EXHIBIT B

City of Portland Bureau of Transportation
Specification for LED Roadway Acorn Luminaire Kits
March 25, 2015

1.0 NORMATIVE REFERENCES

The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by their basic designation only. Versions listed shall be superseded by updated versions as they become available.

American National Standards Institute (ANSI)

- C78.377-2011 (or latest), American National Standard for the Chromaticity of Solid State Lighting Products
- C82.77-2002 (or latest), American National Standard for Harmonic Emission Limits - Related Power Quality Requirements for Lighting Equipment
- C62.41.2-2002 (or latest), IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits
- C62.45-2002 (or latest), ANSI/IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
- C136.22-2004 R2009 (or latest), American National Standard for Roadway and Area Lighting Equipment – Internal Labeling of Luminaires
- C136.31-2010 (or latest), American National Standard for Roadway Lighting Equipment – Luminaire Vibration
- C136.37-2011 (or latest), American National Standard for Roadway and Area Lighting Equipment - Solid State Light Sources Used in Roadway and Area Lighting

American Society for Testing and Materials International (ASTM)

- B117-11 (or latest), Standard Practice for Operating Salt Spray (Fog) Apparatus
- D523-08 (or latest), Standard Test Method for Specular Gloss
- D1654-08 (or latest), Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
- G154-06 (or latest), Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

DesignLights Consortium® (DLC)

- Qualified Products List (www.designlights.org)

ENERGY STAR®

- ENERGY STAR TM-21 Calculator, rev. 08.28.14 (or latest, www.energystar.gov/TM-21Calculator)

Energy Trust of Oregon (ETO)

- Information Sheet 190L (or latest, http://energytrust.org), Incentives for Energy Efficient Lighting

Federal Communications Commission (FCC)

- 47 CFR Part 15, Telecommunication – Radio Frequency Devices

Federal Trade Commission (FTC)

- Complying with the Made in USA Standard, December 1998 (http://business.ftc.gov/advertising-and-marketing/made-usa)

- Green Guides, 16 CFR Part 260, Guides for the Use of Environmental Marketing Claims

Illuminating Engineering Society of North America (IESNA or IES)

- LM-50-13 (or latest), IES Approved Method for Photometric Measurement of Roadway and Street Lighting Installations

- LM-61-06 (or latest), IESNA Approved Guide for Identifying Operating Factors Influencing Measured Vs. Predicted Performance for Installed Outdoor High Intensity Discharge (HID) Luminaires

- LM-63-02 (R2008 or latest), ANSI/IESNA Standard File Format for the Electronic Transfer of Photometric Data and Related Information

- LM-79-08 (or latest), IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products

- LM-80-08 (or latest), IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources

- RP-8-14 (or latest), ANSI / IESNA American National Standard Practice for Roadway Lighting

- RP-16-10 (or latest), ANSI/IES Nomenclature and Definitions for Illuminating Engineering

- TM-15-11 (or latest), Luminaire Classification System for Outdoor Luminaires

- TM-21-11 (or latest), Projecting Long Term Lumen Maintenance of LED Light Sources

LED Lighting Facts

- Submission Requirements (www.lightingfacts.com/About/Content/Manufacturers/SubmissionRequirements)

Lighting Design Lab

- LED Qualified Products List (www.lightingdesignlab.com)

National Electrical Manufacturers Association (NEMA)

- LSD 63-2012, Measurement Methods and Performance Variation for Verification Testing of General Purpose Lamps and Systems

Underwriters Laboratories (UL)

- 1598 Third Edition (or latest), Luminaires

2.0 RELATED DOCUMENTS

2.1 Contract Drawings and conditions of Contract (including General Conditions, Addendum to the General Conditions, Special Conditions, Division 01 Specifications Sections and all other Contract Documents) apply to the work of this section.

3.0 DEFINITIONS

3.1 Lighting terminology used herein is defined in IES RP-16. See referenced documents for additional definitions.

3.1.1 Exception: The term "driver" is used herein to broadly cover both drivers and power supplies, where applicable.

3.1.2 Clarification: The term "LED light source(s)" is used herein per IES LM-80 and TM-21 to broadly cover LED package(s), module(s), and array(s).

3.1.3 Additions:

- The term "kit" or "luminaire kit" used herein includes the LED tower assembly, globe assembly, and all other materials required to complete a single luminaire.
- The 'light fitter casting' (to which the kit adapts) is part of the standard pole assembly, and provided by the pole manufacturer.
- The 'metal support ring' used herein references a thin split aluminum band that is required at the base of acrylic globes to protect from damage caused by overtightening of the set screws.
- The term 'luminaire' used herein references the kit fully assembled on the light fitter.
- The term 'globe assembly' is used herein to reference the acrylic globe, metal support ring, finial, band, and rosettes.

- The term 'LED tower assembly' is used herein to reference the LED tower, driver assemblies, surge protection, and adapter rings / mounting hardware as required.

3.2 Tabulated summary of key parameters and product criteria.

Luminaire Kit Designation: "Single Ornamental"

Case 1a: Single Ornamental - staggered					
SITE PARAMETERS (*See drawings in Appendix A*)					
ROADWAY DATA	Road Width (Curb to Curb)				36 ft
	Median width (including curbs, gutters, and shoulders)				N/A
	Number of vehicular lanes				2
	IES pavement class.	☐ R1	☐ R2	☑ R3 ☐ R4	
SIDEWALK DATA	Sidewalk width				8 ft
	Furnishing Zone (edge of sidewalk to edge of roadway)				4 ft
	Sidewalk on	☑ Both sides of street	☐ Pole side	☐ Other side	
LIGHT POLE DATA	Luminaire kit mounting height				15 ft
	Arm length (horizontal)				0 ft
	Luminaire kits per pole				1
	Pole set-back from curb				2.5 ft
	Pole spacing (one pole cycle, parallel to path of travel)				140 ft
	Pole layout	☐ One side	☐ Opposite	☑ Staggered ☐ Median	
PERFORMANCE CRITERIA					
MAINTAINED ROADWAY ILLUMINATION					
PHOTOPIC ILLUMINANCE	Average horizontal at pavement				0.5
	Avg:min uniformity ratio				N/A
	Max:min uniformity ratio				N/A
MAINTAINED SIDEWALK ILLUMINATION					
PHOTOPIC ILLUMINANCE	Average horizontal at pavement				0.2 fc
	Avg:min uniformity ratio (horizontal)				4.0
LED LUMINAIRE KIT					
INPUT POWER	Max. nominal luminaire kit input power				50 W
VOLTAGE	Nominal luminaire kit input voltage				120-277V
LUMEN MAINT.	Min. % of initial output at 36,000 hours operation				90%
WARRANTY	Min. luminaire kit warranty				10 years
NOMINAL CCT	Rated correlated color temperature				3000 ± 100 K
BUG RATINGS	Max. nominal backlight-uplight-glare ratings				B1-U4-G3
FINISH	Luminaire kit housing finish color				see Appendix B
WEIGHT	Luminaire kit weight (max)				10 lb
EPA	Max. effective projected area				N/A
MOUNTING	Method	☑ Post-top	☐ Side-arm	☐ Trun./yoke ☐ Swivel-tenon	
	Tenon nominal pipe size (NPS)				N/A
VIBRATION	ANSI C136.31	☑ Level 1 (normal)	☐ Level 2 (bridge/overpass)		
THERMAL ENVIRONMENT	Typical min. ambient temperature during operation				-10 °C
	Typical max. ambient temperature during operation				35 °C
ELECTRICAL IMMUNITY	Appendix D	☑ Basic (6kV / 3kA)		☐ Elevated (20kV / 10kA)	
CONTROL INTERFACE	☑ None	☐ ANSI C136.10 (3-pin)	☐ ANSI C136.41, 5-pin	☐ ANSI C136.41, 7-pin	
LED DRIVER	Rated Life / Average expected life (minimum)			50,000 hrs	
	☑ Not dimmable	☐Dimmable, 0-10V (IEC 60929)		☐ Dimmable, DALI (IEC 62386)	

Luminaire Kit Designation: "Single Ornamental"

Case 1b: Single Ornamental – opposed					
SITE PARAMETERS (*See drawings in Appendix A*)					
ROADWAY DATA	Road Width (Curb to Curb)				36 ft
	Median width (including curbs, gutters, and shoulders)				N/A
	Number of vehicular lanes				2
	IES pavement class.	☐ R1	☐ R2	☑ R3 ☐ R4	
SIDEWALK DATA	Sidewalk width				8 ft
	Furnishing Zone (edge of sidewalk to edge of roadway)				4 ft
	Sidewalk on	☑ Both sides of street	☐ Pole side	☐ Other side	
LIGHT POLE DATA	Luminaire kit mounting height				15 ft
	Arm length (horizontal)				0 ft
	Luminaire kits per pole				1
	Pole set-back from curb				2.5 ft
	Pole spacing (one pole cycle, parallel to path of travel)				100 ft
	Pole layout	☐ One side	☑ Opposite	☐ Staggered ☐ Median	
PERFORMANCE CRITERIA					
MAINTAINED ROADWAY ILLUMINATION					
PHOTOPIC ILLUMINANCE	Average horizontal at pavement				0.7
	Avg:min uniformity ratio				3.0
	Max:min uniformity ratio				9.0
MAINTAINED SIDEWALK ILLUMINATION					
PHOTOPIC ILLUMINANCE	Average horizontal at pavement				0.2 fc
	Avg:min uniformity ratio (horizontal)				4.0
LED LUMINAIRE KIT					
INPUT POWER	Max. nominal luminaire kit input power				50 W
VOLTAGE	Nominal luminaire kit input voltage				120-277V
LUMEN MAINT.	Min. % of initial output at 36,000 hours operation				90%
WARRANTY	Min. luminaire kit warranty				10 years
NOMINAL CCT	Rated correlated color temperature				3000 ± 100 K
BUG RATINGS	Max. nominal backlight-uplight-glare ratings				B1-U4-G3
FINISH	Luminaire kit housing finish color				see Appendix B
WEIGHT	Luminaire kit weight (max)				10 lb
EPA	Max. effective projected area				N/A
MOUNTING	Method	☑ Post-top	☐ Side-arm	☐ Trun./yoke ☐ Swivel-tenon	
	Tenon nominal pipe size (NPS)				N/A
VIBRATION	ANSI C136.31	☑ Level 1 (normal)	☐ Level 2 (bridge/overpass)		
THERMAL ENVIRONMENT	Typical min. ambient temperature during operation				-10 °C
	Typical max. ambient temperature during operation				35 °C
ELECTRICAL IMMUNITY	Appendix D	☑ Basic (6kV / 3kA)		☐ Elevated (20kV / 10kA)	
CONTROL INTERFACE	☑ None	☐ ANSI C136.10 (3-pin)	☐ ANSI C136.41, 5-pin	☐ ANSI C136.41, 7-pin	
LED DRIVER	Rated Life / Average expected life (minimum)			50,000 hrs	
	☑ Not dimmable	☐Dimmable, 0-10V (IEC 60929)		☐ Dimmable, DALI (IEC 62386)	

Luminaire Kit Designation: "Twin Ornamental"

Case 2a: Twin Ornamental – 36' staggered				
SITE PARAMETERS (*See drawings in Appendix A*)				
ROADWAY DATA	Road Width (Curb to Curb)			36 ft
	Median width (including curbs, gutters, and shoulders)			N/A
	Number of vehicular lanes			2
	IES pavement class.	☐ R1 ☐ R2 ☑ R3 ☐ R4		
SIDEWALK DATA	Sidewalk width			8 ft
	Furnishing Zone (edge of sidewalk to edge of roadway)			4 ft
	Sidewalk on	☑ Both sides of street ☐ Pole side ☐ Other side		
LIGHT POLE DATA	Luminaire kit mounting height			18.7 ft
	Arm length (horizontal)			+/-17 in
	Luminaire kits per pole			2
	Pole set-back from curb			2.5 ft
	Pole spacing (one pole cycle, parallel to path of travel)			200 ft
	Pole layout	☐ One side ☐ Opposite ☑ Staggered ☐ Median		
PERFORMANCE CRITERIA				
MAINTAINED ROADWAY ILLUMINATION				
PHOTOPIC ILLUMINANCE	Average horizontal at pavement			0.5
	Avg:min uniformity ratio			N/A
	Max:min uniformity ratio			N/A
MAINTAINED SIDEWALK ILLUMINATION				
PHOTOPIC ILLUMINANCE	Average horizontal at pavement			0.2 fc
	Avg:min uniformity ratio (horizontal)			4.0
LED LUMINAIRE KIT				
INPUT POWER	Max. nominal luminaire kit input power			50 W
VOLTAGE	Nominal luminaire kit input voltage			120-277V
LUMEN MAINT.	Min. % of initial output at 36,000 hours operation			90%
WARRANTY	Min. luminaire kit warranty			10 years
NOMINAL CCT	Rated correlated color temperature			3000 ± 100 K
BUG RATINGS	Max. nominal backlight-uplight-glare ratings			B1-U4-G3
FINISH	Luminaire kit housing finish color			see Appendix B
WEIGHT	Luminaire kit weight (max)			10 lb
EPA	Max. effective projected area			N/A
MOUNTING	Method	☐Post-top ☑ Side-arm ☐ Trun./yoke ☐ Swivel-tenon		
	Tenon nominal pipe size (NPS)			N/A
VIBRATION	ANSI C136.31	☑ Level 1 (normal) ☐ Level 2 (bridge/overpass)		
THERMAL ENVIRONMENT	Typical min. ambient temperature during operation			-10 °C
	Typical max. ambient temperature during operation			35 °C
ELECTRICAL IMMUNITY	Appendix D	☑ Basic (6kV / 3kA)		☐ Elevated (20kV / 10kA)
CONTROL INTERFACE	☑ None	☐ ANSI C136.10 (3-pin)	☐ ANSI C136.41, 5-pin	☐ ANSI C136.41, 7-pin
LED DRIVER	Rated Life / Average expected life (minimum)			50,000 hrs
	☑ Not dimmable	☐Dimmable, 0-10V (IEC 60929)	☐ Dimmable, DALI (IEC 62386)	

Luminaire Kit Designation: "Twin Ornamental"

Case 2b: Twin Ornamental – 40' opposed					
SITE PARAMETERS (*See drawings in Appendix A*)					
ROADWAY DATA	Road Width (Curb to Curb)				40 ft
	Median width (including curbs, gutters, and shoulders)				N/A
	Number of vehicular lanes				3
	IES pavement class.	☐ R1	☐ R2	☑ R3 ☐ R4	
SIDEWALK DATA	Sidewalk width				8 ft
	Furnishing Zone (edge of sidewalk to edge of roadway)				4 ft
	Sidewalk on	☑ Both sides of street	☐ Pole side	☐ Other side	
LIGHT POLE DATA	Luminaire kit mounting height				18.7 ft
	Arm length (horizontal)				+/-17 in
	Luminaire kits per pole				2
	Pole set-back from curb				2.5 ft
	Pole spacing (one pole cycle, parallel to path of travel)				100 ft
	Pole layout	☐ One side	☑ Opposite	☐ Staggered ☐ Median	
PERFORMANCE CRITERIA					
MAINTAINED ROADWAY ILLUMINATION					
PHOTOPIC ILLUMINANCE	Average horizontal at pavement				0.7
	Avg:min uniformity ratio				3.0
	Max:min uniformity ratio				9.0
MAINTAINED SIDEWALK ILLUMINATION					
PHOTOPIC ILLUMINANCE	Average horizontal at pavement				0.2 fc
	Avg:min uniformity ratio (horizontal)				4.0
LED LUMINAIRE KIT					
INPUT POWER	Max. nominal luminaire kit input power				50 W
VOLTAGE	Nominal luminaire kit input voltage				120-277V
LUMEN MAINT.	Min. % of initial output at 36,000 hours operation				90%
WARRANTY	Min. luminaire kit warranty				10 years
NOMINAL CCT	Rated correlated color temperature				3000 ± 100 K
BUG RATINGS	Max. nominal backlight-uplight-glare ratings				B1-U4-G3
FINISH	Luminaire kit housing finish color				see Appendix B
WEIGHT	Luminaire kit weight (max)				10 lb
EPA	Max. effective projected area				N/A
MOUNTING	Method	☐ Post-top	☑ Side-arm	☐ Trun./yoke ☐ Swivel-tenon	
	Tenon nominal pipe size (NPS)				N/A
VIBRATION	ANSI C136.31	☑ Level 1 (normal)	☐ Level 2 (bridge/overpass)		
THERMAL ENVIRONMENT	Typical min. ambient temperature during operation				-10 °C
	Typical max. ambient temperature during operation				35 °C
ELECTRICAL IMMUNITY	Appendix D	☑ Basic (6kV / 3kA)		☐ Elevated (20kV / 10kA)	
CONTROL INTERFACE	☑ None	☐ ANSI C136.10 (3-pin)	☐ ANSI C136.41, 5-pin	☐ ANSI C136.41, 7-pin	
LED DRIVER	Rated Life / Average expected life (minimum)			50,000 hrs	
	☑ Not dimmable	☐Dimmable, 0-10V (IEC 60929)		☐ Dimmable, DALI (IEC 62386)	

Luminaire Kit Designation: "Twin Ornamental"

Case 2c: Twin Ornamental – 60' opposed					
SITE PARAMETERS (*See drawings in Appendix A*)					
ROADWAY DATA	Road Width (Curb to Curb)				60 ft
	Median width (including curbs, gutters, and shoulders)				N/A
	Number of vehicular lanes				5
	IES pavement class.	☐ R1	☐ R2	☑ R3 ☐ R4	
SIDEWALK DATA	Sidewalk width				8 ft
	Furnishing Zone (edge of sidewalk to edge of roadway)				4 ft
	Sidewalk on	☑ Both sides of street	☐ Pole side	☐ Other side	
LIGHT POLE DATA	Luminaire kit mounting height				18.7 ft
	Arm length (horizontal)				+/-17 in
	Luminaire kits per pole				2
	Pole set-back from curb				2.5 ft
	Pole spacing (one pole cycle, parallel to path of travel)				100 ft
	Pole layout	☐ One side	☑ Opposite	☐Staggered ☐ Median	
PERFORMANCE CRITERIA					
MAINTAINED ROADWAY ILLUMINATION					
PHOTOPIC ILLUMINANCE	Average horizontal at pavement				0.7
	Avg:min uniformity ratio				3.0
	Max:min uniformity ratio				9.0
MAINTAINED SIDEWALK ILLUMINATION					
PHOTOPIC ILLUMINANCE	Average horizontal at pavement				0.2 fc
	Avg:min uniformity ratio (horizontal)				4.0
LED LUMINAIRE KIT					
INPUT POWER	Max. nominal luminaire kit input power				50 W
VOLTAGE	Nominal luminaire kit input voltage				120-277V
LUMEN MAINT.	Min. % of initial output at 36,000 hours operation				90%
WARRANTY	Min. luminaire kit warranty				10 years
NOMINAL CCT	Rated correlated color temperature				3000 ± 100 K
BUG RATINGS	Max. nominal backlight-uplight-glare ratings				B1-U4-G3
FINISH	Luminaire kit housing finish color				see Appendix B
WEIGHT	Luminaire kit weight (max)				10 lb
EPA	Max. effective projected area				N/A
MOUNTING	Method	☐ Post-top	☑Side-arm	☐ Trun./yoke ☐ Swivel-tenon	
	Tenon nominal pipe size (NPS)				N/A
VIBRATION	ANSI C136.31	☑ Level 1 (normal)	☐ Level 2 (bridge/overpass)		
THERMAL ENVIRONMENT	Typical min. ambient temperature during operation				-10 °C
	Typical max. ambient temperature during operation				35 °C
ELECTRICAL IMMUNITY	Appendix D	☑ Basic (6kV / 3kA)		☐ Elevated (20kV / 10kA)	
CONTROL INTERFACE	☑ None	☐ ANSI C136.10 (3-pin)	☐ ANSI C136.41, 5-pin	☐ ANSI C136.41, 7-pin	
LED DRIVER	Rated Life / Average expected life (minimum)			50,000 hrs	
	☑ Not dimmable	☐Dimmable, 0-10V (IEC 60929)		☐ Dimmable, DALI (IEC 62386)	

3.3 General requirements

3.3.1 Luminaire kits should satisfy the performance criteria summarized in section 3.2 for all cases; failure to conform to the criteria in one or more cases may be basis for rejection.

3.3.2 Twin Ornamental luminaire kits shall utilize Crown Plastics textured acrylic globe model 88269-CL-8F, or approved equal. Reference drawing 'Acorn Kit – Twin Ornamental' in Appendix B.

3.3.3 Single Ornamental luminaire kits shall utilize Crown Plastics textured acrylic globe model 88264-05-8F, or approved equal. Reference drawing 'Acorn Kit – Single Ornamental' in Appendix B.

3.3.4 Luminaire kit shall include all components to complete a luminaire, including (but not limited to):

- Globe assembly (including metal support ring to slip between outside of globe and cast fitter.
- LED tower assembly (including adapter rings if required)

3.3.5 Luminaire kit shall adapt to the standard light fitter casting (provided by the pole manufacturer) directly or via standard adapter rings. The kit shall be tested assembled on an actual light fitter and support, which installs on a 4" diameter riser. Sample castings are available upon request.

3.3.6 Transmissive optical components shall be applied in accordance with OEM design guidelines to ensure suitability for the environment (e.g., electromagnetic, thermal, mechanical, chemical).

3.3.7 Luminaire kit shall be designed for ease of component replacement and end-of-life disassembly.

3.3.8 Nominal luminaire kit input wattage shall account for nominal applied voltage and any reduction in driver efficiency due to sub-optimal driver loading.

3.3.9 Luminaire kit shall accept the voltage or voltage range specified at 50/60 Hz, and shall operate normally for input voltage fluctuations of plus or minus 10 percent.

3.3.10 All internal components shall be assembled and pre-wired using modular electrical connections.

3.3.11 The following shall be in accordance with corresponding sections of ANSI C136.37.

3.3.11.1 Wiring and grounding

3.3.11.2 Terminal blocks for incoming AC lines (electrical mains wires)

3.3.11.3 Latching and hinging

3.3.11.4 Mounting provisions

3.3.11.5 Ingress protection

3.3.12 Luminaire shall meet the "Basic" requirements in Appendix D. Manufacturer shall indicate on submittal form (Appendix C) whether failure of the electrical immunity system can possibly result in disconnect of power to luminaire.

3.3.13 Energy Trust of Oregon Eligibility Requirement - Products submitted must be eligible for Energy Trust of Oregon LED lighting incentives. Presently, Energy Trust utilizes preapproved product lists by three organizations: (a) Lighting Design Laboratory, (b) Design Lights Consortium, or c) ENERGY STAR. Only model numbers exactly matching the products on these lists will be accepted.

3.4 Painted or finished luminaire kit surfaces exposed to the environment

3.4.1 Shall exceed a rating of six per ASTM D1654 after 1000 hours of testing per ASTM B117.

3.4.2 The coating shall exhibit no greater than 30% reduction of gloss per ASTM D523, after 500 hours of QUV testing at ASTM G154 Cycle 6.

3.5 Thermal management

3.5.1 Luminaire kit shall start and operate in ambient temperature range specified.

3.5.2 Maximum rated case temperature of driver and other internal components shall not be exceeded when luminaire kit is operated in ambient temperature range specified.

3.5.3 Liquids or other moving parts shall be clearly indicated in submittals, shall be consistent with product testing, and shall be subject to review by Owner.

3.6 LED driver, photocontrol receptacle, and control interface

3.6.1 Luminaire kit designation(s) indicated "None" in section 3.2 need not accept a control signal, and do not require a dimmable driver.

3.6.2 Luminaire kits shall not include a photocell receptacle or other control interface.

3.7 Electrical safety testing

3.7.1 Luminaire kit shall be listed for wet locations by a U.S. Occupational Safety Health Administration (OSHA) Nationally Recognized Testing Laboratory (NRTL).

3.7.2 Luminaire kit shall have locality-appropriate governing mark and certification.

3.8 Electrical immunity

3.8.1 Manufacturer shall indicate on submittal form in Appendix C whether failure of the electrical immunity system can possibly result in disconnect of power to luminaire kit.

3.9 Interference and power quality

3.9.1 Luminaire kit shall comply with FCC 47 CFR part 15 interference criteria for Class A (non-residential) digital devices.

3.9.2 Luminaire kit shall comply with section 5.2.5 (luminaires rated for outdoor use) of ANSI C82.77 at full input power and across specified voltage range.

3.10 Color attributes

3.10.1 Color Rendering Index (CRI) shall be no less than 60.

3.10.2 Nominal Correlated Color Temperature (CCT) shall be as specified in section 3.2.

3.10.2.1 If submitted nominal CCT is listed in Table 4.1 below, measured CCT and Duv shall be as listed in Table 4.1.

Table 3.1. Allowable CCT and Duv (adapted from ANSI C78.377)

Manufacturer-Rated Nominal CCT (K)	Allowable IES LM-79 Chromaticity Values	
	Measured CCT (K)	Measured Duv
2700	2580 to 2870	-0.006 to 0.006
3000	2870 to 3220	-0.006 to 0.006
3500	3220 to 3710	-0.005 to 0.007
4000	3710 to 4260	-0.005 to 0.007
4500	4260 to 4746	-0.004 to 0.008
5000	4746 to 5311	-0.004 to 0.008
5700	5312 to 6020	-0.003 to 0.009
6500	6022 to 7040	-0.003 to 0.009

3.10.2.2 If submitted nominal CCT is not listed in Table 4.1, measured CCT and Duv shall be as per the criteria for Flexible CCT defined in ANSI C78.377.

3.11 Identification

3.11.1 Luminaire kit shall have an internal label per ANSI C136.22.

4.0 REQUIRED SUBMITTALS

4.1 Completed Appendix C submittal form

4.1.1 Family grouping in accordance with LED Lighting Facts is not permitted.

4.2 Product cutsheets

4.2.1 Cutsheets for luminaire kit, including adapter rings (if required)

4.2.2 Cutsheets for LED light source(s)

4.2.3 Cutsheets for LED driver(s), dimming curve, and reliability data.

4.2.4 Cutsheets for surge protection device, if applicable

4.3 Instructions for installation and maintenance

4.4 IES LM-79 luminaire photometric report(s)

4.4.1 Shall be produced by the test laboratory

4.4.1.1 The test laboratory shall satisfy LED Lighting Facts accreditation requirements.

4.4.2 Shall include the following information

4.4.2.1 Name of test laboratory

4.4.2.2 Report number

4.4.2.3 Date

4.4.2.4 Complete luminaire kit catalog number

4.4.2.5 Description of luminaire kit, LED light source(s), and LED driver(s)

4.4.2.6 A photo of the tested configuration

4.4.2.7 Goniophotometry

a. IES TM-15 Backlight-Uplight-Glare (BUG) ratings shall be for initial (worst-case) values, i.e., Light Loss Factor (LLF) = 1.0.

4.5 Lumen maintenance calculations and supporting test data

4.5.1 Shall be in accordance with LED Lighting Facts guidance.

4.5.1.1 Exception: calculations shall be based on the cumulative hours of operation specified in section 3.2.

4.5.2 Submit completed ENERGY STAR TM-21 Calculator as an electronic Excel file.

4.6 Computer-generated point-by-point photometric analysis of maintained light levels

4.6.1 Calculation/measurement points shall be per IES RP-8. Separated vehicular lanes, bikeways, and walkways shall be evaluated separately.

4.6.2 Calculations shall be for maintained values, i.e. Light Loss Factor (LLF) < 1.0, where LLF = LLD x LDD x LATF, and

4.6.2.1 Lamp Lumen Depreciation (LLD) shall be 0.90 or the value calculated in section 4.5, whichever is lower.

4.6.2.2 Luminaire Dirt Depreciation (LDD) = 0.85

4.6.2.3 Luminaire Ambient Temperature Factor (LATF) = 0.98

4.6.3 Mesopic multipliers (i.e., effective luminance factors) shall not be used. All values shall assume photopic visual adaptation.

4.6.4 Submit IES LM-63 format electronic file containing luminous intensity data associated with submitted LM-79 report(s) and used for point-by-point calculations.

4.7 Documentation required for Energy Trust of Oregon incentive application.

4.8 Summary of Joint Electron Devices Engineering Council (JEDEC) or Japan Electronics and Information Technology Industries (JEITA) reliability testing performed for LED packages

4.9 Summary of reliability testing performed for LED driver(s)

4.10 Written product warranty as per section 6.0 below

4.11 Safety certification and file number indicating compliance with UL 1598

4.11.1 Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratory).

4.12 Documentation supporting any U.S. origin claims for the product, in accordance with FTC guidance.

5.0 QUALITY ASSURANCE

5.1 Before approval, Owner will request luminaire kit sample(s) identical to product configuration(s) submitted for inspection and IES LM-79 testing of luminaire sample(s) to verify the proposed kit (including light source) is a reasonable match to existing inventories, and performance is within manufacturer-reported tolerances.

5.2 Electrically test luminaire kits before shipment from factory.

6.0 WARRANTY

6.1 Warranty shall be of the minimum duration specified in section 3.2, and shall cover maintained integrity and functionality of the following

6.1.1 Luminaire kit wiring and connections

6.1.2 LED light source(s)

6.1.2.1 Negligible light output from more than 10 percent of the LED packages constitutes luminaire kit failure.

6.1.3 LED driver(s)

6.2 Warranty period shall begin 90 days after date of invoice, or as negotiated by owner such as in the case of an auditable asset management system.

7.0 MANUFACTURER SERVICES

7.1 Manufacturer or local sales representative shall provide installation and troubleshooting support via telephone and/or email.

8.0 ELIGIBLE MANUFACTURERS

8.1 Any manufacturer offering products that comply with the required product performance and operation criteria may be considered.

9.0 MEASUREMENT

9.1 The quantities of luminaires will be measured on the unit basis for each type of luminaire.

10.0 PAYMENT

11.1 The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items (as defined in Section 3):

Pay Item	**Unit of Measurement**
(1) LED Roadway Luminaire Kit: Single Ornamental	Each
(2) LED Roadway Luminaire Kit: Twin Ornamental	Each
(3) Globe Assembly: Single Ornamental	Each
(4) Globe Assembly: Twin Ornamental	Each
(5) LED Tower Assembly: Single Ornamental	Each
(6) LED Tower Assembly: Twin Ornamental	Each

Unit Price is per item delivered, including shipping and handling.
Payment terms are net 30 days.

11.0 DELIVERY INSTRUCTIONS

11.1 Delivery of materials will be on standard pallets and will need to be coordinated weekly.

11.2 Non-recyclable materials will not be allowed in packaging of luminaires.

11.3 Luminaires will be delivered FOB to the following address:

Mr. Robert Toner
City of Portland
Albina Yard Stores
3150 N Mississippi Avenue
Portland, OR 97227
(503) 823-4061 Tel / (503) 823-2260 FAX / (503) 823-5984 CELL

13.0 ENERGY TRUST OF OREGON ELIGIBLITY REQUIREMENT

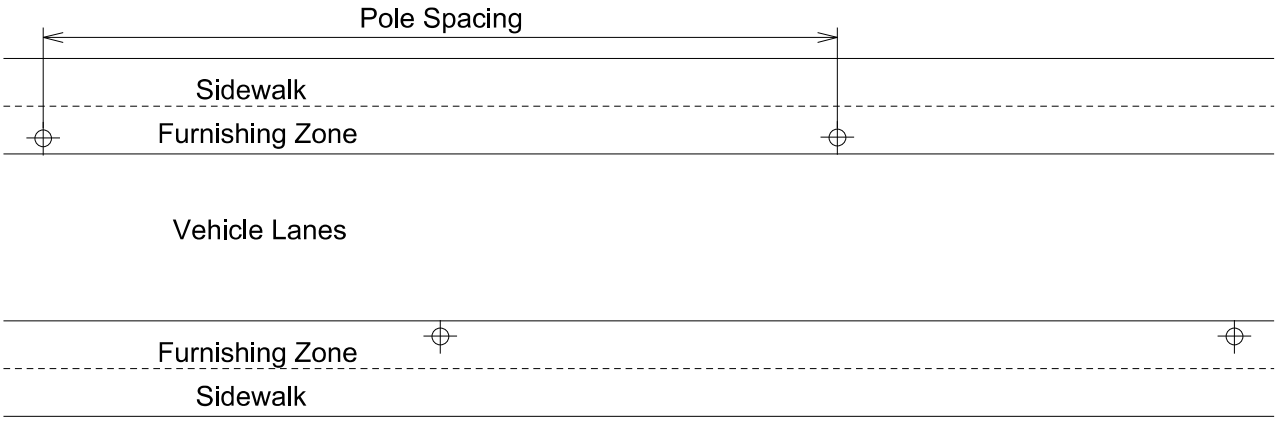
Products submitted must be eligible for Energy Trust of Oregon LED lighting incentives; or show progress that the product will be on a pre-approved list prior to contract execution not to exceed two weeks following the Notice of Intent. Presently, Energy Trust utilizes preapproved product lists by three organizations: (a) Lighting Design Laboratory, (b) the Design Lights Consortium, or c) Energy Star Qualified Products Fixture List. Only model numbers exactly matching the products on these lists will be accepted.

END OF SECTION

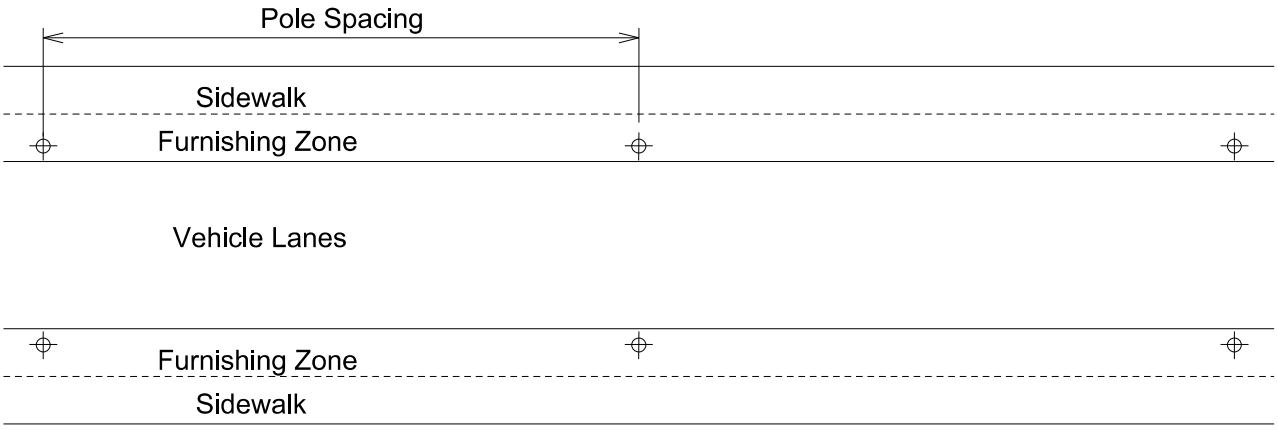
Appendix A — Pole Layout Illustrations

The plan-view drawings provided on the following pages illustrate pole layouts indicated in the “system” specification method of section 1.1. These drawings are not to scale.

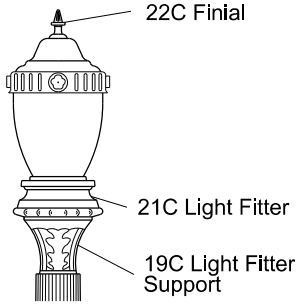
Typical Pole configurations
Single Ornamental



Case 1a: Single Ornamental - Staggered - 2 lanes



Case 1b: Single Ornamental - Opposed - 2 Lanes

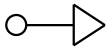


Case 1: Single Ornamental Configuration

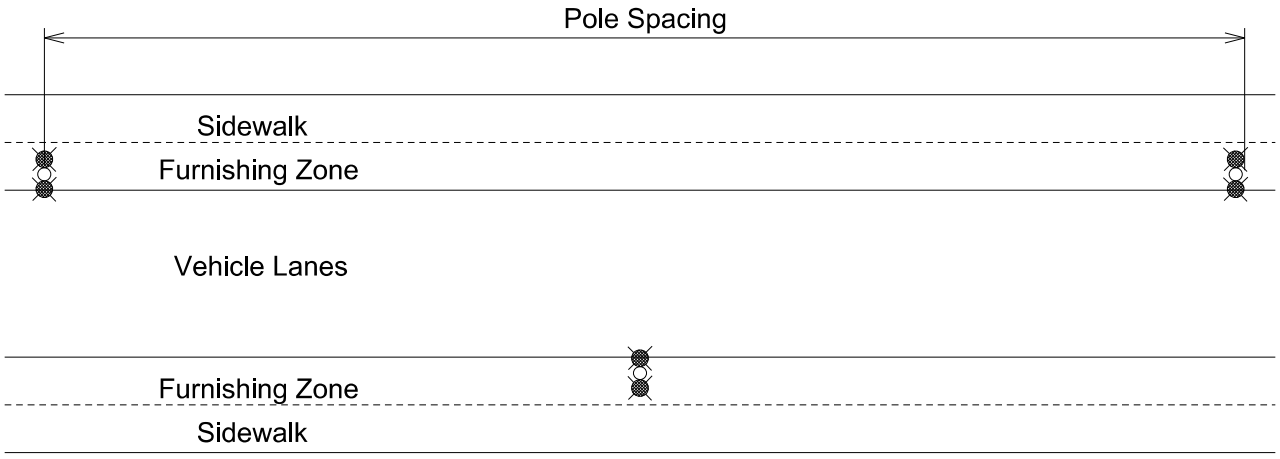
Orientation: Post Top

Arm Length: N/A

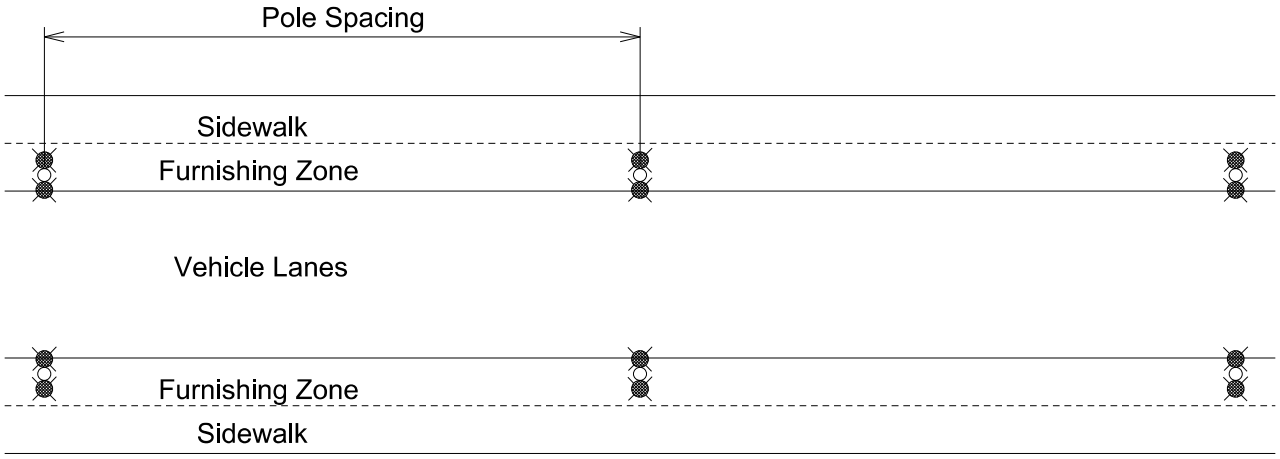
Orientation



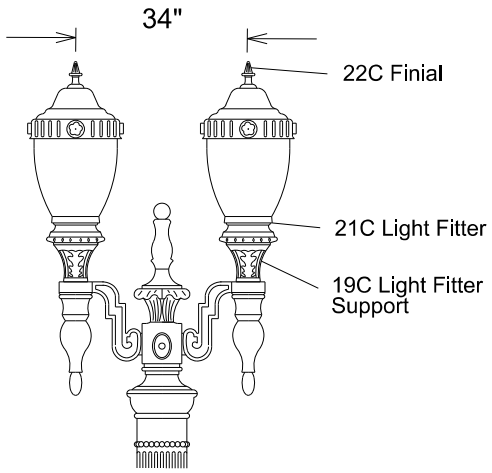
Typical Pole configurations
Twin Ornamental



Case 2a: Twin Ornamental - Staggered - 3 Lanes



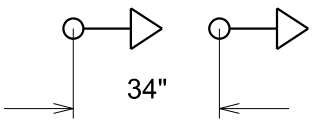
Case 2b: Twin Ornamental - Opposed - 3 Lanes
Case 2c: Twin Ornamental - Opposed - 5 Lanes



Case 2: Twin Ornamental Configuration

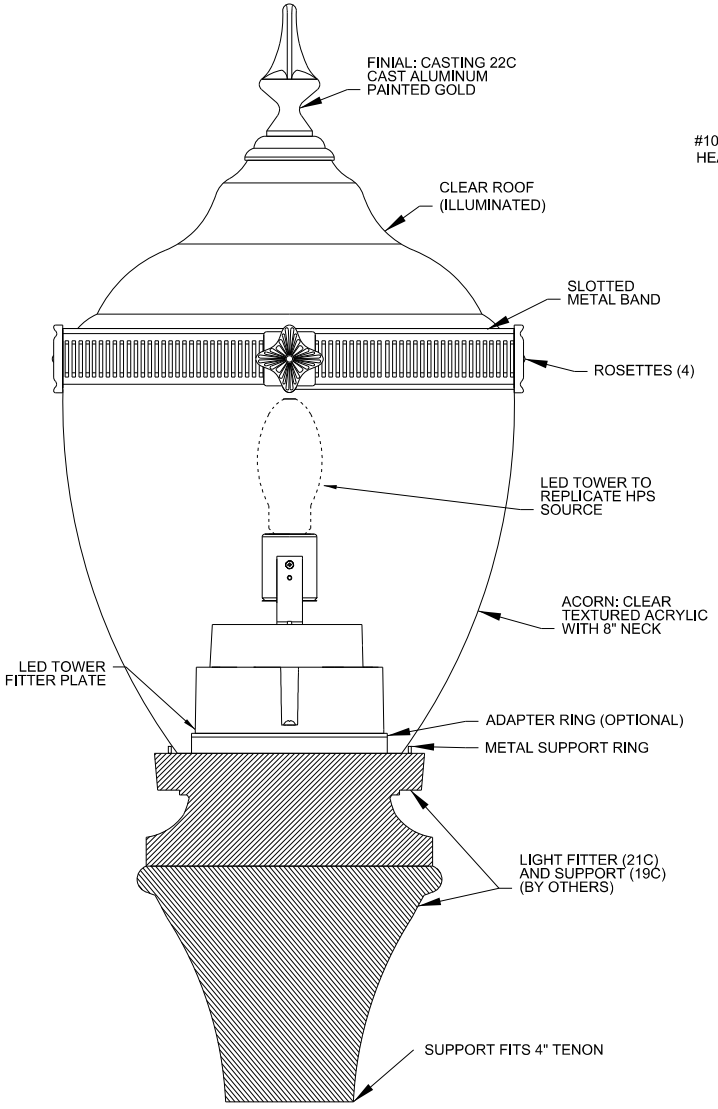
Orientation: Perpendicular to Curb
Arm Length: 17"

Orientation

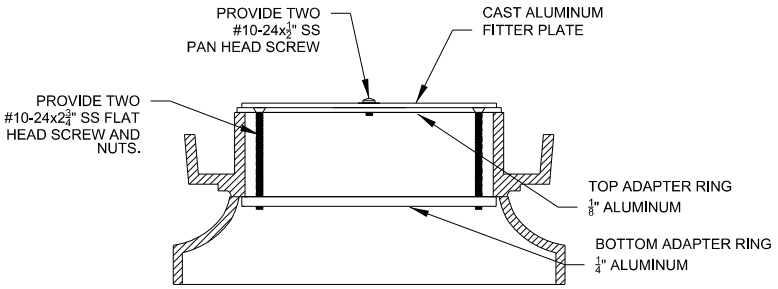


Appendix B— Luminaire Kit Illustrations

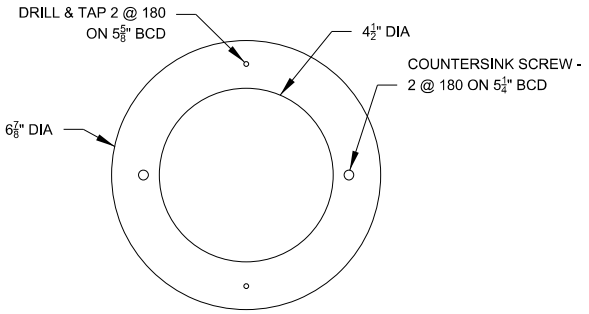
The luminaire kit drawings provided on the following pages illustrate many of the required components as specified in section 4.2. These drawings are not to scale.



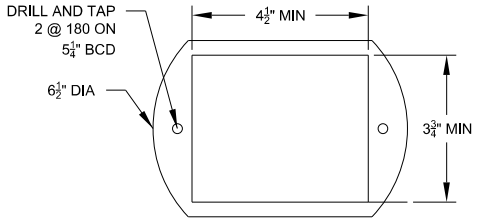
ASSEMBLED FIXTURE



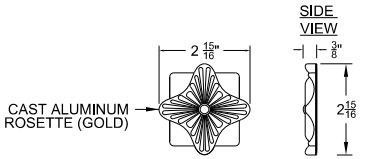
ADAPTER RINGS INSTALLED ON LIGHT FITTER
(OPTIONAL)



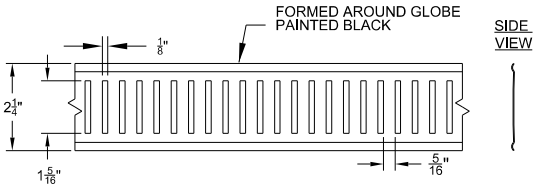
TOP ADAPTER RING
(OPTIONAL)



BOTTOM ADAPTER RING
(OPTIONAL)



ROSETTES



SLOTTED METAL BAND

NOTES:

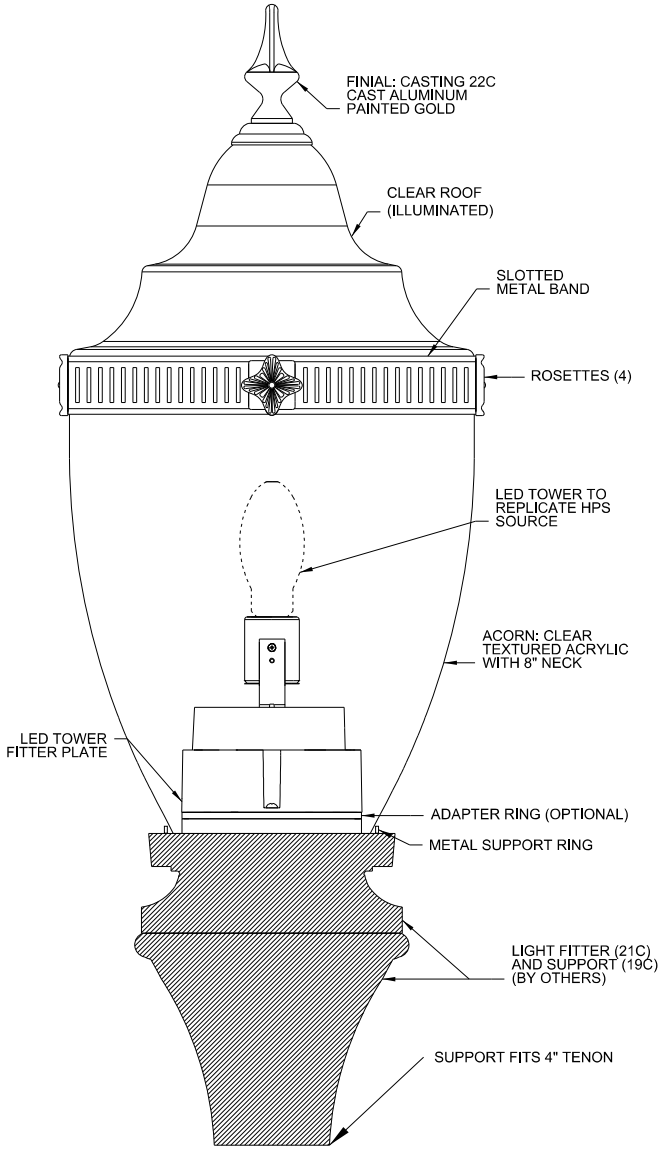
1. METAL BAND MAY BE EITHER BRASS OR ALUMINUM
2. METAL BAND TO BE FORMED AROUND GLOBE
3. METAL BAND AND ROSETTES TO BE AFFIXED WITH SS HARDWARE

CITY OF PORTLAND
OFFICE OF TRANSPORTATION

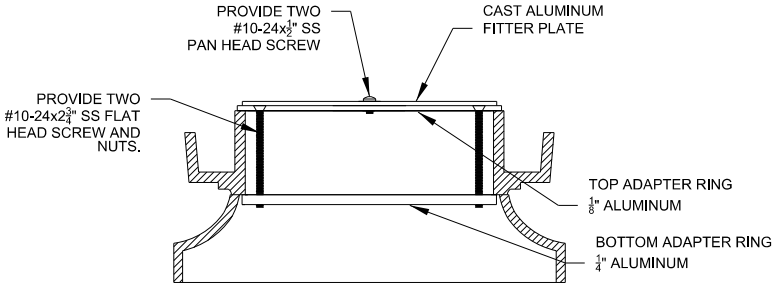
STEVE NOVICK — COMMISSIONER
STEVE TOWNSEN — CITY ENGINEER

REVISION DATE	3/03/15
MODIFIED BY	L. ELBERT
CHECKED BY	L. ELBERT
SCALE	NTS

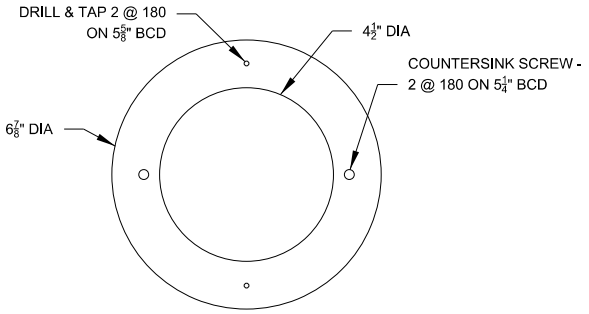
ACORN KIT - SINGLE ORNAMENTAL



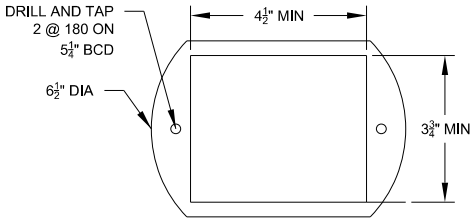
ASSEMBLED FIXTURE



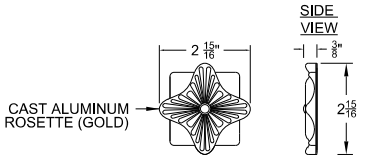
ADAPTER RINGS INSTALLED ON LIGHT FITTER
(OPTIONAL)



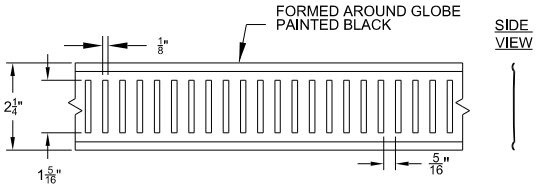
TOP ADAPTER RING
(OPTIONAL)



BOTTOM ADAPTER RING
(OPTIONAL)



ROSETTES



SLOTTED METAL BAND

NOTES:

1. METAL BAND MAY BE EITHER BRASS OR ALUMINUM
2. METAL BAND TO BE FORMED AROUND GLOBE
3. METAL BAND AND ROSETTES TO BE AFFIXED WITH SS HARDWARE

CITY OF PORTLAND
OFFICE OF TRANSPORTATION

STEVE NOVICK, COMMISSIONER
STEVE TOWNSEN, CITY ENGINEER

REVISION DATE	3/03/15
MODIFIED BY	L. ELBERT
CHECKED BY	L. ELBERT
SCALE	NTS

ACORN KIT - TWIN ORNAMENTAL

Appendix C — Product Submittal Form

Luminaire kit designation				
Luminaire kit manufacturer				
Luminaire kit model number				
Nominal IES TM-15 BUG ratings	B =	U =	G =	
Product family testing	☐ Submitted product is identical to tested product	☐ Submitted product differs from tested product(s) as explained in attached letter		
Nominal luminaire kit weight	lb			
Nominal luminaire kit input voltage	V			
Control interface	☐ None	☐ ANSI C136.10 (3-pin)	☐ ANSI C136.41, 5-pin	☐ ANSI C136.41, 7-pin
LED driver	Rated Life / Average Expected Life: Hrs			
	☐ Not dimmable	☐ Dimmable, 0-10V (IEC 60929)	☐ Dimmable, DALI (IEC 62386)	
Electrical immunity—Appendix D	☐ Basic (6kV / 3kA)		☐ Elevated (20kV / 10kA)	
Upon failure of electrical immunity system	☐ Possible disconnect	☐ No possible disconnect		
ANSI C136.31 vibration test level	☐ Level 1 (Normal)	☐ Level 2 (bridge/overpass)		
Thermal management	☐ Liquids or moving parts	☐ No liquids or moving parts		
Luminaire kit warranty period	Years			
Rated life of LED driver(s)	Hours			
IES LM-80 test duration	Hours			
LED lumen maintenance *	☐ Reported (restricted)	☐ Calculated (unrestricted)		
Make/model of LED light source(s)				
	Nominal value	Tolerance (%)		
Luminaire kit input power —initial	W	W		
Luminaire kit input power —maintained **	W	W		
LED drive current—initial	mA	mA		
LED drive current—maintained **	mA	mA		
In-situ LED T_s	°C	°C		
LED lumen maintenance **	%	%		
CCT	K	K		
Additional product description				

* Manufacturer shall indicate which is applicable (check only one box) as per section 4.5. According to IES TM-21, "Reported" values are restricted to 5.5x or 6x (depending on sample size) the duration of IES LM-80 testing, whereas "Calculated" (i.e., projected) values are unrestricted.

** As per section 4.5.

Appendix D— Electrical Immunity

Test Procedure

1. Electrical Immunity Tests 1, 2 and 3, as defined by their Test Specifications, shall be performed on an entire powered and connected luminaire, including any control modules housed within the luminaire, but excluding any control modules mounted externally, such as a NEMA socket connected photo-control. A shorting cap should be placed across any such exterior connector.
2. The luminaire shall be connected to an AC power source with a configuration appropriate for nominal operation. The AC power source shall have a minimum available short-circuit current of 200A. The luminaire shall be tested at the nominal input voltage specified, or at the highest input voltage in the input voltage range specified.
3. Electrical Immunity test waveforms shall be superimposed on the input AC power line at a point within 6 inches (15cm) of entry into the luminaire using appropriate high-voltage probes and a series coupler/decoupler network (CDN) appropriate for each coupling mode, as defined by ANSI/IEEE C62.45-2002. The test area for all tests shall be set up according to ANSI/IEEE C62.45-2002, as appropriate.
4. Prior to electrical immunity testing a set of diagnostic measurements shall be performed, and the results recorded to note the pre-test function of the luminaire after it has reached thermal equilibrium. These measurements should include at a minimum:
    a. For all luminaires, Real Power, Input RMS Current, Power Factor and THD at full power/light output;
    b. For luminaires specified as dimmable, Real Power, Input RMS Current, Power Factor and THD at a minimum of 4 additional dimmed levels, including the rated minimum dimmed level.
5. Tests shall be applied in sequential order (Test 1, followed by Test 2, followed by Test 3). If a failure occurs during Test 3, then Test 3 shall be re-applied to a secondary luminaire of identical construction.
6. Following the completion of Tests 1, 2, and 3, the same set of diagnostic measurements performed pre-test should be repeated for all tested luminaires, and the results recorded to note the post-test function of the luminaire(s).
7. A luminaire must function normally and show no evidence of failure following the completion of Test 1 + Test 2 + Test 3 (for a single tested luminaire), or the completion of Test 1 + Test 2 on a primary luminaire and Test 3 on a secondary luminaire. Abnormal behavior during testing is acceptable.
8. A luminaire failure will be deemed to have occurred if any of the following conditions exists following the completion of testing:
    a. A hard power reset is required to return to normal operation;
    b. A noticeable reduction in full light output (e.g. one or more LEDs fail to produce light, or become unstable) is observed;
    c. Any of the post-test diagnostic measurements exceeds by ±10% the corresponding pre-test diagnostic measurement;
    d. The luminaire, or any component in the luminaire (including but not limited to an electrical connector, a driver, a protection component or module) has ignited or shows evidence of melting or other heat-induced damage. Evidence of cracking, splitting, rupturing, or smoke damage on any component is acceptable.

Test Specifications

NOTE: L1 is typically "HOT", L2 is typically "NEUTRAL" and PE = Protective Earth.

Test 1) Ring Wave: The luminaire shall be subjected to repetitive strikes of a "C Low Ring Wave" as defined in ANSI/IEEE C62.41.2-2002, Scenario 1, Location Category C. The test strikes shall be applied as specified by Table D.1. Prior to testing, the ring wave generator shall be calibrated to simultaneously meet BOTH the specified short circuit current peak and open circuit voltage peak MINIMUM requirements. Note that this may require that the generator charging voltage be raised above the specified level to obtain the specified current peak. Calibrated current probes/transformers designed for measuring high-frequency currents shall be used to measure test waveform currents.

Test waveform current shapes and peaks for all strikes shall be compared to ensure uniformity throughout each set (coupling mode + polarity/phase angle) of test strikes, and the average peak current shall be calculated and recorded. If any individual peak current in a set exceeds by ±10% the average, the test setup shall be checked, and the test strikes repeated.

Table D.1: 0.5 µS – 100Hz Ring Wave Specification

Parameter	**Test Level/Configuration**
Short Circuit Current Peak	0.5 kA
Open Circuit Voltage Peak	6 kV
Coupling Modes	L1 to PE, L2 to PE, L1 to L2
Polarity and Phase Angle	Positive at 90° and Negative at 270°
Test Strikes	5 for each Coupling Mode and Polarity/Phase Angle combination
Time between Strikes	1 minute
Total Number of Strikes	= 5 strikes x 3 coupling modes x 2 polarity/phase angles = 30 total strikes

Test 2) Combination Wave: The luminaire shall be subjected to repetitive strikes of a "C High Combination Wave" or "C Low Combination Wave", as defined in ANSI/IEEE C62.41.2-2002, Scenario 1, Location Category C. The test strikes shall be applied as specified by Table D.2. The "Low" test level shall be used for luminaires with **Basic** Electrical Immunity requirements, while the "High" test level shall be used for luminaires with **Elevated** Electrical Immunity requirements.

Prior to testing, the combination wave generator shall be calibrated to simultaneously meet BOTH the specified short circuit current peak and open circuit voltage peak MINIMUM requirements. Note that this may require that the generator charging voltage be raised above the specified level to obtain the specified current peak. Calibrated current probes/transformers designed for measuring high-frequency currents shall be used to measure test waveform currents.

Test waveform current shapes and peaks for all strikes shall be compared to ensure uniformity throughout each set (coupling mode + polarity/phase angle) of test strikes, and the average peak current shall be calculated and recorded.

If any individual peak current in a set exceeds by ±10% the average, the test setup shall be checked, and the test strikes repeated.

Table D.2: 1.2/50µS – 8/20 µS Combination Wave Specification

Parameter	**Test Level/ Configuration**	
1.2/50 µS Open Circuit Voltage Peak	Low: 6 kV	High: 10kV[1]
8/20 µS Short Circuit Current Peak	Low: 3 kA	High: 10kA
Coupling Modes	L1 to PE, L2 to PE, L1 to L2	
Polarity and Phase Angle	Positive at 90° and Negative at 270°	
Test Strikes	5 for each Coupling Mode and Polarity/Phase Angle combination	
Time Between Strikes	1 minute	
Total Number of Strikes	= 5 strikes x 3 coupling modes x 2 polarity/phase angles = 30 total strikes	

[1] This is a MINIMUM requirement. Note that for most combination wave generators, which have a source impedance of 2Ω, the generator charging voltage will need to be raised above the specified level (to somewhere in the vicinity of 20kV) to obtain the specified current peak.

Test 3) Electrical Fast Transient (EFT): The luminaire shall be subjected to "Electrical Fast Transient Bursts", as defined in ANSI/IEEE C62.41.2 -2002. The test area shall be set up according to IEEE C62.45-2002. The bursts shall be applied as specified by Table D.3. Direct coupling is required; the use of a coupling clamp is not allowed.

Table D.3: Electrical Fast Transient (EFT) Specification

Parameter	**Test Level/ Configuration**
Open Circuit Voltage Peak	3 kV
Burst Repetition Rate	2.5 kHz
Burst Duration	15 milliseconds
Burst Period	300 milliseconds
Coupling Modes	L1 to PE, L2 to PE, L1 to L2
Polarity	Positive and Negative
Test Duration	1 minute for each Coupling Mode and Polarity combination
Total Test Duration	= 1 minute x 3 coupling modes x 2 polarities = 6 minutes