

# **STREET LIGHTING STANDARDS**

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**Adopted by City Council**

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# CITY OF PORTLAND STREET LIGHTING STANDARDS

Class	Portland Street Classification	Horizontal Illumination $E_h$			Luminance $L$				Glare		
		$E_{h(ave)}$ fc	<u>Ave</u> Min	<u>Max</u> Min	$L_{ave}$ FL	<u>Ave</u> Min (Overall)	<u>Max</u> Min (Overall)	<u>Max</u> Min (Longitudinal)	GM	TI	$L_v$
1	Regional Trafficway	$\geq 1.2$	$\leq 3$	$\leq 9$	$\geq 0.30$	$\leq 2.5$	$\leq 5$	$\leq 2.5$	$\geq 6$	$\leq 20$	$\leq .05$
2	Major Traffic Major Transit	$\geq 1.0$	$\leq 3$	$\leq 9$	$\geq 0.24$	$\leq 2.5$	$\leq 5$	$\leq 2.5$	$\geq 6$	$\leq 20$	$\leq .04$
3	District Collector	$\geq 0.7$	$\leq 3$	$\leq 9$	$\geq 0.18$	$\leq 2.5$	$\leq 5$	$\leq 2.5$	$\geq 6$	$\leq 20$	$\leq .03$
4	Neighborhood Collector – Major Transit	$\geq 0.7$	$\leq 3$	$\leq 9$	$\geq 0.18$	$\leq 2.5$	$\leq 5$	$\leq 2.5$	$\geq 6$	$\leq 20$	$\leq .03$
5	Neighborhood Collector – Minor Transit	$\geq 0.5$	$\leq 3$	$\leq 9$	$\geq 0.12$	$\leq 2.5$	$\leq 5$	$\leq 2.5$	$\geq 6$	$\leq 20$	$\leq .02$
6	Local Service	$\geq 0.2$			$\geq 0.06$	$\leq 5$	$\leq 10$	None	$\geq 4$	$\leq 25$	$\leq .05$
7	Intersections								$\geq 7$	$\leq 10$	$\leq .05$

$$L_{ave} \geq 1.5 L_{ave(t)}$$

$$\text{Unif. } \frac{L_{ave(l)}}{L_{min(l)}} \leq 2.5$$

### **Horizontal Illumination, $E_h$ :**

- a. The value of average horizontal illumination,  $E_{h(ave)}$ , is measured in footcandles (fc) and calculated as the average over the area of the traffic lanes including the center median and bike lanes, if any. The area for  $E_{h(ave)}$  does not include parking lanes, sidewalks, berm, or other areas outside of the vehicular traffic lanes. A parking lane will be assigned 7 ft of width.
- b. For design calculations, the end-of-life lamp lumens will be used together with an appropriate luminaire maintenance factor.
- c.  $E'_{h(ave)}$ : The  $E'_{h(ave)}$  is for areas out to 15 ft to each side of the outside traffic lane.
- d. and shall be lighted to a  $\geq 0.2$  fc(ave) if such areas are used for parking or pedestrian traffic. No ratios are specified for the side areas.
- e. Ave/Min values of horizontal illumination are related to twin-beam luminaires at 30-40 foot mounting heights.

### **Luminance, $L$ :**

- a.  $L_{ave}$ , measured in footlamberts (fL), is the average luminance within the traffic lanes from a transverse line 100 ft ahead to about 400 ft ahead of the observation point. The lateral boundaries shall include the area of the traffic lanes. At least 20 points shall be used to calculate  $L_{ave}$  with at least 5 points along the centerline of the outside lane.

The individual luminance points shall be calculated or measured from a point 4.5 ft above the roadway located approximately in the center of the outside lane and at a longitudinal point along the centerline spaced to include the maximum longitudinal variations in road luminance.

For 2-way traffic roadways, the luminances shall be determined for each direction of traffic if the luminance pattern is asymmetric.

- b. Field measurements will be made with a suitable telephotometer using an acceptance aperture with a 2 arc minute vertical angle. At least 20 points will be measured on the roadway within the prescribed area at approximately equal angular increments.
- c. The  $L_{ave}/L_{min}$  ratios shall be calculated for each observer location and shall consider all of the individual luminances within the area. The ratio of  $L_{ave}/L_{min}$  in shall be met for all observer locations.
- d. The  $L_{max}/L_{min}$  ratios shall be calculated overall and along the centerline of the outside lane for each direction of traffic.

**Glare:**

Glare will be evaluated by two criteria: (1) discomfort glare and (b) disability glare.

a. Discomfort Glare

The discomfort from glare is described by a Glare Control Mark, GM, which expresses on an ordinal scale the subjective appraisal of the degree of discomfort experienced. The value of GM is associated to different glare sensations as follows:

**GM-1 "Unbearable"**

**GM-2 "Disturbing"**

**GM-5 "Just admissible"**

**GM-7 "Satisfactory restriction"**

**GM-9 "Unnoticeable"**

The wordings are not intended to indicate an absolute level of glare. They are listed here as used in the international Commission on illumination (CIE) experiments.

The subjective appraisal of the glare and the associated value of the Glare Control

Mark depend on the photometric and geometric characteristics of the lighting installation.

b. Disability Glare

The method for evaluation of disability glare is based on the Holladay formula. According to the formula, the effect of glare is quantified by an equivalent uniform luminance, which describes the effect of the stray light in the eye: lowering the contrast. The relative threshold increment, TI, is expressed as the difference between the threshold under glare condition and its value without glare, expressed in percent of the value without glare.

The veiling luminance,  $L_v$ , represents the illumination at the eye due to glare sources and is the equivalent uniform luminance, in footlamberts, superimposed over the entire visual field.

c. Recommendations on Glare

The recommendations concerning the restriction of glare in road lighting installations have been given in terms of GM and T1. These values should be considered as minimum requirements. If higher values for G and lower values for TI are economically feasible, preference should be given to such an improvement of the glare restrictions.

Field measurements of glare should be made using a telephotometer located at the luminance observation location. The photometer should use a 6 arc minute aperture (approx. 2-inch circle at 100 ft) and should have a mount that can give vertical and horizontal angles with respect to a reference line of sight. All sources within the normal field of view of a driver that are greater than about 20 times the average road luminance should be measured for maximum luminance within a 6' cone angle. The approximate field of view will be  $\pm 30^\circ$  horizontal,  $+ 20^\circ$  vertical to  $- 5^\circ$  vertical. The location and magnitude of each source should be recorded. If the sources subtend a solid angle greater than 0.0002 steradians ( $2 \text{ ft}^2$  at 100 ft), separate measurements should be made in each incremental solid angle.

**Intersections:**

- a. The area used to determine  $L_{ave}$  will be that roadway area within the traveled lanes extending from the centroid of the intersection along each lane to a transverse line 10 ft beyond the point of entry.
- b.  $L_{ave(i)}$  is the average luminance in the intersection,  $L_{ave(r)}$  is the average luminance of the intersecting road with the highest value, and  $L_{min(i)}$  is the minimum luminance in the intersection.