware to prevent accidental opening. A safety cable shall mechanically connect the door to the housing.
   q. Field wires connected to the luminaire shall terminate on a barrier type terminal block secured to the housing. The terminal screws shall be captive and equipped with wire grips for conductors up to No.8. Each terminal position shall be clearly identified.
   r. The power supply shall be contained inside the luminaire.

s. The power supply shall be rated for outdoor operation.
t. Housing shall be fabricated from materials that are designed to withstand a 3000 hour salt spray test as specified in ASTM designation: B117.
u. Each refractor or lens shall be made from UV inhibited high impact plastic (such as acrylic or polycarbonate) or heat and impact resistant glass and be resistant to scratching.
v. All aluminum used in housings and brackets shall be a marine grade alloy with less than 0.2% copper. All exposed aluminum shall be anodized.
w. Polymeric materials of enclosures containing either the power supply or electronic components of the luminaire shall be made of UL94VO flame retardant materials. The lenses of the luminaire are excluded from this requirement.
x. Paint or powder coating of the housing shall conform to the requirements typical to the Arizona Department of Transportation.

11. Luminaire Identification
    a. Each luminaire shall have the manufacturer's name, trademark, model number, serial number, date of manufacture (month-year), and lot number as identification permanently marked inside each unit and the outside of each packaging box.
    b. The following operating characteristics shall be permanently marked inside each unit: rated voltage and rated power in Watts and Volt-Ampere.
    c. Each luminaire shall have a manufacturer affixed label identifying the input wattage. Label shall be one-inch retroreflective numbers visible from the ground.