ENERGY STAR® Program Requirements for Solid State Lighting Luminaires

Proposed Category "A" Additions – Outdoor Area & Parking Garage

Category A: Near-term Applications

Outdoor pole-mounted area and roadway luminaires[1]

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Further Comments on FTE</td><td colspan="4">Fitted Target Efficacy (FTE) evaluates the efficacy with which a luminaire delivers uniform illumination to a ~~rectangular uniform~~ area of coverage (the target area). FTE is calculated using standard absolute luminaire photometry (LM-79-08 test results in LM-63-02 formatted .ies file). Minimum requirements are given in initial lumens per watt of luminaire input power (lm/W).
For DOE FTE calculator (beta version) please see http://www.drintl.com/temp/FTE-Calculator.exe. For calculator instructions, please see http://www.drintl.com/htmlemail/FTE_ReadMe.pdf. For supporting materials, please see http://www.drintl.com/htmlemail/FTEoverview01Jul09.pdf and http://www.drintl.com/htmlemail/FTEalgorithm01Jul09.pdf.</td></tr>
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< 9,500 lumens</td><td>High Output
≥ 9,500 lumens</td><td>Low Output
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† Both requirements must be met for each BUG secondary solid angle: maximum percent of luminaire lumens in zone, and maximum lumens in zone. Secondary solid angles (zones) are per IES TM-15-07. FH-forward high; BH-back high; FVH-forward very high; BVH-back very high; UL-up low; UH-up high.

[1] Including but not limited to luminaires intended for lighting streets, parking lots, walkways, and plazas. Includes decorative post-top luminaires. Excludes luminaires intended to be mounted below eye level, e.g. bollards and steplights.

Outdoor wall-mounted area luminaires (“wall packs”)

Application Requirements		
Minimum Light Output	Luminaire shall deliver a minimum of 300 lumens (initial).	
Maximum Luminous Flux in Glare and Uplight Zones*	FH (60-80°)	48.0% of total luminaire output
	FVH (80-90°)	3.0% of total luminaire output
	UL (90-100°)	2.0% of total luminaire output
	UH (100-180°)	2.0% of total luminaire output
Minimum Luminaire Efficacy	52 lm/W	

*Secondary solid angles (zones) are per IES TM-15-07. FH-forward high; FVH-forward very high; UL-up low; UH-up high.

Parking garage/canopy luminaires

Application Requirements	
Minimum Light Output	Luminaire shall deliver a minimum of 2,000 lumens (initial).
Zonal Lumen Density Requirement	Luminaire shall deliver a minimum of 20% of total lumens in the 60°-70° zone.
Minimum Luminaire Efficacy	70 lm/W

Attachment A -- Definitions

Average-to-minimum ratio	A requirement establishing the greatest allowable difference between the average illuminance and the minimum illuminance measured in a given area. For example, to meet a 6:1 average-to-minimum ratio, the average illuminance value (lumens per unit of area, such as footcandles [lm/sq. ft.], lux [lm/m^2], or lumens per mounting height squared [lm/MH^2]) measured in a given area must not be more than six times the lowest value measured in that area.
BUG	Backlight, Uplight, and Glare Ratings defined in Addendum A to IESNA TM-15-07, Luminaire Classification System for Outdoor Luminaires.
House-side	The hemisphere behind the luminaire containing all backlight, i.e., opposite of street-side. Some controlled luminous flux in this region can be beneficial for mast-arm-mounted luminaires, luminaires located between sidewalk and street, luminaires along curving roads, etc.
Maximum-to-minimum ratio	A requirement establishing the greatest allowable difference between the maximum illuminance and the minimum illuminance measured in a given area. For example, to meet a 30:1 maximum-to-minimum ratio, the highest illuminance value measured in a given area must not be more than thirty times the lowest value measured in that area.
Mounting height (MH)	The vertical distance between finished grade and the optical center of the luminaire.
Shielded luminaire	Luminaire with a uniform area of coverage extending less than 1.5 times the mounting height (MH) in the backward (house-side) direction.
Uniform area of coverage	For purposes of this document: the "pool" of horizontal illumination covered to ratios of 30:1 maximum-to-minimum and 6:1 average-to-minimum. Both requirements must be met, i.e., max:min cannot be more than 30:1 and avg:min cannot be more than 6:1.

Further Comments on FTE

1. Photometric pattern overlap is not undesirable in most roadway and area lighting applications. It is actually necessary to ensure reasonable vertical illuminance from more than one direction at the midpoints of the poles and to provide some lighting redundancy. FTE would preferentially rate non-overlapping photometric patterns at higher FTE while promoting lighting solutions with "holes" in the vertical illuminance of the site and susceptibility to localized dark zones in the event of various fixture failure modes. In the illustration of Figure 1 of the FTE Overview, the square patterns with 0% overlap would create lighting conditions with zero vertical illuminance along the quadrant boundaries yet a fixture achieving such results would get a maximum FTE while delivering unacceptable lighting performance on most sites.

2. While rectangular patterns can be relatively efficient in lighting areas with high geometric regularity, it is not necessarily true that non-rectangular patterns are less efficient. Efficient coupling to the target area is a function of the target area shape and how the photometric pattern compliments that shape. As an example, consider a trapezoidal pattern in a roadway fixture designed to complement itself in a stagger arrangement. Both a rectangular and trapezoidal pattern could create comparable solutions in a straight roadway situation, but FTE would advantage the rectangular pattern while the on-ground performance could be very comparable. Similarly, non-rectangular patterns may be desirable as shape elements when attempting to efficiently light oddly shaped site elements (e.g. circular truck turnarounds or rapidly curving roads and drives).

3. The choice to use IESNA uniformity limits as the boundaries of the FTE metric to define "useful" versus "wasted" light ignores the realities of normal practice and capability. In many cases, IESNA recommendations were developed as a balance of what is desirable and what is feasible. In some cases, commercially available HID photometric patterns could not support higher uniformity and as such the standards were written to be reasonable w/r to commercial capability at the time the standards were last updated. SSL systems bring new capability to photometric design that can significantly improve lighting uniformity. Additionally, contemporary lighting practice would seldom if ever design a lighting system at the limits of the RP-20 allowances. Typical practice in major retail environments is 3-6X better than RP-20 limits and SSL systems can move that mark further on sites with high spatial regularity. Roadway designs do tend to be designed to the limits of the RP-8 standard's uniformity bounds, but mostly driven by an interest or economic rationale to absolutely maximize pole spacing rather than optimizing lighting and visibility performance. Additionally the complication of roadway lighting being influenced by

automotive forward lighting and the conditions of positive and negative contrast zones must be considered. All the factors lead us to at least consider whether or not FTE's uniform assumptions about max/min and avg/min boundaries are appropriate for the application requirements of the two major product types in the Energy Star standard … area and roadway.

4. Backlight may or may not be beneficial in any given application. Arbitrarily including it or excluding it in a computation intended to represent a fixture's ability to efficiently light an application has little if any relevance absent the context of the application. Street scenarios needing sidewalk illuminance and luminance conditions for pedestrian visibility directly benefit from backlight (but are seldom explicitly specified in a municipal lighting specification). Site boundary conditions in environments with strict trespass limits, close proximity neighbors, or environmentally sensitive areas directly benefit from zero-backlight conditions. Both conditions could be rated with high FTE, but only the site conditions can determine if the available efficacy is useful in the application.

5. We disagree that "a tell-tale sign of uncontrolled backlight is non-rectangularity". In many cases it is an artifact of optical design limitations in a system with better than average backlight control and whether or not it is a disadvantage is dependant on the application requirements. As noted in 2 above, a trapezoidal distribution in a straight road in stagger arrangement can be quite competitive with the rectangular solution and the 'non-rectangular' backlight is not a disadvantage when sidewalk lighting is required and the patterns are complementary.

6. There is a fundamental difference in lighting approach to roadways and area lighting. Roadways per RP-8 are average-based and can have veiling luminance requirements that mandate specific approaches to the photometric design of a roadway lighting product. These constraints, in-effect, drive the photometric designer to solutions with a minimum non-uniformity. This limitation on uniformity forces roadway photometric solutions to higher LPD per minimum fc than can be achieved in applications that can allow or benefit from high uniformity solutions. Parking lots and general area lighting per RP-20 are minimum based designs and can support alternative approaches to the photometric design based on high uniformity lighting solutions that maximize the opportunity. FTE does not differentiate between these spec driven scenarios and may artificially rank products better or worse versus Energy Star criteria when in reality, the pattern match to the application geometry may dominate the LPD performance of the solution.

7. We agree that DOE needs an appropriate efficacy parameter for use in Energy Star standards. Setting the metric such that 20% energy savings

are achieved is certainly consistent with normal Energy Star practice. The overall goal is to promote adoption of lighting solutions that result in real-world energy savings. In addition there is a strong desire to avoid creating confusion in the market about the value of an Energy Star rated product. We are not sure that FTE is the right metric approach and would encourage DOE to consider a system's ability to achieve a site-based LPD 20% below the industry norm as the primary metric. The goal should be to minimize LPD (i.e. reduce energy) for the given site or application minimums and lighting quality requirements).

8. DOE indicated in its documentation that "hundreds" of IES files from commercially available fixtures were analyzed against the FTE metric to establish the FTE minimums. We assume that DOE also conducted correlation studies demonstrating that FTE was an accurate predictor of application performance against typical application specifications in the application space the products are targeted to satisfy. It is appropriate in this case to make a sanitized version of this analysis available to the public for review.