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FUNDAMENTALS OF LIGHTING – ADDENDA #1
BUG RATINGS – Backlight, Uplight, and Glare (ref. TM-15 and addenda)

The lumens within each LCS solid angle provide data that can relate to an evaluation of light trespass and sky glow.
As illustrated in **Figure 1**, the primary solid angles defined by the LCS are:

- Forward Light
- Back Light
- Uplight

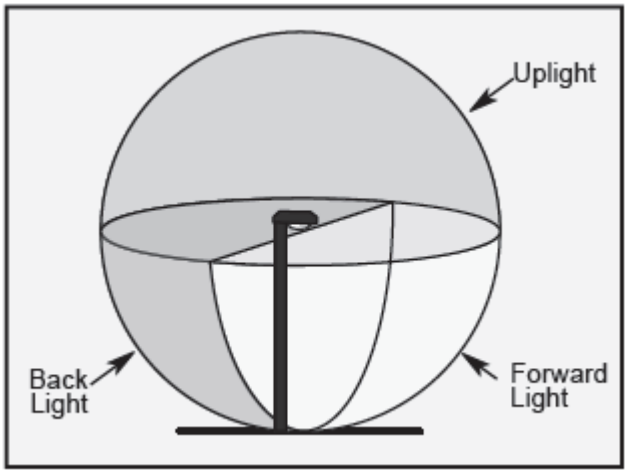


Figure 1. The three primary solid angles of the Luminaire Classification System (LCS).

The sum of percentages of lamp lumens within these three primary solid angles is equal to the photometric luminaire efficiency.

$$\text{Photometric Luminaire Efficiency (\%)} = 100 \times \frac{\{\text{Forward Light (lumens)} + \text{Back Light (lumens)} + \text{Uplight (lumens)}\}}{\text{total bare lamp lumens}}$$

Photometric Luminaire Efficiency (%) = Forward Light (%) + Back Light (%) + Uplight (%)

Trapped Light (%) = 100% – Photometric Luminaire Efficiency (%)

Forward Light

Forward light describes the lumen distribution in front of the luminaire. The forward light solid angle is defined between 0 and 90 degrees vertical, and 270 to 90 degrees horizontal in front of the luminaire. The forward light solid angle is further refined into four vertical secondary solid

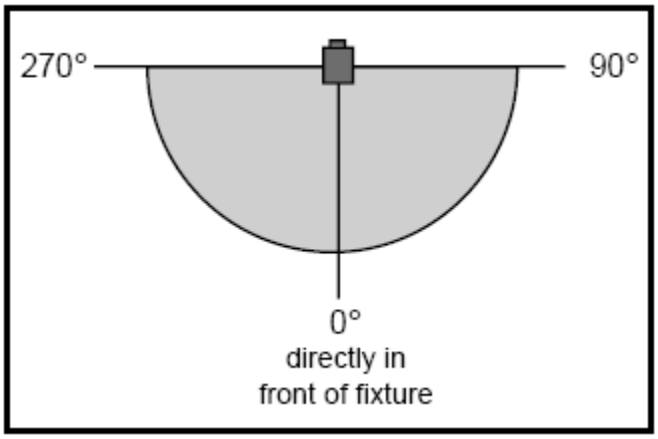
angles to evaluate the distribution of light in front of the luminaire. The forward light secondary solid angles (see **Figure 3**) are defined as follows:

- Forward light low secondary solid angle (FL) - Percent lamp lumens between 0 and 30 degrees vertical (or luminaire lumens within that solid angle) in front of the luminaire. This is the light emitted from directly below the luminaire to 0.6 mounting heights away from luminaire.

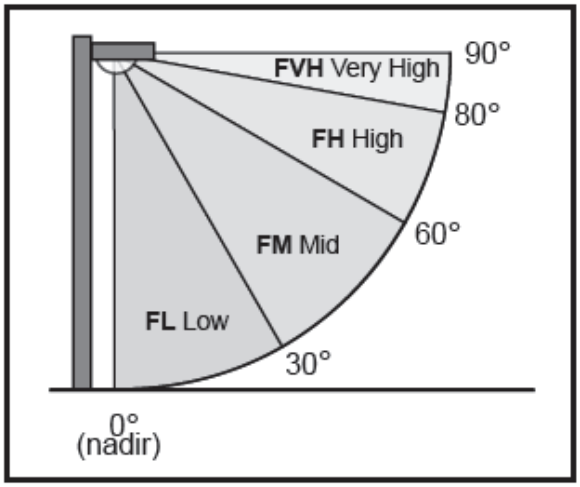
- Forward light mid secondary solid angle (FM) - Percent lamp lumens between 30 and 60 degrees vertical (or luminaire lumens within that solid angle) in front of the luminaire. This is the light emitted from 0.6 to 1.7 mounting heights away from the luminaire.

- Forward light high secondary solid angle (FH) - Percent lamp lumens between 60 and 80 degrees vertical (or luminaire lumens within that solid angle) in front of the luminaire. This is the light emitted from 1.7 to 5.7 mounting heights away from the luminaire.

- Forward light very high secondary solid angle (FVH) - Percent lamp lumens between 80 and 90 degrees vertical (or luminaire lumens within that solid angle) in front of the luminaire. This is the light emitted beyond 5.7 mounting heights away from the luminaire.



Plan view for forward solid angle



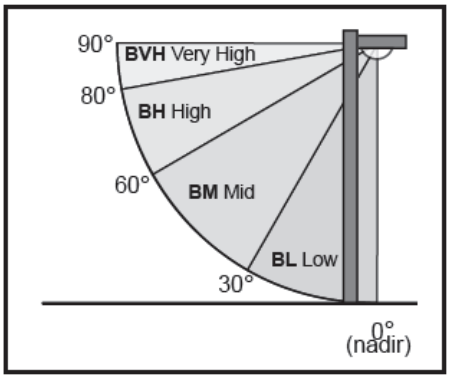
Section view for forward solid angle.

Backlight, Uplight, and Glare (BUG) Ratings

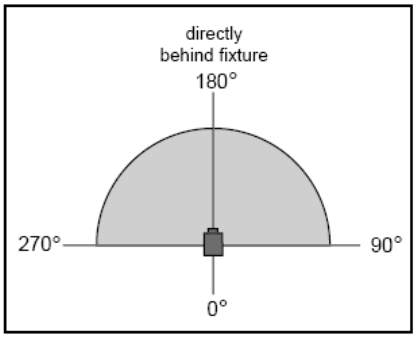
The following Backlight, Uplight, and Glare ratings may be used to evaluate luminaire optical performance related to light trespass, sky glow, and high angle brightness control. These ratings are based on a zonal lumen calculations for secondary solid angles defined in TM-15-07. The zonal lumen thresholds listed in the following three tables are based on data from photometric testing procedures approved by the Illuminating Engineering Society for outdoor luminaries (LM-31 or LM-35).

Table A-1: Backlight Ratings (maximum zonal lumens)

	Secondary Solid Angle	B0	B1	B2	B3	B4	B5
Backlight / Trespass	**BH**	110	500	1000	2500	5000	>5000
	BM	220	1000	2500	5000	8500	>8500
	BL	110	500	1000	2500	5000	>5000



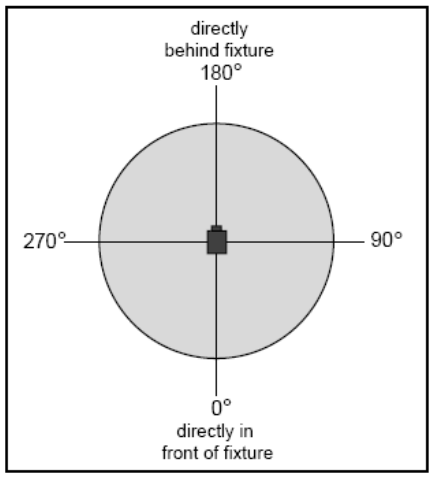
Section view for back light solid angle.



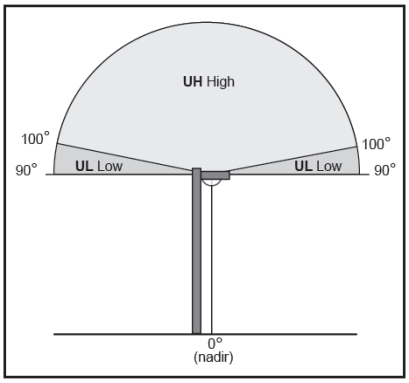
Plan view for back light solid angle, (bottom

Table A-2: Uplight Ratings (maximum zonal lumens)

	Secondary Solid Angle	U0	U1	U2	U3	U4	U5
Uplight / Skyglow	**UH**	0	10	100	500	1000	>1000
	UL	0	10	100	500	1000	>1000
	FVH	10	75	150			>150
	BVH	10	75	150			>150



Plan view for uplight solid angle



Section view for uplight solid angle

Table A-3: Glare Ratings (maximum zonal lumens)

Glare Rating for
Asymmetrical Luminaire Types (Type I, Type II, Type III, Type IV)

	Secondary Solid Angle	G0	G1	G2	G3	G4	G5
Glare / Offensive Light	**FVH**	10	250	375	500	750	>750
	BVH	10	250	375	500	750	>750
	FH	660	1800	5000	7500	12000	>12000
	BH	110	500	1000	2500	5000	>5000

Glare Rating for
Quadrilateral Symmetrical Luminaire Types (Type V, Type V Square)

	Secondary Solid Angle	G0	G1	G2	G3	G4	G5
Glare / Offensive Light	**FVH**	10	250	375	500	750	>750
	BVH	10	250	375	500	750	>750
	FH	660	1800	5000	7500	12000	>12000
	BH	660	1800	5000	7500	12000	>12000

Notes to Tables A-1, A-2, and A-3:

(1) Any one rating is determined by the maximum rating obtained for that table. For example, if the BH zone is rated B1, the BM zone is rated B2, and the BL zone is rated B1, then the *backlight rating for the luminaire* is B2.

(2) To determine BUG ratings, the photometric test data must include data in the upper hemisphere unless no light is emitted above 90 degrees vertical (for example, if the luminaire has a flat lens and opaque sides), per the IES Testing Procedures Committee recommendations.

(3) It is recommended that the photometric test density include values at least every 2.5 degrees vertically. If a photometric test does not include data points every 2.5 degrees vertically, the BUG ratings shall be determined based on appropriate interpolation.

(4) A “quadrilateral symmetric” luminaire shall meet one of the following definitions:

a. A Type V luminaire is one with a distribution that has circular symmetry, defined by the IESNA as being essentially the same at all lateral angles around the luminaire.

b. A Type VS luminaire is one where the zonal lumens for each of the eight horizontal octants (0-45, 45-90, 90-135, 135-180, 180-225, 225-270, 270-315, 315-360) are within ±10 percent of the average zonal lumens of all octants.