Municipal Solid-State STREET LIGHTING CONSORTIUM

U.S. Department of Energy

Reading and Understanding LM-79

Chris Nye

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- L.M. Seventynine –

-

Who is he and what does he have to do with LED Street Lighting?

The Significance of LM-79 for LED Street Lighting Applications

- Review of photometric testing
- Need for special testing procedure (LM-79) for LED luminaires
- Deciphering an LM-79 test report
- Importance of LM-79 in specifications
- Bad actors – what they do and how to stop them

Photometric Testing Review

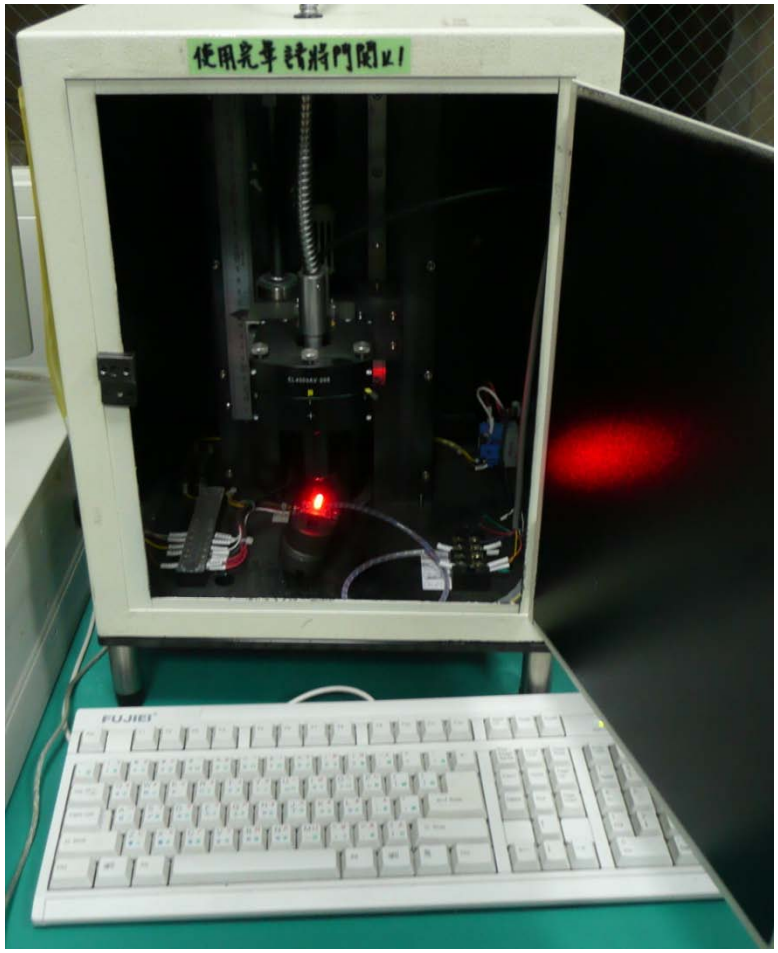
- This style of goniophotometer swings mirror 180° and rotates luminaire 360°
- Reflected light is measured from remote photodetector.
- Candela values are recorded at discreet angles (typically every 2½° or 5°) .

Photometric Testing Review

- Data is recorded in an IES formatted file.
- Lumens are calculated.
- Based on measured input watts, efficacy is calculated.
- LM-79 test report is generated.

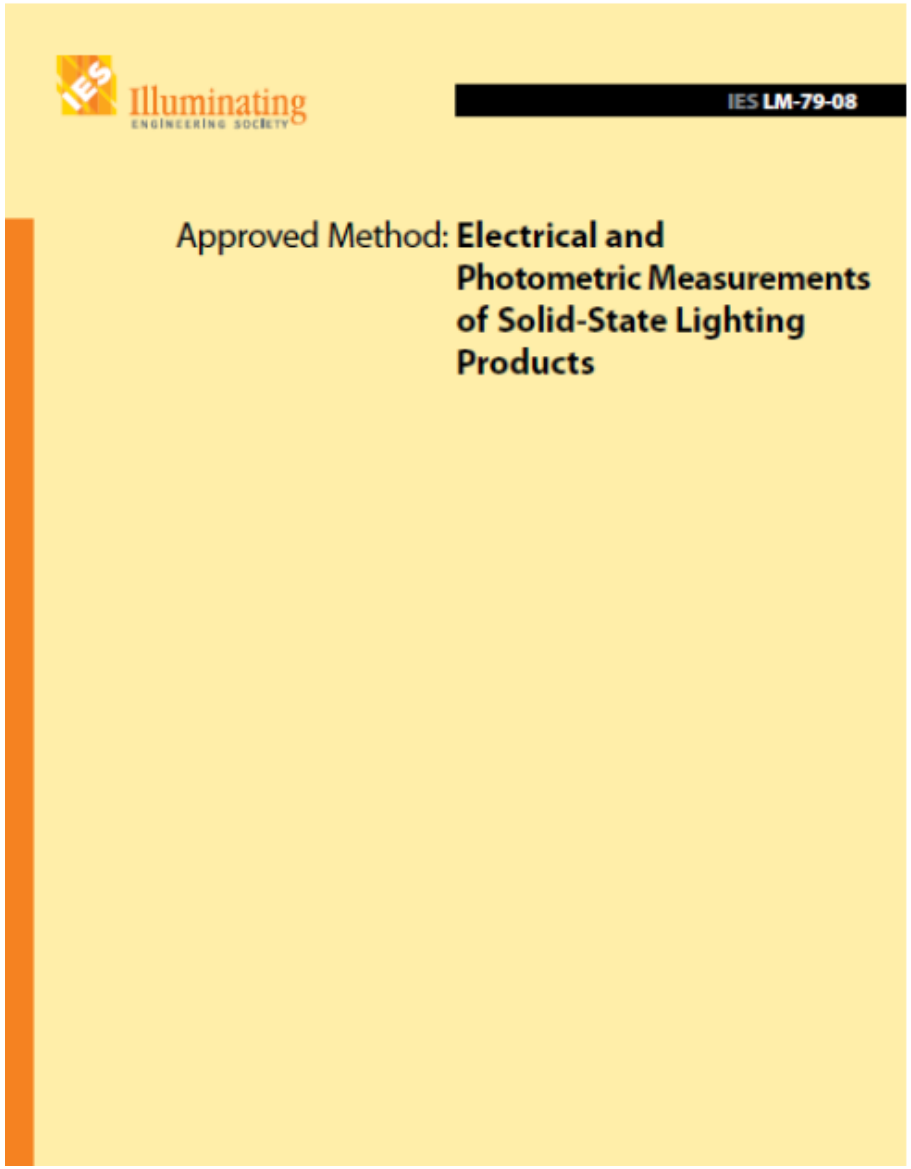
Photometric Testing Review

- IES files can also be created using optical designs tools including:
  - optical design software such as Photopia
  - micro-goniophotometer
- These are NOT the same as LM-79 data.



LM-79

- IES photometric testing procedure for LED luminaires
- Specifies ambient temperature, stabilization process, testing equipment etc.
- Requires using "Absolute Photometry"



Relative vs. Absolute Photometry

Relative Photometry

- Relative photometry used for traditional sources (incandescent, fluorescent, HID) to account for lamp lumen tolerances and to isolate luminaire performance.
- Reference lamp is stabilized and tested first.
- Luminaire is then tested with reference lamp and adjusted to published lumen value.

Absolute Photometry

- Absolute photometry is used for LED luminaires where LEDs cannot be easily isolated in testing and don't have rated lumen value.
- Luminaire is tested and the absolute (unadjusted) data is recorded.

LM-79 Test Report

Caliper Approved Testing Lab

Interesting Stuff

Picture of Luminaire

Distribution Classification
Note: Not all Type 2s are created equal

Number of lumens and where they are

LTL LUMINAIRE TESTING LABORATORY, INC.

905 Harrison Street · Allentown, PA 18103 · 610-770-1044 · Fax 610-770-8912 · www.LuminaireTesting.com

LTL NUMBER: 23319 DATE: 2011-05-09
PREPARED FOR: LEOTEK ELECTRONICS
CATALOG NUMBER: GC1/GCD1/GCA1/GCAD1-60E-XX-NW-2-XX-700 (700MA)
LUMINAIRE: CAST GRAY ENAMEL ALUMINUM HOUSING, FORMED GRAY ENAMEL ALUMINUM REFLECTOR, NO ENCLOSURE
LAMP: 60 WHITE LEDS WITH CLEAR PLASTIC OPTICS BELOW EACH
LED POWER SUPPLY: ONE ADVANCE "XITANIUM" LED-INTA-0700C-210-DN
ELECTRICAL VALUES: 120.0VAC, 1.130A, 135.3W, PF=0.998
LUMINAIRE EFFICACY: 71.6 LUMENS/WATT
NOTE: THIS TEST WAS PERFORMED USING THE CALIBRATED PHOTODETECTOR METHOD OF ABSOLUTE PHOTOMETRY.*

IES CLASSIFICATION: **TYPE II**
LONGITUDINAL CLASSIFICATION: **MEDIUM**
CUTOFF CLASSIFICATION: **FULL-CUTOFF****

**CUTOFF DESIGNATION IS NOT DEFINED FOR ABSOLUTE PHOTOMETRIC TESTS. THIS CUTOFF RATING IS BASED ON THE MAXIMUM CANDELA READING PER LUMINAIRE RATED AT 1000 LUMENS

FLUX DISTRIBUTION

LUMENS	DOWNWARD	UPWARD	TOTALS
HOUSE SIDE	2648.56	0.00	2648.56
STREET SIDE	7032.50	0.00	7032.50
TOTALS	9681.05	0.00	9681.05

Approved By: Brian Mayer

*DATA WAS ACQUIRED USING THE CALIBRATED PHOTODETECTOR METHOD OF ABSOLUTE PHOTOMETRY. A UDT MODEL #211 PHOTODETECTOR AND UDT MODEL #S370 OPTOMETER COMBINATION WERE USED AS A STANDARD. A SPECTRAL MISMATCH CORRECTION FACTOR WAS EMPLOYED BASED ON THE SPECTRAL RESPONSIVITY OF THE PHOTODETECTOR AND THE SPECTRAL POWER DISTRIBUTION OF THE TEST SUBJECT.

TESTING WAS PERFORMED IN ACCORDANCE WITH IES LM-79-08.
TEST ANGULAR INCREMENTS AND REPORT FORMATTING WAS BASED ON IES LM-31-95.

LM-79 Test Report

Interesting Stuff

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SUSTAINING MEMBER of the IESNA

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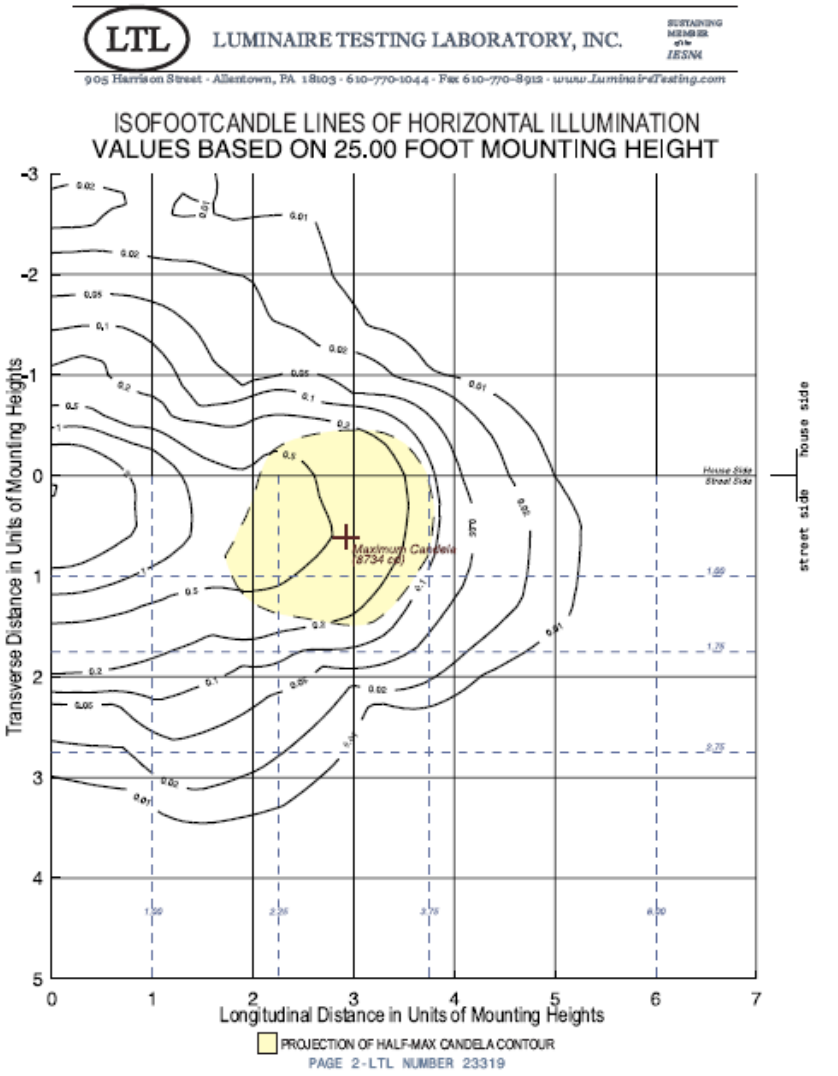
LM-79 Test Report

Isofootcandle chart provides quick visual representation of distribution



LM-79 Test Report

Actual measured candela table showing light intensity at various angles.

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CANDELA DISTRIBUTION

	0	5	15	25	35	45	55	65	75	78.2	85	90
180	0	0	0	0	0	0	0	0	0	0	0	0
175	0	0	0	0	0	0	0	0	0	0	0	0
165	0	0	0	0	0	0	0	0	0	0	0	0
155	0	0	0	0	0	0	0	0	0	0	0	0
145	0	0	0	0	0	0	0	0	0	0	0	0
135	0	0	0	0	0	0	0	0	0	0	0	0
125	0	0	0	0	0	0	0	0	0	0	0	0
115	0	0	0	0	0	0	0	0	0	0	0	0
105	0	0	0	0	0	0	0	0	0	0	0	0
95	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0
87.5	7	8	35	2	0	0	0	0	0	0	0	0
85	575	578	424	57	57	50	47	54	73	80	85	69
82.5	252	238	137	102	125	106	106	135	268	286	314	213
80	112	114	122	148	200	172	158	274	776	786	757	513
77.5	117	122	151	210	301	277	236	936	1981	1997	1844	1295
75	145	155	199	414	557	573	521	3309	4484	4960	4939	4374
72.5	179	195	247	731	885	968	1526	5376	7642	8499	7887	7355
71.5	195	214	267	852	1001	1142	2075	5733	8037	**8734**	7850	7373
70	246	272	331	992	1164	1375	2914	6150	8237	8492	7419	7066
67.5	336	358	414	1212	1376	1685	3632	6355	7666	7304	6668	6359
65	842	884	1127	1415	1569	1889	3516	5553	5912	5706	5417	5054
62.5	1386	1388	1469	1567	1721	2062	3225	4464	4239	4025	3694	3370
60	1547	1539	1603	1700	1863	2280	3149	3946	3620	3466	3110	2789
57.5	1658	1648	1716	1836	2039	2476	3150	3734	3471	3316	2880	2533
55	1791	1784	1869	2013	2262	2668	3226	3661	3359	3203	2834	2444
52.5	2005	2003	2099	2244	2486	2864	3359	3645	3497	3389	3032	2683
50	2281	2280	2365	2492	2710	3061	3508	3769	3438	3271	2998	2770
47.5	2553	2551	2631	2775	2952	3177	3597	3615	3127	3045	2868	2697
45	2884	2891	2987	3038	3080	3250	3542	3363	3011	2959	2841	2706
40	3192	3172	3178	3192	3220	3250	3168	2966	2863	2818	2684	2534
35	3290	3261	3219	3076	2909	2866	2898	2931	2865	2815	2660	2501
30	2668	2646	2641	2678	2789	2868	2944	2973	2889	2837	2702	2554
25	2739	2726	2796	2927	2993	3033	3052	3045	2942	2890	2749	2610
20	3107	3083	3109	3157	3183	3183	3170	3121	3000	2942	2795	2662
15	3296	3267	3272	3284	3283	3268	3227	3151	3009	2955	2828	2723
10	3330	3304	3301	3297	3276	3237	3172	3082	2962	2924	2836	2763
5	3169	3146	3139	3123	3090	3051	2992	2937	2873	2854	2812	2774
0	2778	2778	2778	2778	2778	2778	2778	2778	2778	2778	2778	2778

LM-79 Test Report

LUMINAIRE TESTING LABORATORY, INC.
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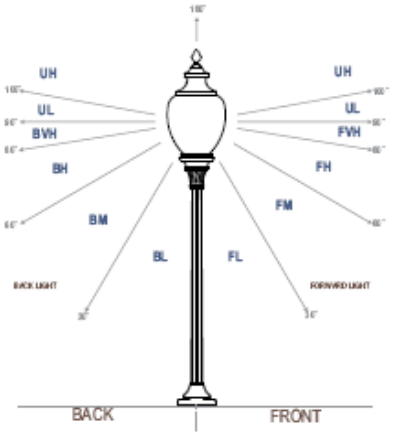
FLUX DISTRIBUTION TABLE BASED ON THE IESNA LUMINAIRE CLASSIFICATION SYSTEM



ZONE	FLUX LUMINAIRE LUMENS	% OF LUMINAIRE LUMENS
FORWARD LIGHT	7032	72.6
FL (0°-30°)	1268	13.1
FM (30°-60°)	3316	34.3
FH (60°-80°)	2385	24.6
FVH (80°-90°)	63	0.7
BACK LIGHT	2649	27.4
BL (0°-30°)	751	7.8
BM (30°-60°)	1039	10.7
BH (60°-80°)	793	8.2
BVH (80°-90°)	66	0.7
UPLIGHT	0	0.0
UL (90°-100°)	0	0.0
UH (100°-180°)	0	0.0
TRAPPED LIGHT	NA	NA

Lumen distribution in designated zones and BUG (Backlight, Uplight and Glare) ratings

BUG (Backlight, Uplight, Glare) Rating	
Asymmetrical Luminaire Types (Type I, II, III, IV)	B2 U1 G2
Quadrilateral Symmetrical Luminaire Types (Type V, Area Light)	B2 U1 G2

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Applying IES Files in Roadway Lighting Designs

- Using design software such as AGi-32 or Visual
- Create roadway with appropriate site geometry or import drawing file
- Designate pole locations, mounting heights, luminaire orientations.
- Import the IES files of the appropriate luminaire
- Specify light loss factor
- Run the application

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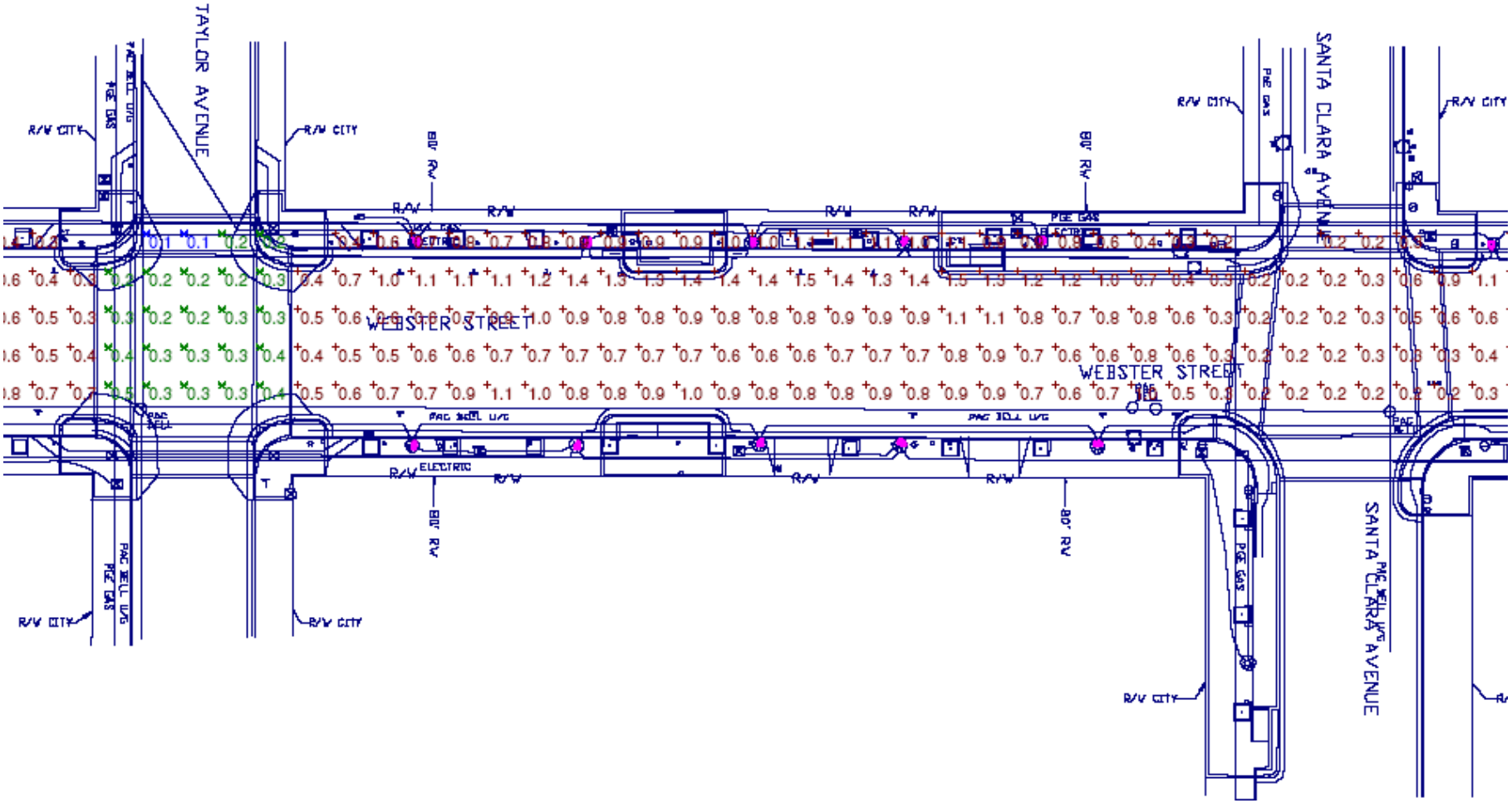
Applying IES Files in Roadway Lighting Designs



Applying IES Files in Roadway Lighting Designs

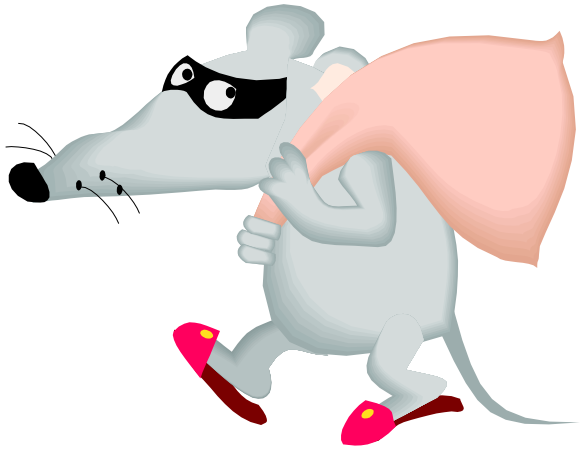
Roadway Optimizer - Layout Comparison

	Units	85W Induction	100W HPS	60 LEDs
Luminaire Mounting Height	Feet	28	28	28
Roadway Width	Feet	40	40	40
Pole Spacing	Feet	120	120	120
Illuminance - Average	Maintained FC	0.64	0.78	0.69
Illuminance - Maximum	Maintained FC	1.6	2.3	1.3
Illumunance - Minimum	Maintained FC	0.1	0.3	0.4
Uniformity - Avg./Min		6.4	2.6	1.73
System Power	Watts	88	130	71
100 Avg. FC/Watt		7.3	6.0	9.7
100 Min. FC/Watt		1.1	2.3	5.6

Applying IES Files in Roadway Lighting Designs

- This method allows for an unbiased comparison of HID vs. multiple LED or induction luminaires for the actual application being evaluated.
- Credible manufacturers support this approach

Bad Actors



Bad Actors

What they can do:

1. Not produce LM-79 IES files/reports
   - Offer “virtual photometry” eg. Photopia
   - Offer factored data (May be OK if properly identified)
2. Produce LM-79 reports for units that are not the product they are selling.
   - Different LEDs (easy to do and hard to catch)
   - Different luminaire (optical system, thermal properties, missing lens etc.)

Bad Actors

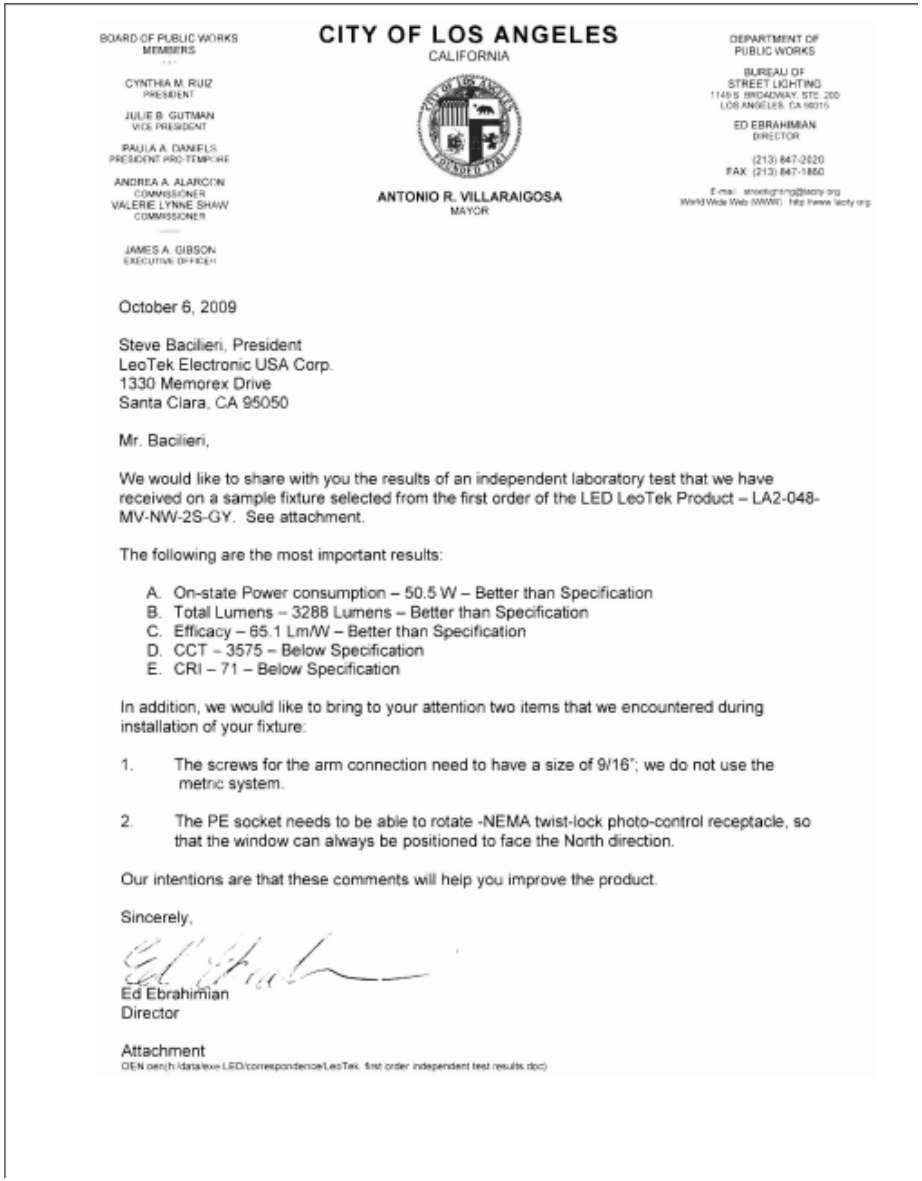
How you can protect yourself:

Bad Actors

How you can protect yourself:

1. Require manufacturers to provide LM-79 reports from Caliper approved testing lab.
2. Carefully review the reports - even the picture.
3. Use credible manufacturers with track records, but don't discourage start-ups.
4. Check references.
5. Trust, but verify. Send random sample units to testing labs and compare results.

Trust, but verify.



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October 6, 2009

Steve Bacilieri, President
LeoTek Electronic USA Corp.
1330 Memorex Drive
Santa Clara, CA 95050

Mr. Bacilieri,

We would like to share with you the results of an independent laboratory test that we have received on a sample fixture selected from the first order of the LED LeoTek Product – LA2-048-MV-NW-2S-GY. See attachment.

The following are the most important results:

A. On-state Power consumption – 50.5 W – Better than Specification
B. Total Lumens – 3288 Lumens – Better than Specification
C. Efficacy – 65.1 Lm/W – Better than Specification
D. CCT – 3575 – Below Specification
E. CRI – 71 – Below Specification

In addition, we would like to bring to your attention two items that we encountered during installation of your fixture:

1. The screws for the arm connection need to have a size of 9/16"; we do not use the metric system.

2. The PE socket needs to be able to rotate -NEMA twist-lock photo-control receptacle, so that the window can always be positioned to face the North direction.

Our intentions are that these comments will help you improve the product.

Sincerely,

Ed Ebrahimian
Director

Attachment
OEN oen:(h:/data/exe-LED/correspondence/LeoTek. first order independent test results.doc)

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