CALIFORNIA LIGHTING TECHNOLOGY CENTER

Directional Lamp Testing

Report Draft

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Prepared for: PG&E

Prepared by:
California Lighting Technology Center

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Notes – Integrating Sphere

- Power measurement taken with a Yokogawa PZ4000
- Photometric measurements made with a SMS-500 Spectrometer in a 2 meter integrating sphere
- Measurements taken in accordance with LM-79
- Auxiliary correction applied for fixture self absorptions
- All lamps run for approximately 1 hour immediately prior to testing for lamp stabilization/temperature equilibrium

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Notes – Goniophotometer Type C

- Power measurements taken on a Xitron 2802 power analyzer
- Photometric measurements made with a T-10 Konica Minolta Illuminance meter
- Measurements presented in accordance with LM-63-2002
- Stray light correction applied

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LED Directional Lamp Selection

- The selection of lamps for this testing program was based on the lamp shape. The lamps selected for testing include Par38, Par30, and Par20 replacement lamps.
- A variety of beam angles were considered for this testing program. The beam angles represented range from 12º to 40º beam angle.
- Sixteen products were selected for testing. Two samples of each product were procured.

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LED Directional Lamp Selection

- This test report present the results of LED MR16 replacement lamp testing performed in a gonio-photometer and a 2-meter integrating sphere.
- Gonio-Photometer Testing
  - One sample each of the sixteen products selected for this testing program were tested in the gonio-photometer.
  - Gonio-photometer tests were done with the lamp in the base-up position.
  - Gonio-photometer tests were done with the lamp in open air conditions.
- 2-Meter Integrating Sphere Testing
  - Two samples each of the twenty products selected for this testing program were tested in the 2-meter integrating sphere.
  - Every sample was tested in multiple orientation and multiple housing as seen below.

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Sphere Testing Housings & Orientations

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LED Directional Testing Summary
By Lamp Shape

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Directional Replacement Lamp Summary – Average of Lamp Shapes

Serial #	CRI	Efficacy
Par 38	85.8	59
Par 30	86.3	56.8
Par 20	84.8	58.6
Average	85.6	58.1

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PAR 38 LED Replacement Lamps

Serial #	System Power (W)	Gonio. Output (lm)	Beam Lumens	Measured CBCP	CCT	CRI	Measured Beam Angle	Efficacy
DIR-05-01	16.5	906	408	1698	2967	87.8	37	54.9
DIR-06-01	19.5	1111	417	5274	3416	84.8	22.5	57.0
DIR-07-01	23.8	1417	644	7112	4119	86.5	23.3	59.5
DIR-08-01	14	948	547	1056	3942	78.7	50.5	67.7
DIR-10-01	16.3	1007	481	1622	3050	82.3	39.1	61.8
DIR-12-01	14	828	442	12408	3144	81.5	14.6	59.1
DIR-14-01	15.8	893.5	392	3468	2763	91.2	25.3	56.6
DIR-16-01	11.16	616.26	255	4585	2711	93.6	18	55.2
Average						85.8		59

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PAR 30 LED Replacement Lamps

Serial #	System Power (W)	Gonio. Output (lm)	Beam Lumens	Measured CBCP	CCT	CRI	Measured Beam Angle	Efficacy
DIR-02-01	12.7	774	322	3140	2717	85.9	24.5	60.9
DIR-03-01	11.3	518	202	4965	2983	82.8	16.8	45.8
DIR-04-01	13.1	776	351	3247	2773	87.3	25.8	59.2
DIR-15-01	10.03	613.6	215	6029	3010	89.0	14.4	61.2
Average						86.3		56.8

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PAR 20 LED Replacement Lamps

Serial #	System Power (W)	Gonio. Output (lm)	Beam Lumens	Measured CBCP	CCT	CRI	Measured Beam Angle	Efficacy
DIR-01-01	7.4	426	109	3514	3048	82.7	14.2	57.6
DIR-09-01	9.8	683	354	1471	5163	85.2	38.8	69.7
DIR-11-01	4.92	279.17	175	158.64	2856	88.7	82.3	56.7
DIR-13-01	8.5	428	237	551	2846	82.7	50	50.4
Average						84.8		58.6

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2-Meter Integrating Sphere
Summary Charts
Averages

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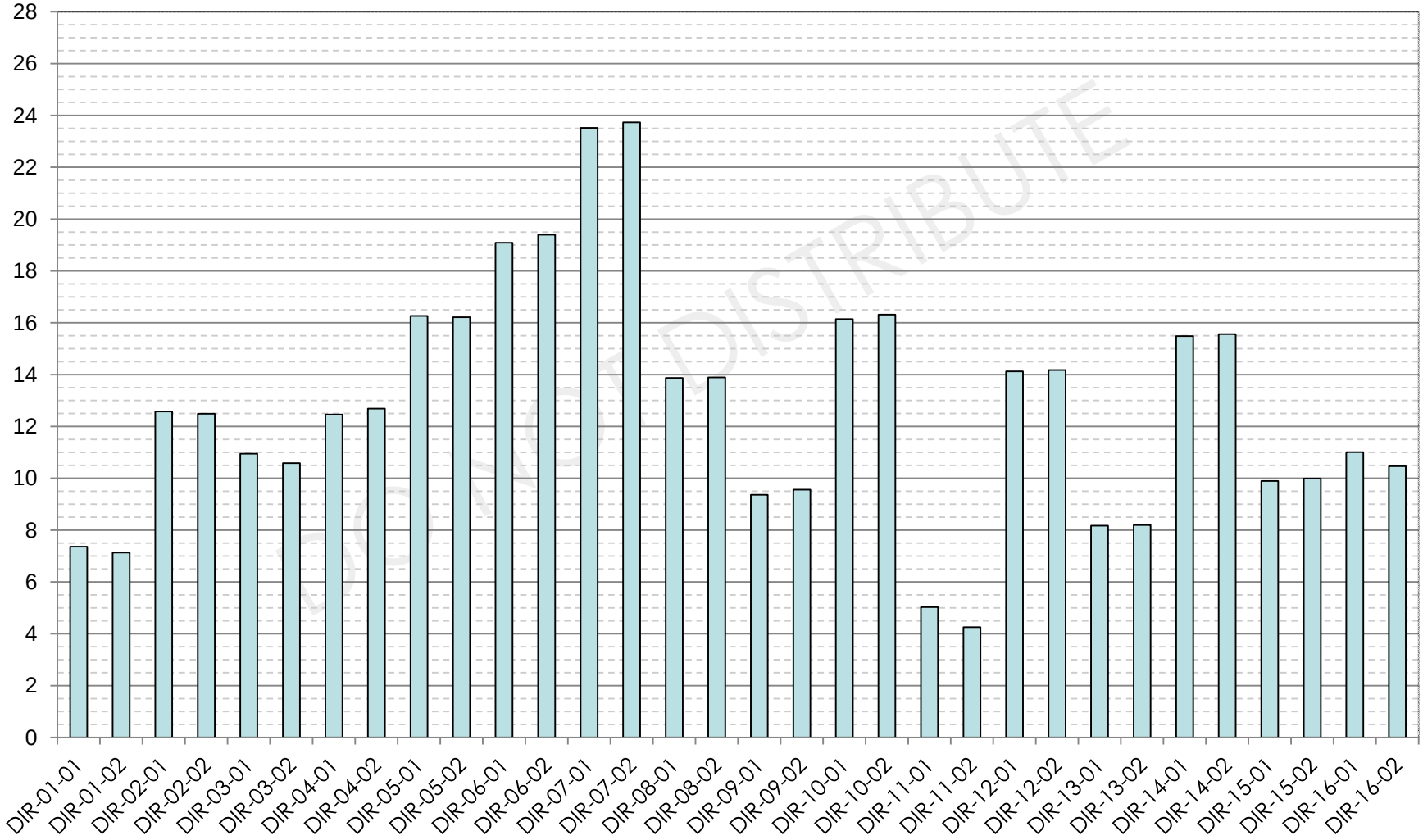
System Power

Minor gridlines = 0.5 W



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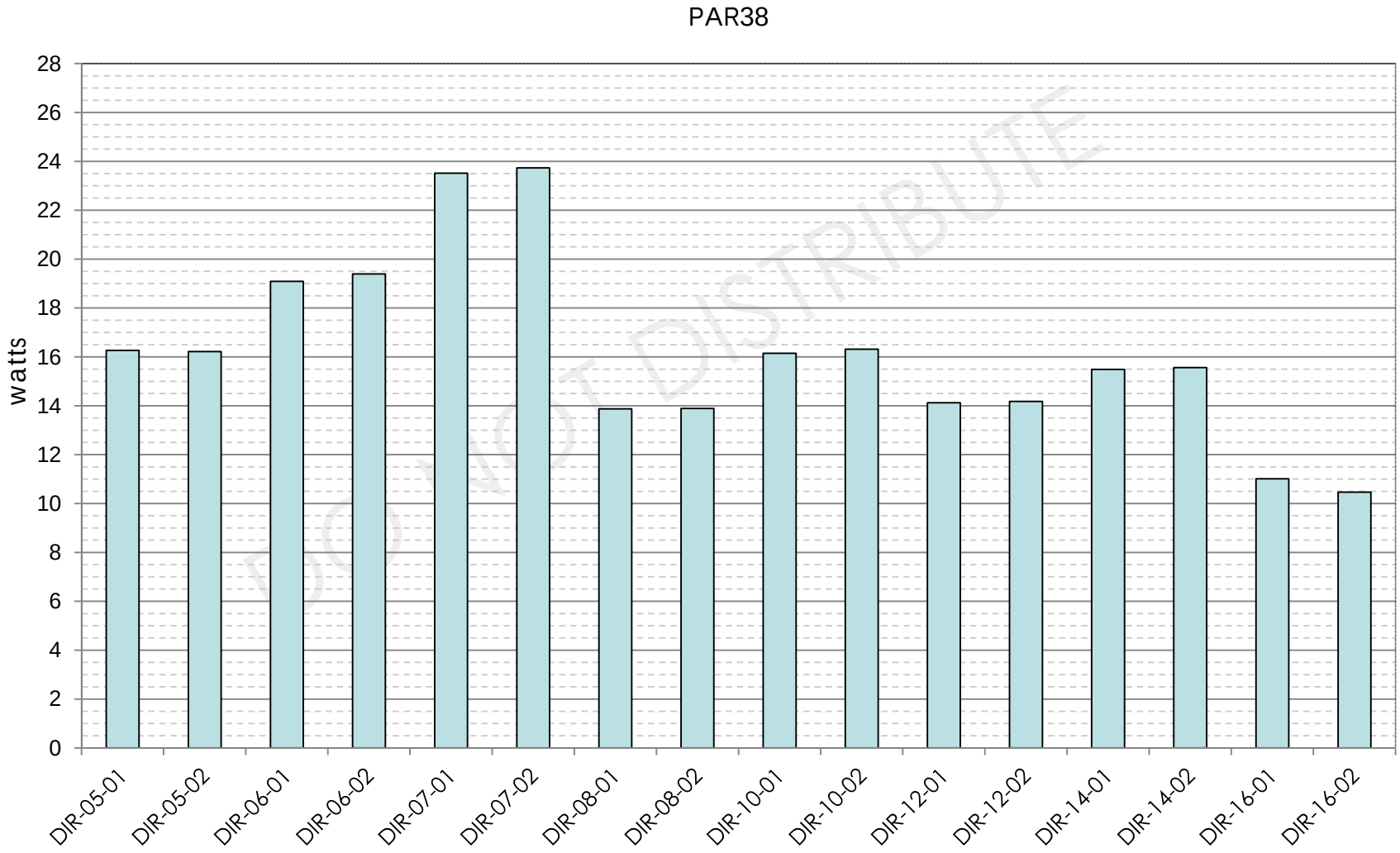
System Power – Sorted by lamp size

Minor gridlines = 0.5 W



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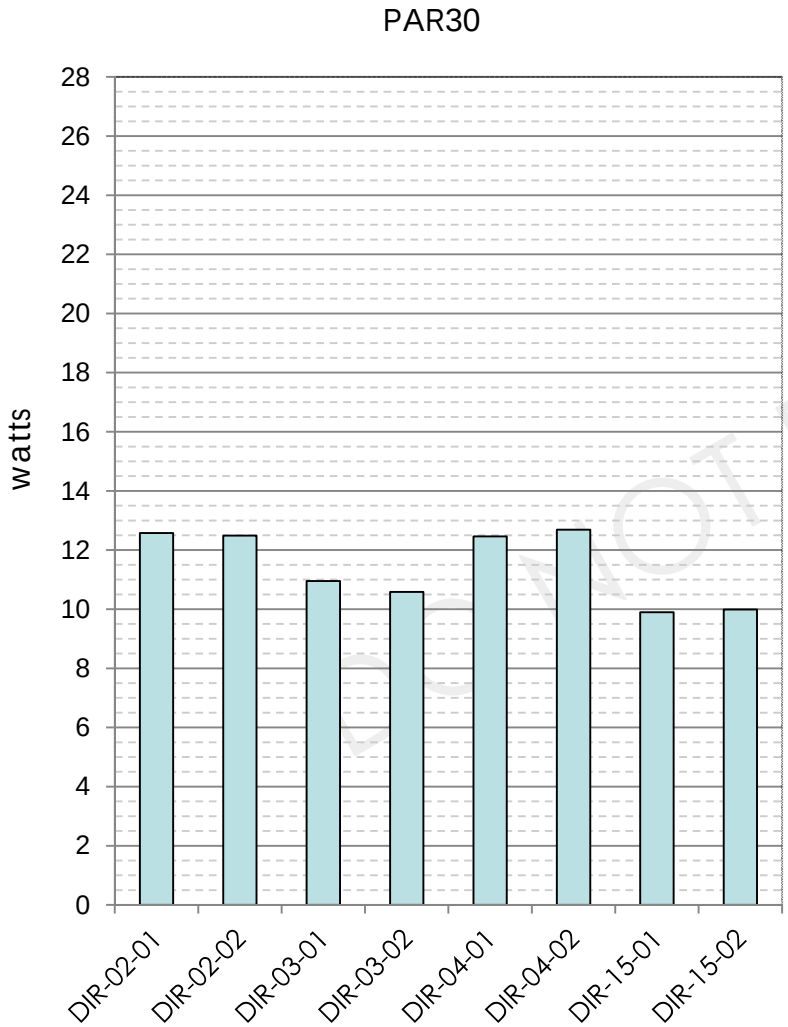
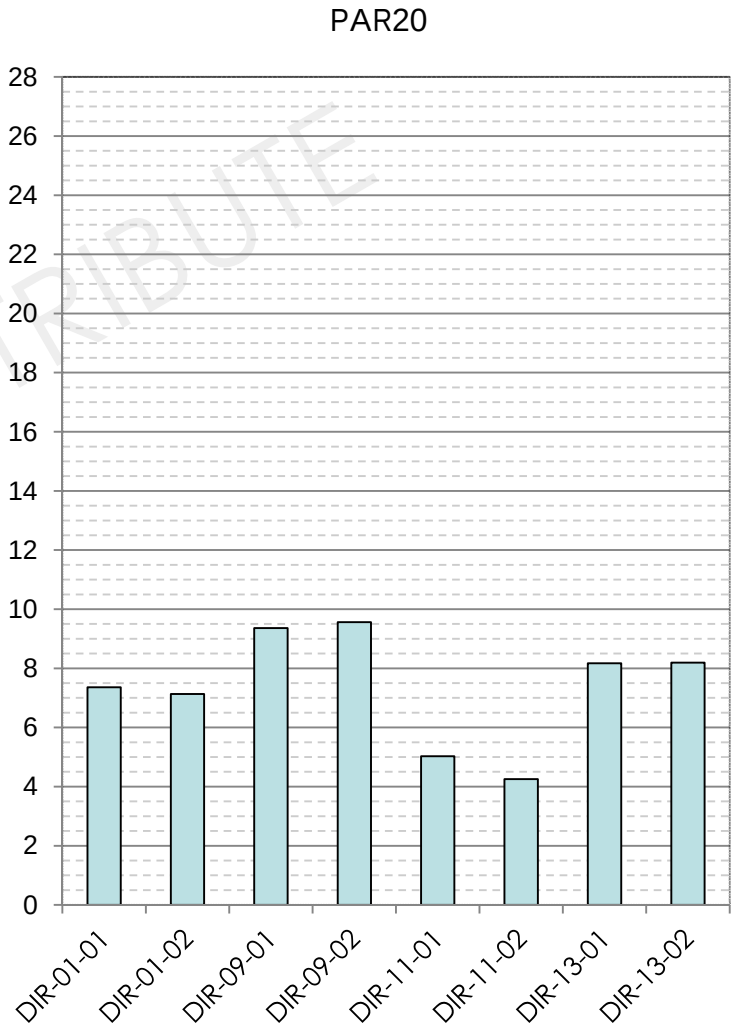
System Power – Sorted by lamp size

Minor gridlines = 0.5 W





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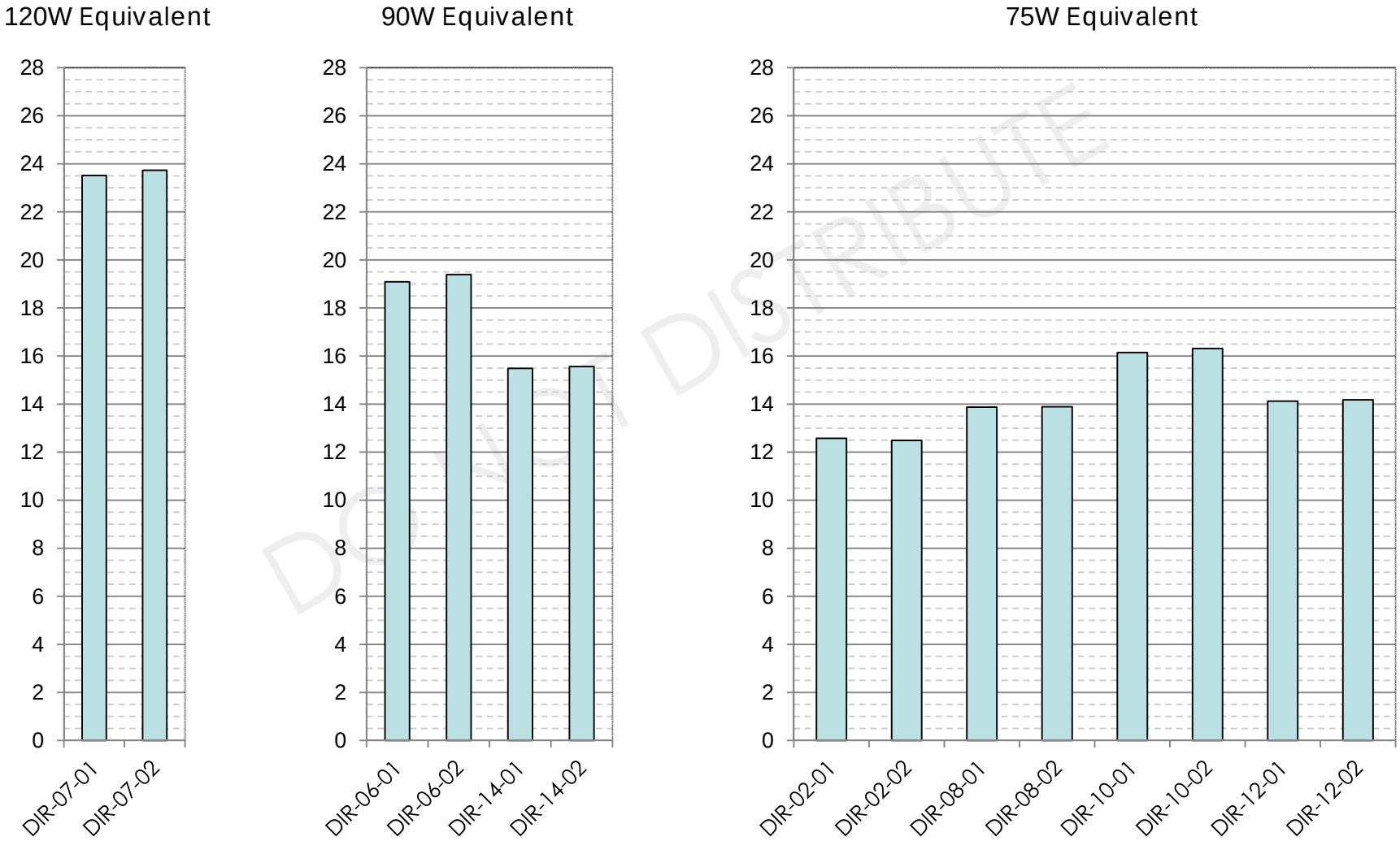
Minor gridlines = 0.5 W



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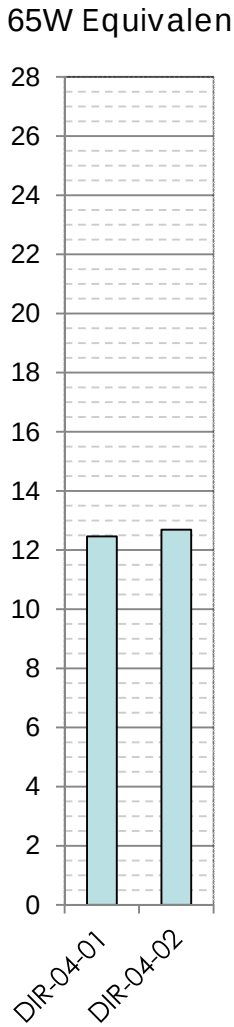

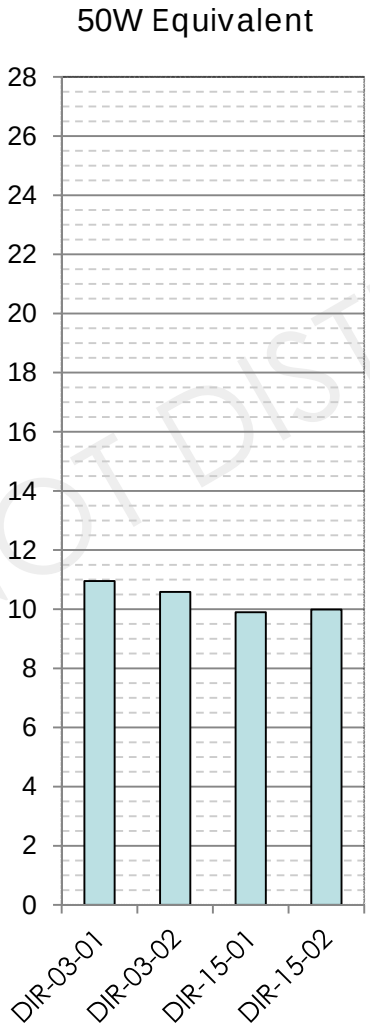

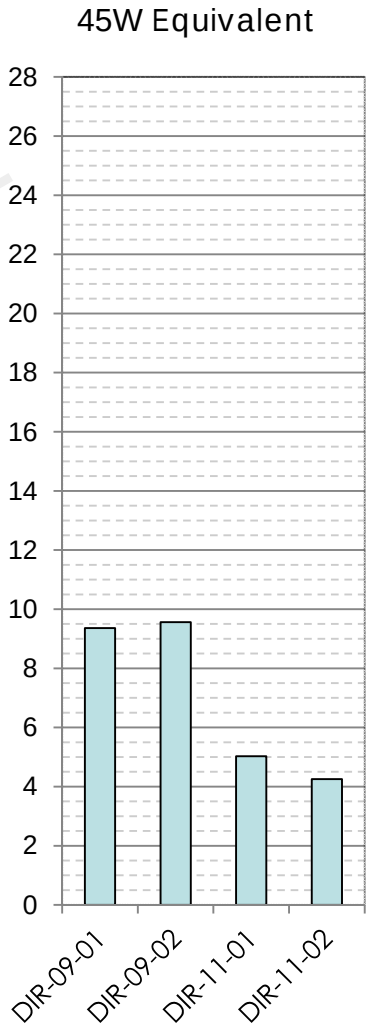

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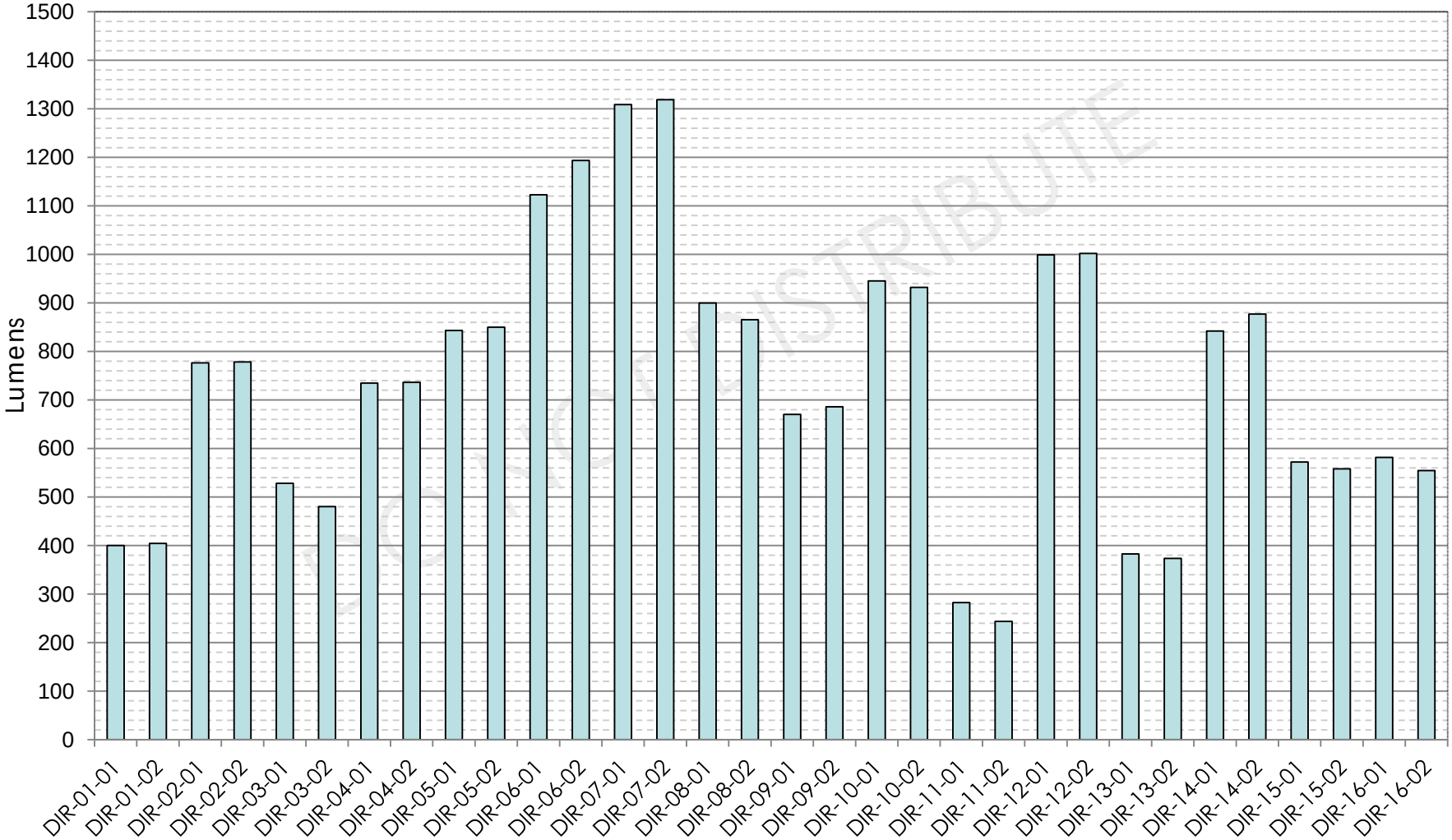
Output

Minor gridlines = 20 lumens



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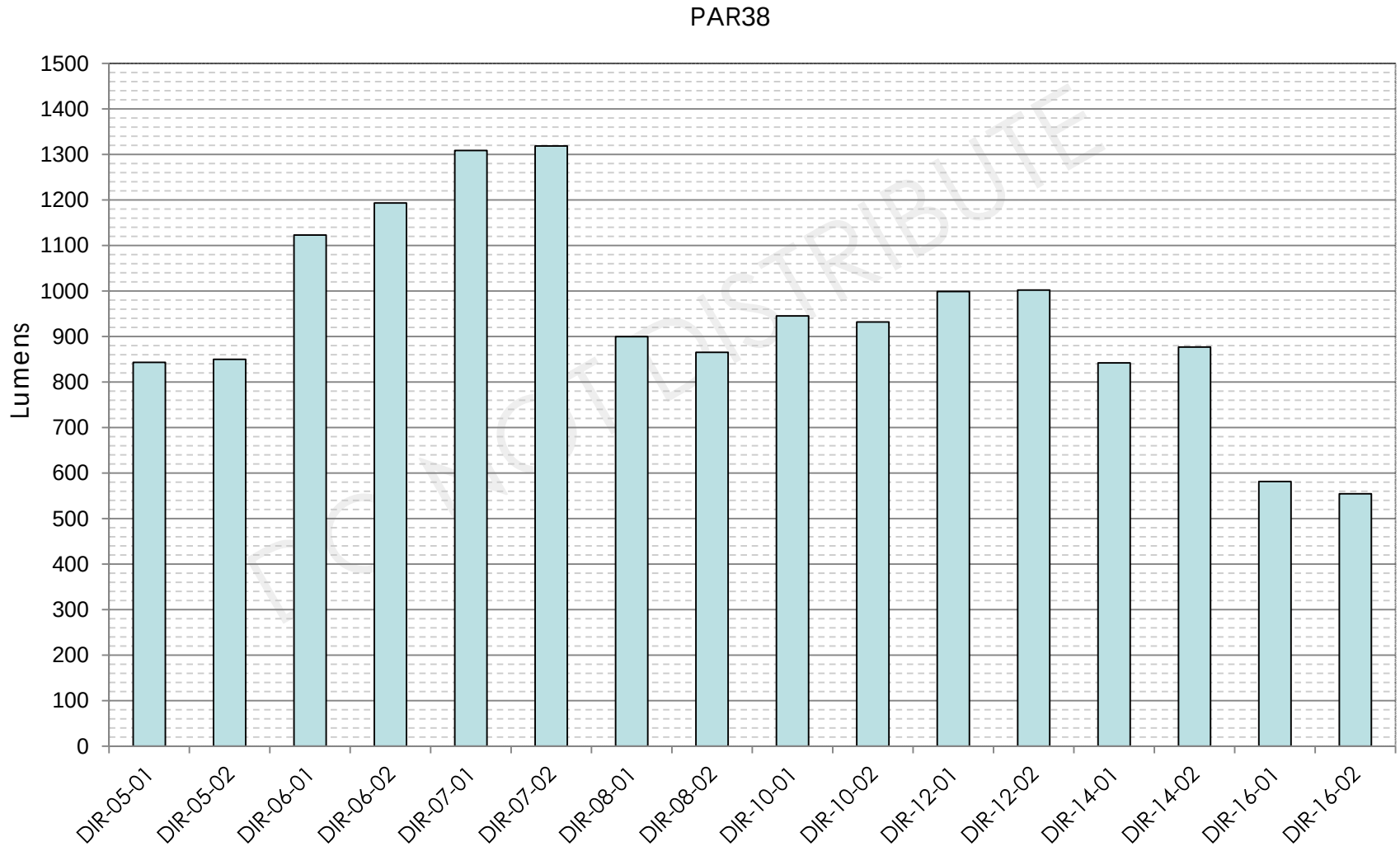
Output – Sorted by lamp size

Minor gridlines = 20 lumens



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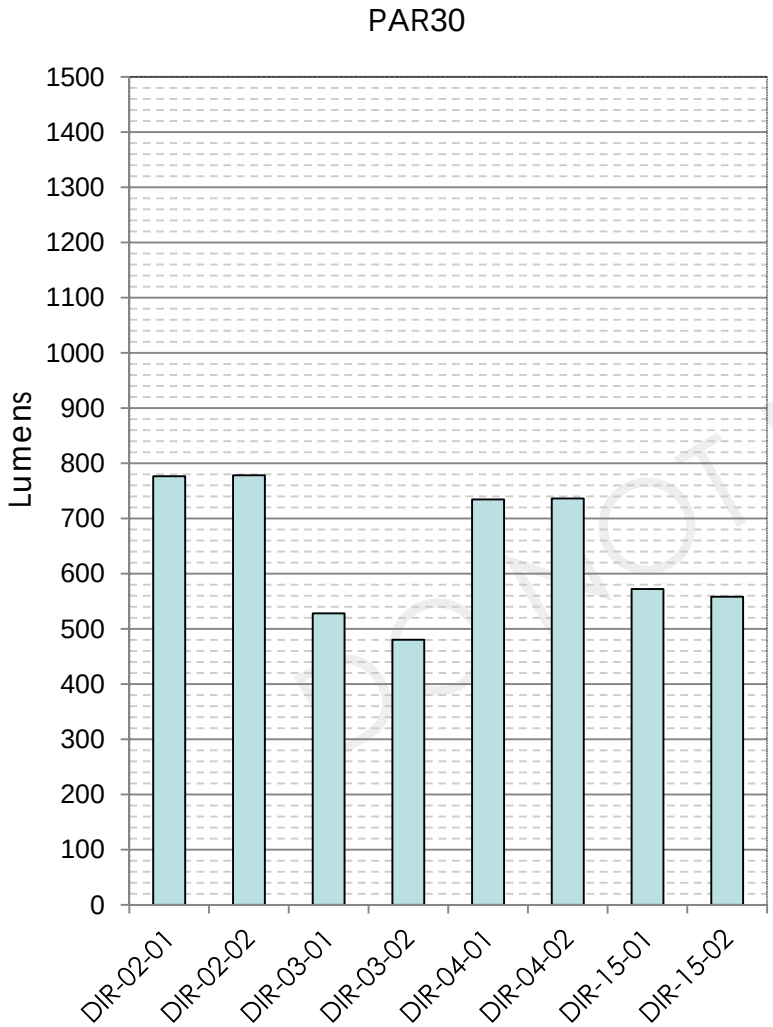

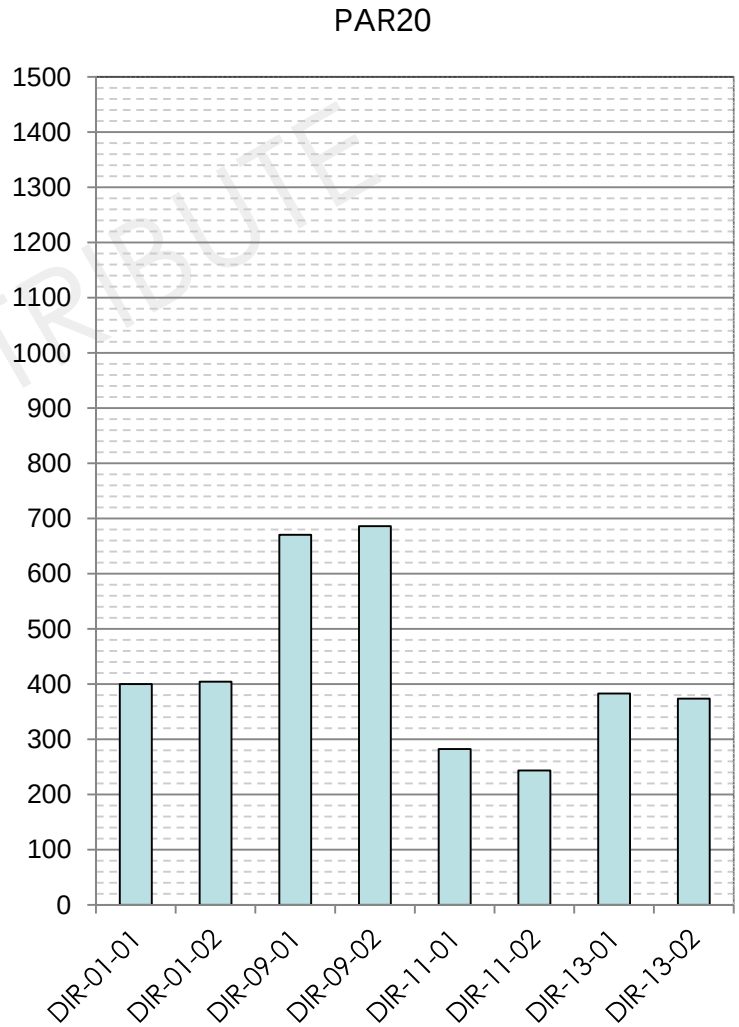

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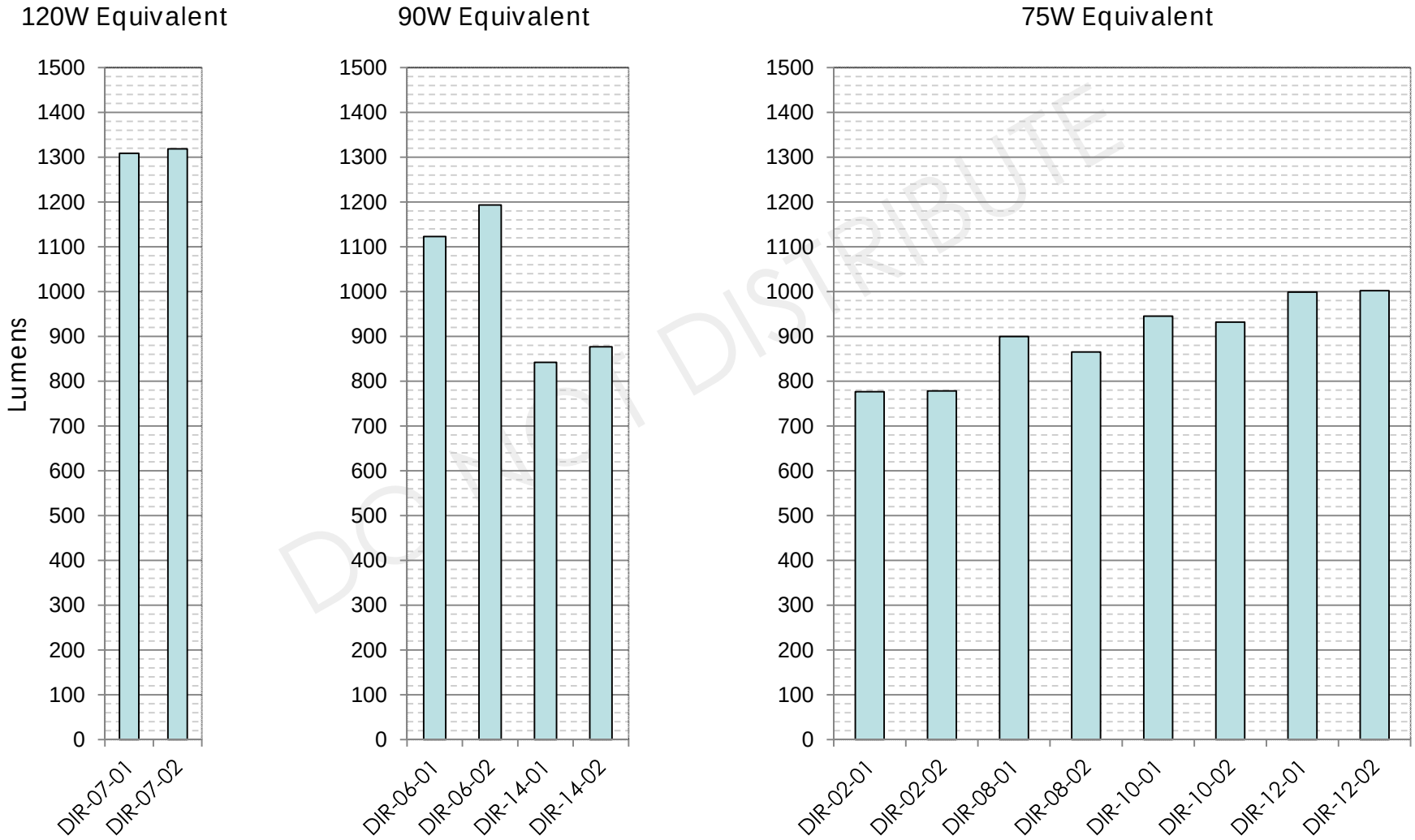

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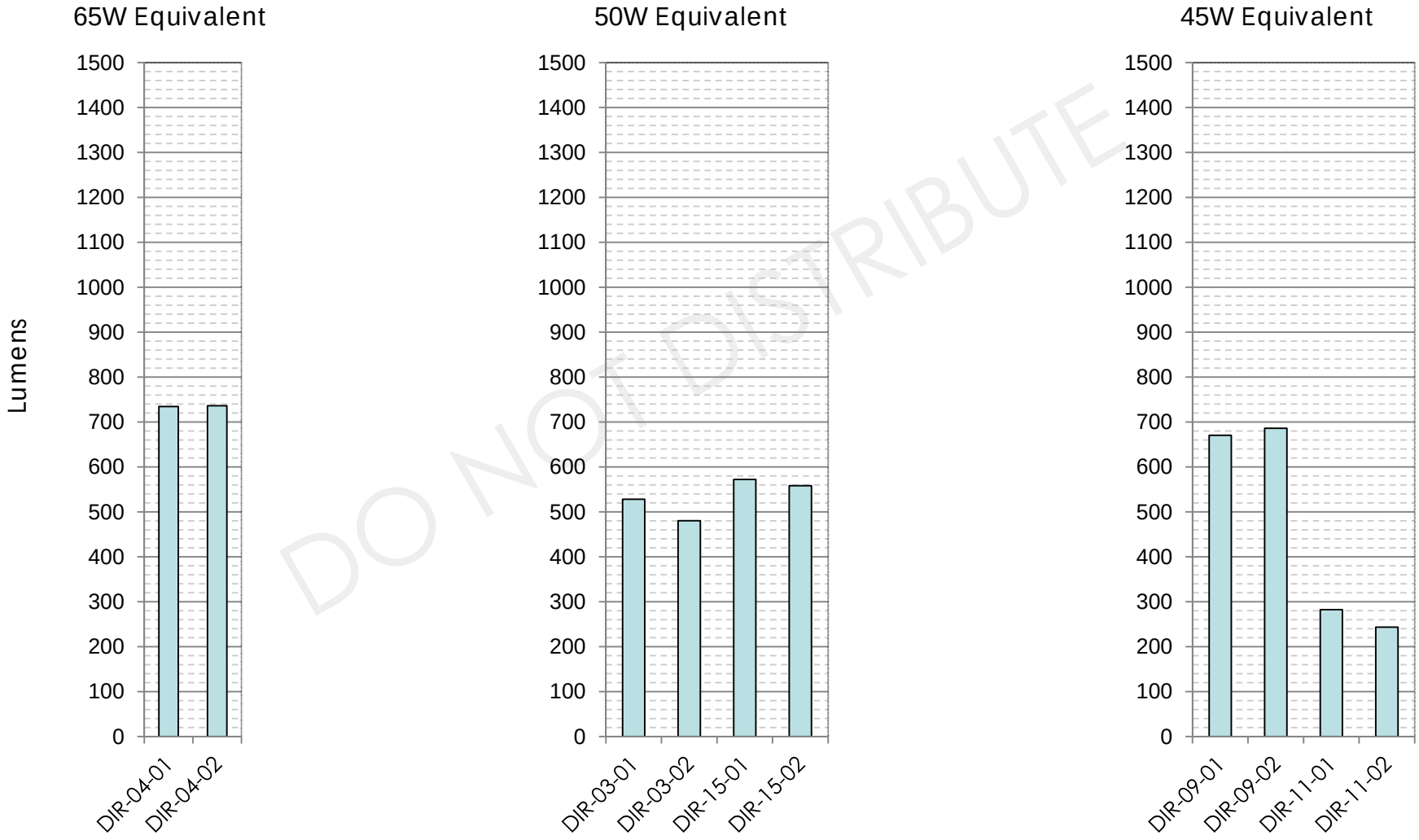

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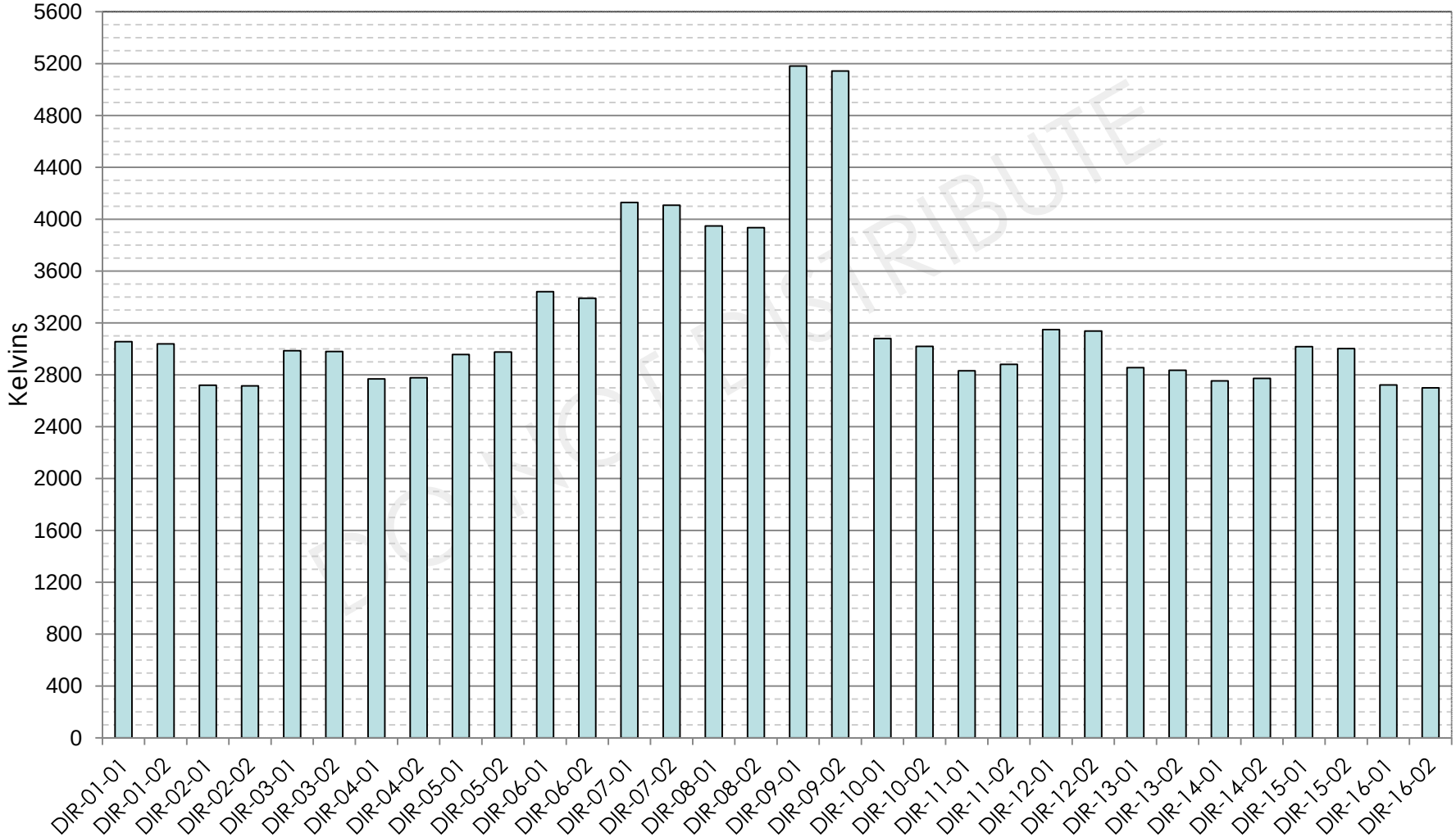
CCT

Minor gridlines = 100 Kelvins



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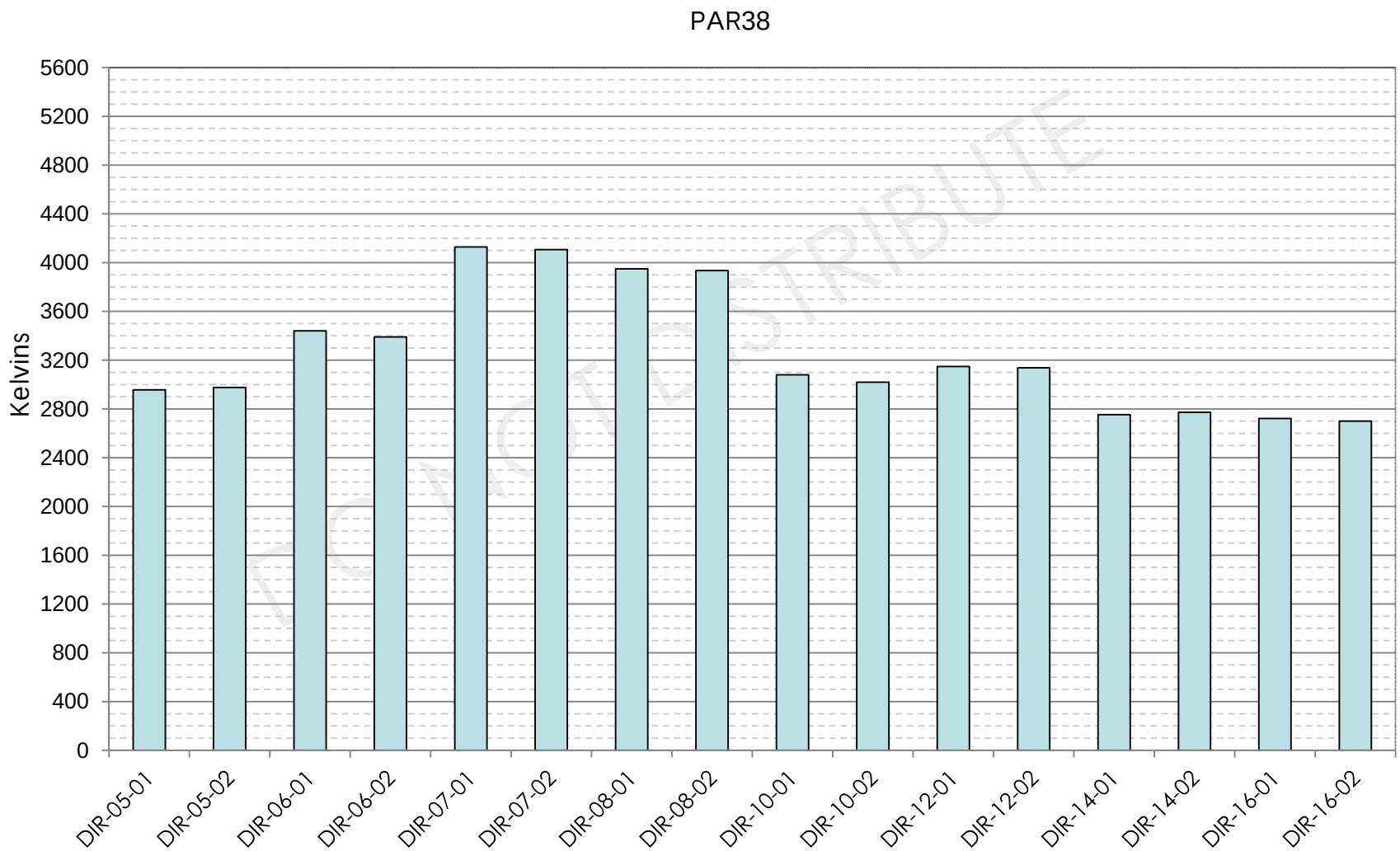
CCT – Sorted by lamp size

Minor gridlines = 100 Kelvins



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CCT – Sorted by lamp size

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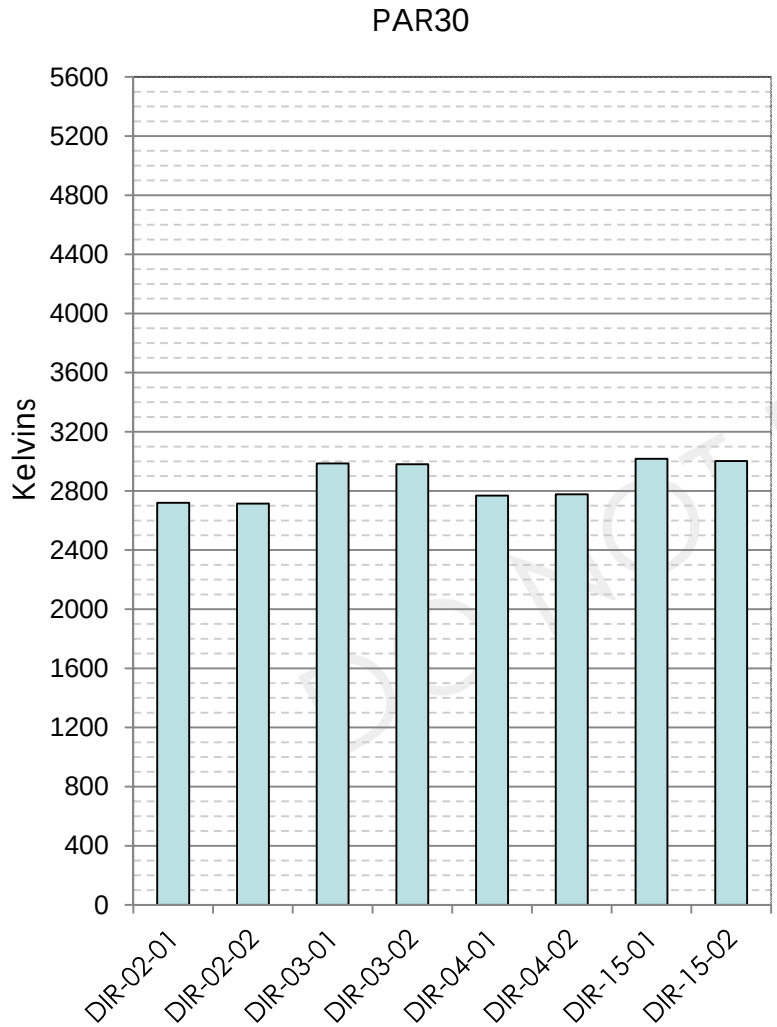

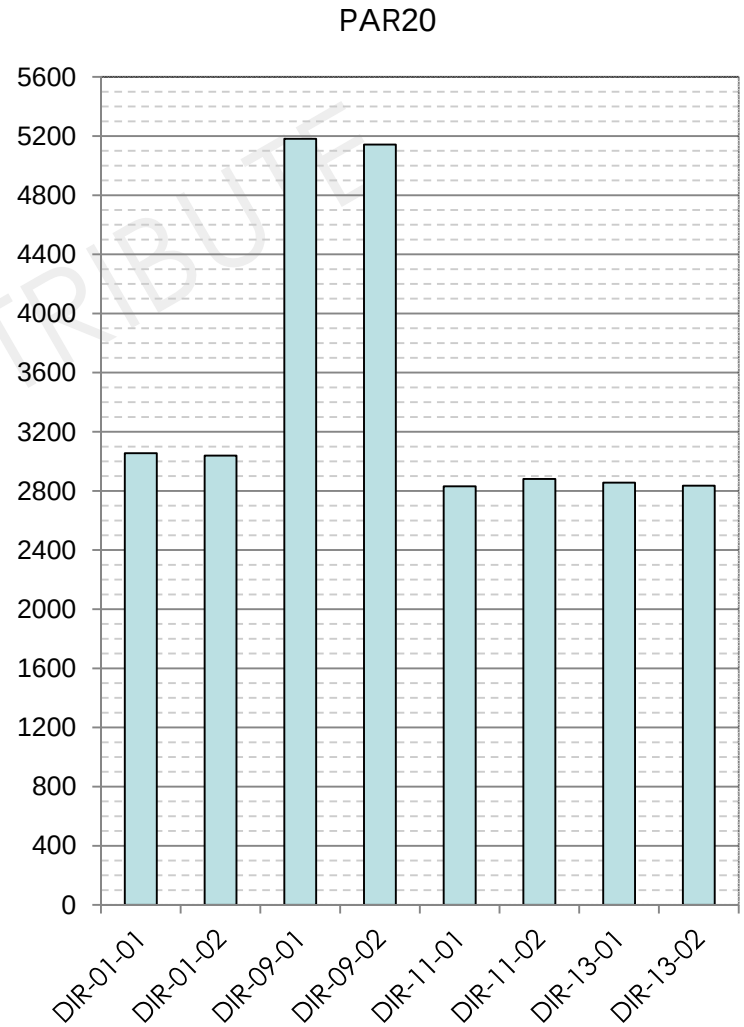

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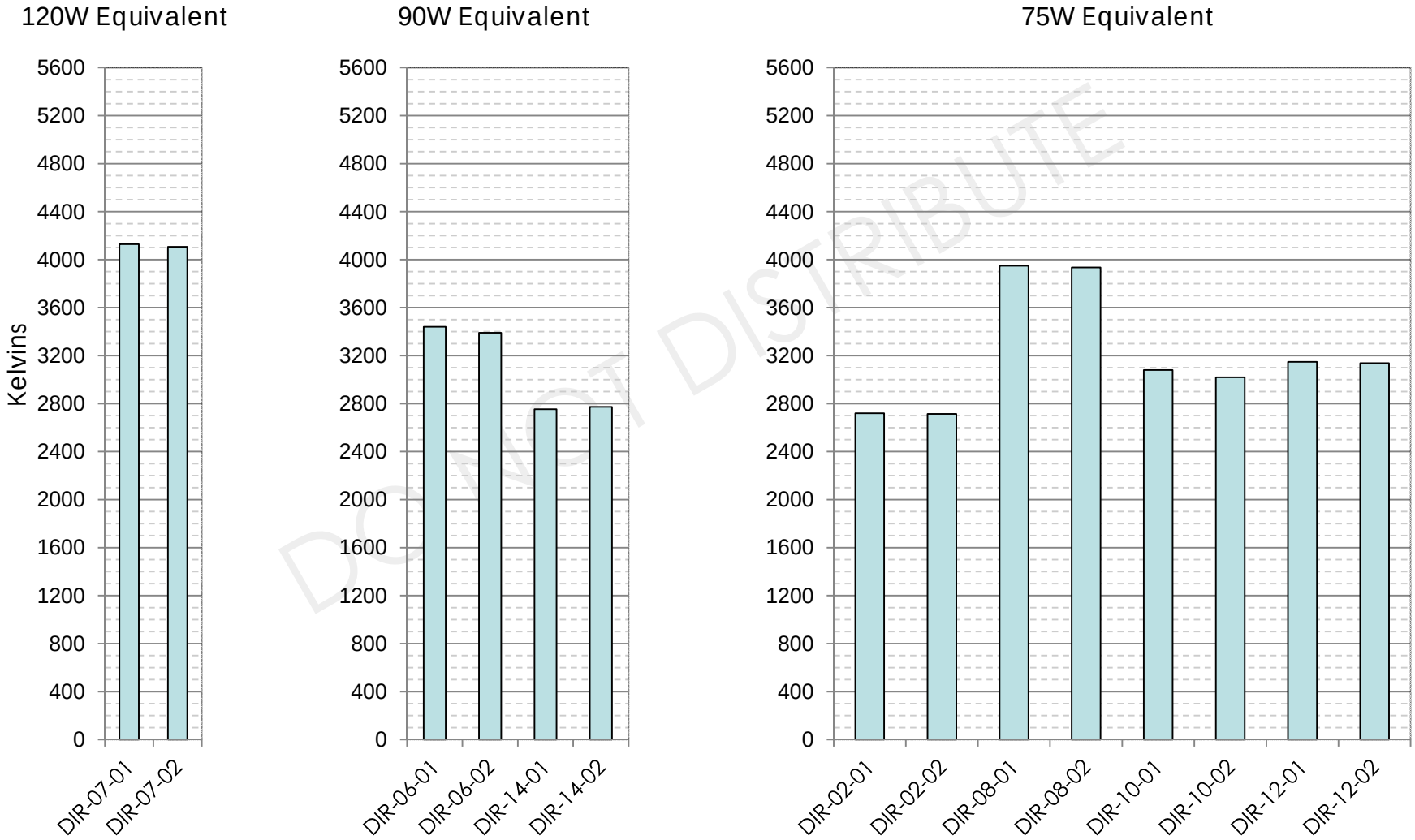

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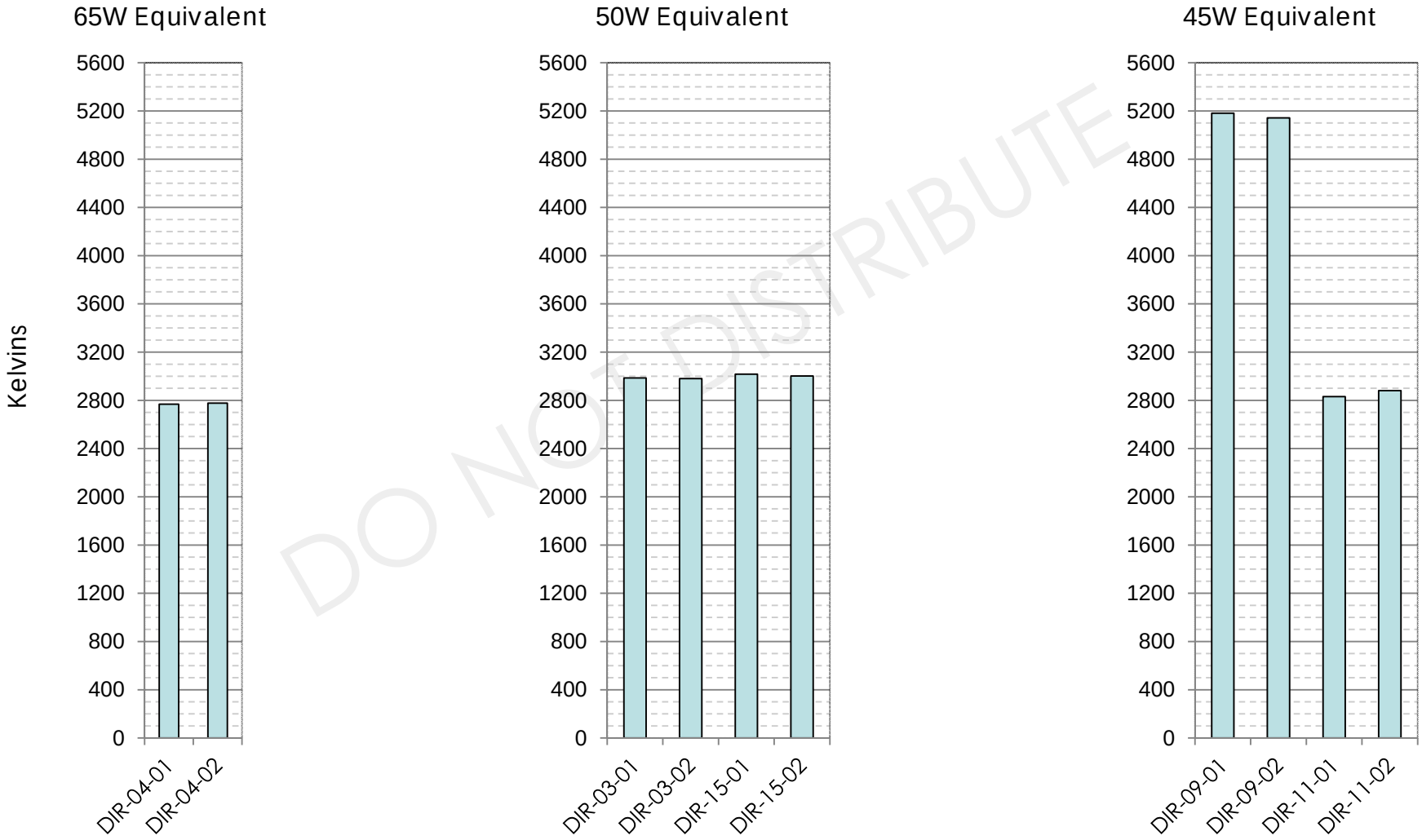

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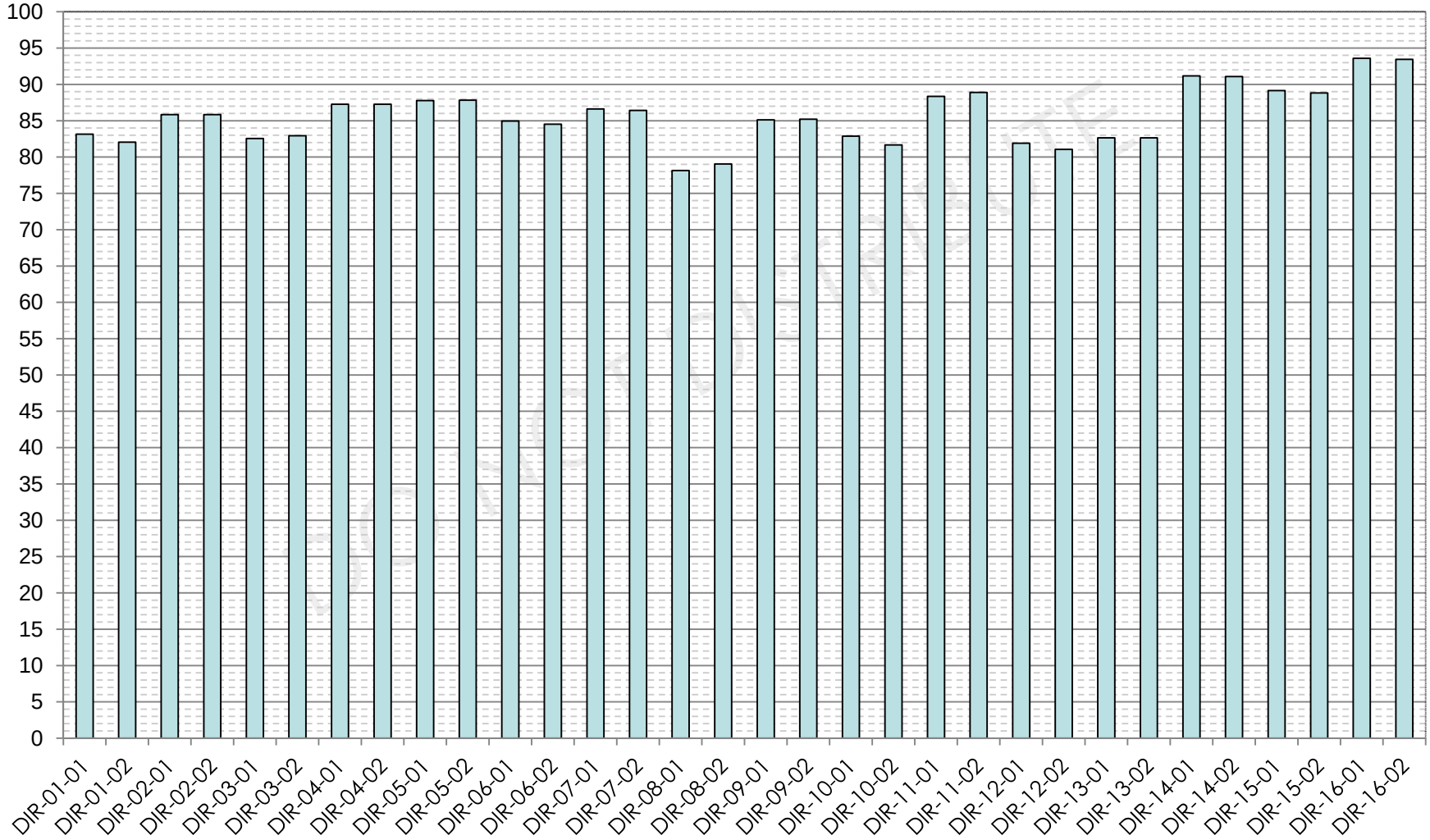
CRI

Minor gridlines = 1 CRI



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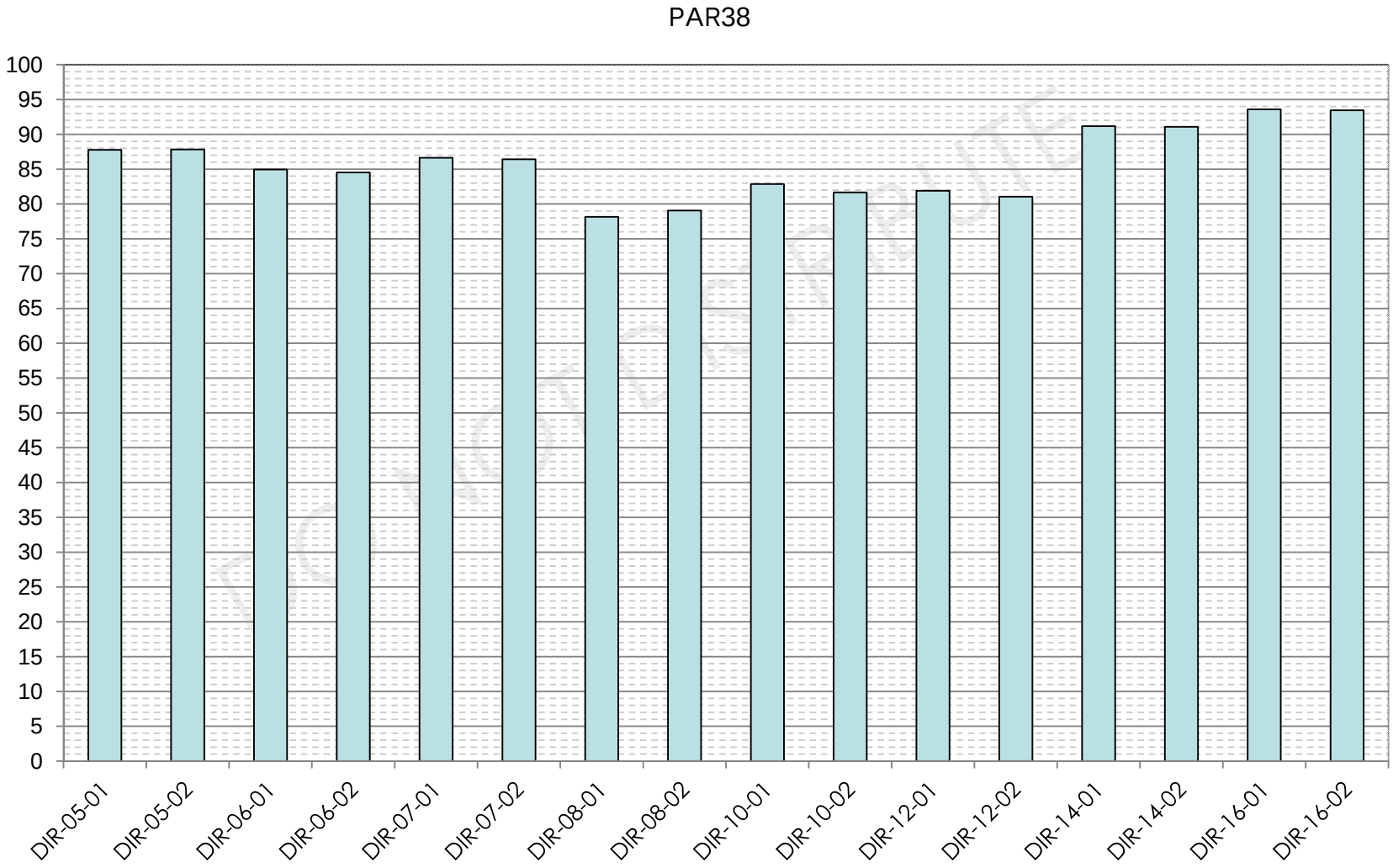
CRI – Sorted by lamp size

Minor gridlines = 1 CRI



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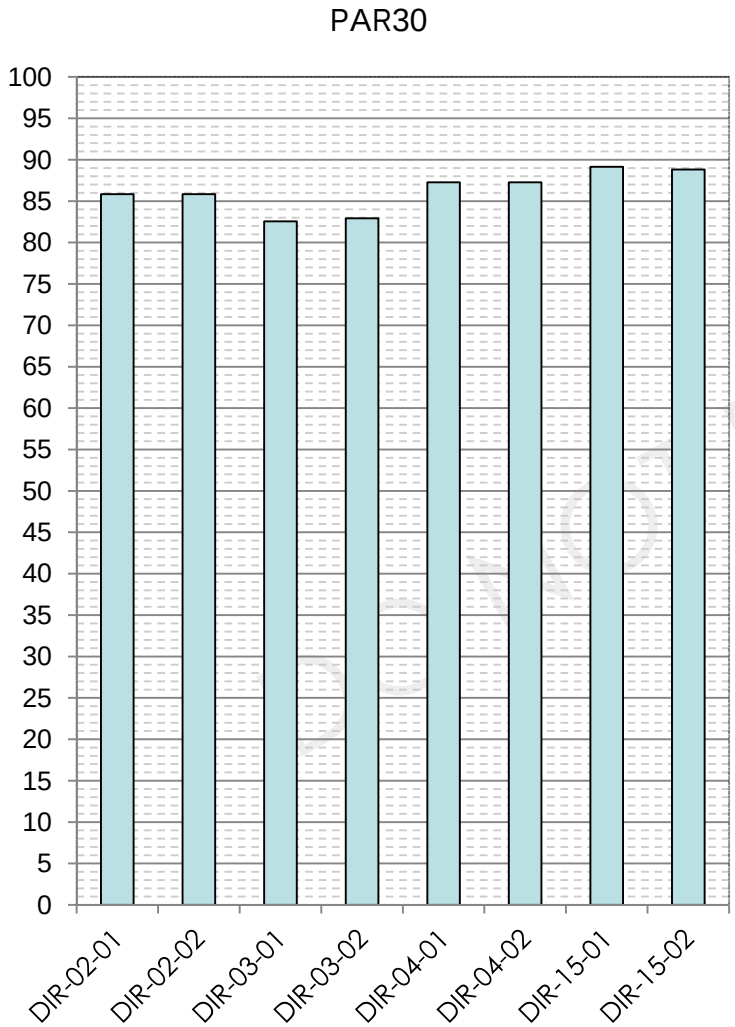
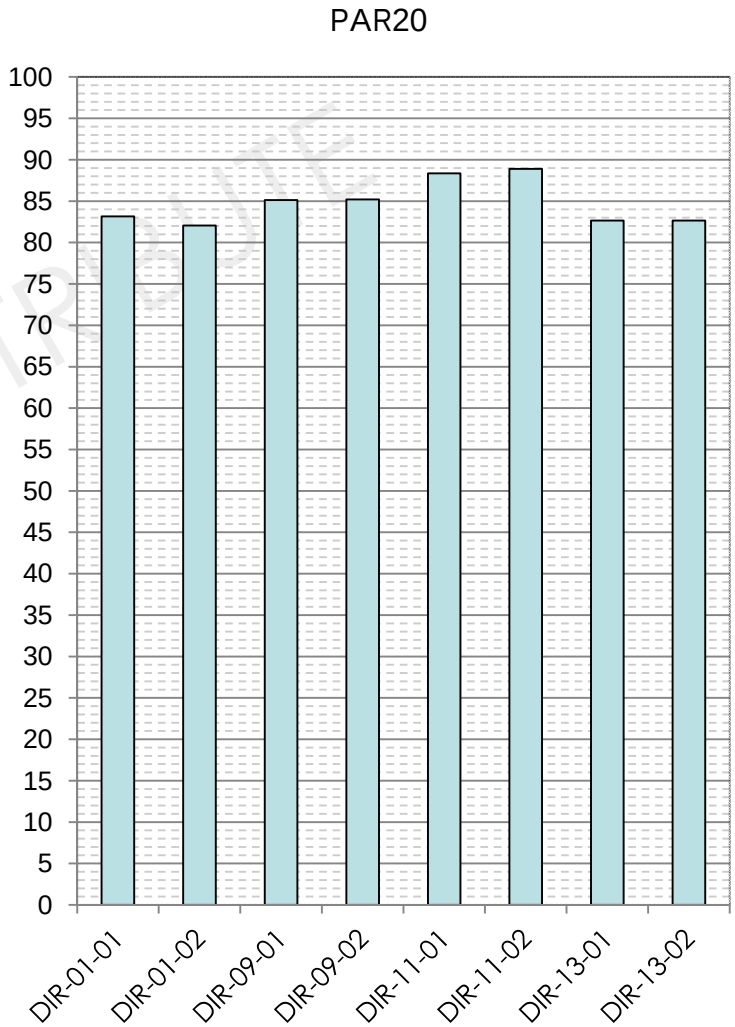
CRI – Sorted by lamp size

Minor gridlines = 1 CRI





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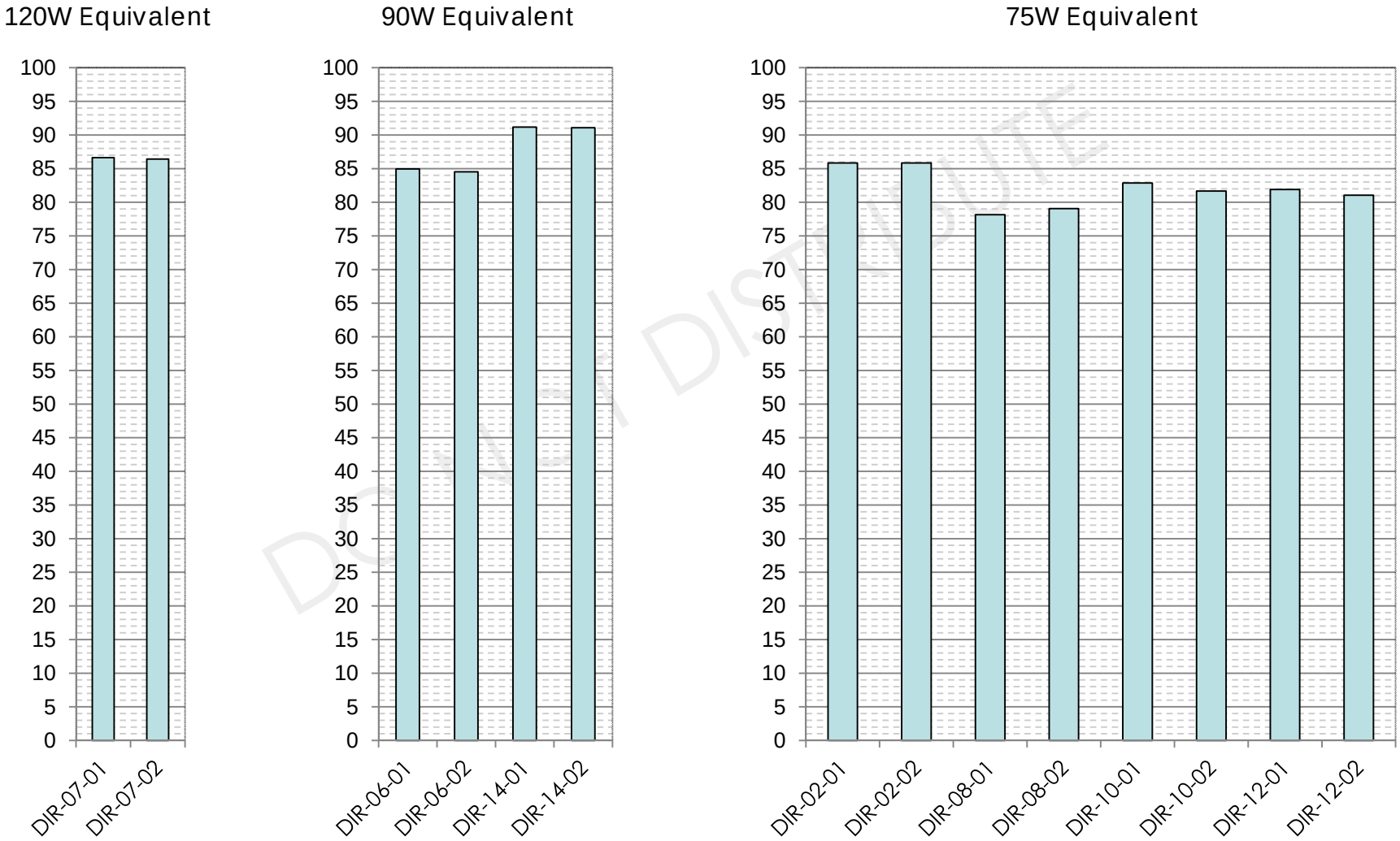
CRI

Minor gridlines = 1 CRI



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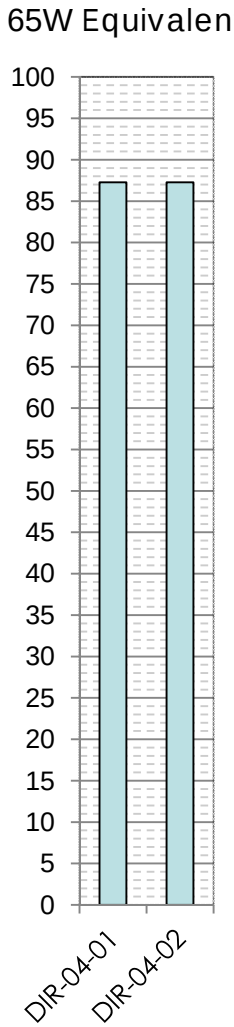
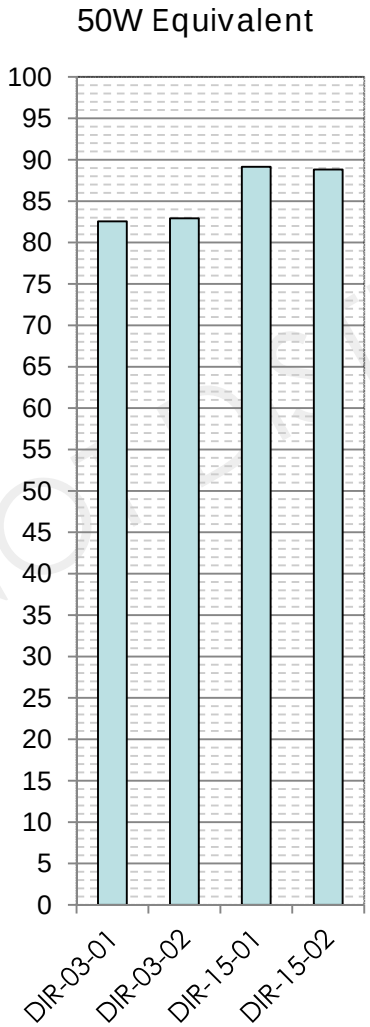
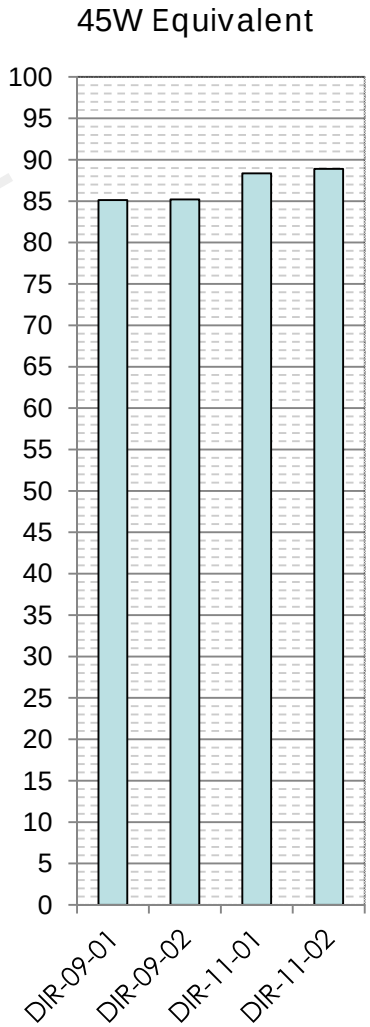
CRI

Minor gridlines = 1 CRI







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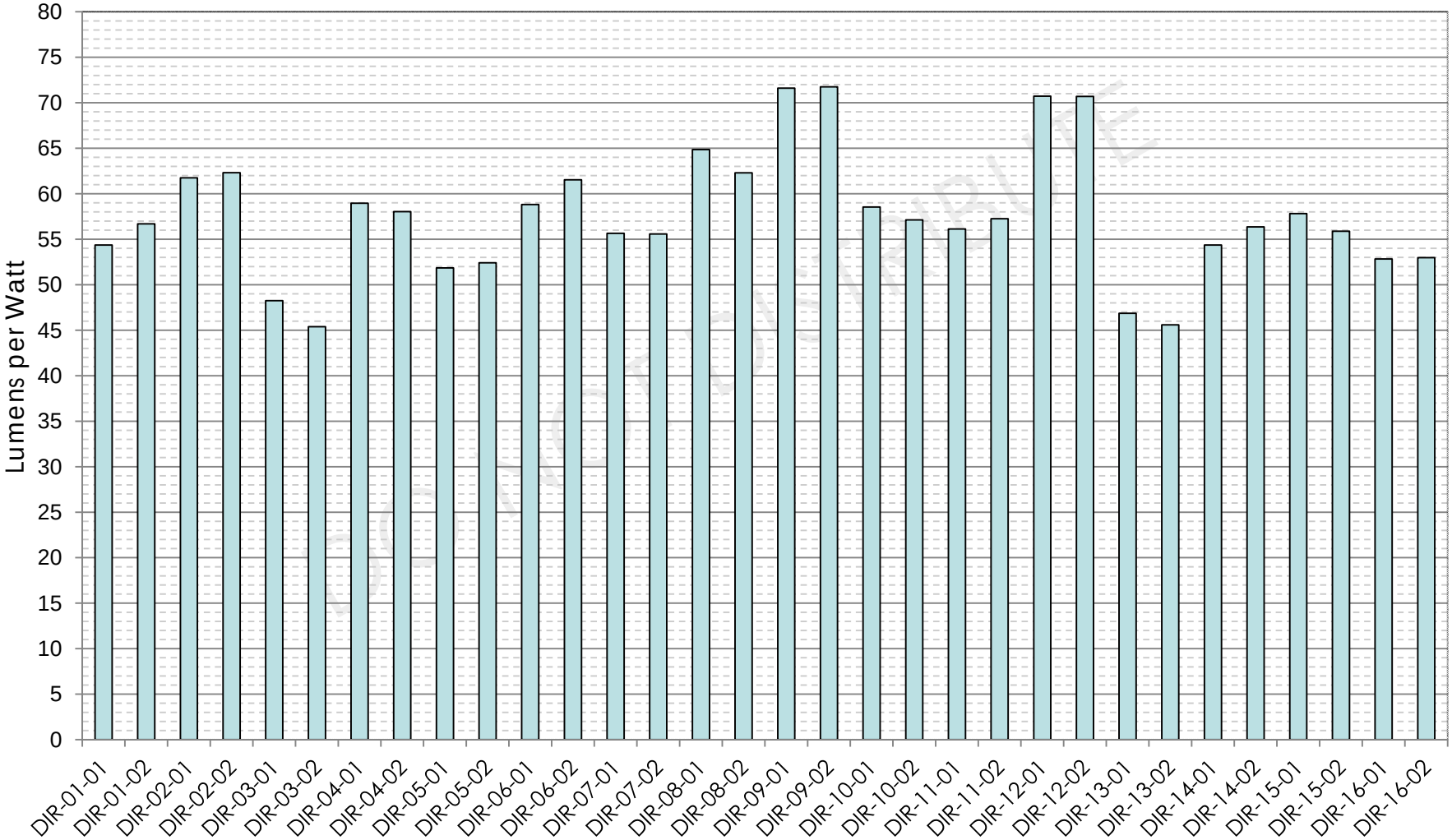
Efficacy

Minor gridlines = 1 LpW



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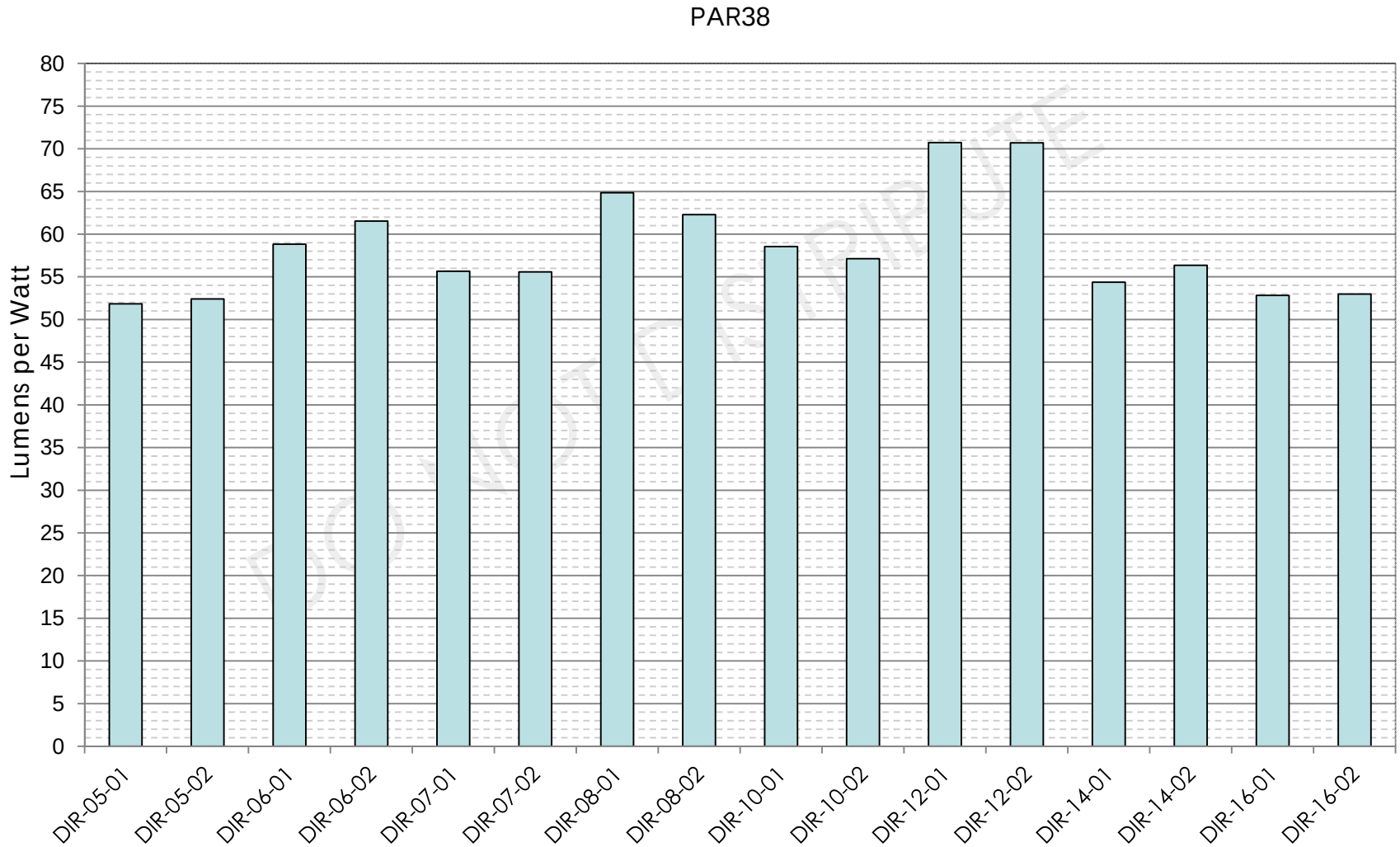
Efficacy – Sorted by lamp size

Minor gridlines = 1 LpW



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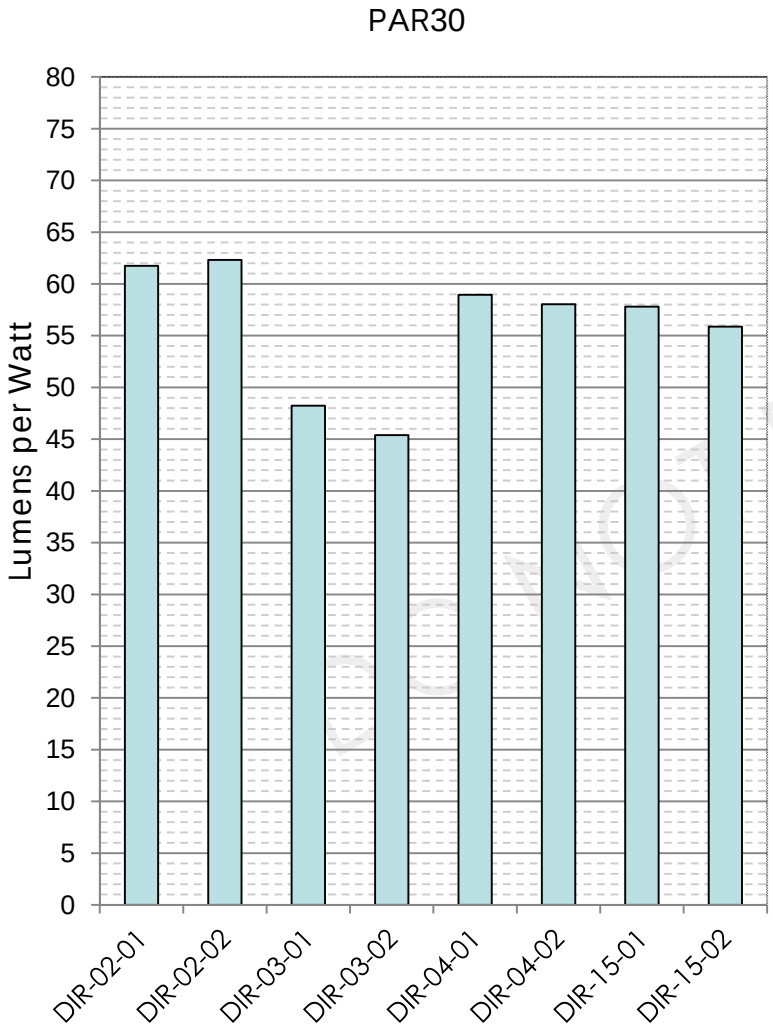
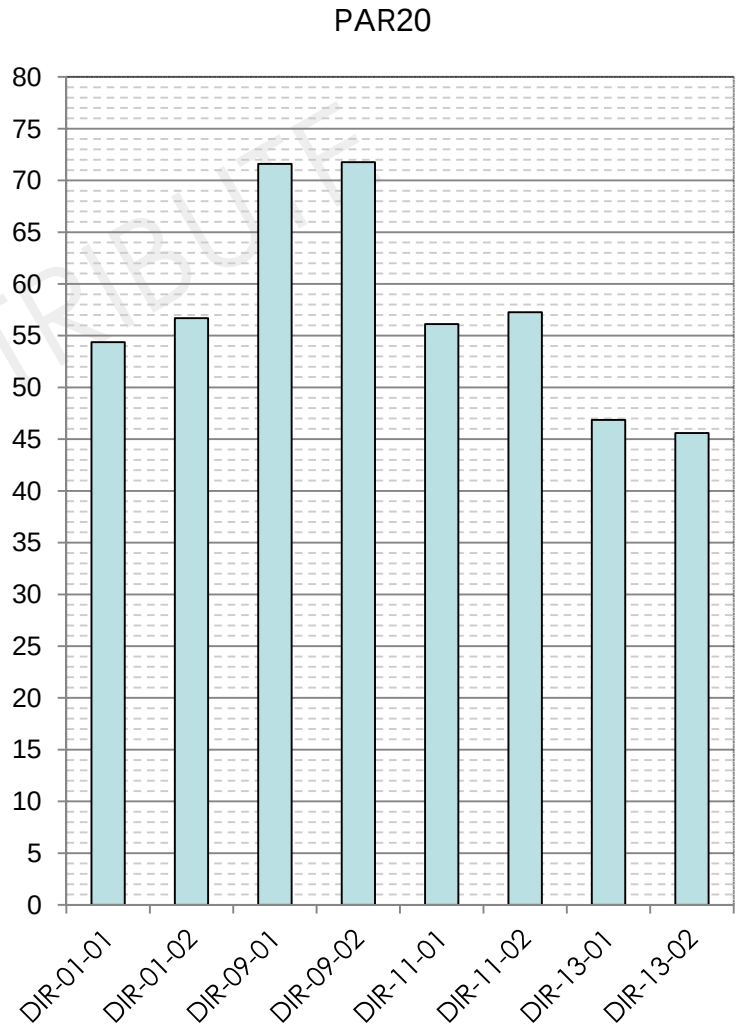
Efficacy – Sorted by lamp size

Minor gridlines = 1 LpW





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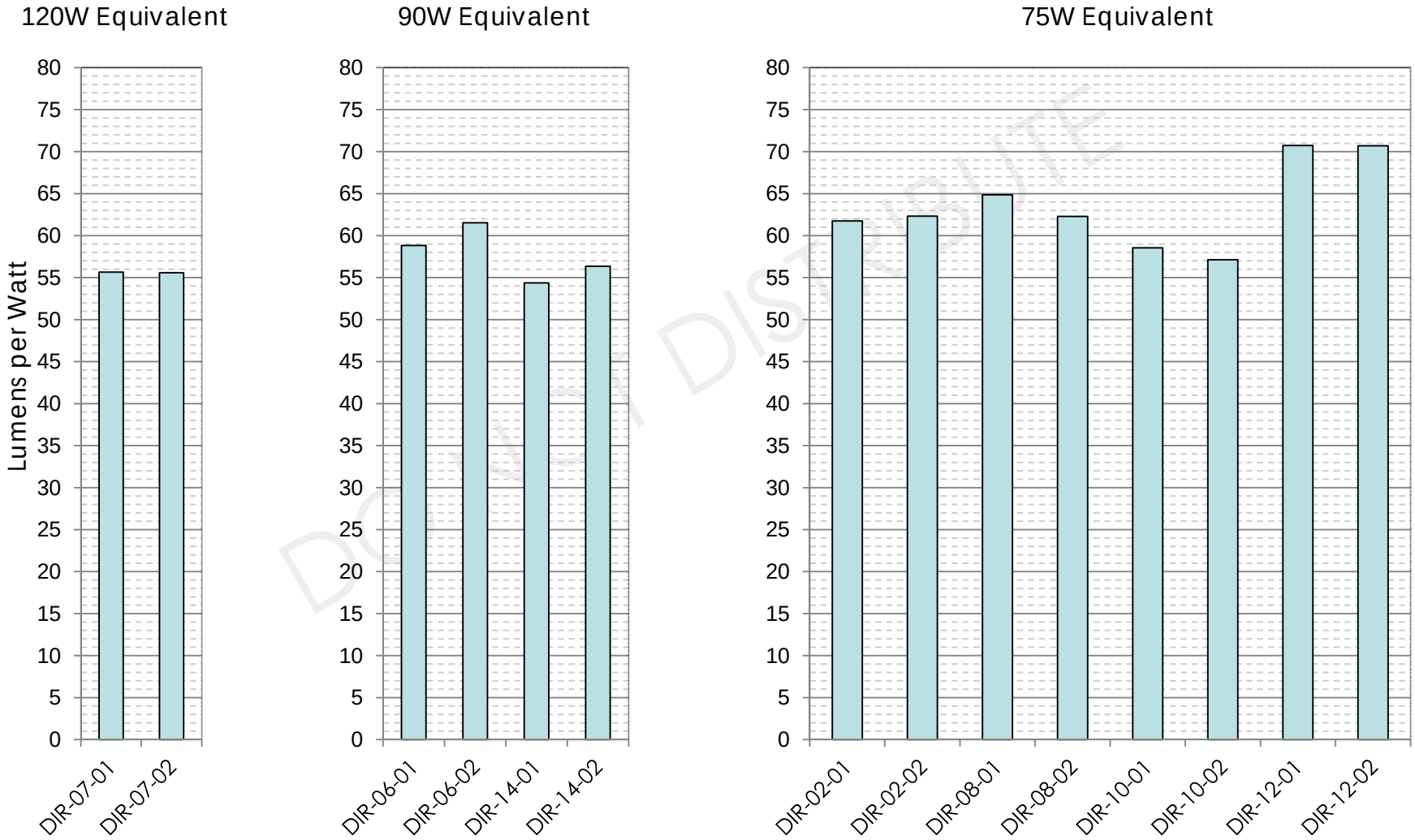
Minor gridlines = 1 LpW



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Efficacy

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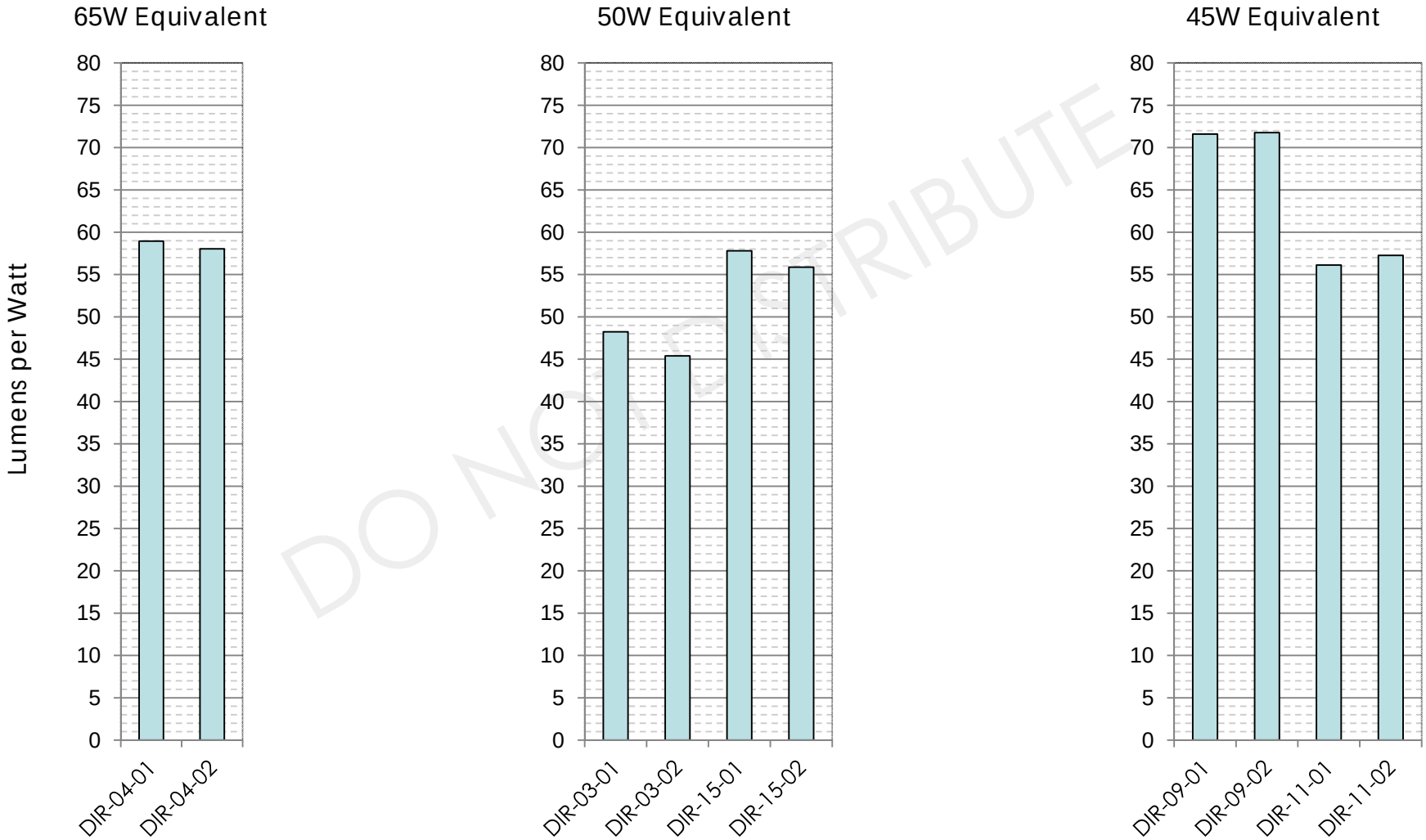

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Goniometer
Summary Charts

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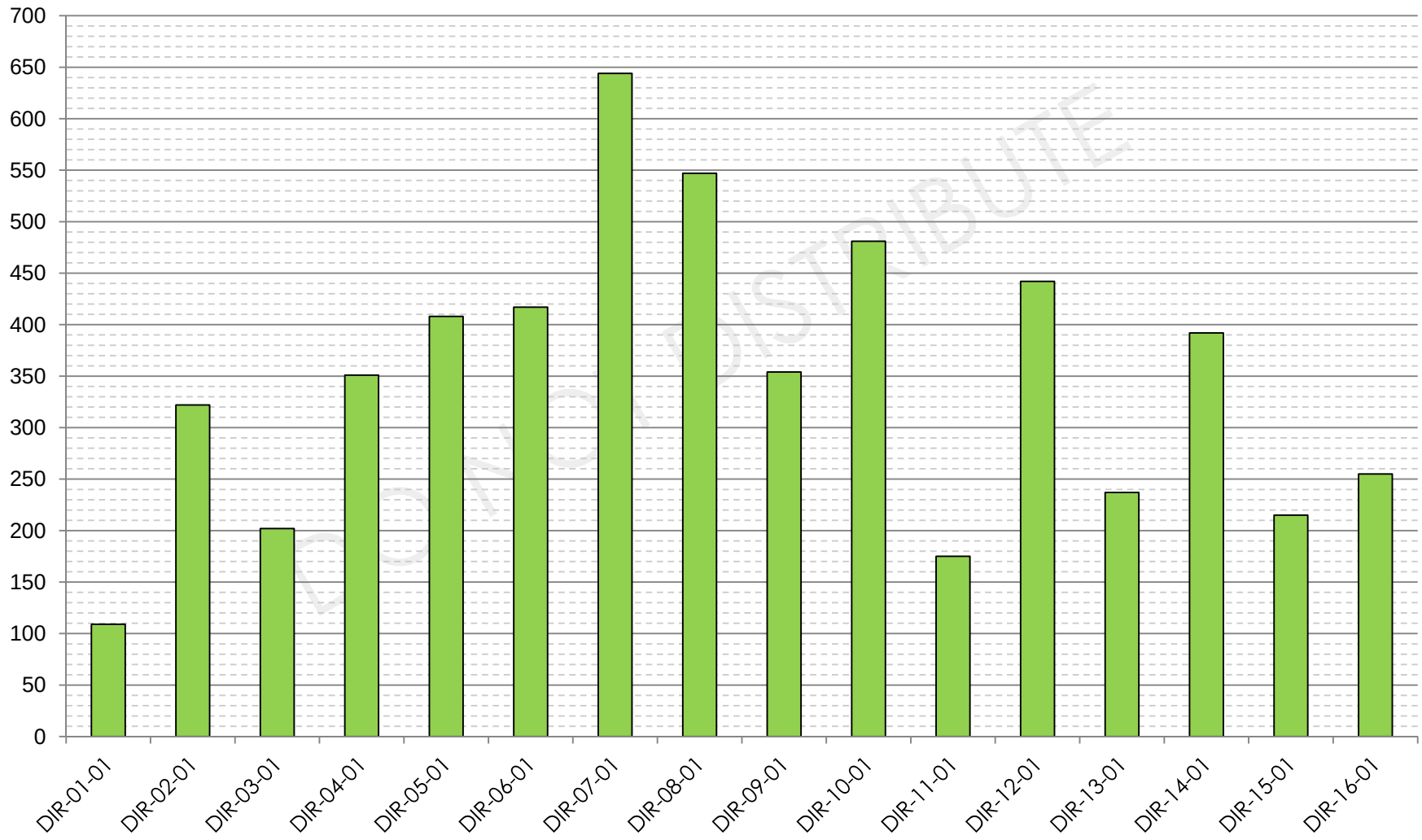
Beam Lumens

Minor gridlines = 10 Lumens



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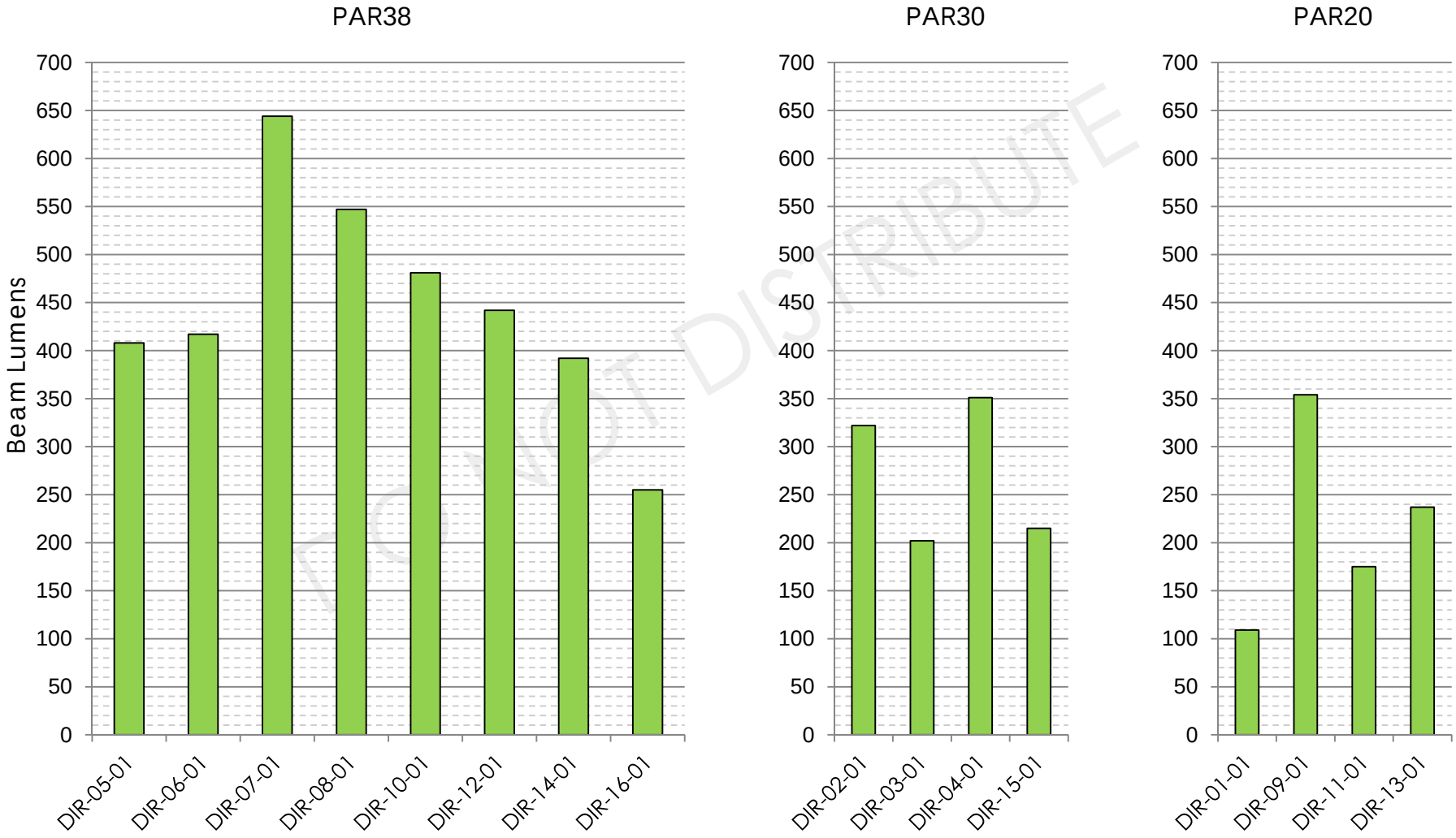
Beam Lumens – Sorted by lamp size

Minor gridlines = 10 Lumens



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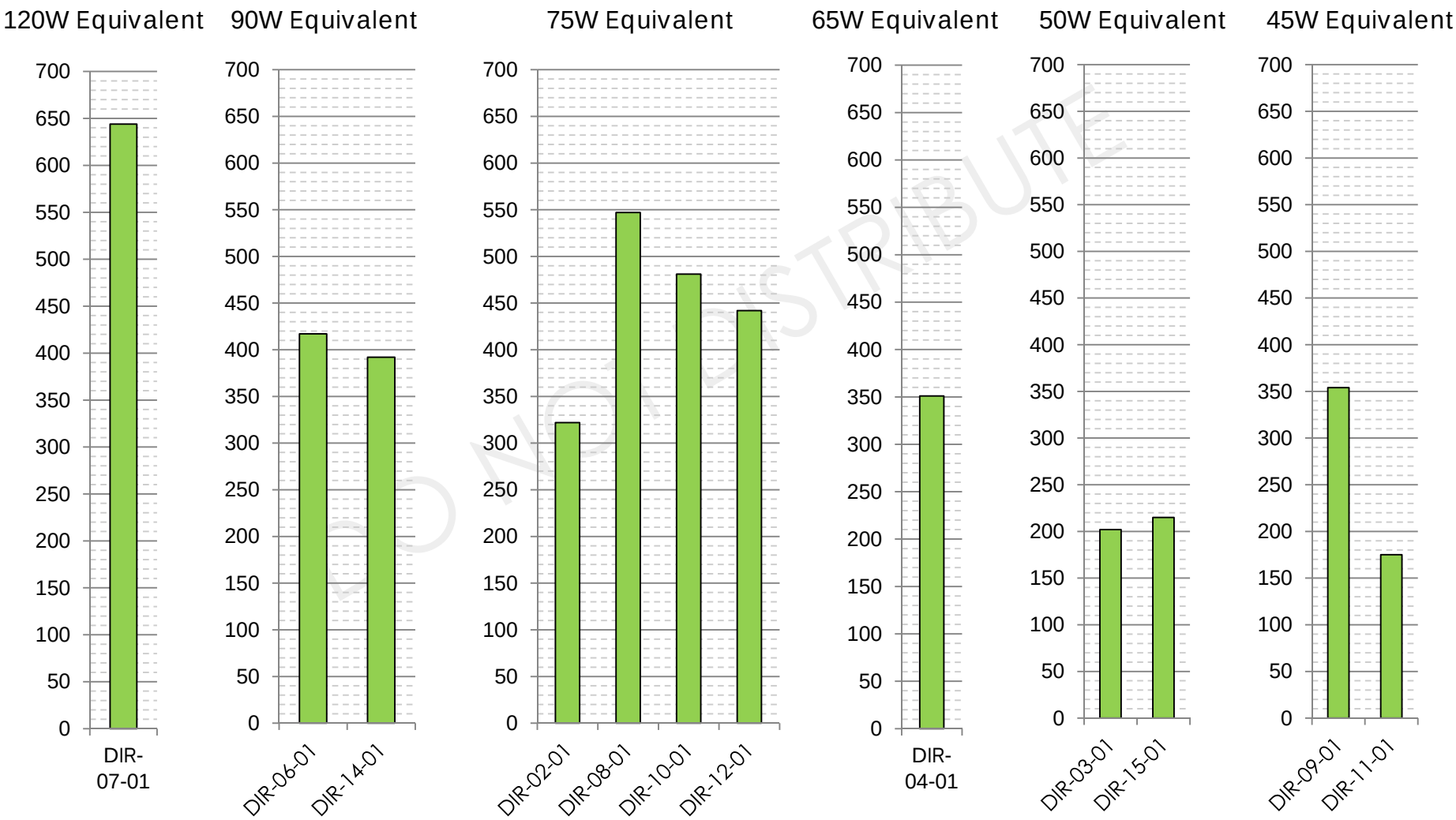
Beam Lumens

Minor gridlines = 10 Lumens



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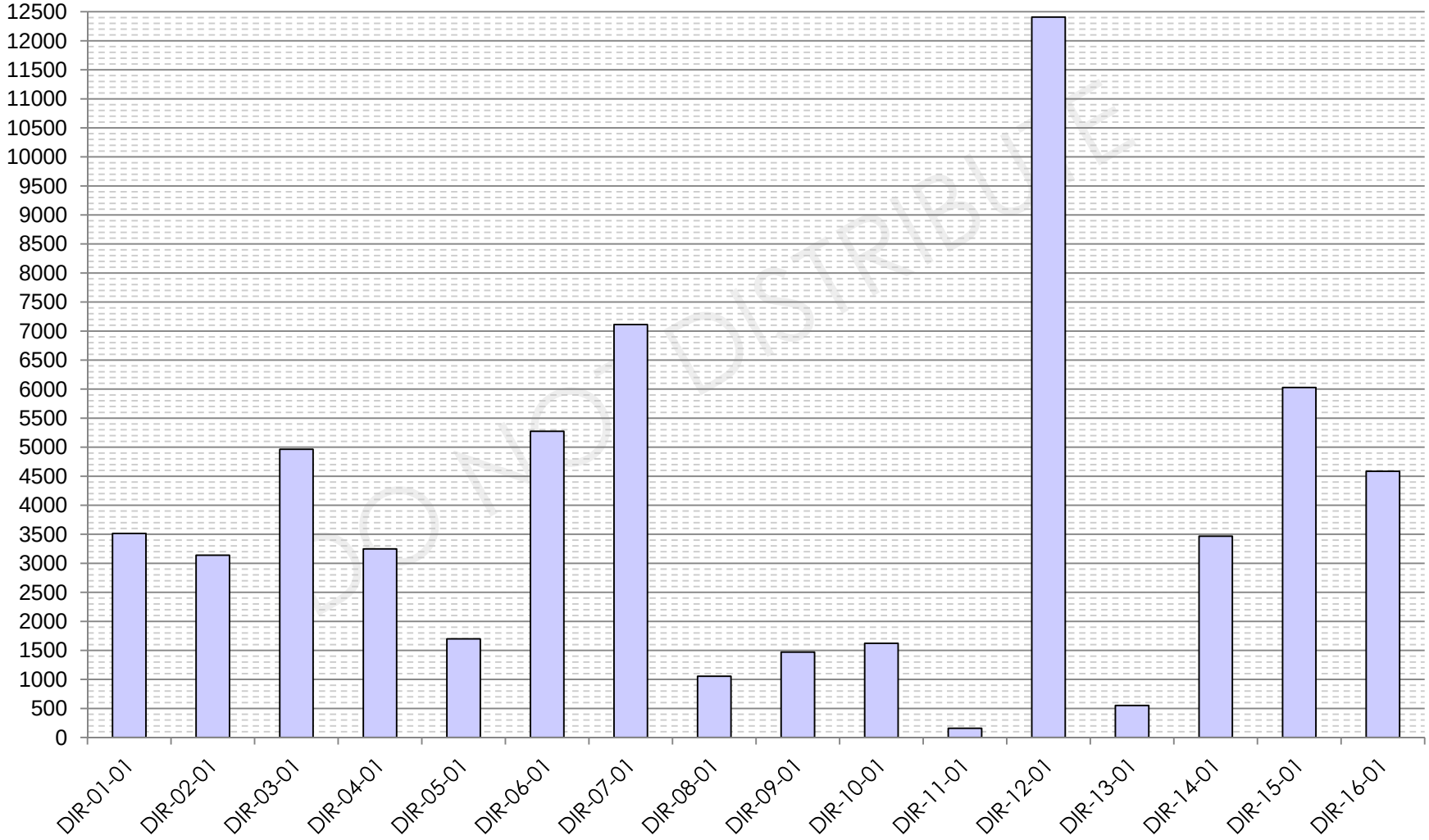
Center Beam Candlepower

Minor gridlines = 100 Candela



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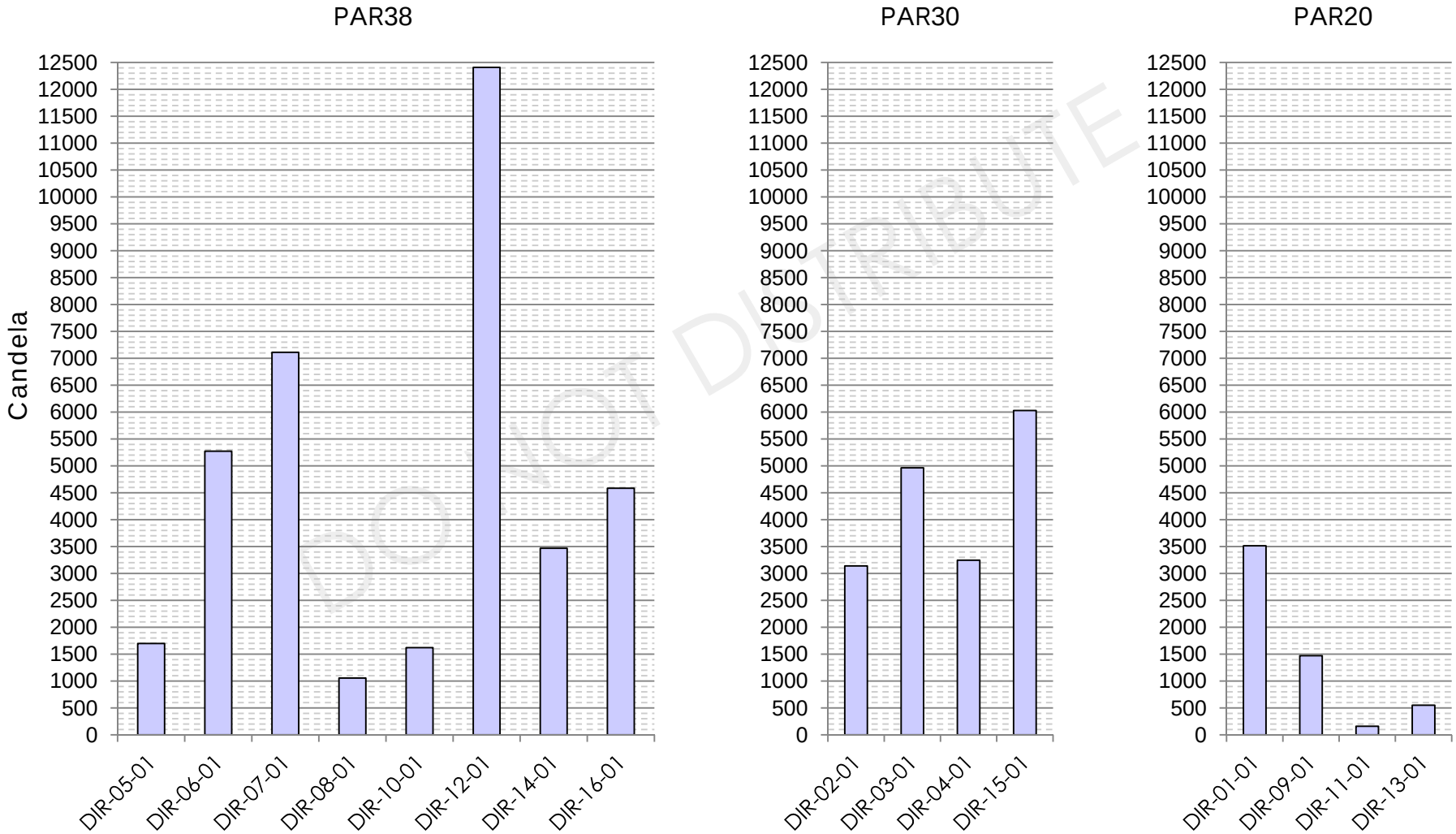
Center Beam Candlepower – Sorted by lamp size

Minor gridlines = 100 Candela



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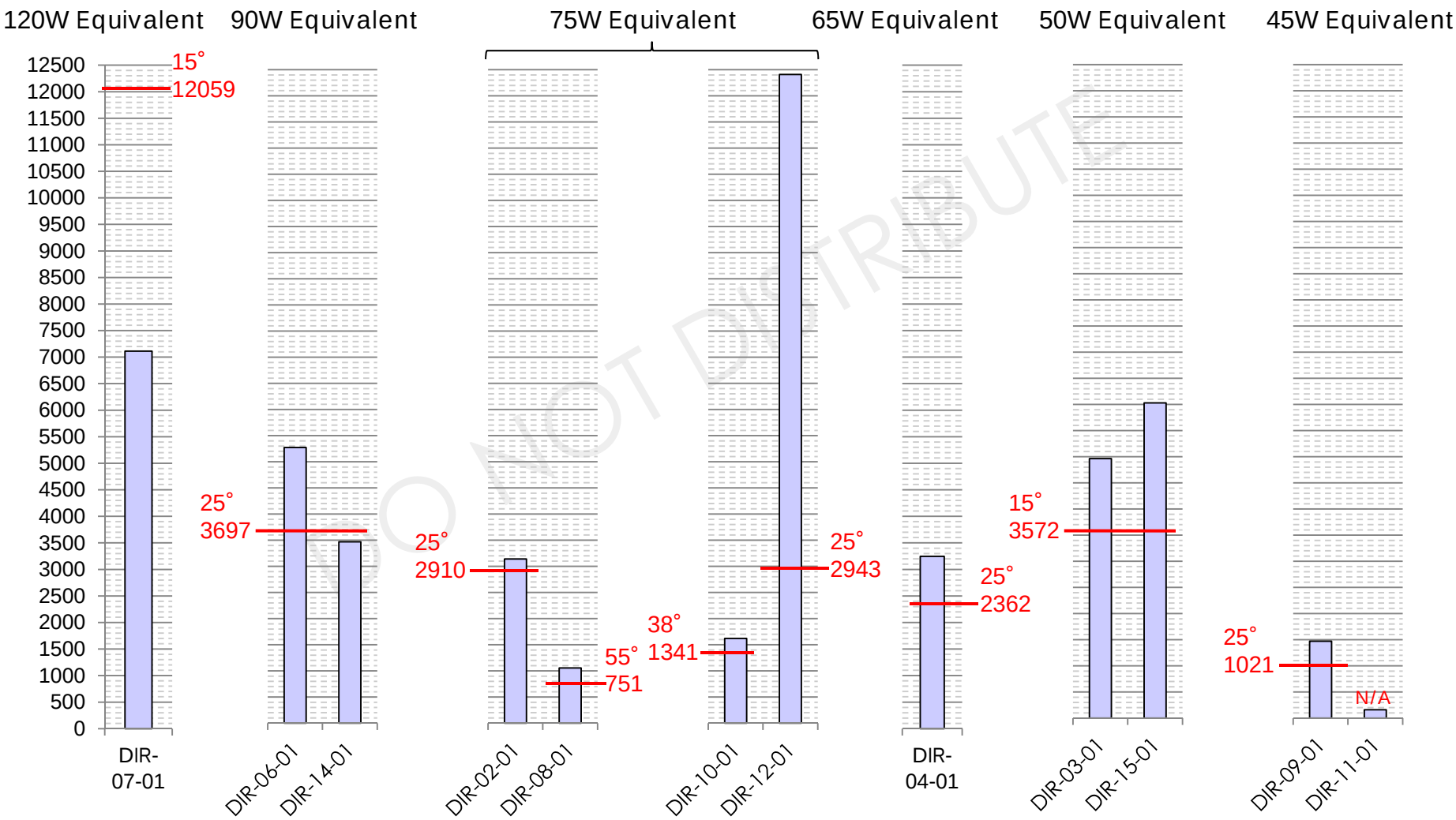
Center Beam Candlepower

Red lines denote ENERGY STAR minimum requirements.
Minimum candela values calculated with "ENERGY STAR Integral LED Lamp Center Beam Intensity Benchmark Tool"
Minor gridlines = 100 Candela



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2-Meter Integrating Sphere
Summary Charts
By Orientation

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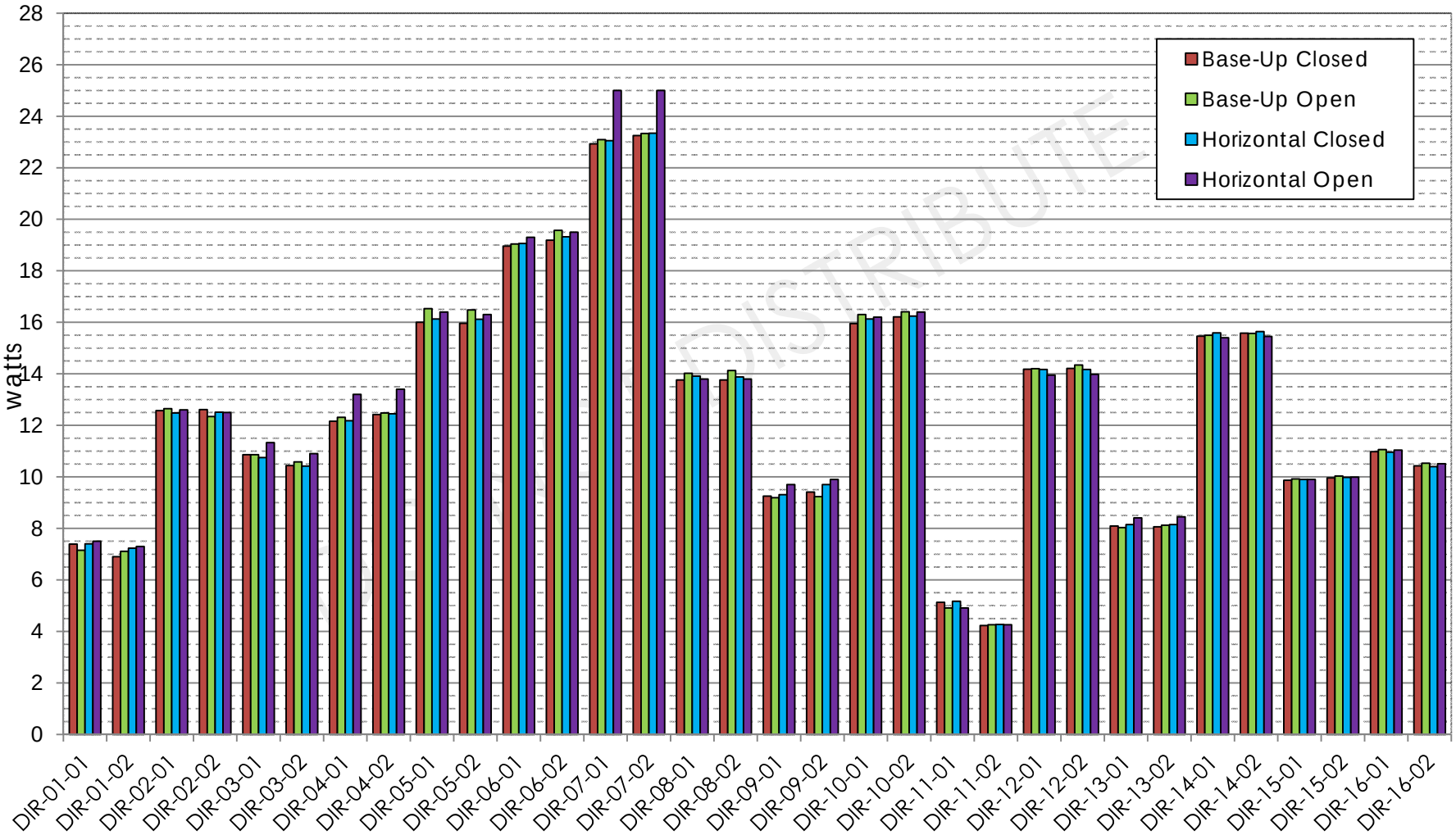
System Power

Minor gridlines = 0.5 W



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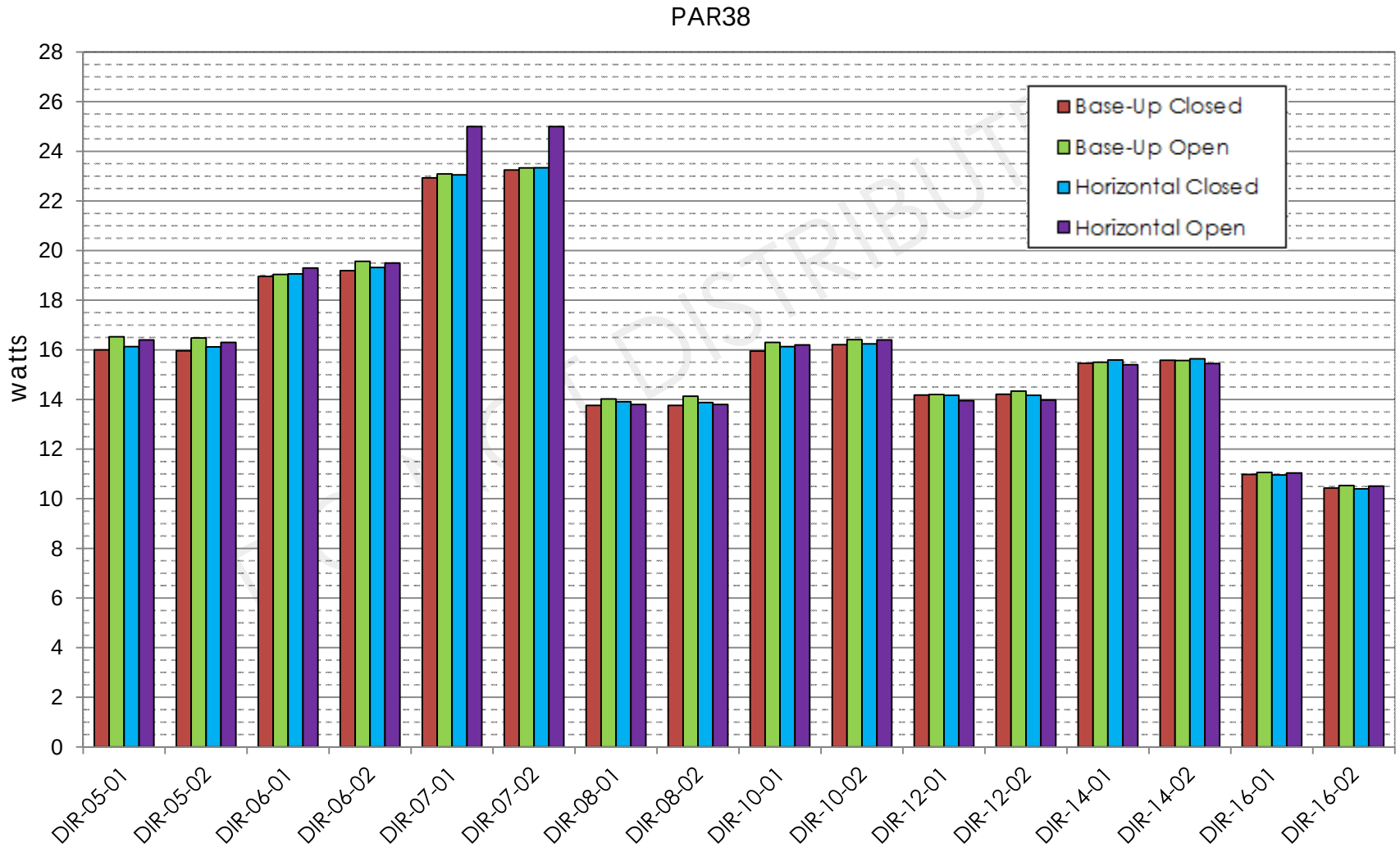
System Power – Sorted by lamp size

Minor gridlines = 0.5 W



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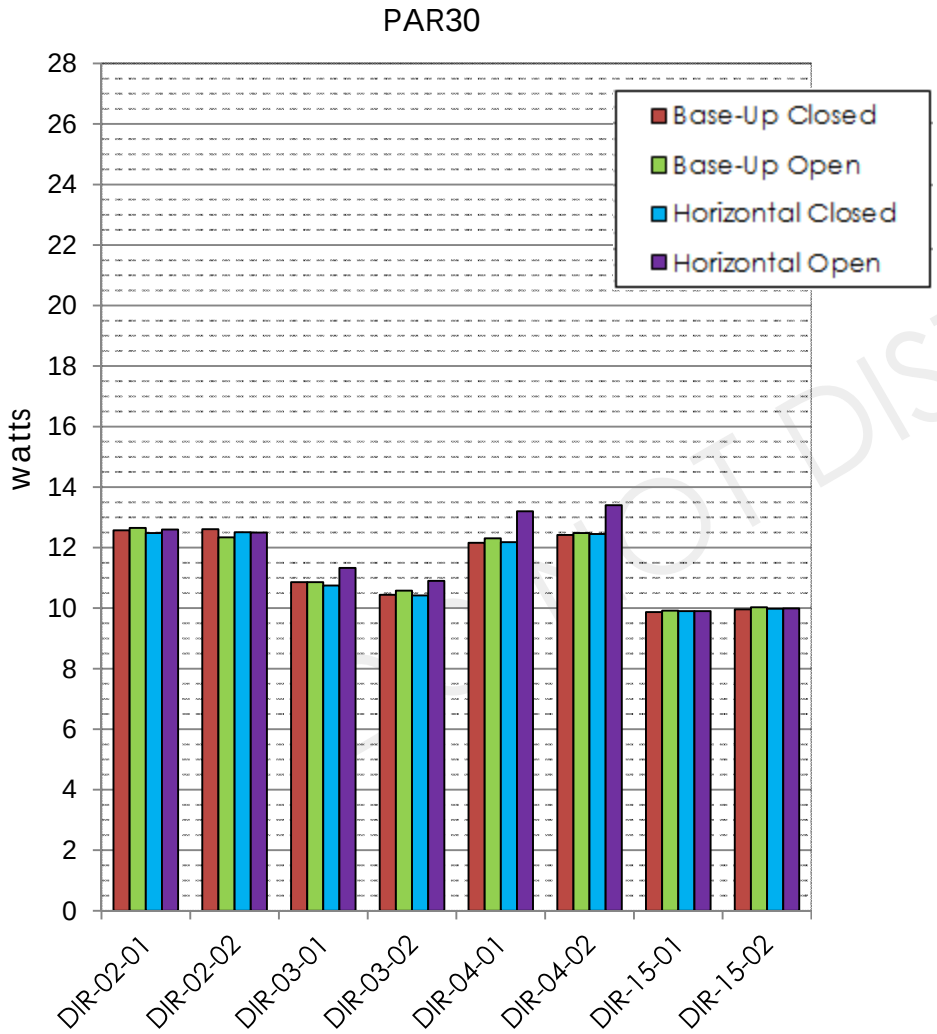
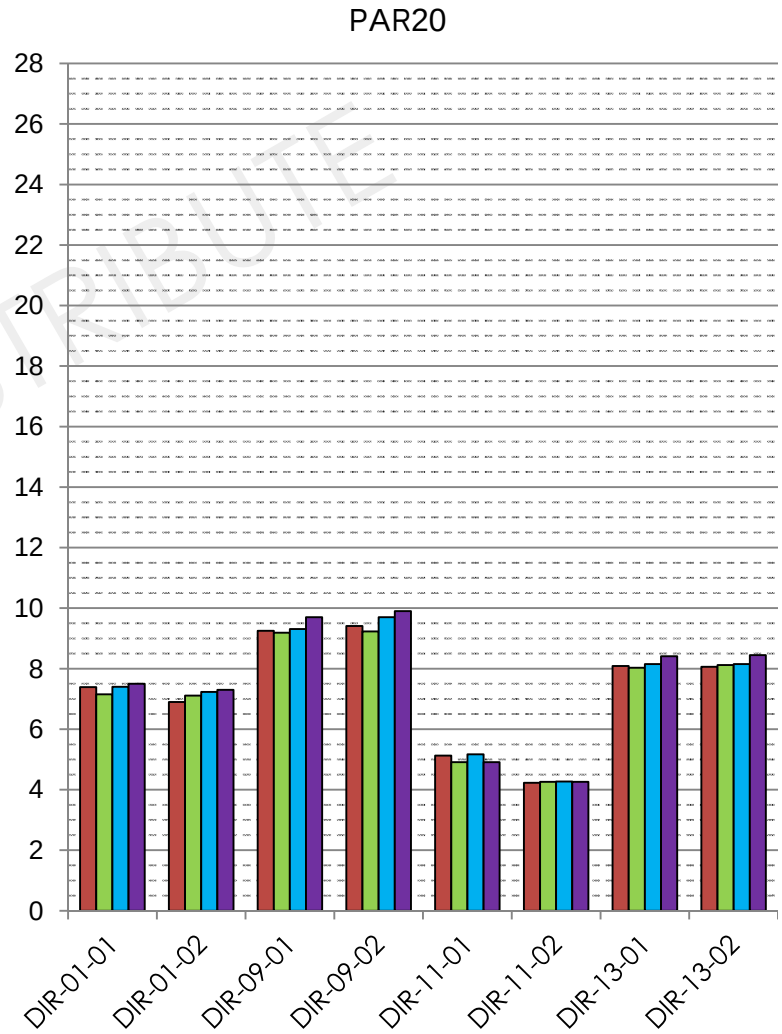
System Power – Sorted by lamp size

Minor gridlines = 0.5 W





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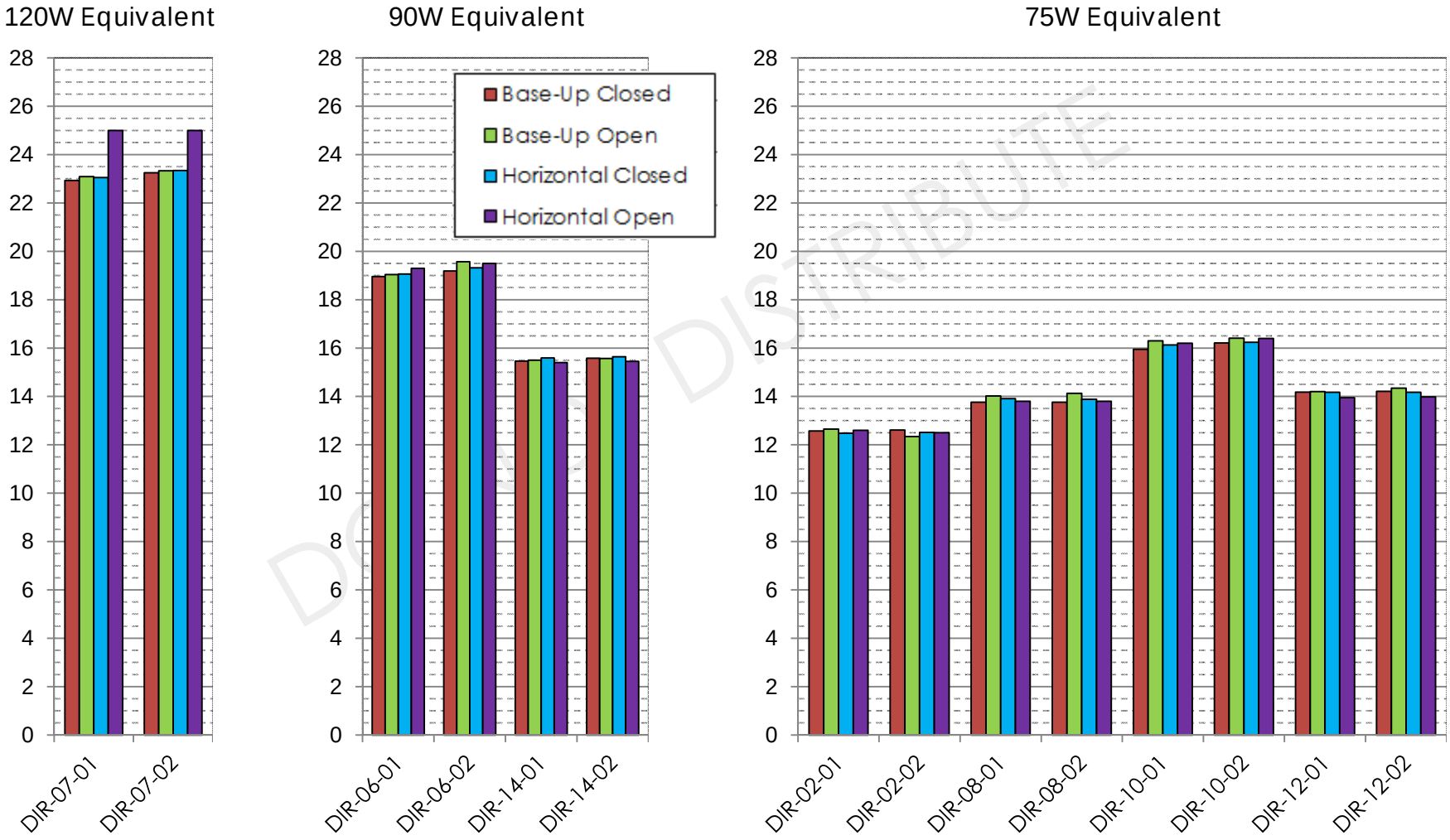
System Power

Minor gridlines = 0.5 W



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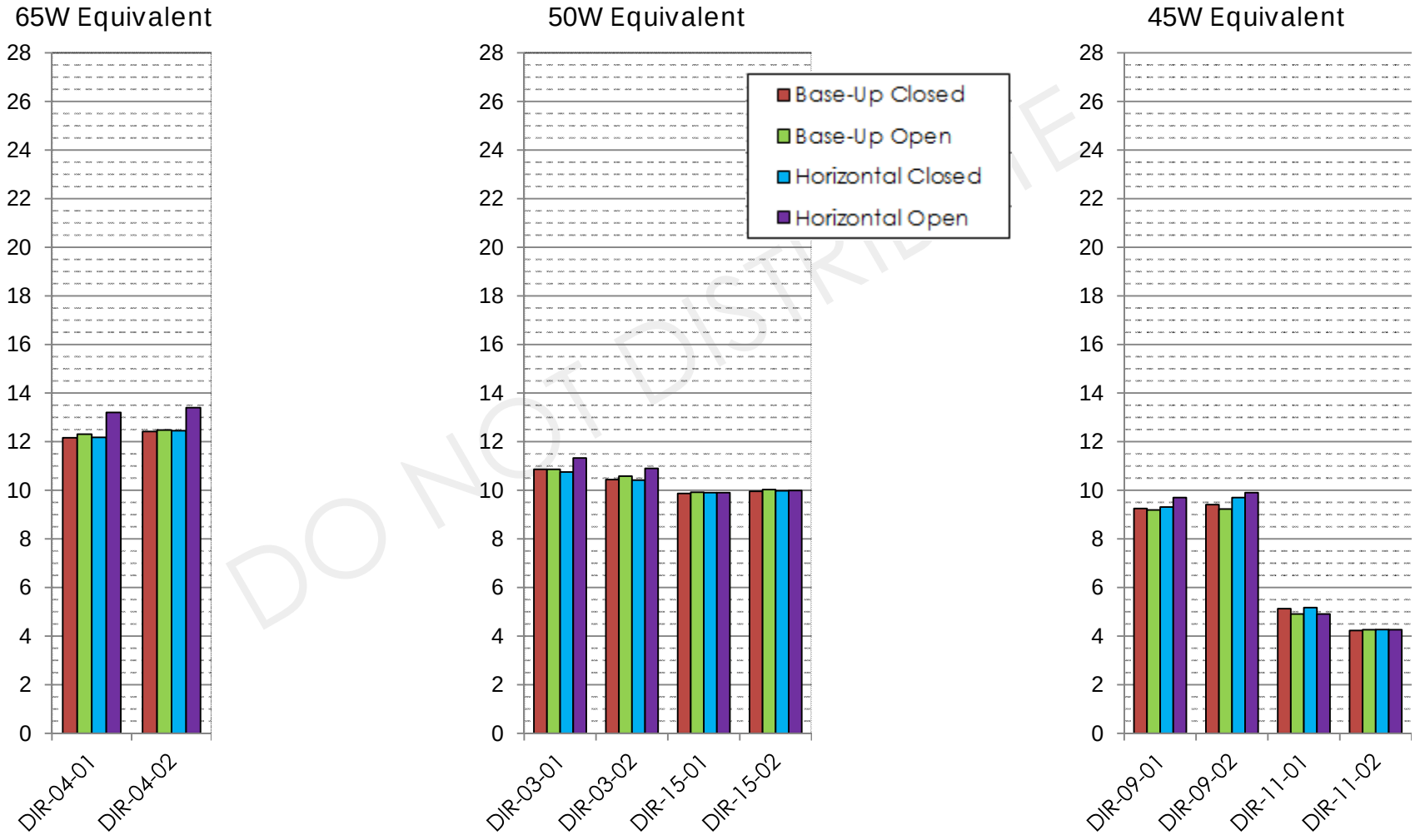
System Power

Minor gridlines = 0.5 W



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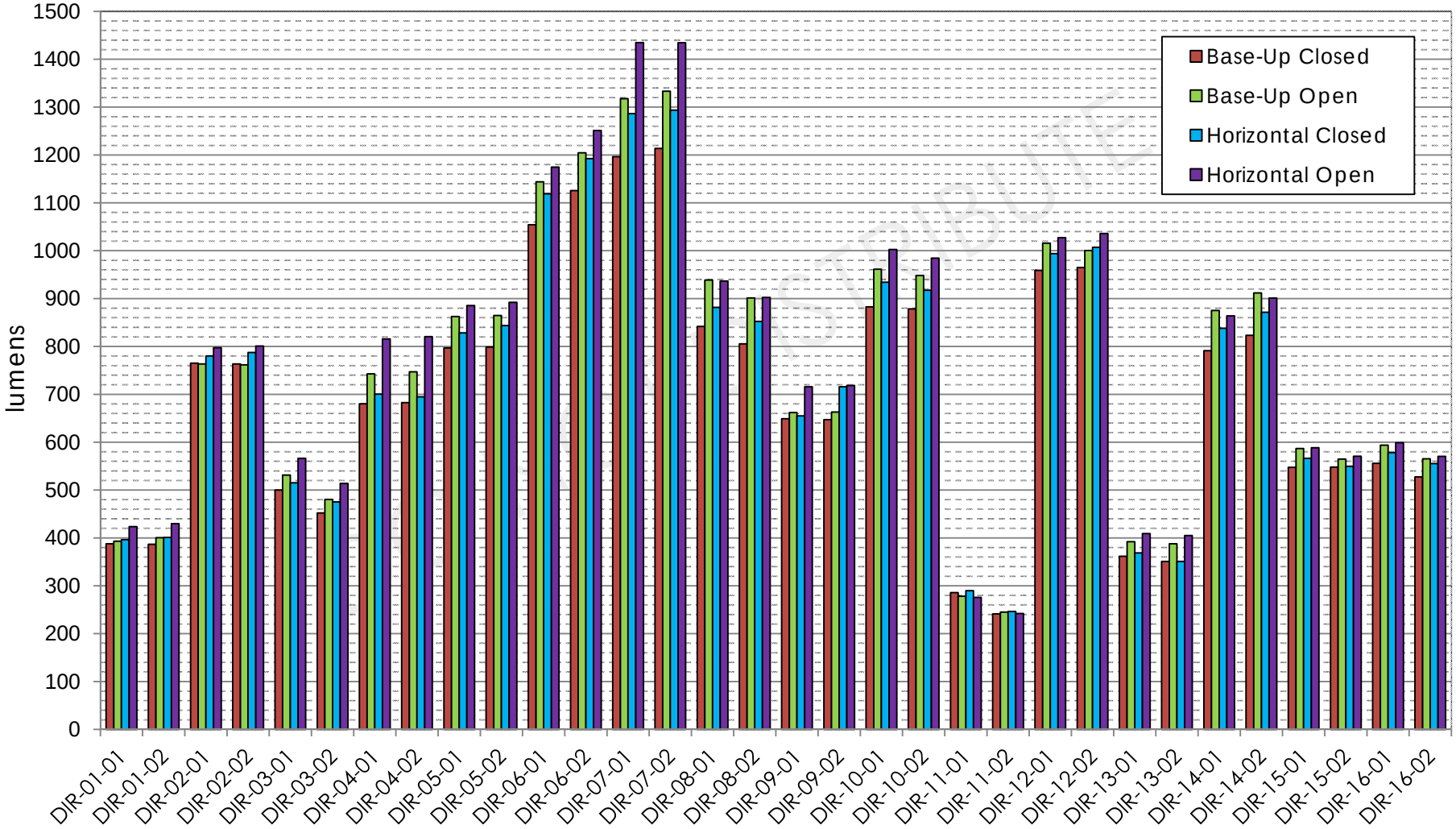
Output

Minor gridlines = 20 lumens



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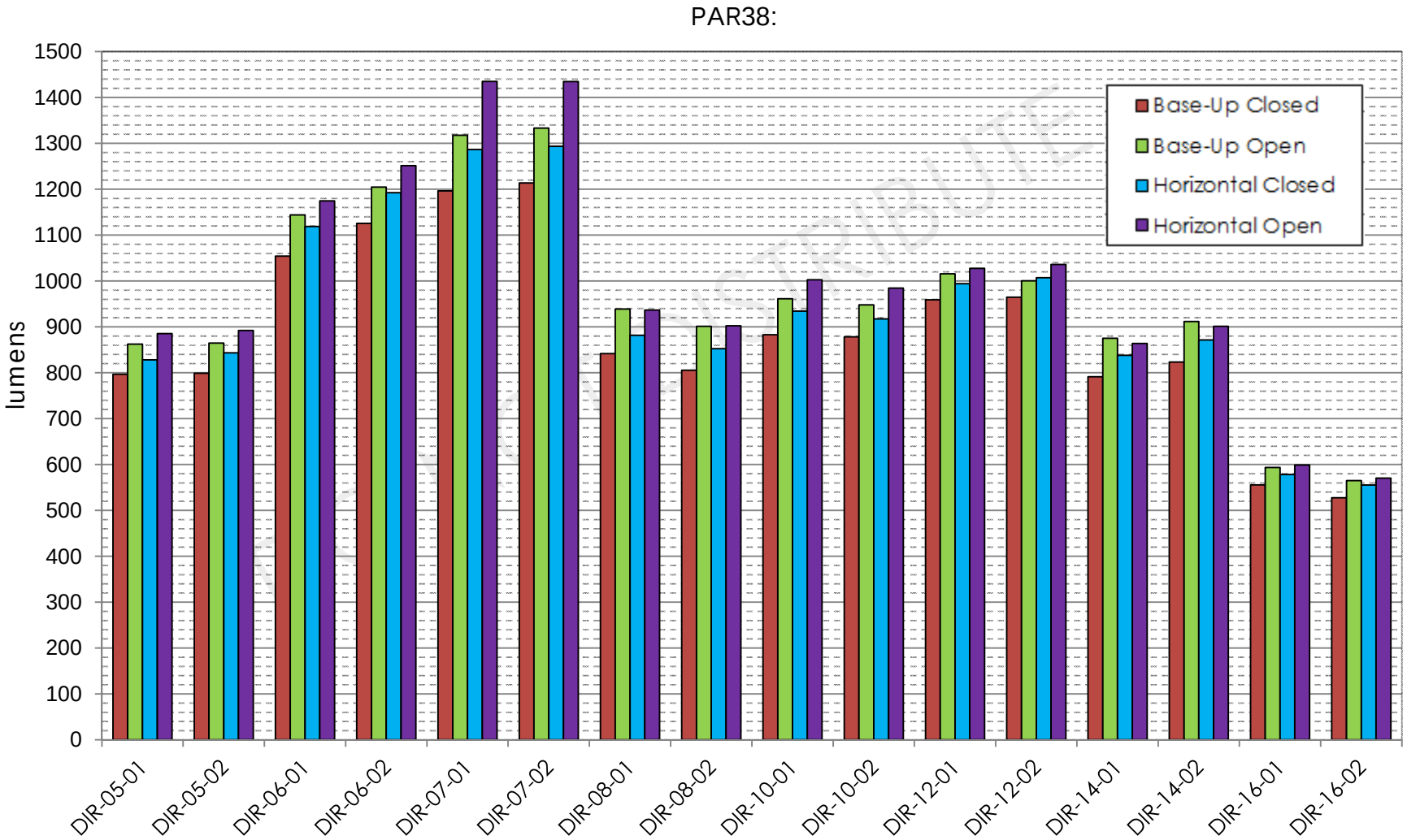
Output – Sorted by lamp size

Minor gridlines = 20 lumens



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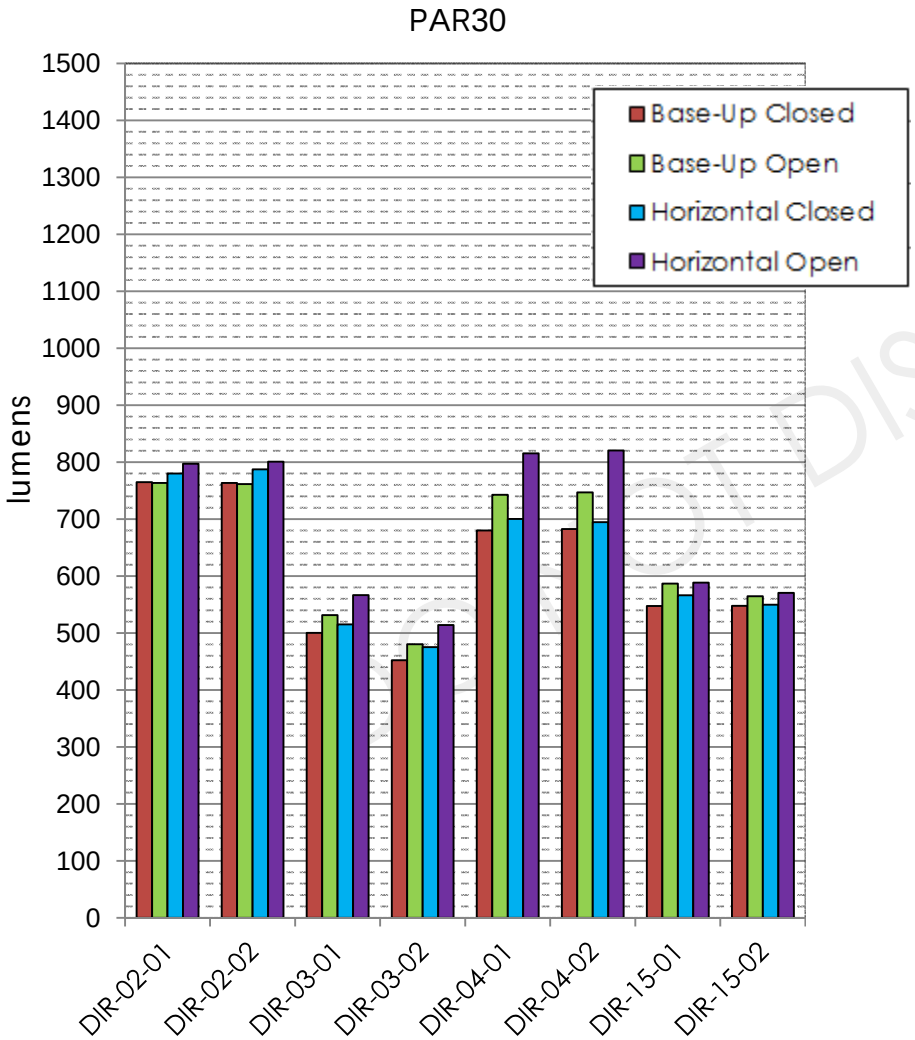
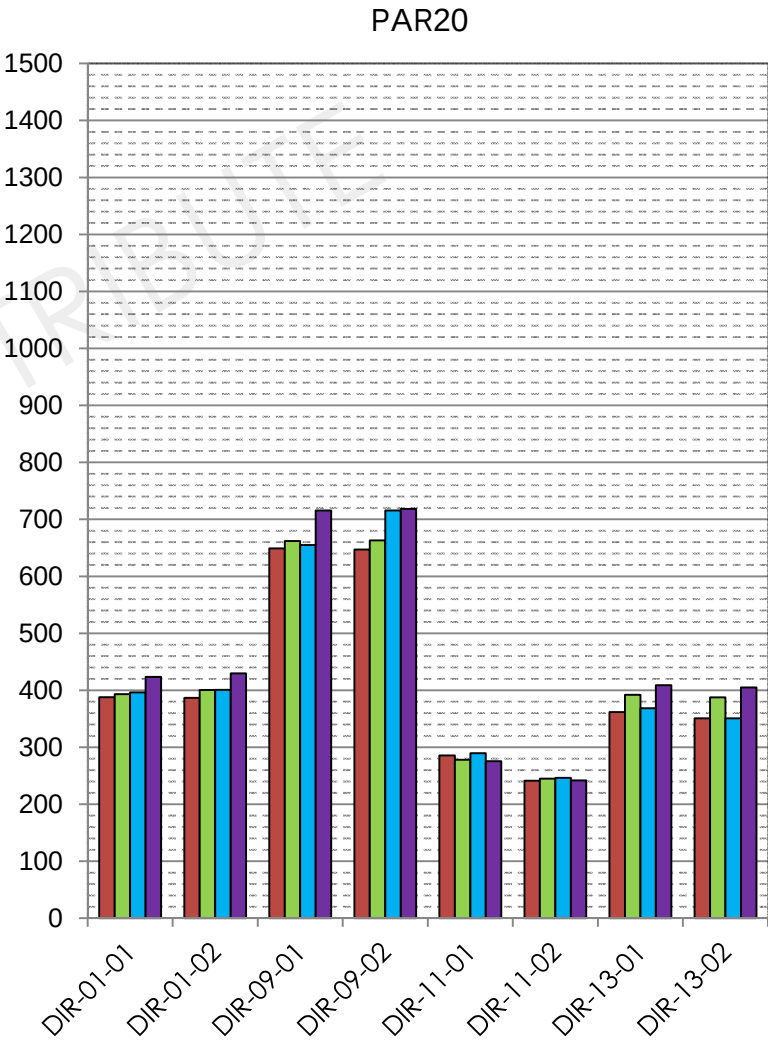
Output – Sorted by lamp size

Minor gridlines = 20 lumens





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Output

Minor gridlines = 20 lumens

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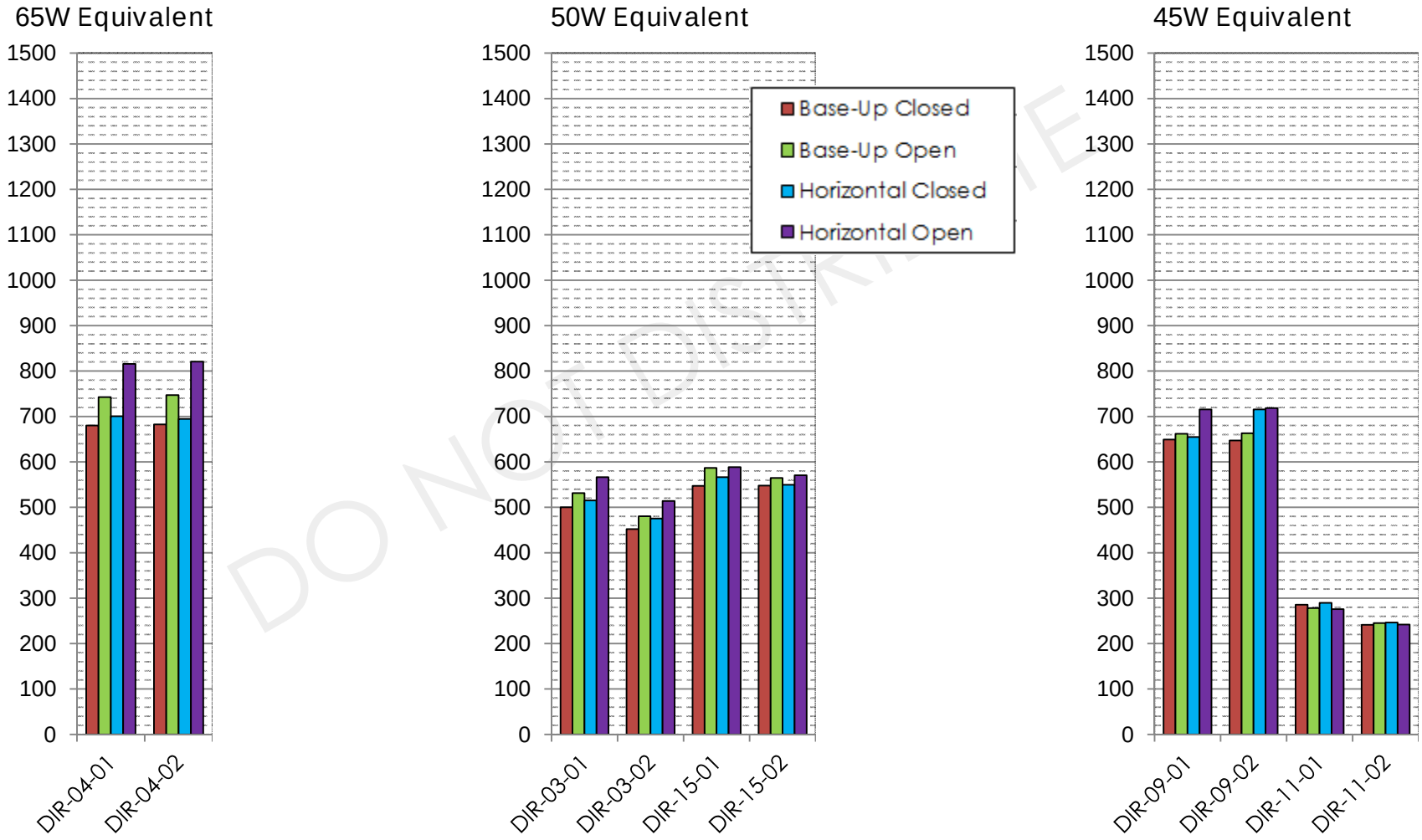
Output

Minor gridlines = 20 lumens



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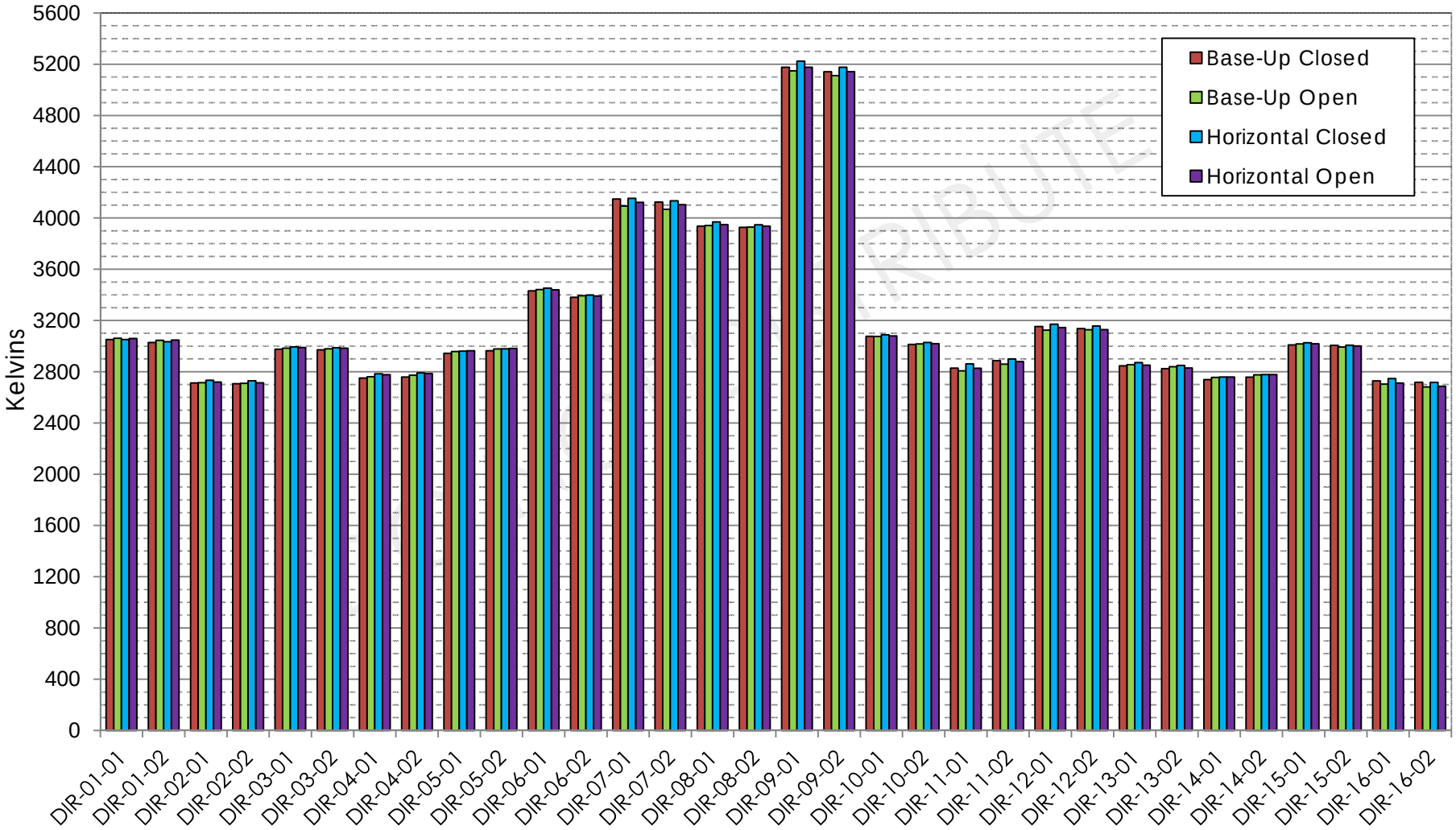
CCT

Minor gridlines = 100 Kelvins



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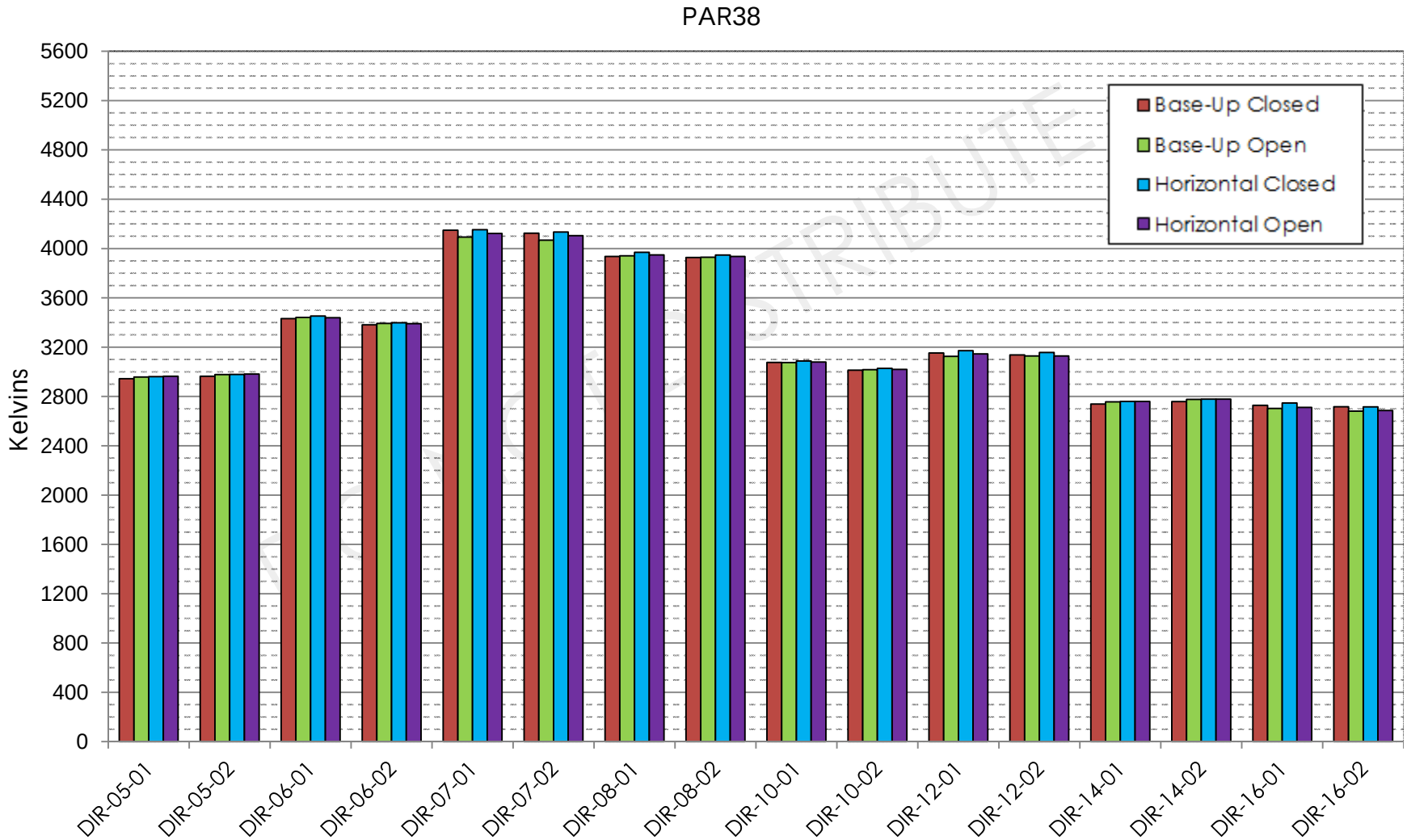
CCT – Sorted by lamp size

Minor gridlines = 100 Kelvins



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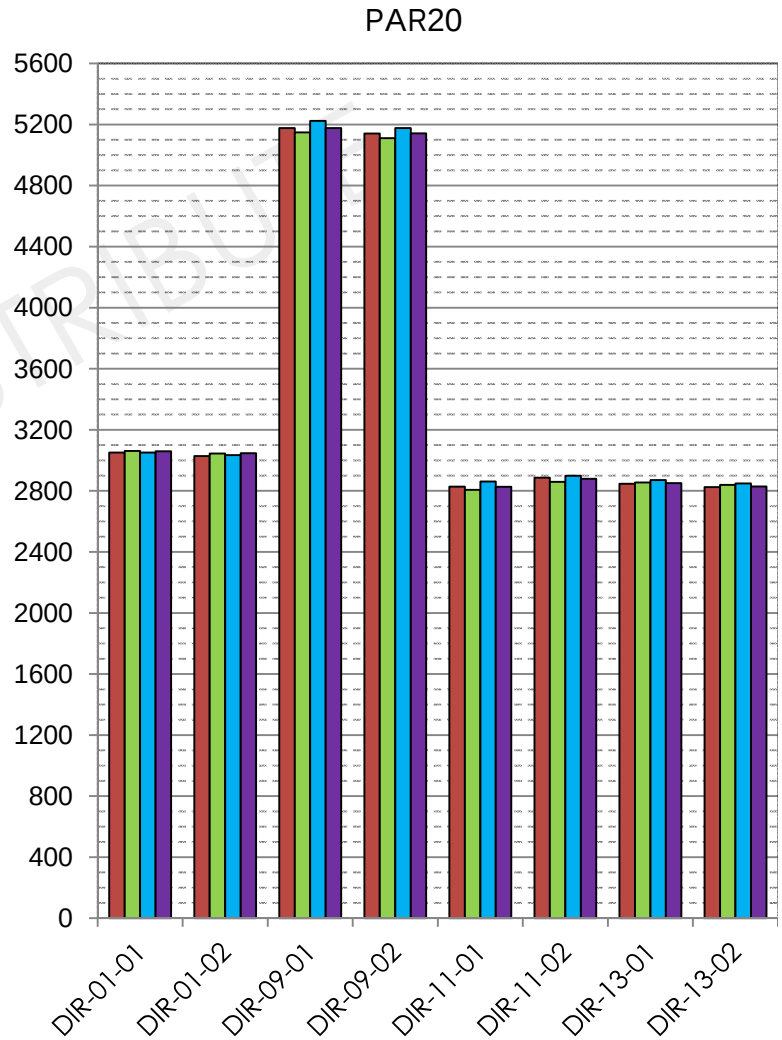
CCT – Sorted by lamp size

Minor gridlines = 100 Kelvins



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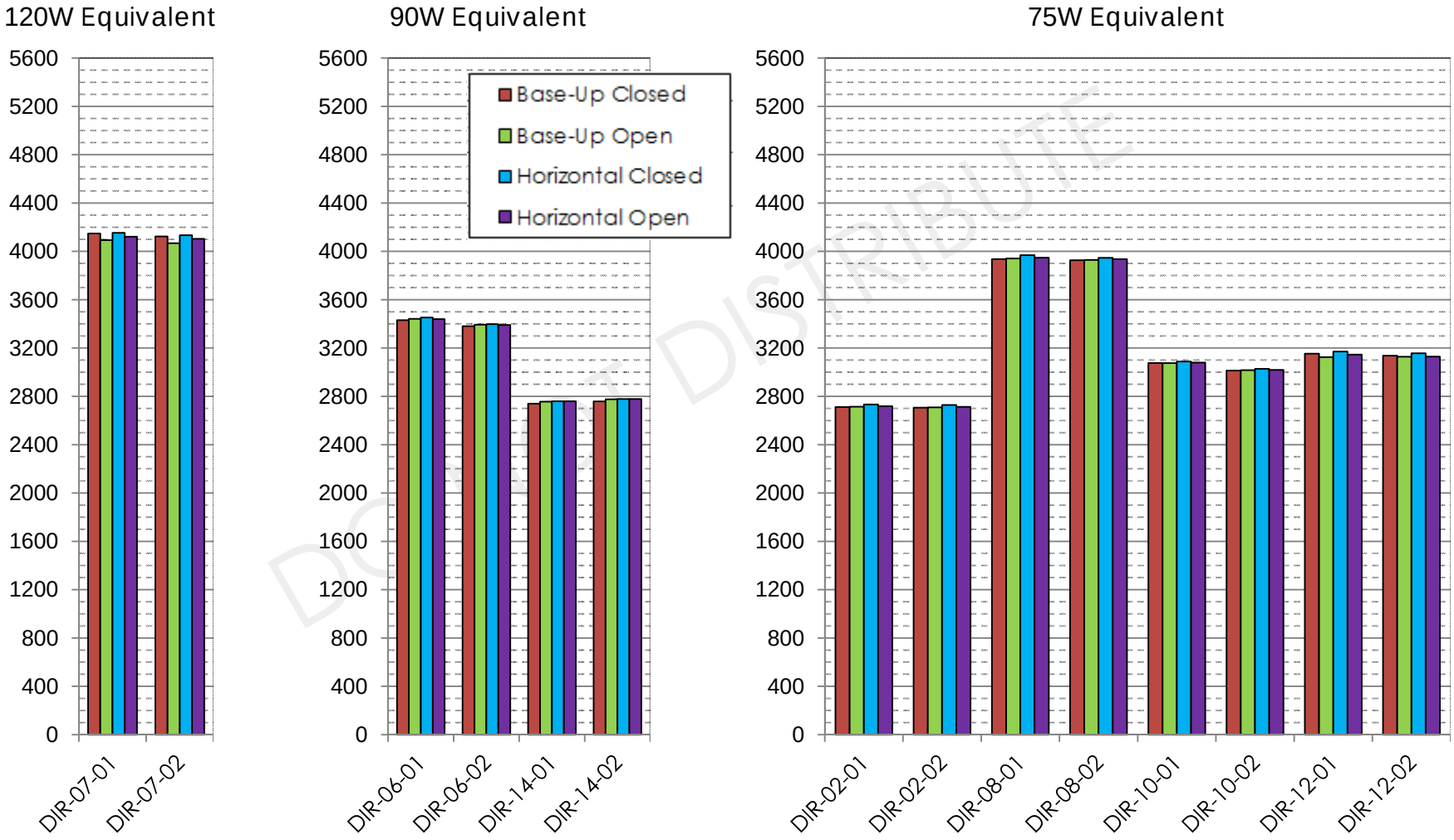
CCT

Minor gridlines = 100 Kelvins



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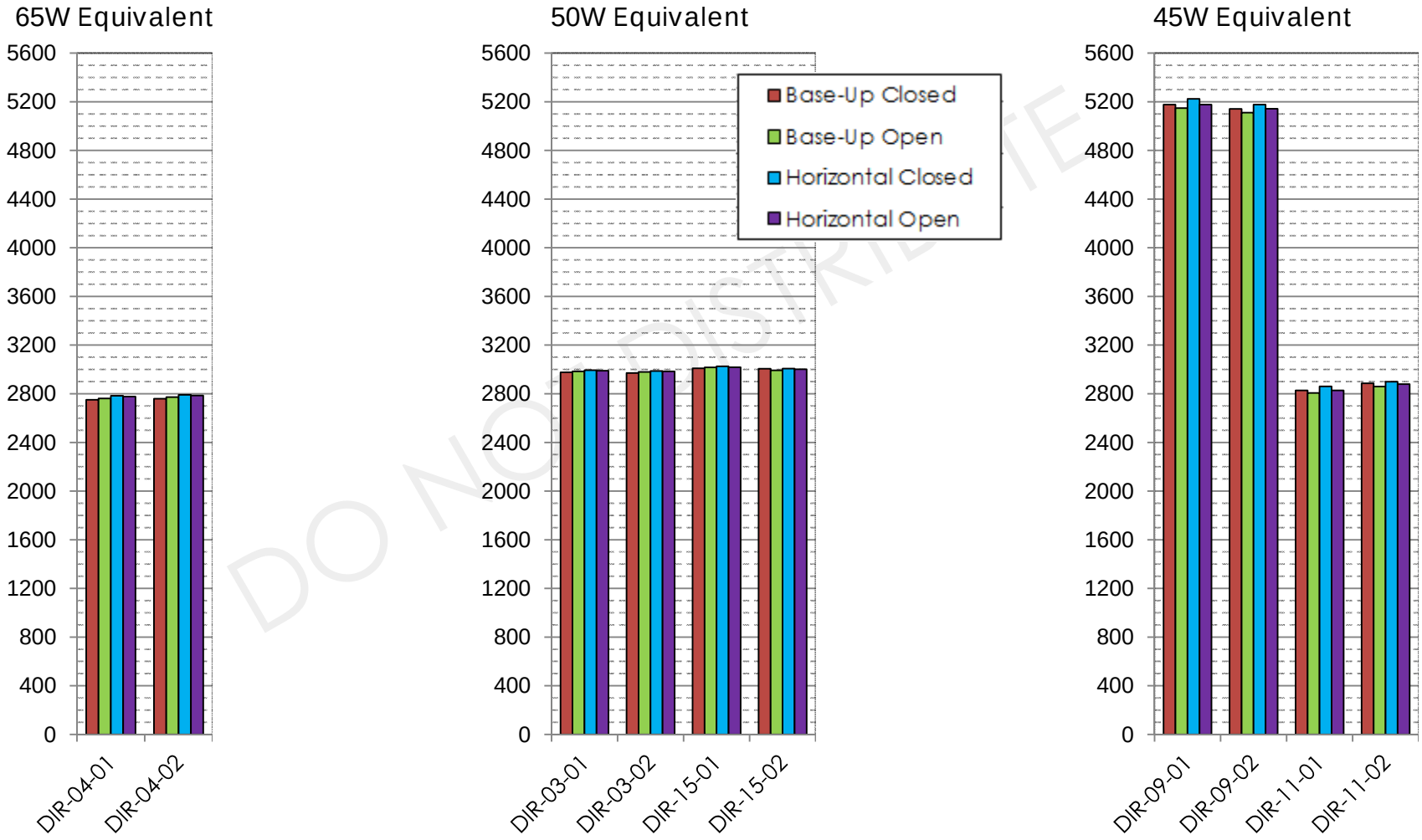
CCT

Minor gridlines = 100 Kelvins



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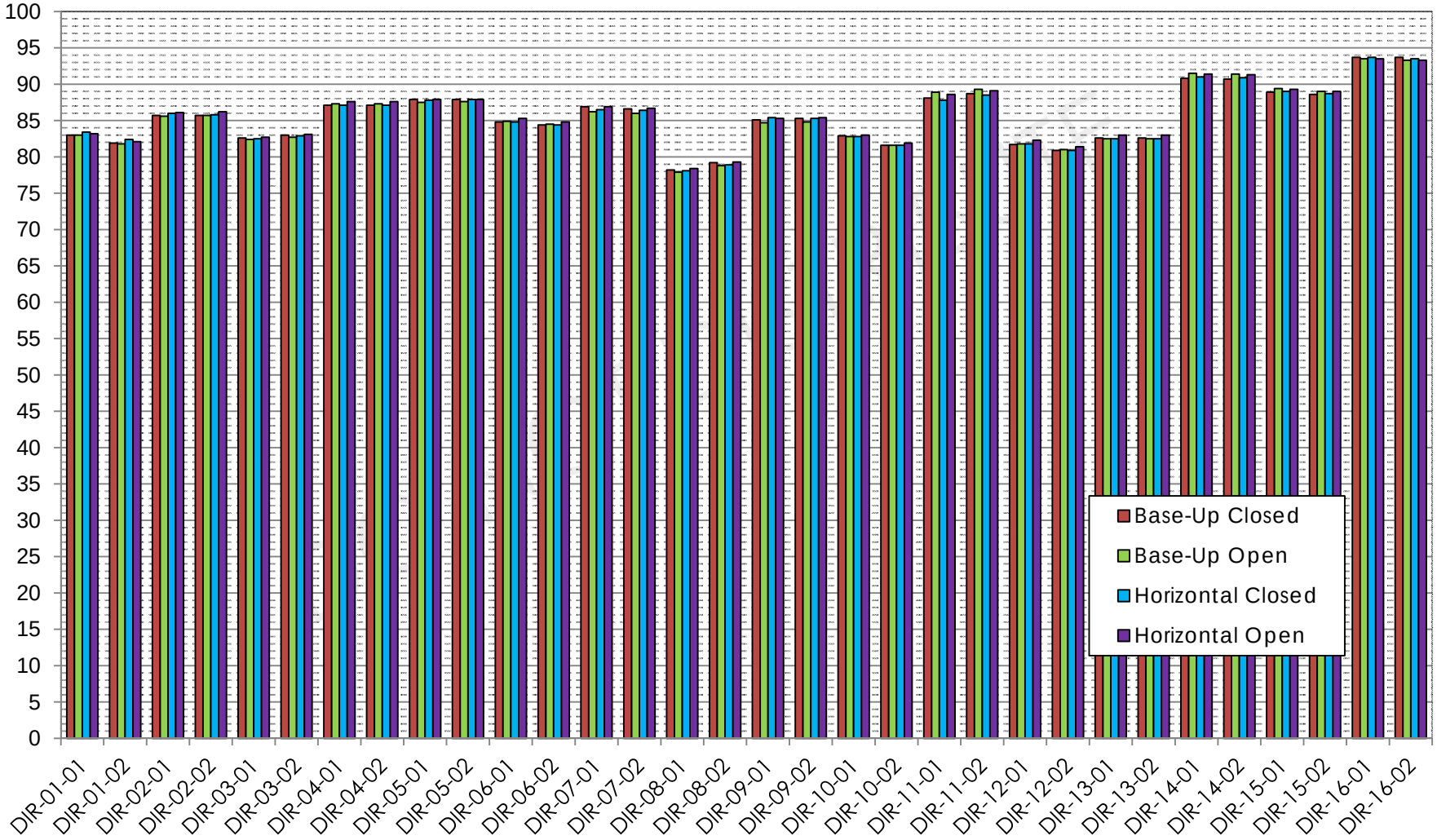
CRI

Minor gridlines = 1 CRI



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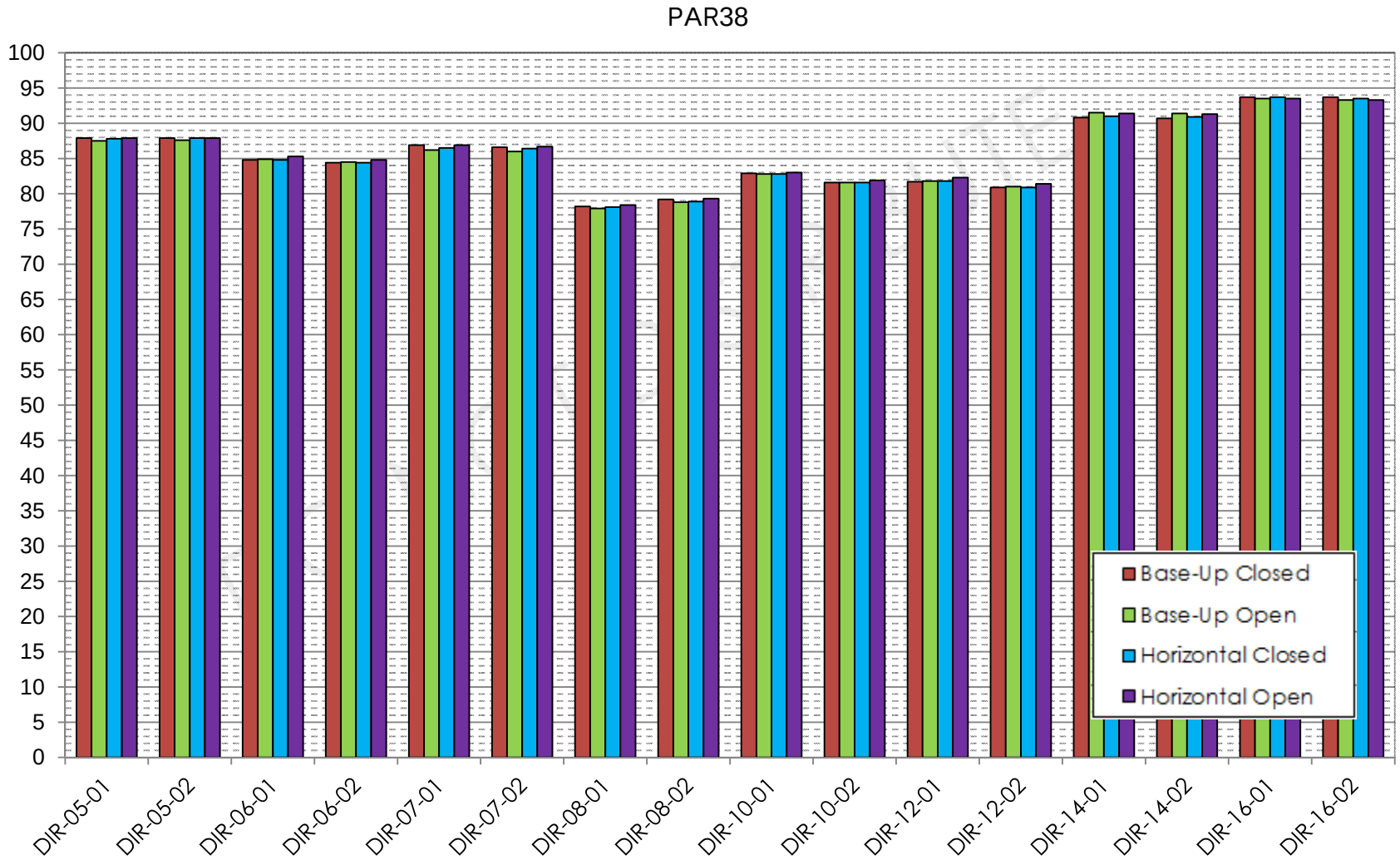
CRI – Sorted by lamp size

Minor gridlines = 1 CRI



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CRI – Sorted by lamp size

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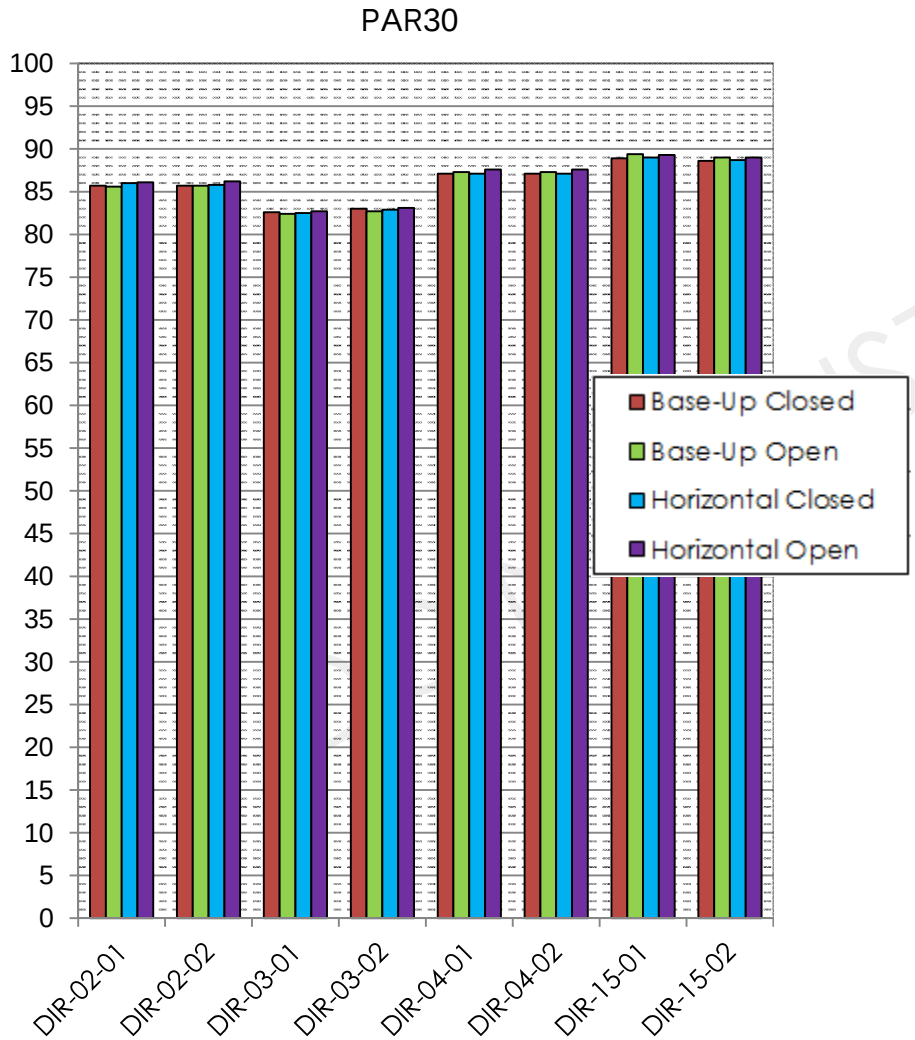

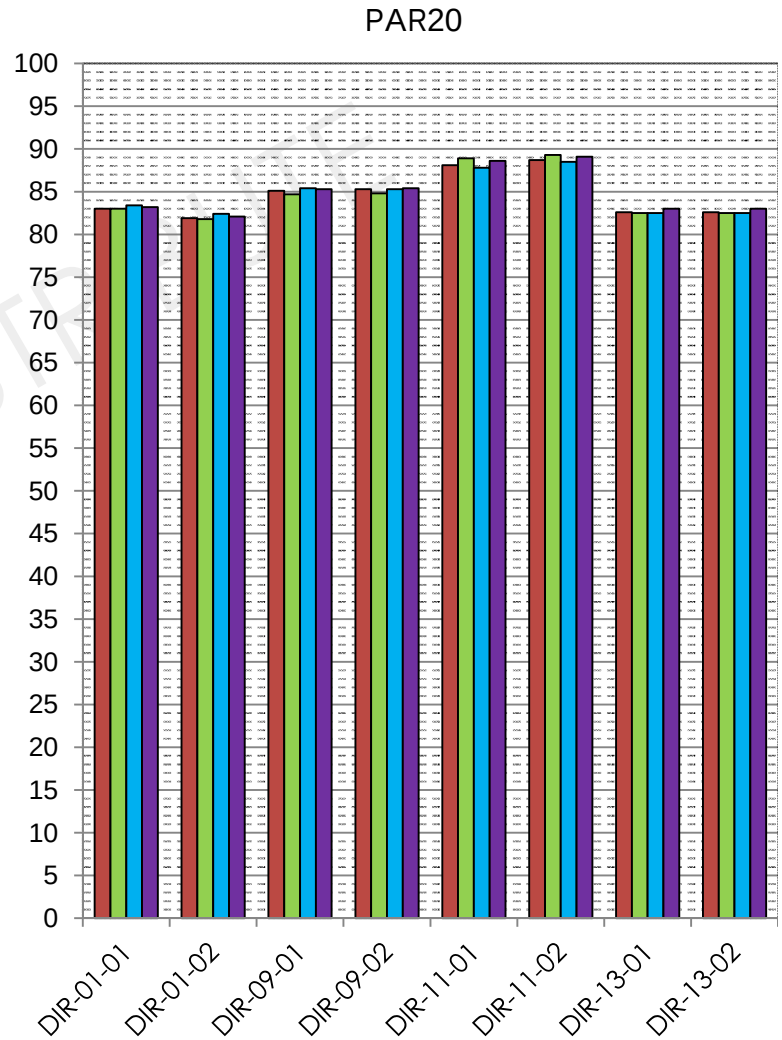

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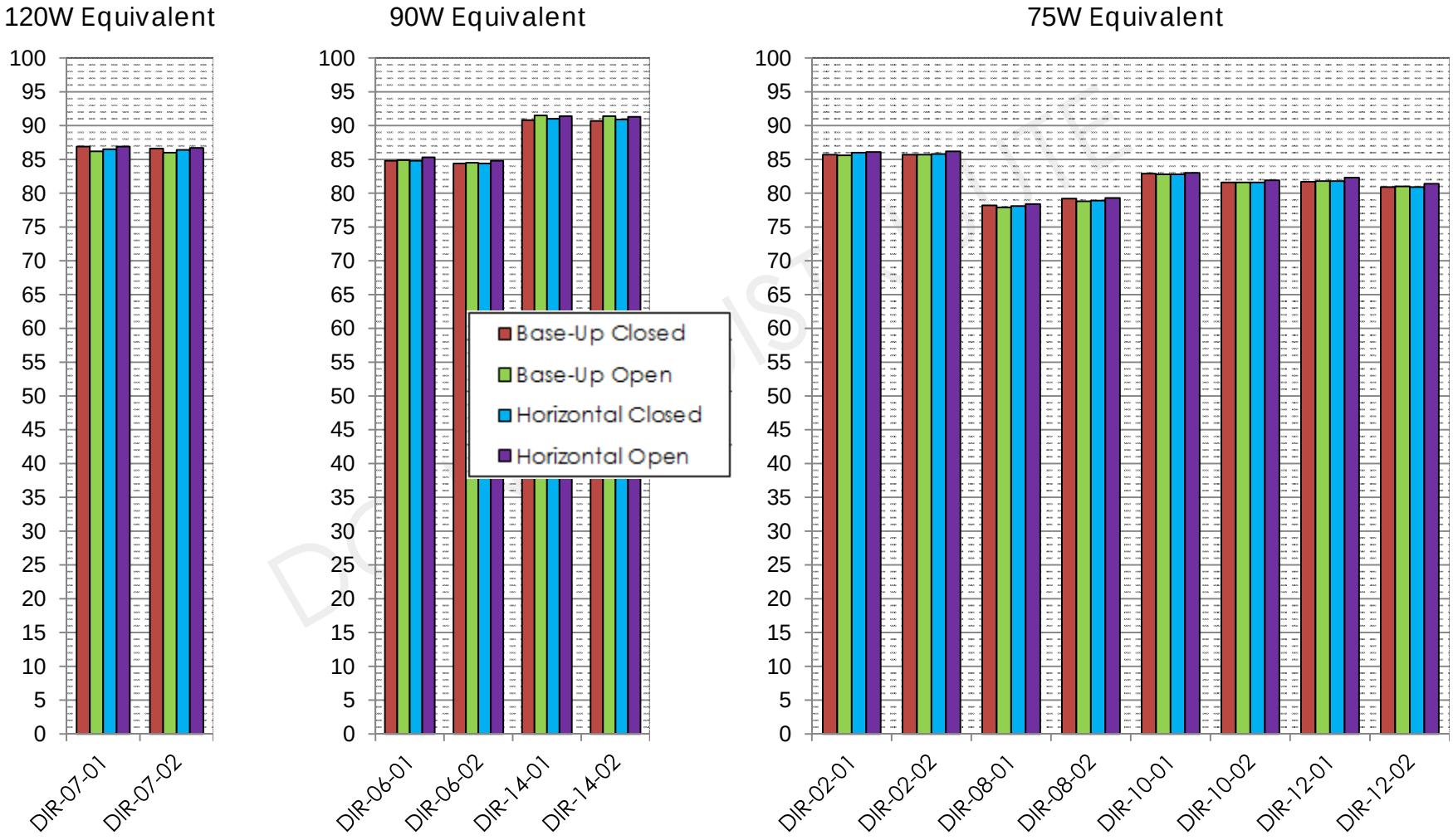
CRI

Minor gridlines = 1 CRI



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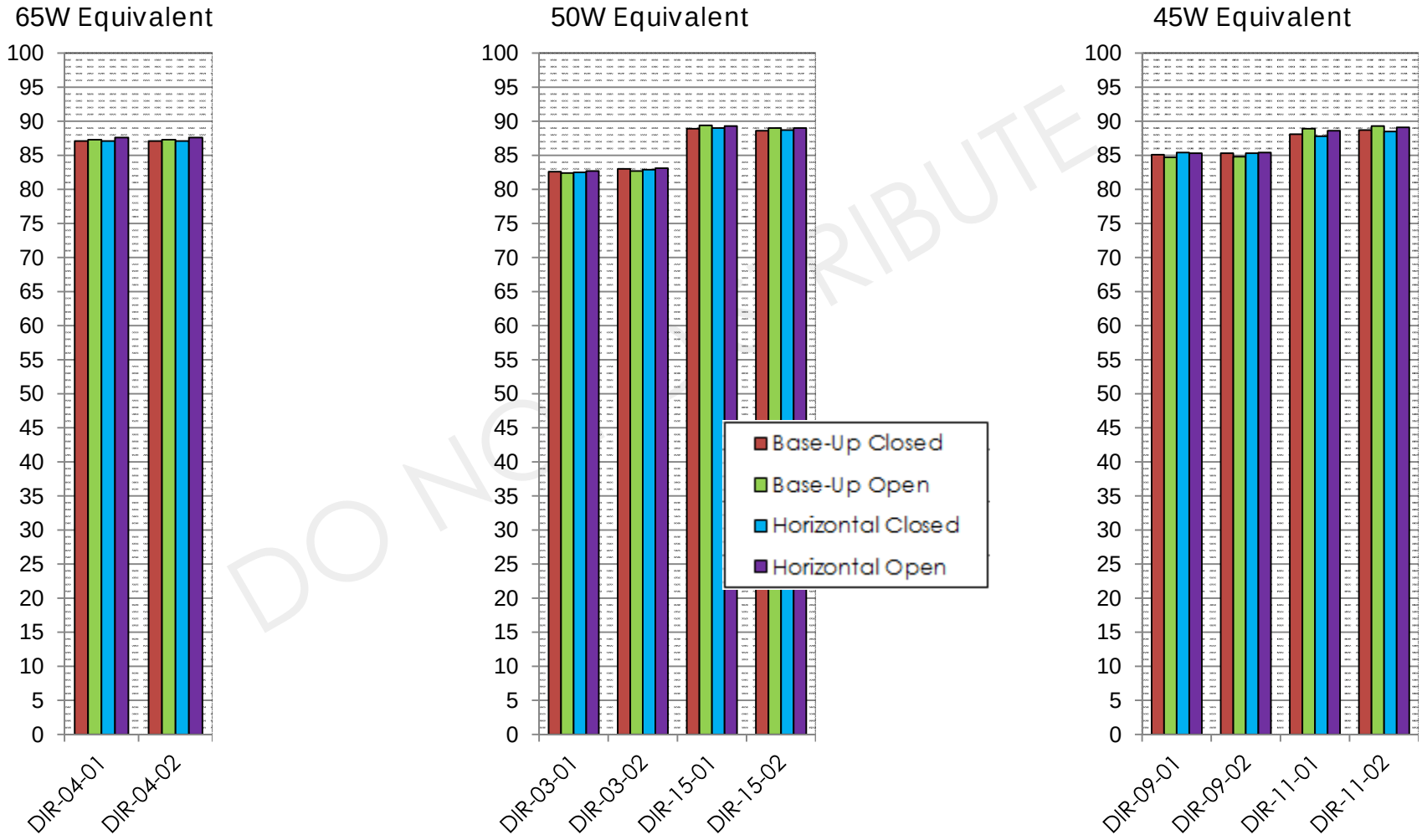
CRI

Minor gridlines = 1 CRI



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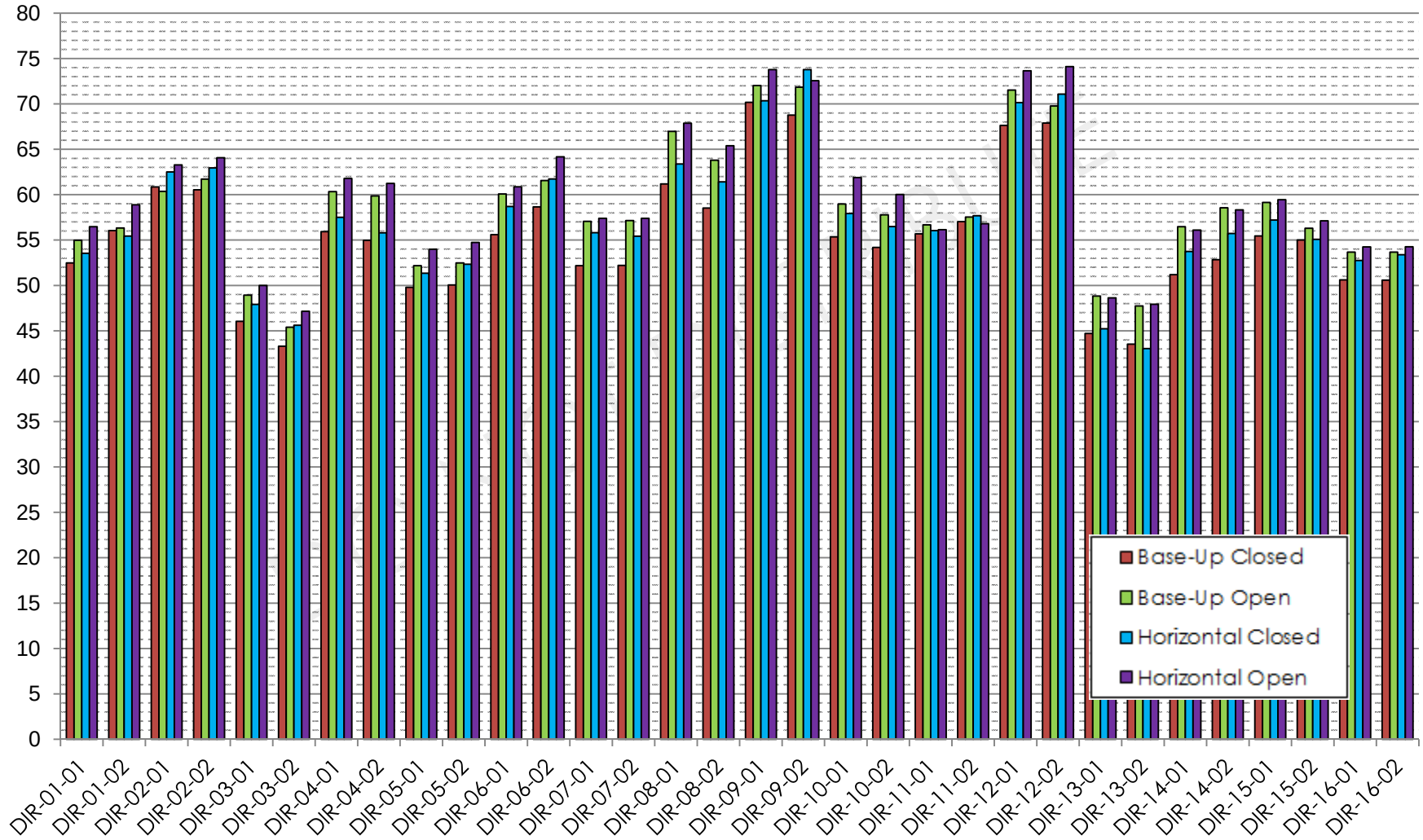
Efficacy (lumens per watt)

Minor gridlines = 1 LpW



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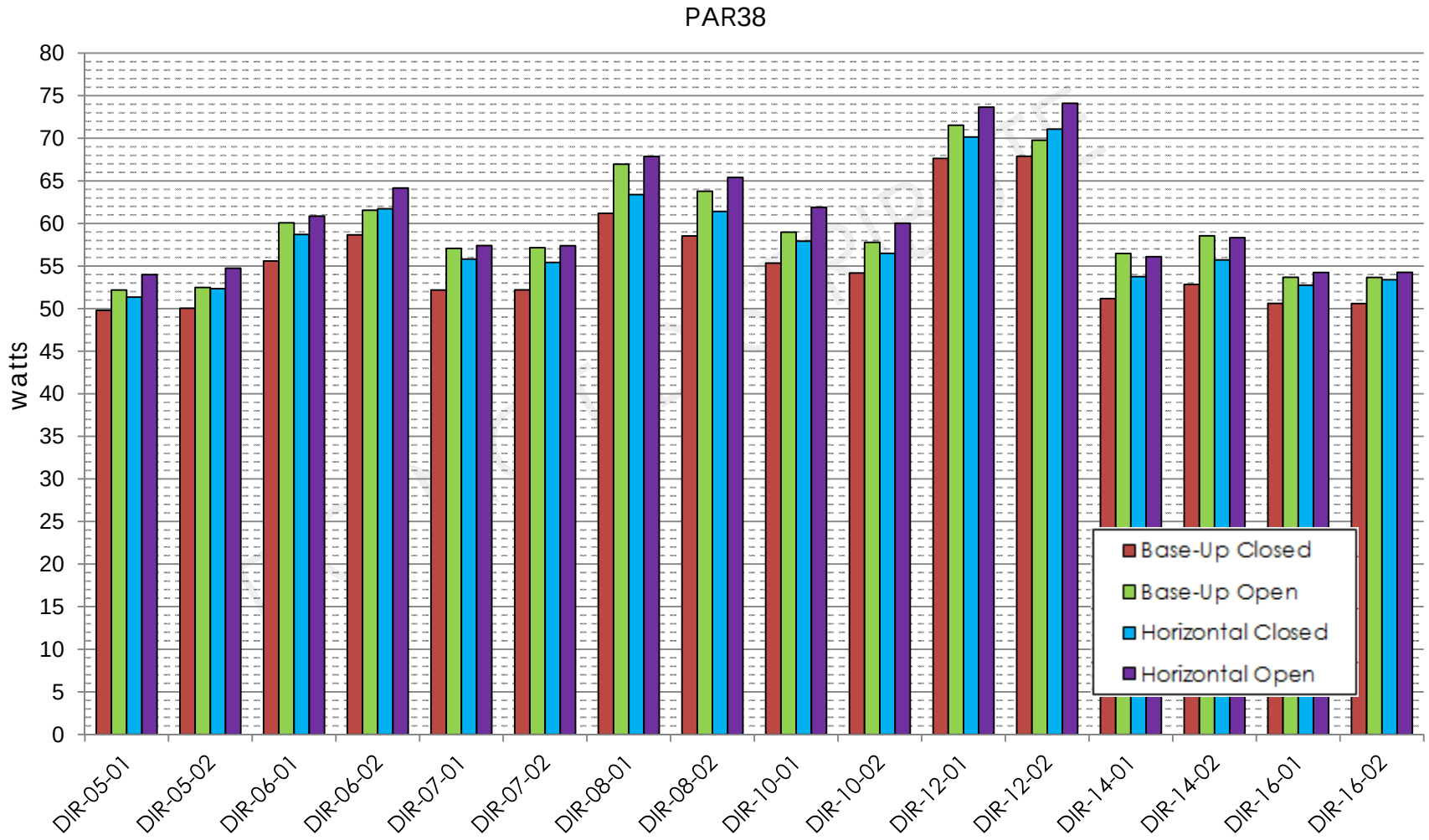

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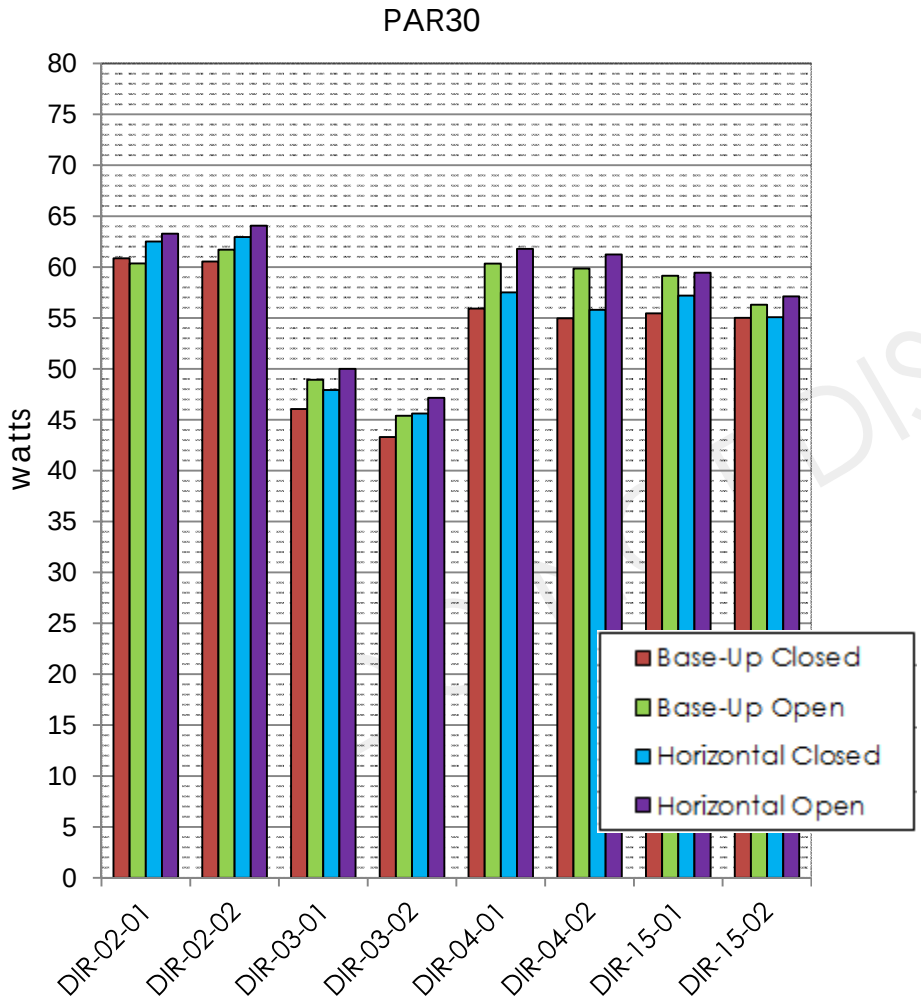

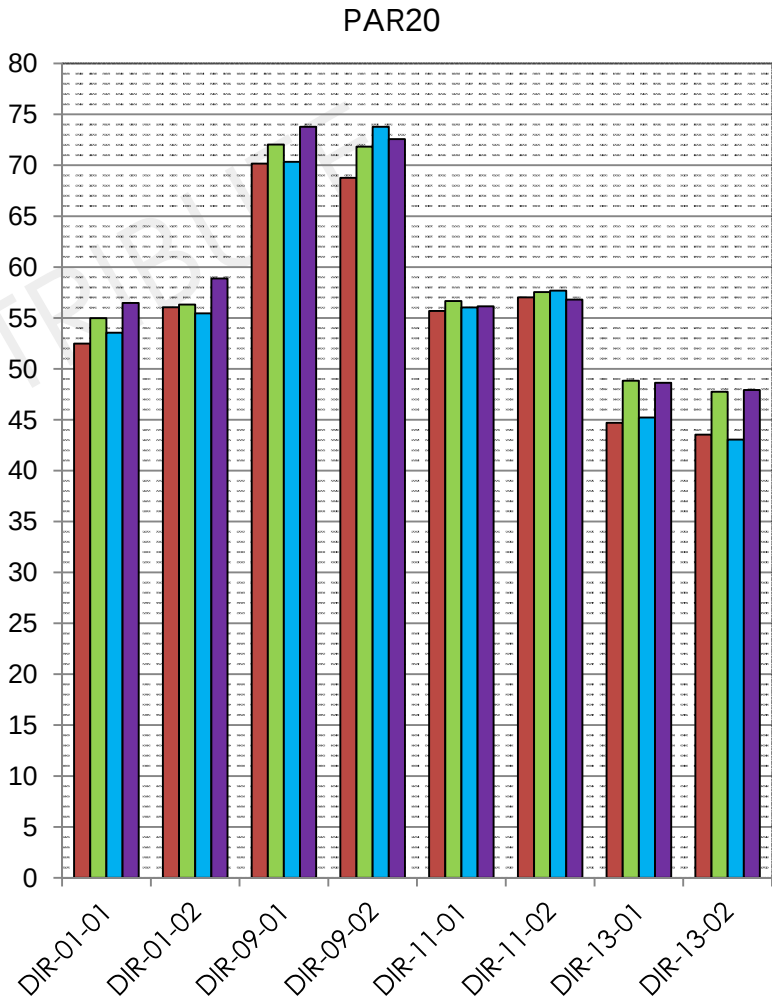

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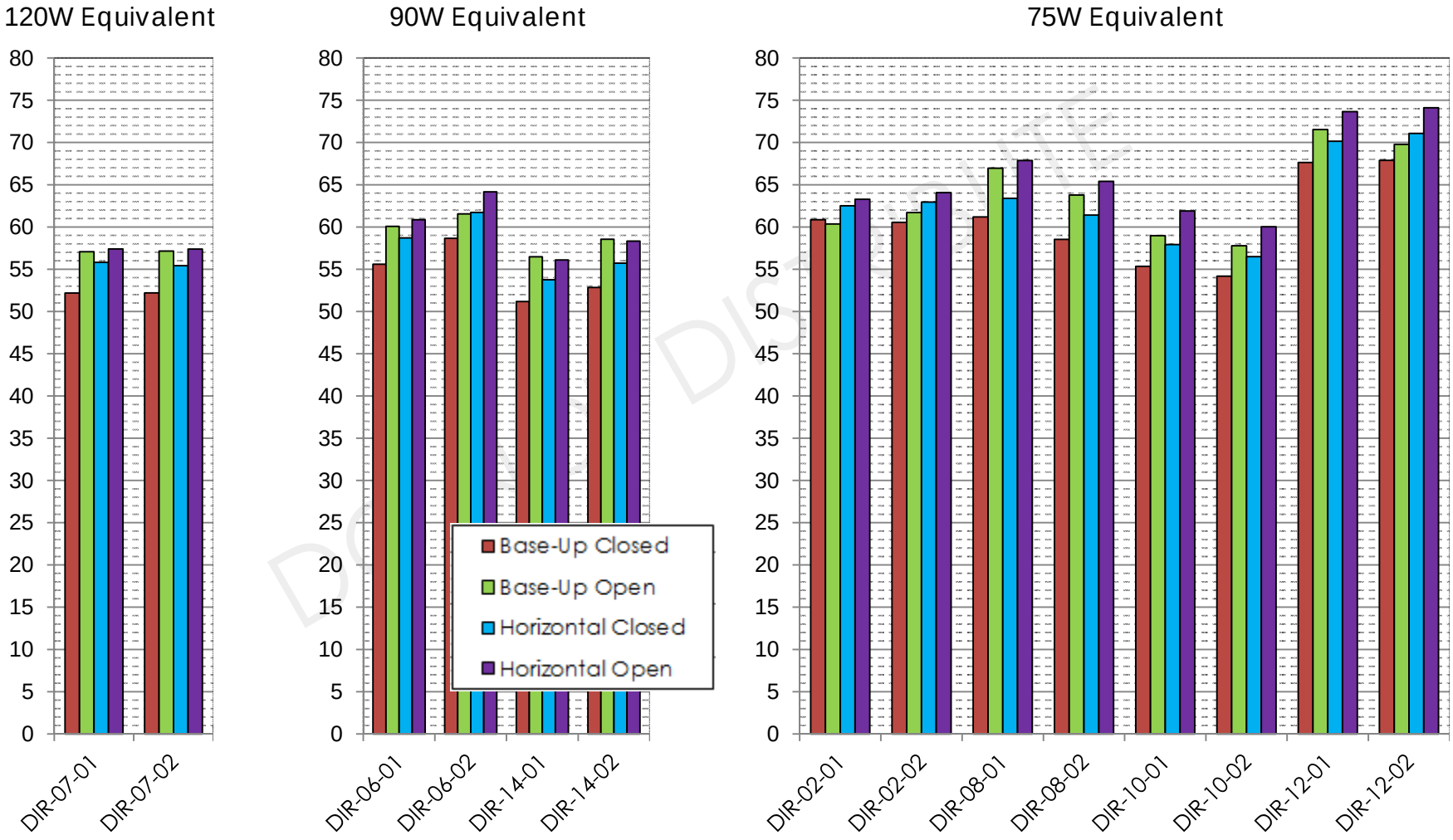

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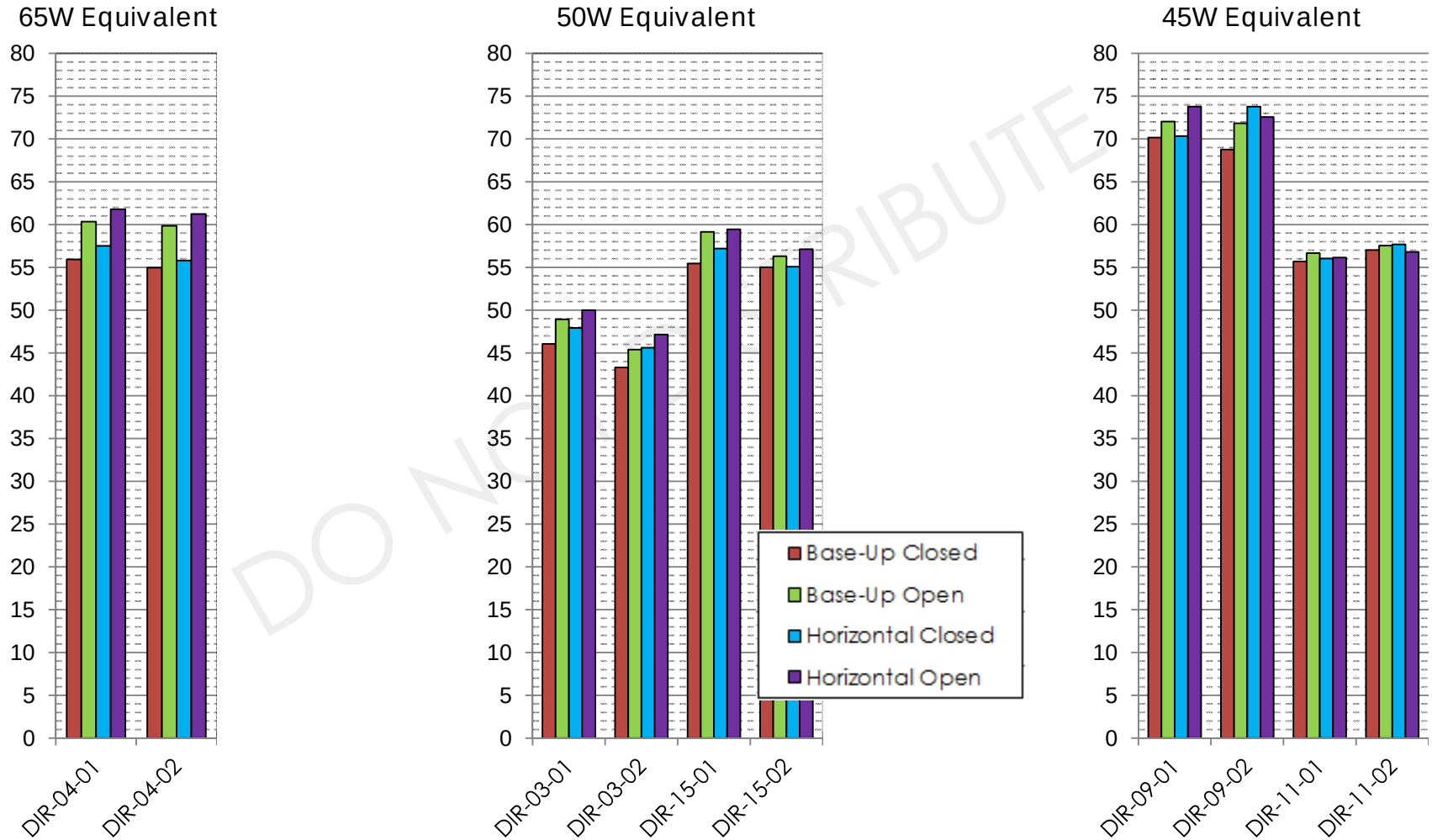
Minor gridlines = 1 LpW



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Summary Tables
Photometric Data

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Goniophotometer Summary

Serial #	System Power (W)	Gonio. Output (lm)	Beam Lumens	Measured CBCP	Mfg. Rated CBCP	ES Minimum CBCP	Measured Beam Angle	Mfg. Rated Beam Angle	Efficacy
DIR-01-01	7.4	426	109	3514	3400	-	14.2	12	57.6
DIR-02-01	12.7	774	322	3140	3200	2910	24.5	25	60.9
DIR-03-01	11.3	518	202	4965	-	3572	16.8	15	45.8
DIR-04-01	13.1	776	351	3247	3014	2362	25.8	25	59.2
DIR-05-01	16.5	906	408	1698	-	-	37	40	54.9
DIR-06-01	19.5	1111	417	5274	4400	3697	22.5	25	57.0
DIR-07-01	23.8	1417	644	7112	9400	12059	23.3	15	59.5
DIR-08-01	14	948	547	1056	852	751	50.5	55	67.7
DIR-09-01	9.8	683	354	1471	2500	1021	38.8	25	69.7
DIR-10-01	16.3	1007	481	1622	-	1341	39.1	38	61.8
DIR-11-01	4.92	279.17	175	158.64	-	-	82.3	-	56.7
DIR-12-01	14	828	442	12408	3370	2943	14.6	25	59.1
DIR-13-01	8.5	428	237	551	650		50	45	50.4
DIR-14-01	15.8	893.5	392	3468	3100	3697	25.3	25	56.6
DIR-15-01	10.03	613.6	215	6029	5400	3572	14.4	15	61.2
DIR-16-01	11.16	616.26	255	4585	4800	-	18	20	55.2

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Sphere Photometric Summary: Base-Up Closed

Serial #	System Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
DIR-01-01	7.4	388	3051	83.0	52.5
DIR-01-02	6.9	387	3028	81.9	56.0
DIR-02-01	12.6	765	2712	85.7	60.9
DIR-02-02	12.6	763	2706	85.7	60.5
DIR-03-01	10.9	500	2976	82.6	46.1
DIR-03-02	10.4	452	2971	83.0	43.3
DIR-04-01	12.2	680	2751	87.1	55.9
DIR-04-02	12.4	683	2759	87.1	55.0
DIR-05-01	16.0	797	2944	87.9	49.8
DIR-05-02	16.0	799	2964	87.9	50.1
DIR-06-01	19.0	1054	3431	84.8	55.6
DIR-06-02	19.2	1126	3381	84.4	58.7
DIR-07-01	22.9	1196	4148	86.9	52.2
DIR-07-02	23.3	1214	4124	86.6	52.2
DIR-08-01	13.8	842	3936	78.2	61.2
DIR-08-02	13.8	805	3927	79.2	58.5

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Sphere Photometric Summary: Base-Up Closed

Serial #	System Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
DIR-09-01	9.3	649	5177	85.1	70.2
DIR-09-02	9.4	647	5141	85.3	68.8
DIR-10-01	16.0	883	3076	82.9	55.3
DIR-10-02	16.2	878	3013	81.6	54.2
DIR-11-01	5.1	286	2828	88.1	55.7
DIR-11-02	4.2	241	2886	88.7	57.0
DIR-12-01	14.2	959	3153	81.7	67.6
DIR-12-02	14.2	965	3137	80.9	67.9
DIR-13-01	8.1	362	2846	82.6	44.7
DIR-13-02	8.1	351	2824	82.6	43.5
DIR-14-01	15.5	791	2739	90.8	51.2
DIR-14-02	15.6	823	2758	90.7	52.8
DIR-15-01	9.9	547	3009	88.9	55.5
DIR-15-02	10.0	548	3006	88.6	55.0
DIR-16-01	11.0	556	2728	93.7	50.6
DIR-16-02	10.4	528	2717	93.7	50.6

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Sphere Photometric Summary: Base-Up Open

Serial #	System Power (W)	Sphere Output (lm)	Mfg. Rated Output (lm)	Measured CCT	Mfg. Rated CCT	Measured CRI	Mfg. Rated CRI	Efficacy
DIR-01-01	7.2	393	330	3061	3000	83.0	80	55.0
DIR-01-02	7.1	400	330	3045	3000	81.8	80	56.3
DIR-02-01	12.7	764	-	2714	2700	85.6	80	60.4
DIR-02-02	12.3	762	-	2709	2700	85.7	80	61.7
DIR-03-01	10.9	531	550	2984	3000	82.4	82	48.9
DIR-03-02	10.6	480	550	2979	3000	82.7	82	45.4
DIR-04-01	12.3	743	725	2761	2700	87.3	85	60.3
DIR-04-02	12.5	747	725	2773	2700	87.3	85	59.9
DIR-05-01	16.5	862	820	2958	2700	87.5	90	52.2
DIR-05-02	16.5	865	820	2978	2700	87.6	90	52.5
DIR-06-01	19.0	1144	1120	3441	3500	84.9	84	60.1
DIR-06-02	19.6	1205	1120	3393	3500	84.5	84	61.6
DIR-07-01	23.1	1318	1375	4093	4000	86.2	85	57.1
DIR-07-02	23.3	1333	1375	4068	4000	86.0	85	57.1
DIR-08-01	14.0	939	824	3941	4000	77.9	83	67.0
DIR-08-02	14.1	901	824	3929	4000	78.8	83	63.8

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Sphere Photometric Summary: Base-Up Open

Serial #	System Power (W)	Sphere Output (lm)	Mfg. Rated Output (lm)	Measured CCT	Mfg. Rated CCT	Measured CRI	Mfg. Rated CRI	Efficacy
DIR-09-01	9.2	662	580	5148	5000	84.7	80	72.0
DIR-09-02	9.2	663	580	5111	5000	84.8	80	71.8
DIR-10-01	16.3	961	885	3075	3000	82.8	-	59.0
DIR-10-02	16.4	948	885	3017	3000	81.6	-	57.8
DIR-11-01	4.9	278	450	2807	2600	88.9	-	56.7
DIR-11-02	4.3	245	450	2859	2600	89.3	-	57.5
DIR-12-01	14.2	1016	800	3125	3000	81.8	90	71.5
DIR-12-02	14.3	1000	800	3128	3000	81.0	90	69.8
DIR-13-01	8.0	392	530	2855	4000	82.5	85	48.8
DIR-13-02	8.1	388	530	2839	4000	82.5	85	47.7
DIR-14-01	15.5	875	750	2756	2700	91.5	90	56.5
DIR-14-02	15.6	912	750	2776	2700	91.4	90	58.6
DIR-15-01	9.9	587	550	3017	3000	89.4	89	59.1
DIR-15-02	10.0	565	550	2993	3000	89.0	89	56.3
DIR-16-01	11.1	594	600	2703	2700	93.5	94	53.7
DIR-16-02	10.5	565	600	2681	2700	93.3	94	53.7

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Sphere Photometric Summary: Horizontal Closed

Serial #	System Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
DIR-01-01	7.4	396	3051	83.4	53.5
DIR-01-02	7.2	401	3034	82.4	55.4
DIR-02-01	12.5	780	2733	86.0	62.5
DIR-02-02	12.5	787	2729	85.8	62.9
DIR-03-01	10.8	515	2994	82.5	47.9
DIR-03-02	10.4	475	2987	82.9	45.6
DIR-04-01	12.2	700	2784	87.1	57.5
DIR-04-02	12.5	695	2791	87.1	55.8
DIR-05-01	16.1	828	2961	87.8	51.4
DIR-05-02	16.1	844	2979	87.9	52.3
DIR-06-01	19.1	1119	3452	84.8	58.7
DIR-06-02	19.3	1192	3398	84.4	61.7
DIR-07-01	23.1	1287	4153	86.5	55.8
DIR-07-02	23.3	1294	4134	86.4	55.4
DIR-08-01	13.9	882	3969	78.1	63.4
DIR-08-02	13.9	852	3947	78.9	61.4

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Sphere Photometric Summary: Horizontal Closed

Serial #	System Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
DIR-09-01	9.3	655	5224	85.4	70.3
DIR-09-02	9.7	716	5177	85.3	73.8
DIR-10-01	16.1	934	3088	82.8	57.9
DIR-10-02	16.2	917	3028	81.6	56.5
DIR-11-01	5.2	290	2861	87.8	56.0
DIR-11-02	4.3	246	2899	88.5	57.7
DIR-12-01	14.2	994	3171	81.8	70.1
DIR-12-02	14.2	1007	3157	80.9	71.1
DIR-13-01	8.2	369	2871	82.5	45.2
DIR-13-02	8.2	351	2849	82.5	43.0
DIR-14-01	15.6	838	2759	91.0	53.7
DIR-14-02	15.6	872	2778	90.9	55.7
DIR-15-01	9.9	566	3026	89.0	57.2
DIR-15-02	10.0	550	3007	88.7	55.1
DIR-16-01	11.0	578	2747	93.7	52.8
DIR-16-02	10.4	555	2716	93.5	53.4

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Sphere Photometric Summary: Horizontal Open

Serial #	System Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
DIR-01-01	7.5	424	3059	83.2	56.5
DIR-01-02	7.3	430	3047	82.1	58.9
DIR-02-01	12.6	797	2719	86.1	63.3
DIR-02-02	12.5	801	2713	86.2	64.1
DIR-03-01	11.3	566	2989	82.7	50.0
DIR-03-02	10.9	514	2984	83.1	47.1
DIR-04-01	13.2	816	2777	87.6	61.8
DIR-04-02	13.4	821	2786	87.6	61.2
DIR-05-01	16.4	885	2964	87.9	54.0
DIR-05-02	16.3	892	2982	87.9	54.7
DIR-06-01	19.3	1175	3439	85.3	60.9
DIR-06-02	19.5	1251	3391	84.8	64.2
DIR-07-01	25.0	1435	4122	86.9	57.4
DIR-07-02	25.0	1435	4104	86.7	57.4
DIR-08-01	13.8	937	3948	78.4	67.9
DIR-08-02	13.8	902	3936	79.3	65.4

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Sphere Photometric Summary: Horizontal Open

Serial #	System Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
DIR-09-01	9.7	716	5177	85.3	73.8
DIR-09-02	9.9	718	5142	85.4	72.6
DIR-10-01	16.2	1003	3079	83.0	61.9
DIR-10-02	16.4	984	3019	81.9	60.0
DIR-11-01	4.9	276	2827	88.6	56.1
DIR-11-02	4.3	242	2879	89.1	56.8
DIR-12-01	14.0	1027	3145	82.3	73.7
DIR-12-02	14.0	1036	3129	81.4	74.1
DIR-13-01	8.4	409	2851	83.0	48.6
DIR-13-02	8.5	405	2829	83.0	47.9
DIR-14-01	15.4	864	2759	91.4	56.1
DIR-14-02	15.5	901	2778	91.3	58.3
DIR-15-01	9.9	589	3018	89.3	59.4
DIR-15-02	10.0	571	3001	89.0	57.1
DIR-16-01	11.0	599	2711	93.5	54.2
DIR-16-02	10.5	570	2686	93.3	54.3

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Summary Tables
Electrical Data

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Electrical Summary: Base-Up Closed

Serial #	Voltage	Current (A)	Power (W)	Power Factor	UTHD%	ITHD%
DIR-01-01	120.0	0.062	7.4	0.55	0.19	8.41
DIR-01-02	120.0	0.058	6.9	0.53	0.11	8.24
DIR-02-01	120.0	0.105	12.6	0.60	0.12	59.32
DIR-02-02	120.0	0.105	12.6	0.60	0.16	58.58
DIR-03-01	120.0	0.091	10.9	0.69	0.13	14.41
DIR-03-02	120.0	0.087	10.4	0.67	0.07	14.52
DIR-04-01	120.0	0.101	12.2	0.73	0.10	5.26
DIR-04-02	120.0	0.104	12.4	0.74	0.08	5.57
DIR-05-01	120.0	0.133	16.0	0.99	1.14	6.53
DIR-05-02	120.0	0.133	16.0	0.99	0.23	6.39
DIR-06-01	120.0	0.158	19.0	0.75	0.86	65.29
DIR-06-02	120.0	0.160	19.2	0.75	0.71	65.46
DIR-07-01	120.0	0.191	22.9	1.00	1.29	1.60
DIR-07-02	120.0	0.194	23.3	1.00	1.08	1.52
DIR-08-01	120.0	0.115	13.8	0.92	0.46	35.71
DIR-08-02	120.0	0.115	13.8	0.92	0.30	35.62

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Electrical Summary: Base-Up Closed

Serial #	Voltage	Current (A)	Power (W)	Power Factor	UTHD%	ITHD%
DIR-09-01	120.0	0.077	9.3	0.62	0.09	5.42
DIR-09-02	120.0	0.078	9.4	0.63	17.31	7.75
DIR-10-01	120.0	0.133	16.0	0.87	0.95	40.04
DIR-10-02	120.0	0.135	16.2	0.86	1.20	42.78
DIR-11-01	120.0	0.043	5.1	0.96	1.32	8.35
DIR-11-02	120.0	0.035	4.2	0.91	1.18	10.63
DIR-12-01	120.0	0.118	14.2	0.99	1.20	10.41
DIR-12-02	120.0	0.118	14.2	0.99	0.51	9.99
DIR-13-01	120.0	0.067	8.1	0.51	0.11	38.39
DIR-13-02	120.0	0.067	8.1	0.50	0.08	38.78
DIR-14-01	120.0	0.129	15.5	0.75	0.17	65.44
DIR-14-02	120.0	0.130	15.6	0.75	0.31	65.07
DIR-15-01	120.0	0.082	9.9	0.77	0.86	62.40
DIR-15-02	120.0	0.083	10.0	0.78	0.75	61.28
DIR-16-01	120.0	0.092	11.0	0.93	0.70	17.13
DIR-16-02	120.0	0.087	10.4	0.93	0.14	16.31

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Electrical Summary: Base-Up Open

Serial #	Voltage	Current (A)	Power (W)	Mfg. Rated Power (W)	Power Factor	UTHD%	ITHD%
DIR-01-01	120.0	0.060	7.2	7	0.97	1.20	12.77
DIR-01-02	120.0	0.059	7.1	7	0.53	0.08	7.28
DIR-02-01	120.0	0.105	12.7	13	0.60	0.19	56.71
DIR-02-02	120.0	0.103	12.3	13	0.59	0.07	57.40
DIR-03-01	120.0	0.091	10.9	10	0.68	0.07	14.05
DIR-03-02	120.0	0.088	10.6	10	0.68	0.10	14.53
DIR-04-01	120.0	0.103	12.3	13	0.73	0.22	5.29
DIR-04-02	120.0	0.104	12.5	13	0.74	0.08	5.57
DIR-05-01	120.0	0.138	16.5	17	0.83	0.14	6.42
DIR-05-02	120.0	0.137	16.5	17	0.83	0.08	6.34
DIR-06-01	120.0	0.159	19.0	20.3	0.68	0.07	60.97
DIR-06-02	120.0	0.163	19.6	20.3	0.68	0.10	60.97
DIR-07-01	120.0	0.192	23.1	24	0.90	0.12	2.81
DIR-07-02	120.0	0.194	23.3	24	0.90	0.09	2.74
DIR-08-01	120.0	0.117	14.0	13.5	0.75	0.14	28.86
DIR-08-02	120.0	0.118	14.1	13.5	0.75	0.12	28.79

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Electrical Summary: Base-Up Open

Serial #	Voltage	Current (A)	Power (W)	Mfg. Rated Power (W)	Power Factor	UTHD%	ITHD%
DIR-09-01	120.0	0.077	9.2	9	0.62	0.89	4.20
DIR-09-02	120.0	0.077	9.2	9	0.62	0.58	4.02
DIR-10-01	120.0	0.136	16.3	18	0.75	1.12	34.27
DIR-10-02	120.0	0.137	16.4	18	0.74	0.35	37.02
DIR-11-01	120.0	0.041	4.9	8	1.00	1.97	34.79
DIR-11-02	120.0	0.035	4.2	8	1.00	2.01	4.044
DIR-12-01	120.0	0.118	14.2	14	0.78	0.11	9.95
DIR-12-02	120.0	0.120	14.3	14	0.79	0.81	8.83
DIR-13-01	120.0	0.067	8.0	8	0.50	0.10	38.41
DIR-13-02	120.0	0.068	8.1	8	0.51	0.09	39.16
DIR-14-01	120.0	0.132	15.8	16	0.99	2.02	58.49
DIR-14-02	120.0	0.132	15.9	16	0.99	1.98	58.29
DIR-15-01	120.0	0.083	10.0	10	0.99	1.98	53.72
DIR-15-02	120.0	0.084	10.1	10	0.99	1.93	52.43
DIR-16-01	120.0	0.092	11.0	12	0.93	1.95	17.19
DIR-16-02	120.0	0.087	10.5	12	0.92	1.96	15.97

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Electrical Summary: Horizontal Closed

Serial #	Voltage	Current (A)	Power (W)	Power Factor	UTHD%	ITHD%
DIR-01-01	120.0	0.061	7.4	0.98	1.79	12.36
DIR-01-02	120.0	0.060	7.2	0.98	2.11	12.22
DIR-02-01	120.0	0.105	12.6	0.99	1.79	62.64
DIR-02-02	120.0	0.104	12.5	0.71	0.74	69.41
DIR-03-01	120.0	0.094	11.2	0.99	1.88	19.17
DIR-03-02	120.0	0.087	10.4	0.97	0.99	20.15
DIR-04-01	120.0	0.102	12.2	0.99	1.03	5.12
DIR-04-02	120.0	0.104	12.5	0.99	1.12	4.70
DIR-05-01	120.0	0.134	16.1	1.00	0.49	6.60
DIR-05-02	120.0	0.134	16.1	0.99	2.25	6.30
DIR-06-01	120.0	0.159	19.1	0.75	0.81	65.48
DIR-06-02	120.0	0.161	19.3	0.74	0.17	65.67
DIR-07-01	120.0	0.192	23.1	1.00	0.82	1.40
DIR-07-02	120.0	0.195	23.3	1.00	0.77	1.53
DIR-08-01	120.0	0.116	13.9	0.93	0.80	35.52
DIR-08-02	120.0	0.116	13.9	0.92	0.17	35.46

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Electrical Summary: Horizontal Closed

Serial #	Voltage	Current (A)	Power (W)	Power Factor	UTHD%	ITHD%
DIR-09-01	120.0	0.078	9.3	0.94	0.85	2.83
DIR-09-02	120.0	0.082	9.9	0.94	2.02	5.23
DIR-10-01	120.0	0.134	16.1	0.88	0.27	39.64
DIR-10-02	120.0	0.135	16.2	0.86	1.28	42.99
DIR-11-01	120.0	0.043	5.2	0.96	1.31	7.98
DIR-11-02	120.0	0.036	4.3	0.91	1.13	10.23
DIR-12-01	120.0	0.118	14.2	0.99	0.68	10.48
DIR-12-02	120.0	0.118	14.2	0.99	0.46	10.82
DIR-13-01	120.0	0.068	8.2	0.71	1.24	53.26
DIR-13-02	120.0	0.068	8.2	0.71	0.48	52.81
DIR-14-01	120.0	0.130	15.6	0.74	0.63	65.80
DIR-14-02	120.0	0.130	15.6	0.75	1.29	65.68
DIR-15-01	120.0	0.083	9.9	0.77	1.24	62.46
DIR-15-02	120.0	0.083	10.0	0.82	0.70	61.36
DIR-16-01	120.0	0.091	11.0	0.93	0.22	17.08
DIR-16-02	120.0	0.087	10.4	0.92	0.91	15.87

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Electrical Summary: Horizontal Open

Serial #	Voltage	Current (A)	Power (W)	Power Factor	UTHD%	ITHD%
DIR-01-01	120.0	0.061	7.4	0.98	1.77	12.44
DIR-01-02	120.0	0.060	7.2	0.98	2.12	12.6
DIR-02-01	120.0	0.106	12.7	0.99	1.77	62.5
DIR-02-02	120.0	0.105	12.6	0.99	2.16	62.4
DIR-03-01	120.0	0.094	11.3	0.99	1.80	19.08
DIR-03-02	120.0	0.091	10.9	0.99	2.10	19.68
DIR-04-01	120.0	0.108	13.0	0.99	2.04	5.53
DIR-04-02	120.0	0.111	13.3	0.99	2.03	5.27
DIR-05-01	120.0	0.137	16.5	1.00	1.79	6.55
DIR-05-02	120.0	0.136	16.4	1.00	2.08	6.73
DIR-06-01	120.0	0.161	19.3	0.99	1.77	61.49
DIR-06-02	120.0	0.163	19.5	0.99	2.05	61.46
DIR-07-01	120.0	0.206	24.8	1.00	2.09	3.11
DIR-07-02	120.0	0.206	24.8	1.00	2.09	3.11
DIR-08-01	120.0	0.116	13.9	0.99	2.05	33.75
DIR-08-02	120.0	0.116	13.9	0.99	2.02	33.75

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Electrical Summary: Horizontal Open

Serial #	Voltage	Current (A)	Power (W)	Power Factor	UTHD%	ITHD%
DIR-09-01	120.0	0.082	9.8	0.94	2.08	5.47
DIR-09-02	120.0	0.082	9.9	0.94	1.97	5.16
DIR-10-01	120.0	0.137	16.4	0.95	2.08	40.09
DIR-10-02	120.0	0.138	16.6	0.95	1.98	42.99
DIR-11-01	120.0	0.041	4.9	1.00	1.92	32.78
DIR-11-02	120.0	0.034	4.1	1.00	1.93	31.29
DIR-12-01	120.0	0.117	14.1	1.00	1.98	10.39
DIR-12-02	120.0	0.118	14.1	0.99	1.90	10.08
DIR-13-01	120.0	0.071	8.5	0.84	1.88	53.51
DIR-13-02	120.0	0.071	8.5	0.84	1.90	53.36
DIR-14-01	120.0	0.131	15.7	0.99	1.94	58.43
DIR-14-02	120.0	0.132	15.8	0.99	1.92	58.24
DIR-15-01	120.0	0.083	10.0	0.99	2.00	53.35
DIR-15-02	120.0	0.084	10.0	0.99	1.96	52.43
DIR-16-01	120.0	0.092	11.0	0.93	1.91	17.32
DIR-16-02	120.0	0.087	10.5	0.93	1.95	16.02

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DIR-01

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-01-01

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	7.4	388	3051	83.0	52.5
Base-Up Open	7.2	393	3061	83.0	55.0
Horizontal Open	7.4	396	3051	83.4	53.5
Horizontal Open	7.5	424	3059	83.2	56.5
Average	7.4	400	3056	83.2	54.4

Mfg. Rated Output (lumens): 330

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.062	7.4	0.55	0.19	8.41
Base-Up Open	120.0	0.060	7.2	0.97	1.20	12.77
Horizontal Open	120.0	0.061	7.4	0.98	1.79	12.36
Horizontal Open	120.0	0.061	7.4	0.98	1.77	12.44
Average	120.0	0.061	7.3	0.87	1.24	11.50

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	81.5	90.9	96.0	78.6	80.4	86.6	85.0	64.7	20.4	76.7	74.5	66.7	83.7	97.7	83.0
Base-Up Open	81.6	90.8	95.9	78.8	80.4	86.5	85.0	64.8	20.4	76.5	74.7	66.4	83.7	97.6	83.0
Horizontal Open	82.1	91.5	96.2	78.9	81.0	87.4	84.9	65.2	22.0	78.0	74.9	68.3	84.3	98.0	83.4
Horizontal Open	81.8	91.1	96.1	78.9	80.7	87.0	85.0	65.1	21.5	77.3	74.8	67.4	84.0	97.8	83.2
Average	81.8	91.1	96.1	78.8	80.6	86.9	85.0	65.0	21.1	77.1	74.7	67.2	83.9	97.8	83.2

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-01-02

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	6.9	387	3028	81.9	56.0
Base-Up Open	7.1	400	3045	81.8	56.3
Horizontal Open	7.2	401	3034	82.4	55.4
Horizontal Open	7.3	430	3047	82.1	58.9
Average	7.1	404	3039	82.1	56.7

Mfg. Rated Output (lumens): 330

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.058	6.9	0.53	0.11	8.24
Base-Up Open	120.0	0.059	7.1	0.53	0.08	7.28
Horizontal Open	120.0	0.060	7.2	0.98	2.11	12.22
Horizontal Open	120.0	0.060	7.2	0.98	2.12	12.60
Average	120.0	0.059	7.1	0.76	1.11	10.09

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	80.2	89.2	95.1	78.2	78.8	84.3	85.3	63.9	17.1	73.0	73.9	63.5	82.0	96.8	81.9
Base-Up Open	80.1	89.0	94.9	78.3	78.7	84.0	85.4	63.9	16.6	72.5	74.1	62.9	81.9	96.7	81.8
Horizontal Open	80.7	89.8	95.5	78.6	79.5	85.1	85.3	64.4	18.7	74.3	74.3	65.2	82.6	97.1	82.4
Horizontal Open	80.5	89.4	95.1	78.5	79.2	84.6	85.4	64.4	18.1	73.5	74.2	64.1	82.3	96.9	82.1
Average	80.4	89.4	95.2	78.4	79.1	84.5	85.4	64.2	17.6	73.3	74.1	63.9	82.2	96.9	82.1

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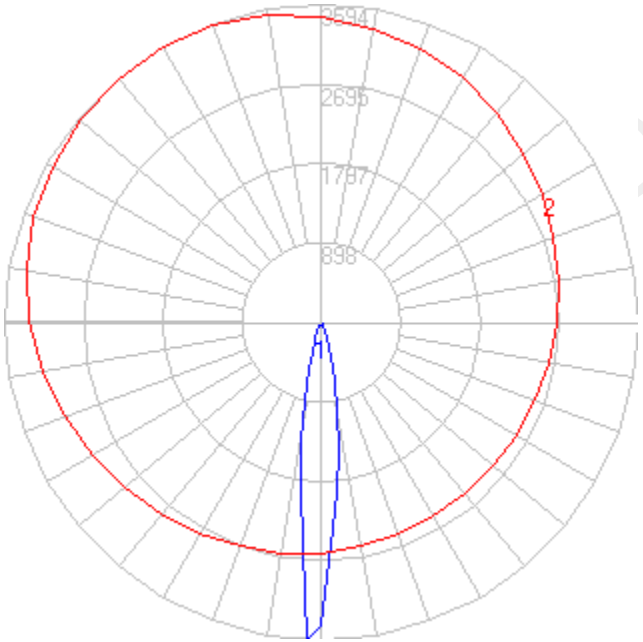
Goniophotometer Characterization: DIR-01-01

Power (W)	Gonio. Output (lm)	Beam Lumens	Center Beam Candlepower	Beam Angle	Efficacy
7.4	426	109	3514	14.2	57.6



Vertical Plane Through Horizontal Angles:
Blue: 120˚ - 300˚ (Through Max Candela)

Horizontal Cone Through Vertical Angle:
Red: 2.5˚ (Through Max Candela)

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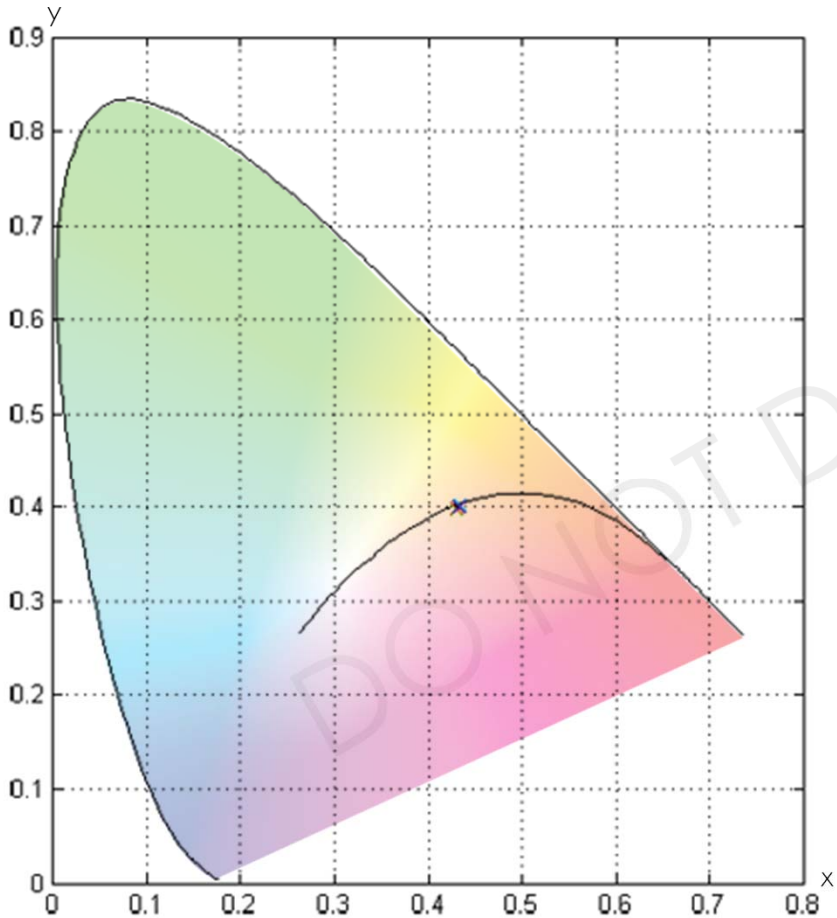
Photometric Summary: DIR-01



Chromaticity Diagram CIE 1931, 2 Degree

DIR-01-01	CIE X	CIE Y
Base-Up Closed	0.4310	0.3980
Base-Up Open	0.4301	0.3974
Base-Up Semi-Closed	0.4306	0.3971
Horizontal Open	0.4301	0.3972
Average	0.4305	0.3974

DIR-01-02	CIE X	CIE Y
Base-Up Closed	0.4340	0.4016
Base-Up Open	0.4330	0.4016
Base-Up Semi-Closed	0.4331	0.4005
Horizontal Open	0.4324	0.4005
Average	0.4331	0.4011

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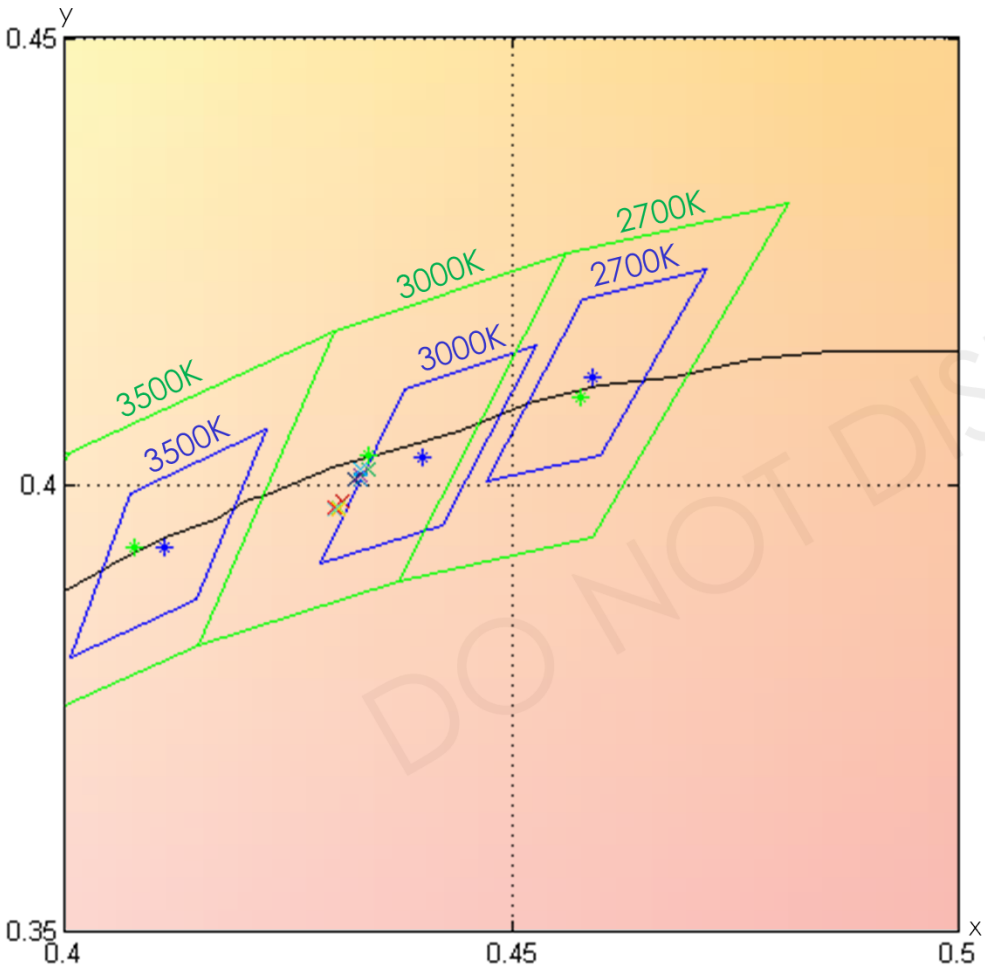
Photometric Summary: DIR-01



DIR-01-01	CIE X	CIE Y
Base-Up Closed	0.4310	0.3980
Base-Up Open	0.4301	0.3974
Base-Up Semi-Closed	0.4306	0.3971
Horizontal Open	0.4301	0.3972
Average	0.4305	0.3974

DIR-01-02	CIE X	CIE Y
Base-Up Closed	0.4340	0.4016
Base-Up Open	0.4330	0.4016
Base-Up Semi-Closed	0.4331	0.4005
Horizontal Open	0.4324	0.4005
Average	0.4331	0.4011

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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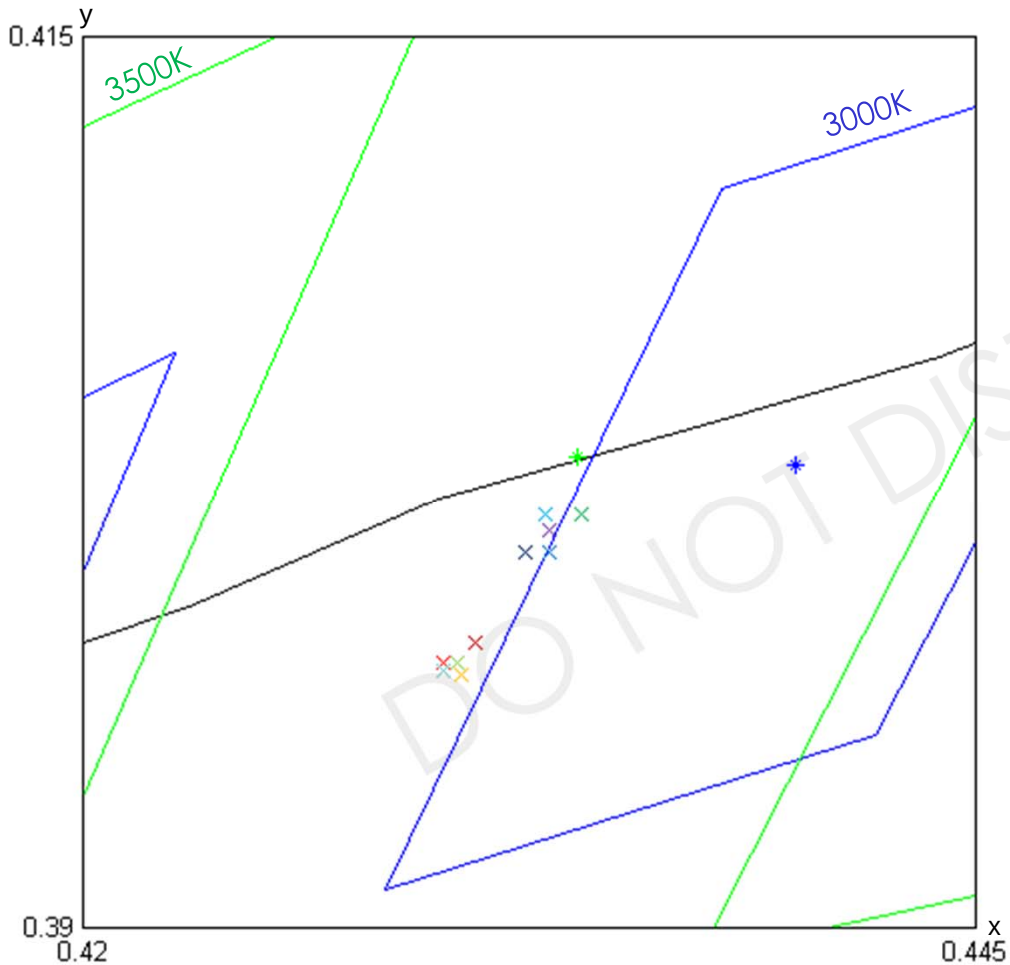
Photometric Summary: DIR-01



DIR-01-01	CIE X	CIE Y
Base-Up Closed	0.4310	0.3980
Base-Up Open	0.4301	0.3974
Base-Up Semi-Closed	0.4306	0.3971
Horizontal Open	0.4301	0.3972
Average	0.4305	0.3974

DIR-01-02	CIE X	CIE Y
Base-Up Closed	0.4340	0.4016
Base-Up Open	0.4330	0.4016
Base-Up Semi-Closed	0.4331	0.4005
Horizontal Open	0.4324	0.4005
Average	0.4331	0.4011

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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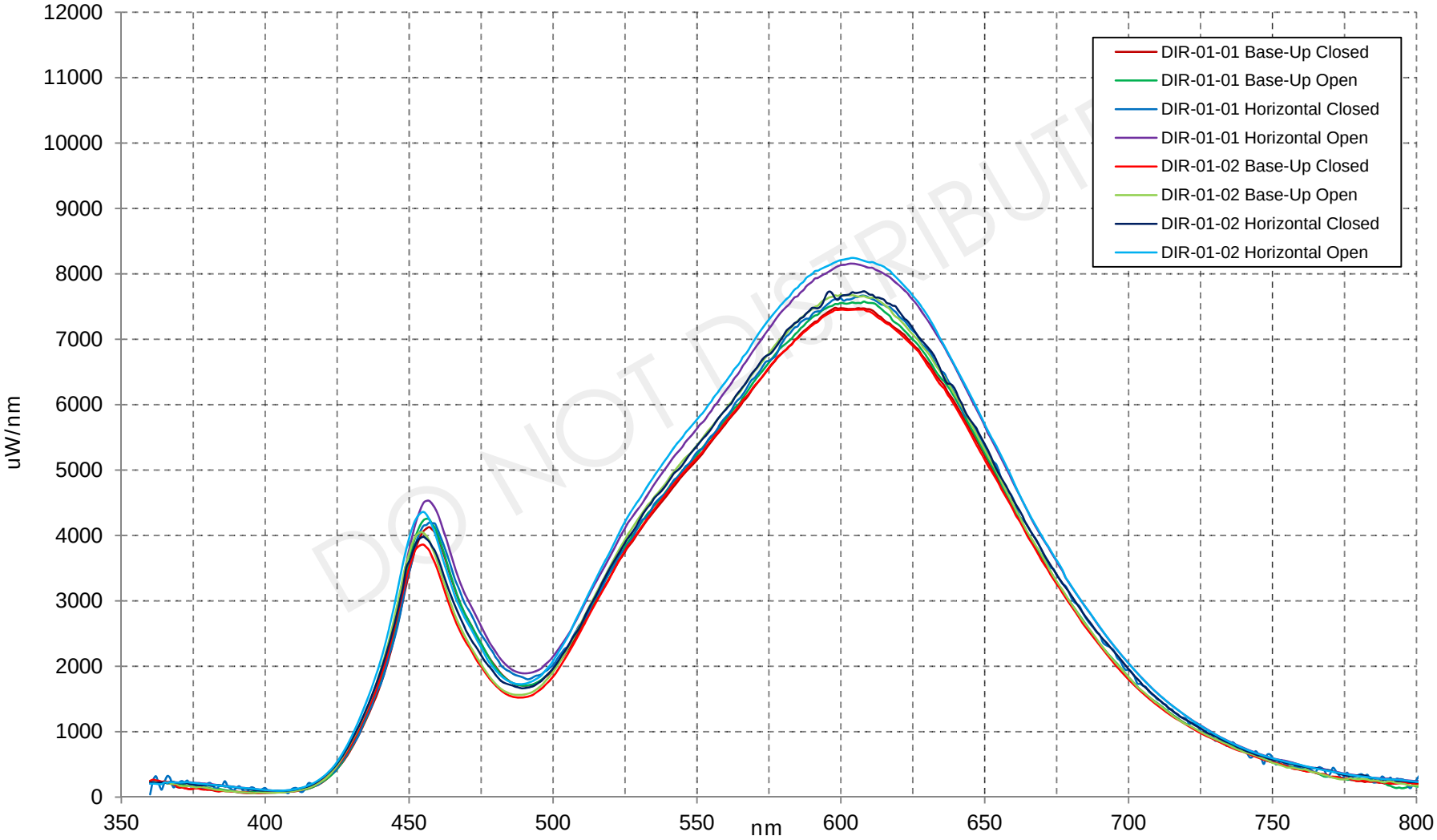
Spectral Power Distribution: DIR-01



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DIR-02

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-02-01

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	12.6	765	2712	85.7	60.9
Base-Up Open	12.7	764	2714	85.6	60.4
Horizontal Open	12.5	780	2733	86.0	62.5
Horizontal Open	12.6	797	2719	86.1	63.3
Average	12.6	776	2720	85.9	61.7

Mfg. Rated Output (lumens): N/A

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.105	12.6	0.60	0.12	59.32
Base-Up Open	120.0	0.105	12.7	0.60	0.19	56.71
Horizontal Open	120.0	0.105	12.6	0.99	1.79	62.64
Horizontal Open	120.0	0.106	12.7	0.99	1.77	62.50
Average	120.0	0.105	12.6	0.80	0.97	60.29

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	84.4	91.3	97.5	85.4	84.3	90.2	86.2	66.4	25.3	80.4	86.0	77.0	85.9	98.4	85.7
Base-Up Open	84.3	91.2	97.5	85.4	84.2	90.1	86.2	66.2	24.8	80.2	86.1	76.9	85.7	98.4	85.6
Horizontal Open	84.8	91.5	97.5	85.7	84.7	90.4	86.5	67.2	26.9	80.7	86.4	77.3	86.2	98.4	86.0
Horizontal Open	84.9	91.5	97.5	86.0	84.8	90.5	86.5	67.2	27.0	80.7	86.9	77.5	86.3	98.3	86.1
Average	84.6	91.4	97.5	85.6	84.5	90.3	86.4	66.8	26.0	80.5	86.4	77.2	86.0	98.4	85.9

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-02-02

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	12.6	763	2706	85.7	60.5
Base-Up Open	12.3	762	2709	85.7	61.7
Horizontal Open	12.5	787	2729	85.8	62.9
Horizontal Open	12.5	801	2713	86.2	64.1
Average	12.5	778	2714	85.9	62.3

Mfg. Rated Output (lumens): N/A

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.105	12.6	0.60	0.16	58.58
Base-Up Open	120.0	0.103	12.3	0.59	0.07	57.40
Horizontal Open	120.0	0.104	12.5	0.71	0.74	69.41
Horizontal Open	120.0	0.105	12.6	0.99	2.16	62.40
Average	120.0	0.104	12.5	0.72	0.78	61.95

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	84.4	91.3	97.5	85.4	84.3	90.3	86.1	66.3	25.3	80.4	86.1	77.1	85.9	98.4	85.7
Base-Up Open	84.3	91.2	97.5	85.4	84.2	90.2	86.2	66.2	24.9	80.2	86.2	77.0	85.8	98.4	85.7
Horizontal Open	84.5	91.2	97.5	85.6	84.3	90.1	86.3	66.6	25.4	80.2	86.3	76.8	85.9	98.3	85.8
Horizontal Open	85.0	91.5	97.5	86.1	84.9	90.6	86.5	67.2	27.1	80.8	87.1	77.8	86.4	98.3	86.2
Average	84.6	91.3	97.5	85.6	84.4	90.3	86.3	66.6	25.7	80.4	86.4	77.2	86.0	98.4	85.9

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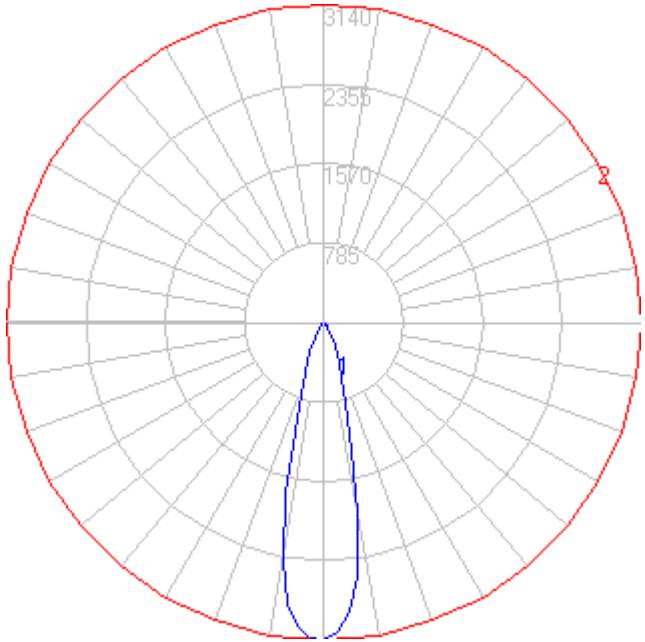
Goniophotometer Characterization: DIR-02-01

Power (W)	Gonio. Output (lm)	Beam Lumens	Center Beam Candlepower	Beam Angle	Efficacy
12.7	774	322	3140	24.5	60.9



Vertical Plane Through Horizontal Angles:
Blue: 0˚ - 180˚ (Through Max Candela)

Horizontal Cone Through Vertical Angle:
Red: 0˚ (Through Max Candela)

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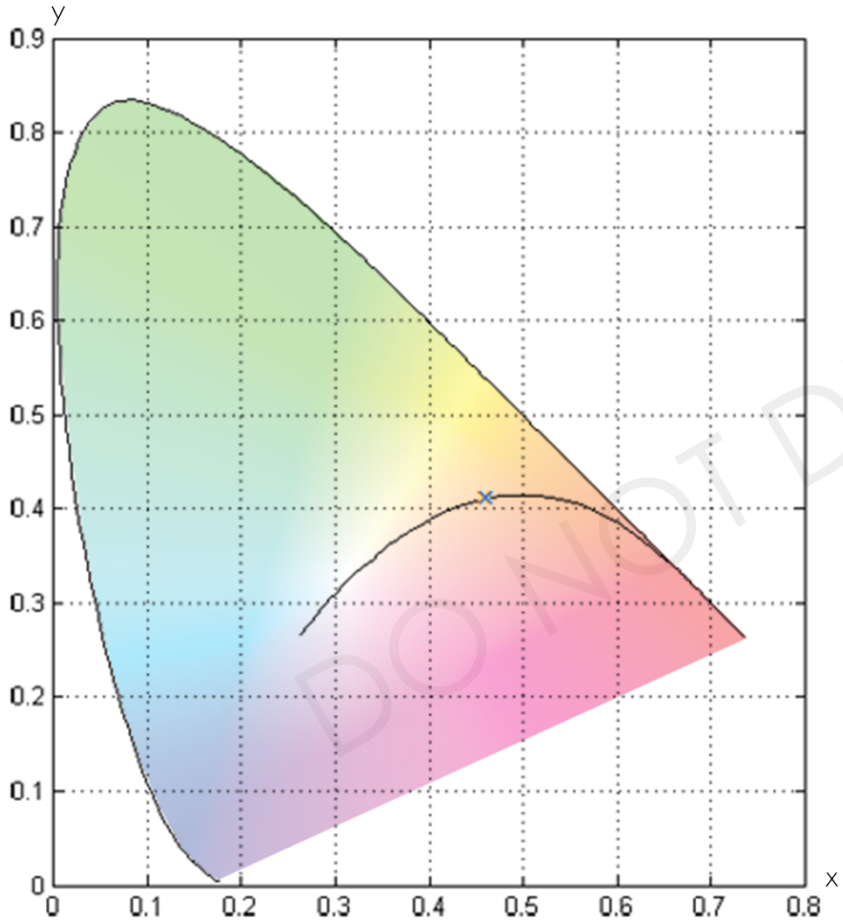
Photometric Summary: DIR-02



Chromaticity Diagram CIE 1931, 2 Degree

DIR-02-01	CIE X	CIE Y
Base-Up Closed	0.4597	0.4119
Base-Up Open	0.4598	0.4124
Base-Up Semi-Closed	0.4578	0.4114
Horizontal Open	0.4591	0.4118
Average	0.4591	0.4119

DIR-02-02	CIE X	CIE Y
Base-Up Closed	0.4601	0.4119
Base-Up Open	0.4602	0.4125
Base-Up Semi-Closed	0.4586	0.4121
Horizontal Open	0.4595	0.4118
Average	0.4596	0.4121

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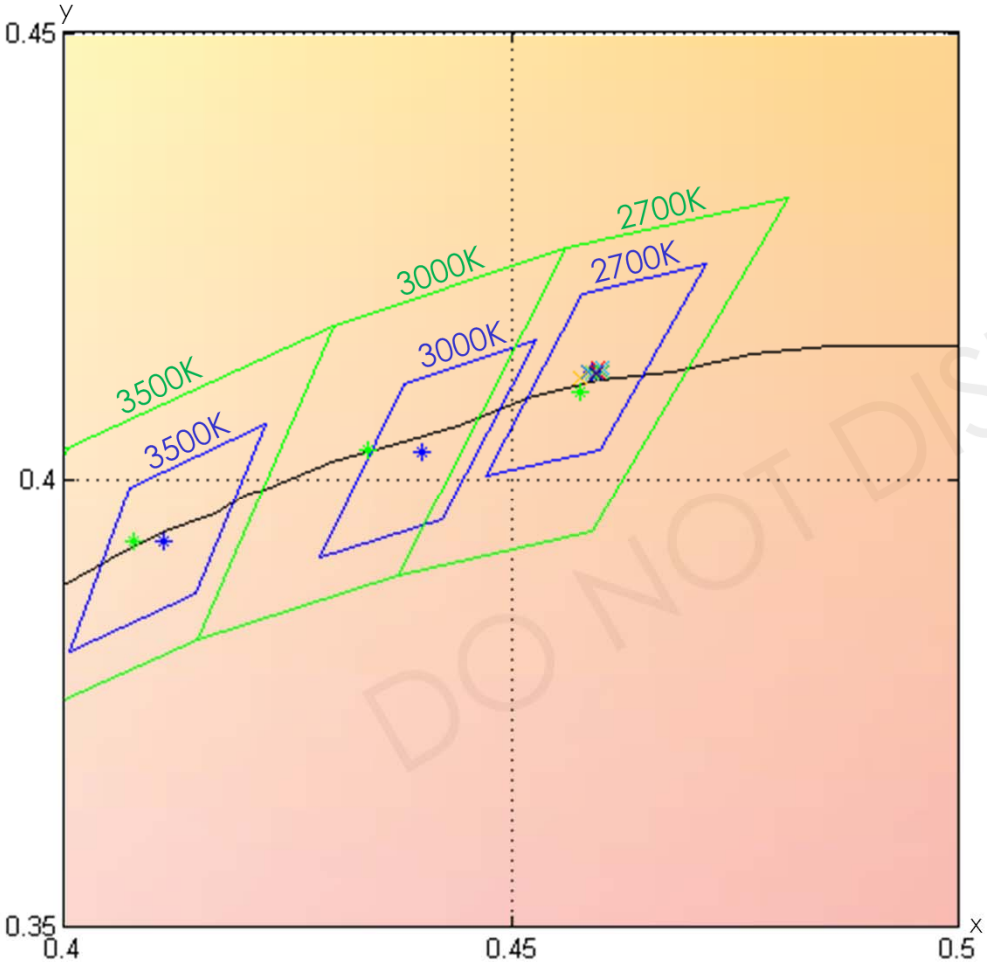
Photometric Summary: DIR-02



	DIR-02-01	CIE X	CIE Y
✖	Base-Up Closed	0.4597	0.4119
✖	Base-Up Open	0.4598	0.4124
✖	Base-Up Semi-Closed	0.4578	0.4114
✖	Horizontal Open	0.4591	0.4118
✖	Average	0.4591	0.4119

	DIR-02-02	CIE X	CIE Y
✖	Base-Up Closed	0.4601	0.4119
✖	Base-Up Open	0.4602	0.4125
✖	Base-Up Semi-Closed	0.4586	0.4121
✖	Horizontal Open	0.4595	0.4118
✖	Average	0.4596	0.4121

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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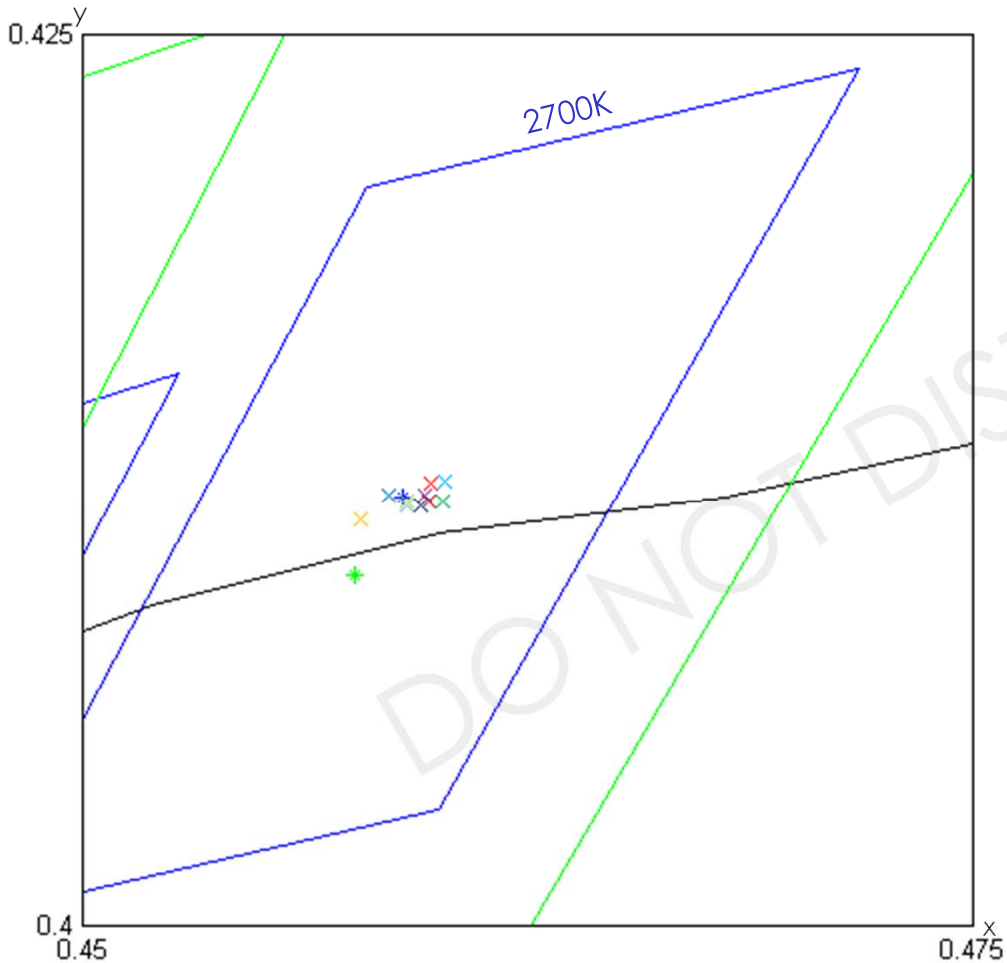
Photometric Summary: DIR-02



DIR-02-01	CIE X	CIE Y
Base-Up Closed	0.4597	0.4119
Base-Up Open	0.4598	0.4124
Base-Up Semi-Closed	0.4578	0.4114
Horizontal Open	0.4591	0.4118
Average	0.4591	0.4119

DIR-02-02	CIE X	CIE Y
Base-Up Closed	0.4601	0.4119
Base-Up Open	0.4602	0.4125
Base-Up Semi-Closed	0.4586	0.4121
Horizontal Open	0.4595	0.4118
Average	0.4596	0.4121

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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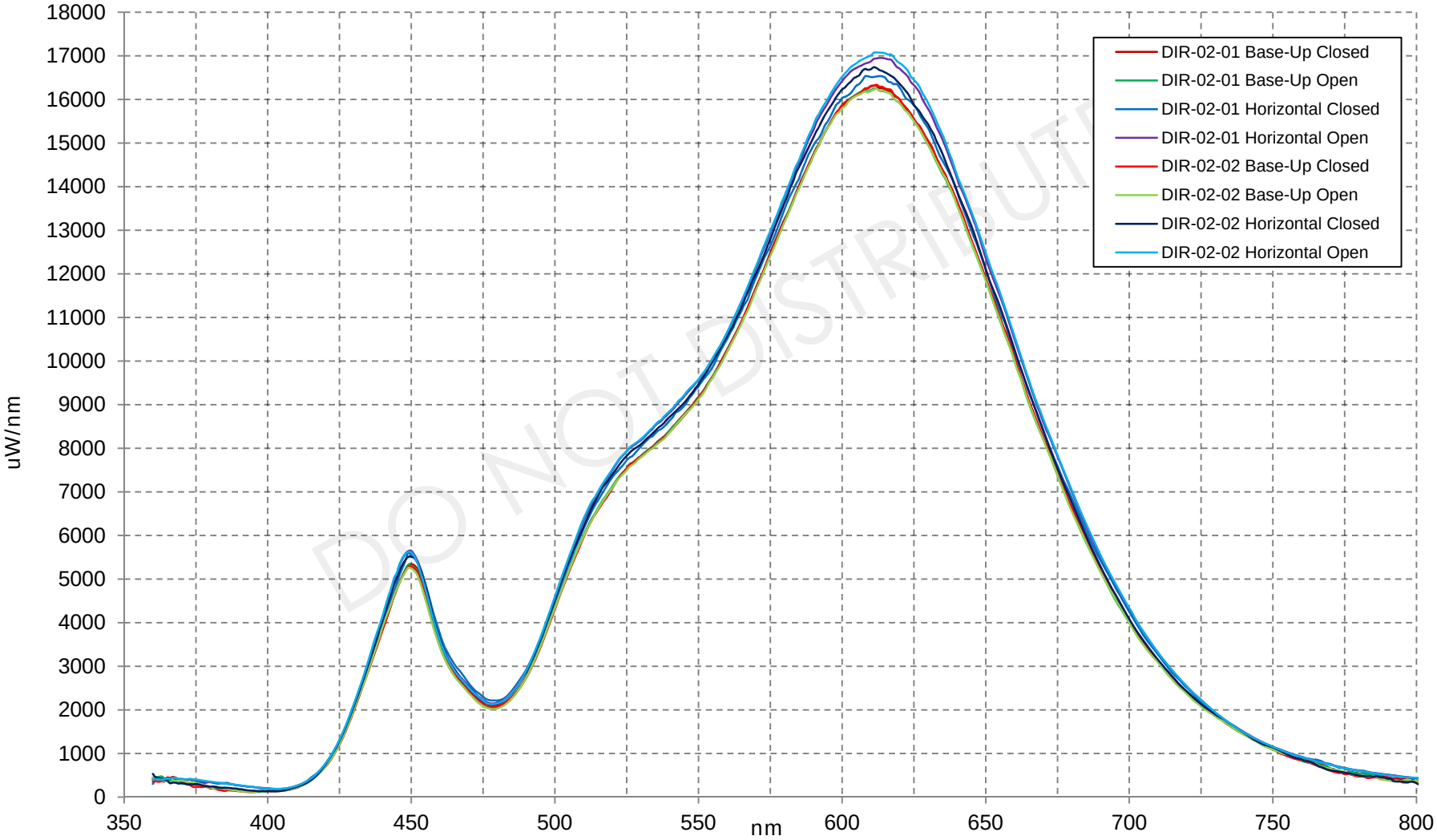
Spectral Power Distribution: DIR-02



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DIR-03

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-03-01

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	10.9	500	2976	82.6	46.1
Base-Up Open	10.9	531	2984	82.4	48.9
Horizontal Open	10.8	515	2994	82.5	47.9
Horizontal Open	11.3	566	2989	82.7	50.0
Average	11.0	528	2986	82.6	48.2

Mfg. Rated Output (lumens): 550

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.091	10.9	0.69	0.13	14.41
Base-Up Open	120.0	0.091	10.9	0.68	0.07	14.05
Horizontal Open	120.0	0.094	11.2	0.99	1.88	19.17
Horizontal Open	120.0	0.094	11.3	0.99	1.80	19.08
Average	120.0	0.092	11.1	0.84	0.97	16.68

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	81.7	88.6	92.4	80.2	80.0	83.1	86.6	68.1	26.4	71.2	76.0	65.4	82.9	95.0	82.6
Base-Up Open	81.5	88.4	92.2	80.2	79.8	82.8	86.6	68.0	25.8	70.7	76.0	64.8	82.6	94.9	82.4
Horizontal Open	81.5	88.5	92.5	80.1	79.9	83.0	86.6	68.0	25.9	71.0	75.9	65.2	82.7	95.0	82.5
Horizontal Open	81.8	88.7	92.4	80.4	80.2	83.2	86.7	68.3	26.9	71.4	76.2	65.6	83.0	95.0	82.7
Average	81.6	88.6	92.4	80.2	80.0	83.0	86.6	68.1	26.3	71.1	76.0	65.3	82.8	95.0	82.6

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-03-02

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	10.4	452	2971	83.0	43.3
Base-Up Open	10.6	480	2979	82.7	45.4
Horizontal Open	10.4	475	2987	82.9	45.6
Horizontal Open	10.9	514	2984	83.1	47.1
Average	10.6	480	2980	82.9	45.4

Mfg. Rated Output (lumens): 550

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.087	10.4	0.67	0.07	14.52
Base-Up Open	120.0	0.088	10.6	0.68	0.10	14.53
Horizontal Open	120.0	0.087	10.4	0.97	0.99	20.15
Horizontal Open	120.0	0.091	10.9	0.99	2.10	19.68
Average	120.0	0.088	10.6	0.83	0.82	17.22

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	81.8	89.1	93.4	80.3	80.1	83.9	87.0	68.1	26.6	72.4	75.9	65.1	83.1	95.6	83.0
Base-Up Open	81.5	88.9	93.2	80.1	79.9	83.5	87.0	67.9	25.7	71.8	75.7	64.4	82.9	95.4	82.7
Horizontal Open	81.7	89.1	93.4	80.2	80.1	83.8	87.1	68.1	26.3	72.3	75.9	65.0	83.1	95.6	82.9
Horizontal Open	82.0	89.2	93.3	80.5	80.3	83.9	87.2	68.5	27.2	72.5	76.1	65.2	83.3	95.5	83.1
Average	81.8	89.1	93.3	80.3	80.1	83.8	87.1	68.2	26.5	72.3	75.9	64.9	83.1	95.5	82.9

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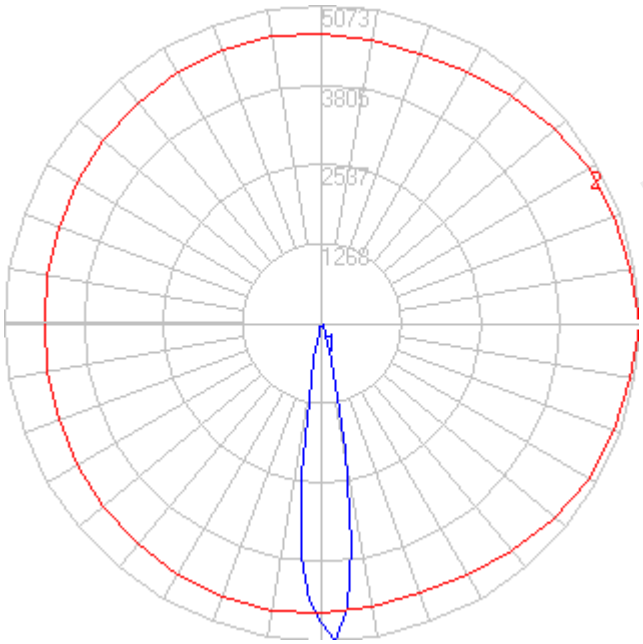
Goniophotometer Characterization: DIR-03-01

Power (W)	Gonio. Output (lm)	Beam Lumens	Center Beam Candlepower	Beam Angle	Efficacy
11.3	518	202	4965	16.8	45.8



Vertical Plane Through Horizontal Angles:
Blue: 0˚ - 180˚ (Through Max Candela)

Horizontal Cone Through Vertical Angle:
Red: 2.5˚ (Through Max Candela)

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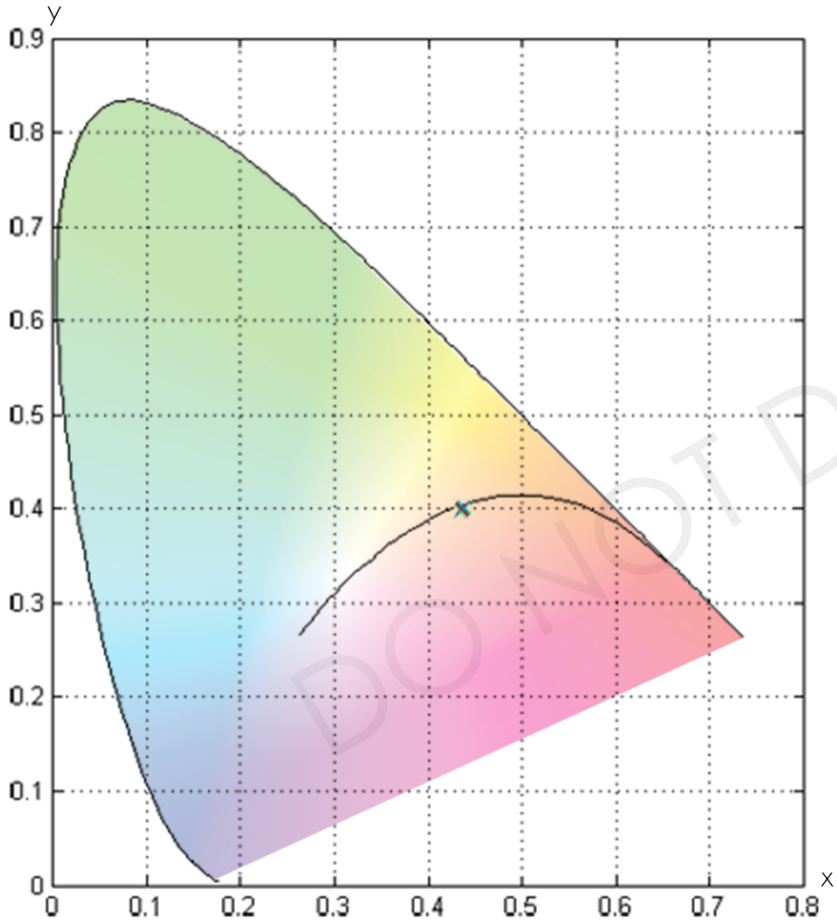
Photometric Summary: DIR-03



Chromaticity Diagram CIE 1931, 2 Degree

DIR-03-01	CIE X	CIE Y
Base-Up Closed	0.4351	0.3977
Base-Up Open	0.4349	0.3982
Base-Up Semi-Closed	0.4341	0.3978
Horizontal Open	0.4341	0.3972
Average	0.4346	0.3977

DIR-03-02	CIE X	CIE Y
Base-Up Closed	0.4372	0.4012
Base-Up Open	0.4369	0.4016
Base-Up Semi-Closed	0.4361	0.4011
Horizontal Open	0.4361	0.4007
Average	0.4366	0.4012

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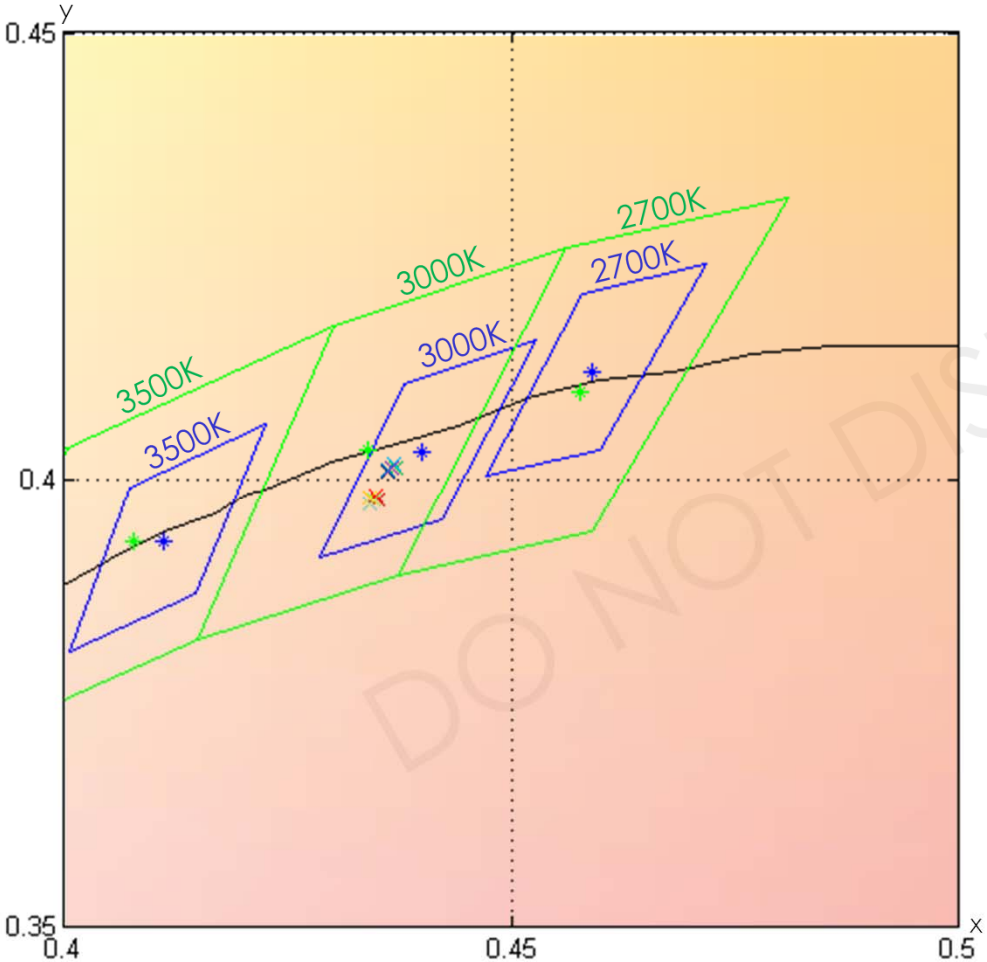
Photometric Summary: DIR-03



	DIR-03-01	CIE X	CIE Y
✖	Base-Up Closed	0.4351	0.3977
✖	Base-Up Open	0.4349	0.3982
✖	Base-Up Semi-Closed	0.4341	0.3978
✖	Horizontal Open	0.4341	0.3972
✖	Average	0.4346	0.3977

	DIR-03-02	CIE X	CIE Y
✖	Base-Up Closed	0.4372	0.4012
✖	Base-Up Open	0.4369	0.4016
✖	Base-Up Semi-Closed	0.4361	0.4011
✖	Horizontal Open	0.4361	0.4007
✖	Average	0.4366	0.4012

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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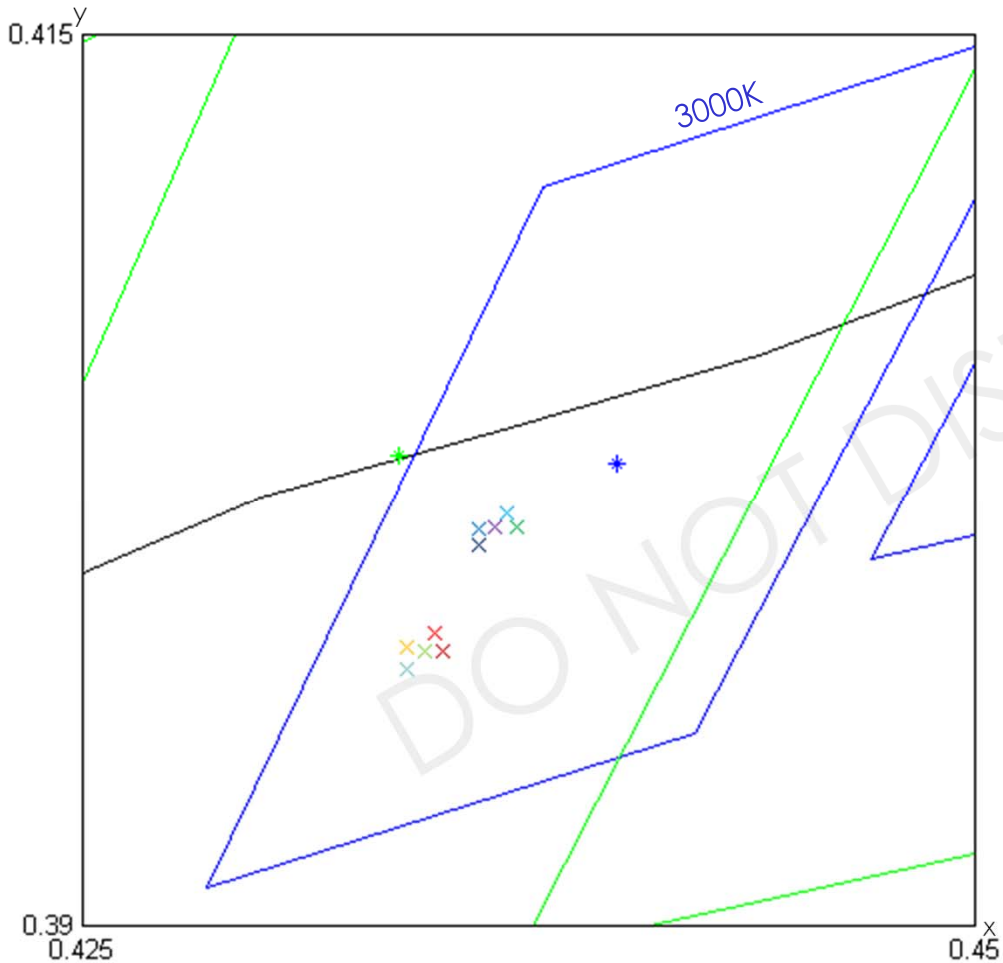
Photometric Summary: DIR-03



	DIR-03-01	CIE X	CIE Y
✖	Base-Up Closed	0.4351	0.3977
✖	Base-Up Open	0.4349	0.3982
✖	Base-Up Semi-Closed	0.4341	0.3978
✖	Horizontal Open	0.4341	0.3972
✖	Average	0.4346	0.3977

	DIR-03-02	CIE X	CIE Y
✖	Base-Up Closed	0.4372	0.4012
✖	Base-Up Open	0.4369	0.4016
✖	Base-Up Semi-Closed	0.4361	0.4011
✖	Horizontal Open	0.4361	0.4007
✖	Average	0.4366	0.4012

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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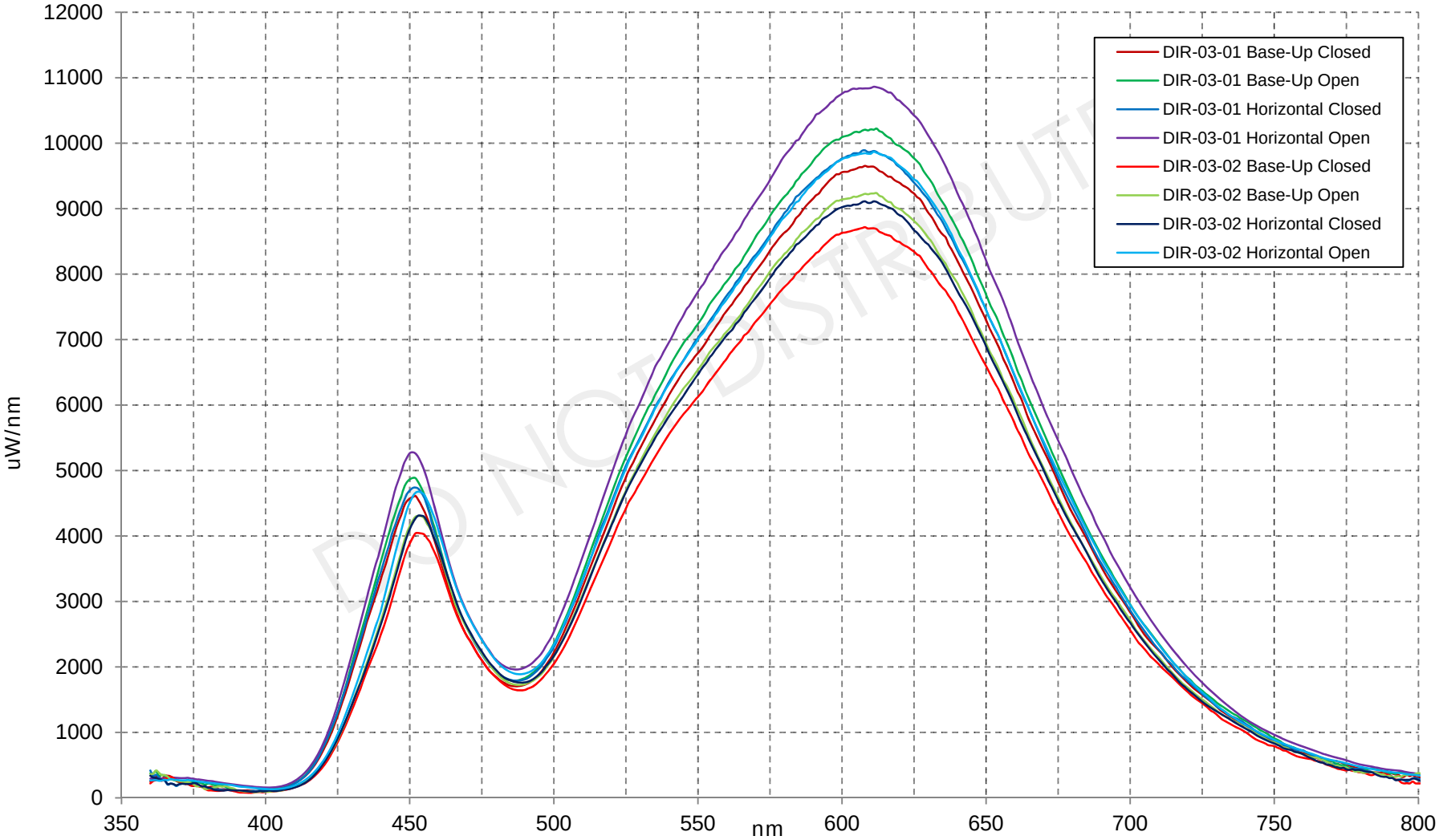
Spectral Power Distribution: DIR-03



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DIR-04

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-04-01

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	12.2	680	2751	87.1	55.9
Base-Up Open	12.3	743	2761	87.3	60.3
Horizontal Open	12.2	700	2784	87.1	57.5
Horizontal Open	13.2	816	2777	87.6	61.8
Average	12.5	735	2768	87.3	58.9

Mfg. Rated Output (lumens): 725

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.101	12.2	0.73	0.10	5.26
Base-Up Open	120.0	0.103	12.3	0.73	0.22	5.29
Horizontal Open	120.0	0.102	12.2	0.99	1.03	5.12
Horizontal Open	120.0	0.108	13.0	0.99	2.04	5.53
Average	120.0	0.103	12.4	0.86	0.85	5.30

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	86.3	92.7	97.7	86.8	86.3	91.9	86.7	68.7	30.9	83.3	87.7	79.3	87.8	98.7	87.1
Base-Up Open	86.5	92.6	97.7	87.2	86.5	91.9	87.0	69.1	31.3	83.2	88.4	79.5	87.9	98.6	87.3
Horizontal Open	86.2	92.6	97.7	86.7	86.2	91.8	86.8	68.7	30.6	83.1	87.5	79.0	87.7	98.7	87.1
Horizontal Open	86.9	92.8	97.7	87.5	86.8	92.2	87.2	69.7	32.8	83.6	88.6	79.8	88.3	98.6	87.6
Average	86.5	92.7	97.7	87.1	86.5	92.0	86.9	69.1	31.4	83.3	88.1	79.4	87.9	98.7	87.3

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-04-02

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	12.4	683	2759	87.1	55.0
Base-Up Open	12.5	747	2773	87.3	59.9
Horizontal Open	12.5	695	2791	87.1	55.8
Horizontal Open	13.4	821	2786	87.6	61.2
Average	12.7	736	2777	87.3	58.0

Mfg. Rated Output (lumens): 725

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.104	12.4	0.74	0.08	5.57
Base-Up Open	120.0	0.104	12.5	0.74	0.08	5.57
Horizontal Open	120.0	0.104	12.5	0.99	1.12	4.70
Horizontal Open	120.0	0.111	13.3	0.99	2.03	5.27
Average	120.0	0.106	12.7	0.87	0.83	5.28

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	86.2	92.6	97.8	86.7	86.1	91.8	86.8	68.6	30.5	83.1	87.6	78.9	87.7	98.7	87.1
Base-Up Open	86.5	92.5	97.8	87.3	86.4	91.9	87.1	69.1	31.2	83.1	88.4	79.2	87.8	98.6	87.3
Horizontal Open	86.1	92.5	97.7	86.7	86.1	91.7	86.9	68.7	30.3	82.9	87.5	78.6	87.6	98.7	87.1
Horizontal Open	86.8	92.7	97.7	87.5	86.8	92.0	87.4	69.8	32.7	83.4	88.6	79.5	88.2	98.6	87.6
Average	86.4	92.6	97.8	87.1	86.4	91.9	87.1	69.1	31.2	83.1	88.0	79.1	87.8	98.7	87.3

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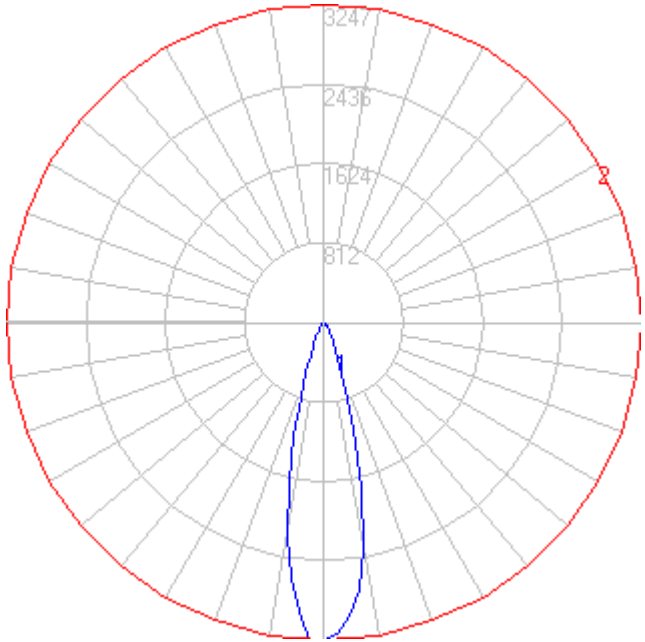
Goniophotometer Characterization: DIR-04-01

Power (W)	Gonio. Output (lm)	Beam Lumens	Center Beam Candlepower	Beam Angle	Efficacy
13.1	776	351	3247	25.8	59.2



Vertical Plane Through Horizontal Angles:
Blue: 0˚ - 180˚ (Through Max Candela)

Horizontal Cone Through Vertical Angle:
Red: 0˚ (Through Max Candela)

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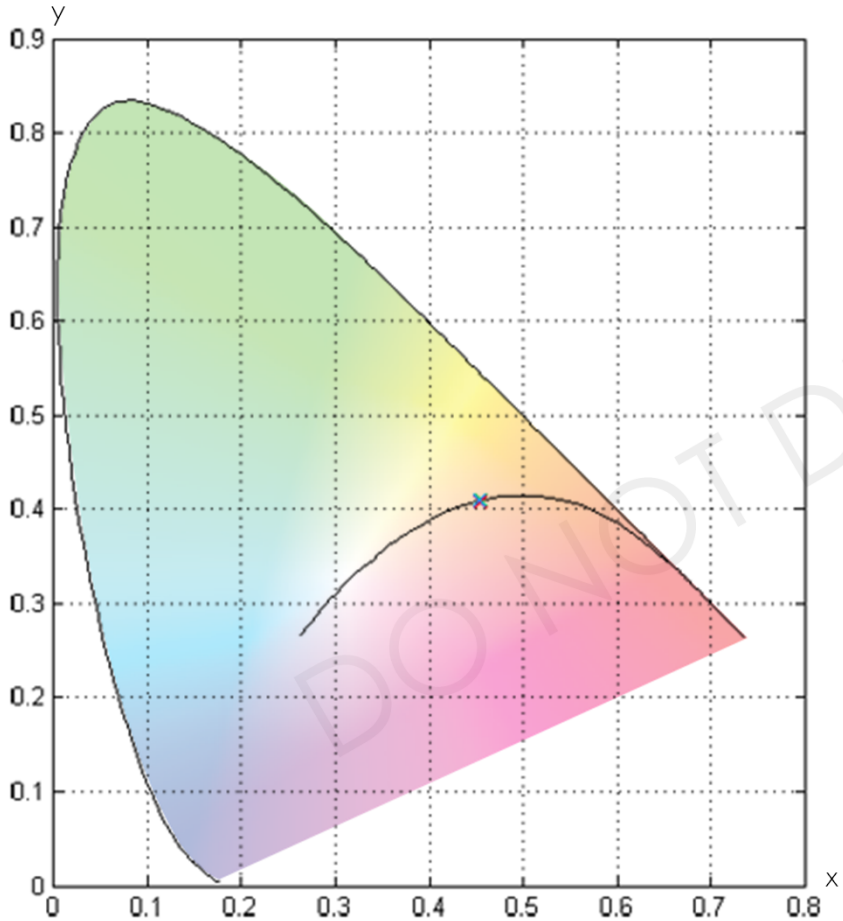
Photometric Summary: DIR-04



Chromaticity Diagram CIE 1931, 2 Degree

DIR-04-01	CIE X	CIE Y
Base-Up Closed	0.4549	0.4083
Base-Up Open	0.4545	0.4088
Base-Up Semi-Closed	0.4524	0.4078
Horizontal Open	0.4529	0.4078
Average	0.4537	0.4082

DIR-04-02	CIE X	CIE Y
Base-Up Closed	0.4549	0.4093
Base-Up Open	0.4541	0.4095
Base-Up Semi-Closed	0.4525	0.4088
Horizontal Open	0.4528	0.4087
Average	0.4536	0.4091

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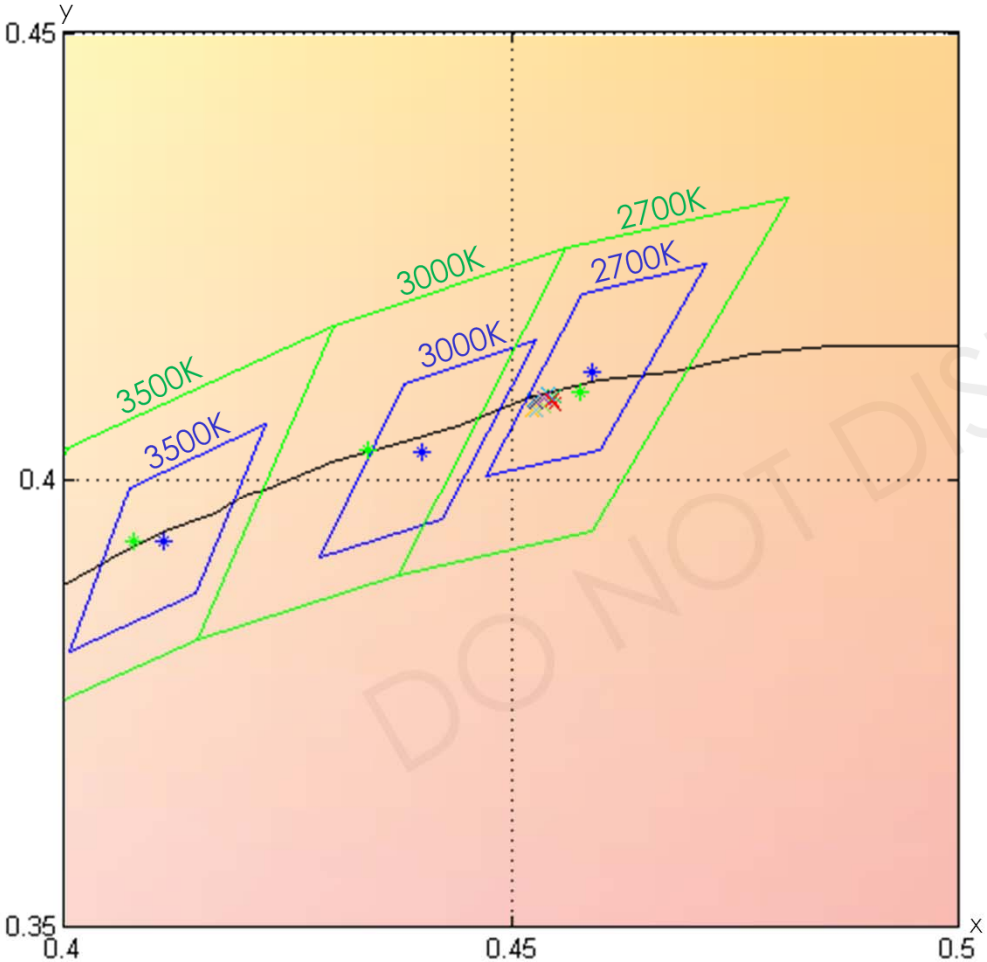
Photometric Summary: DIR-04



	DIR-04-01	CIE X	CIE Y
✖	Base-Up Closed	0.4549	0.4083
✖	Base-Up Open	0.4545	0.4088
✖	Base-Up Semi-Closed	0.4524	0.4078
✖	Horizontal Open	0.4529	0.4078
✖	Average	0.4537	0.4082

	DIR-04-02	CIE X	CIE Y
✖	Base-Up Closed	0.4549	0.4093
✖	Base-Up Open	0.4541	0.4095
✖	Base-Up Semi-Closed	0.4525	0.4088
✖	Horizontal Open	0.4528	0.4087
✖	Average	0.4536	0.4091

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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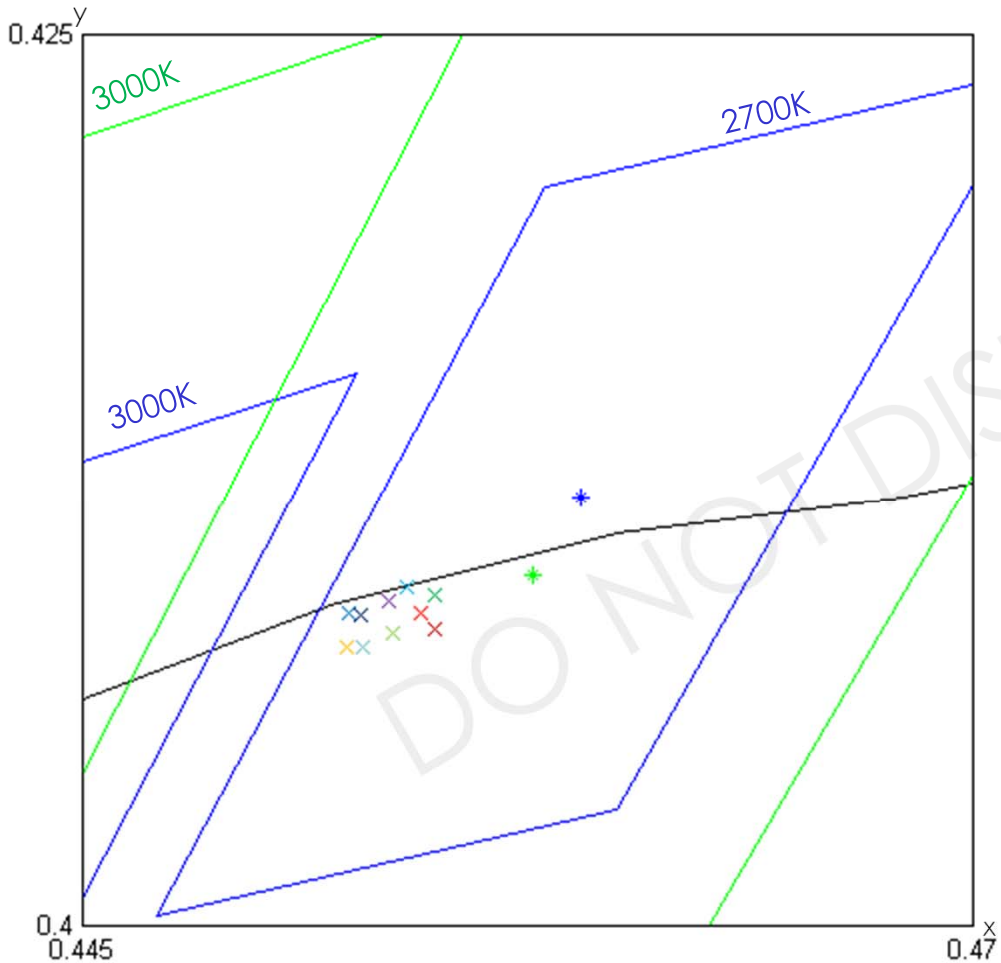
Photometric Summary: DIR-04



DIR-04-01	CIE X	CIE Y
Base-Up Closed	0.4549	0.4083
Base-Up Open	0.4545	0.4088
Base-Up Semi-Closed	0.4524	0.4078
Horizontal Open	0.4529	0.4078
Average	0.4537	0.4082

DIR-04-02	CIE X	CIE Y
Base-Up Closed	0.4549	0.4093
Base-Up Open	0.4541	0.4095
Base-Up Semi-Closed	0.4525	0.4088
Horizontal Open	0.4528	0.4087
Average	0.4536	0.4091

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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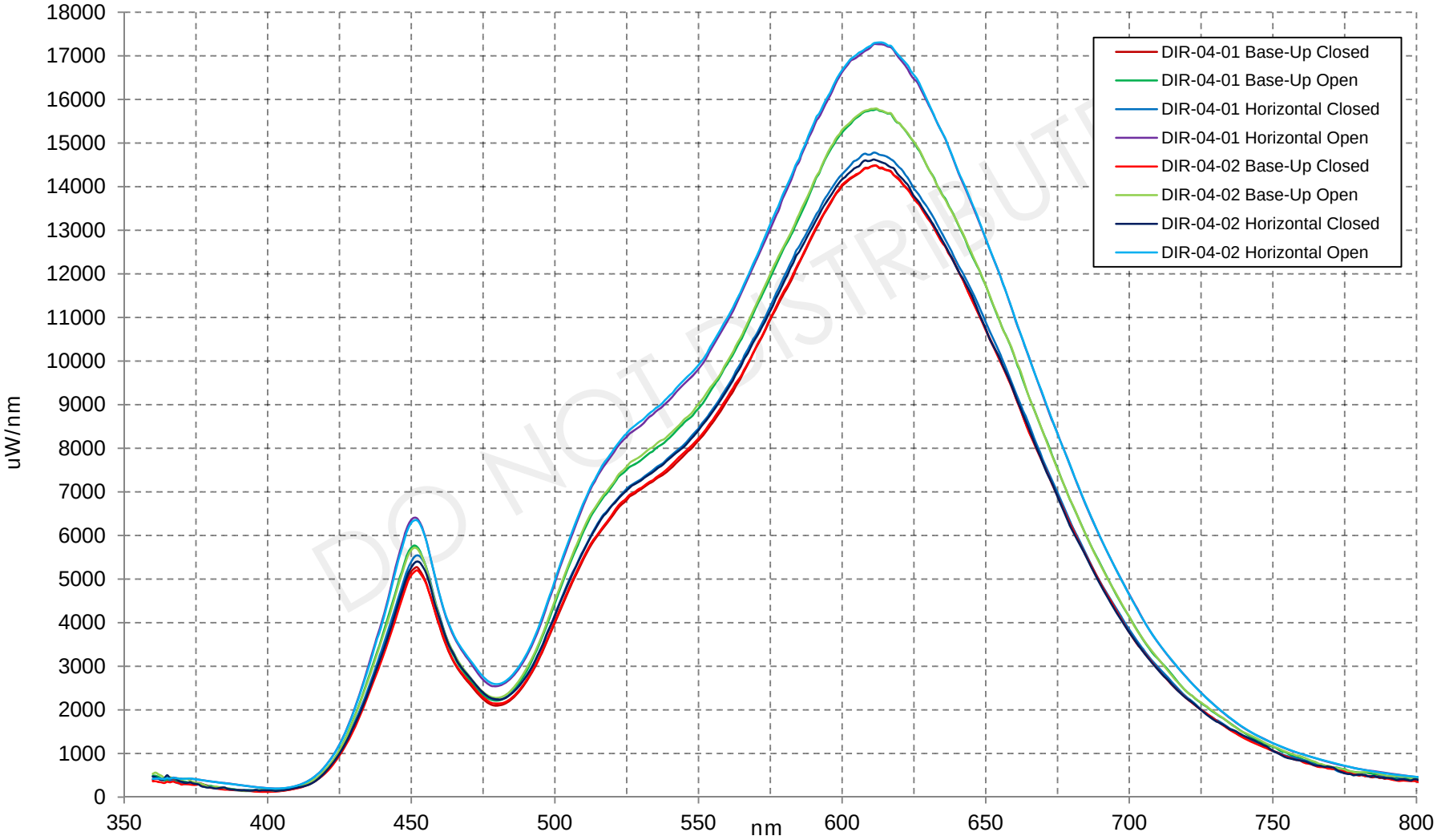
Spectral Power Distribution: DIR-04



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DIR-05

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-05-01

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	16.0	797	2944	87.9	49.8
Base-Up Open	16.5	862	2958	87.5	52.2
Horizontal Open	16.1	828	2961	87.8	51.4
Horizontal Open	16.4	885	2964	87.9	54.0
Average	16.3	843	2957	87.8	51.8

Mfg. Rated Output (lumens): 820

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.133	16.0	0.99	1.14	6.53
Base-Up Open	120.0	0.138	16.5	0.83	0.14	6.42
Horizontal Open	120.0	0.134	16.1	1.00	0.49	6.60
Horizontal Open	120.0	0.137	16.5	1.00	1.79	6.55
Average	120.0	0.136	16.3	0.96	0.89	6.53

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	88.7	90.6	89.7	88.1	86.8	85.8	91.3	82.0	56.9	75.8	86.4	70.5	88.6	93.2	87.9
Base-Up Open	88.5	90.0	88.9	88.1	86.4	85.1	91.2	82.1	56.8	74.6	86.5	69.2	88.3	92.8	87.5
Horizontal Open	88.7	90.5	89.5	88.1	86.7	85.7	91.2	82.0	56.8	75.6	86.5	70.3	88.6	93.1	87.8
Horizontal Open	88.8	90.4	89.2	88.3	86.8	85.6	91.3	82.4	57.7	75.4	86.7	70.1	88.7	93.0	87.9
Average	88.7	90.4	89.3	88.2	86.7	85.6	91.3	82.1	57.1	75.4	86.5	70.0	88.6	93.0	87.8

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-05-02

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	16.0	799	2964	87.9	50.1
Base-Up Open	16.5	865	2978	87.6	52.5
Horizontal Open	16.1	844	2979	87.9	52.3
Horizontal Open	16.3	892	2982	87.9	54.7
Average	16.2	850	2976	87.8	52.4

Mfg. Rated Output (lumens): 820

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.133	16.0	0.99	0.23	6.39
Base-Up Open	120.0	0.137	16.5	0.83	0.08	6.34
Horizontal Open	120.0	0.134	16.1	0.99	2.25	6.30
Horizontal Open	120.0	0.136	16.4	1.00	2.08	6.73
Average	120.0	0.135	16.2	0.95	1.16	6.44

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	88.6	90.6	89.9	88.1	86.7	85.9	91.5	81.8	56.4	75.9	86.2	70.0	88.5	93.4	87.9
Base-Up Open	88.4	90.1	89.1	88.1	86.4	85.2	91.5	82.2	56.6	74.8	86.4	68.9	88.3	92.9	87.6
Horizontal Open	88.7	90.5	89.6	88.2	86.7	85.7	91.5	82.2	57.1	75.6	86.4	69.9	88.6	93.2	87.9
Horizontal Open	88.7	90.5	89.5	88.2	86.7	85.6	91.6	82.4	57.4	75.5	86.5	69.8	88.6	93.1	87.9
Average	88.6	90.4	89.5	88.2	86.6	85.6	91.5	82.2	56.9	75.5	86.4	69.7	88.5	93.2	87.8

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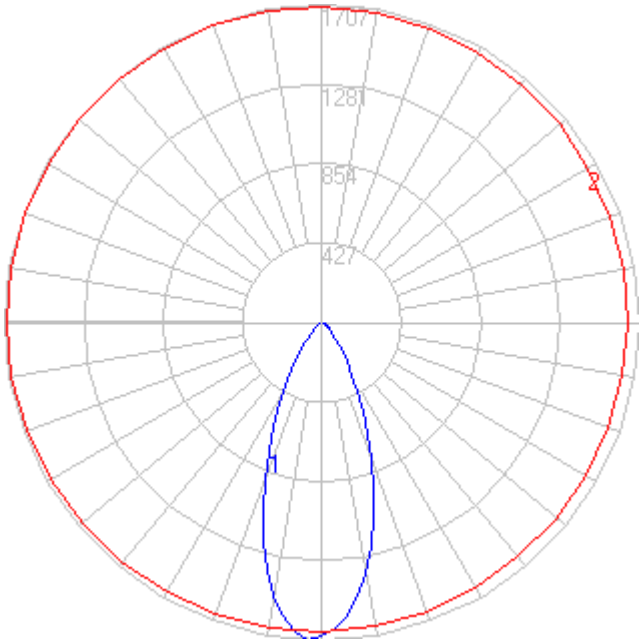
Goniophotometer Characterization: DIR-05-01

Power (W)	Gonio. Output (lm)	Beam Lumens	Center Beam Candlepower	Beam Angle	Efficacy
16.5	906	408	1698	37	54.9



Vertical Plane Through Horizontal Angles:
Blue: 140˚ - 320˚ (Through Max Candela)

Horizontal Cone Through Vertical Angle:
Red: 2.5˚ (Through Max Candela)

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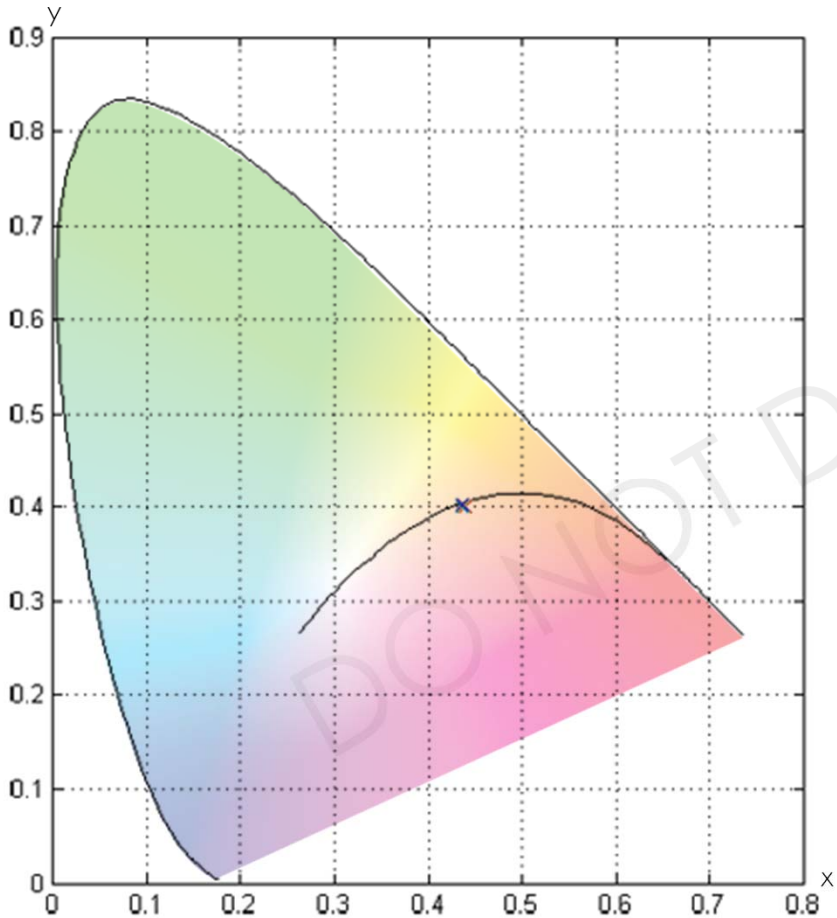
Photometric Summary: DIR-05



Chromaticity Diagram CIE 1931, 2 Degree

DIR-05-01	CIE X	CIE Y
Base-Up Closed	0.4388	0.4011
Base-Up Open	0.4386	0.4026
Base-Up Semi-Closed	0.4376	0.4008
Horizontal Open	0.4377	0.4013
Average	0.4382	0.4015

DIR-05-02	CIE X	CIE Y
Base-Up Closed	0.4379	0.4018
Base-Up Open	0.4375	0.4028
Base-Up Semi-Closed	0.4367	0.4012
Horizontal Open	0.4368	0.4018
Average	0.4372	0.4019

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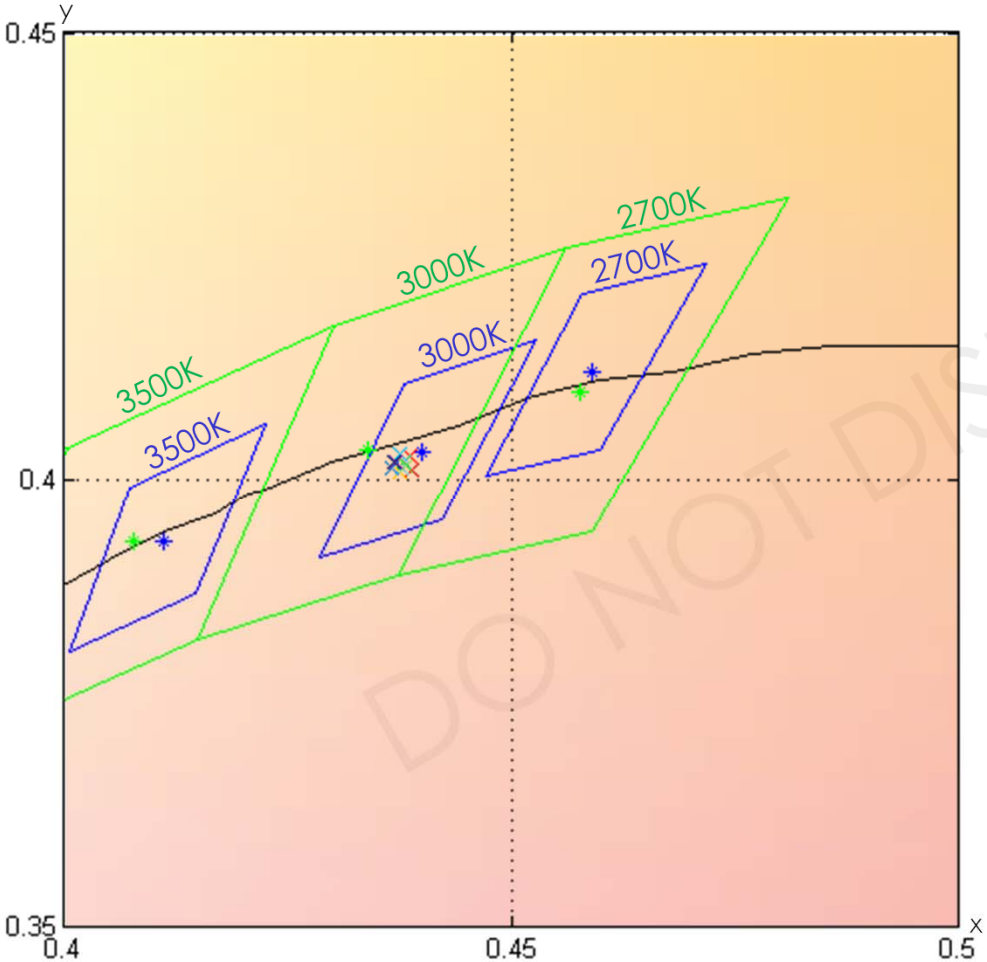
Photometric Summary: DIR-05



	DIR-05-01	CIE X	CIE Y
✖	Base-Up Closed	0.4388	0.4011
✖	Base-Up Open	0.4386	0.4026
✖	Base-Up Semi-Closed	0.4376	0.4008
✖	Horizontal Open	0.4377	0.4013
✖	Average	0.4382	0.4015

	DIR-05-02	CIE X	CIE Y
✖	Base-Up Closed	0.4379	0.4018
✖	Base-Up Open	0.4375	0.4028
✖	Base-Up Semi-Closed	0.4367	0.4012
✖	Horizontal Open	0.4368	0.4018
✖	Average	0.4372	0.4019

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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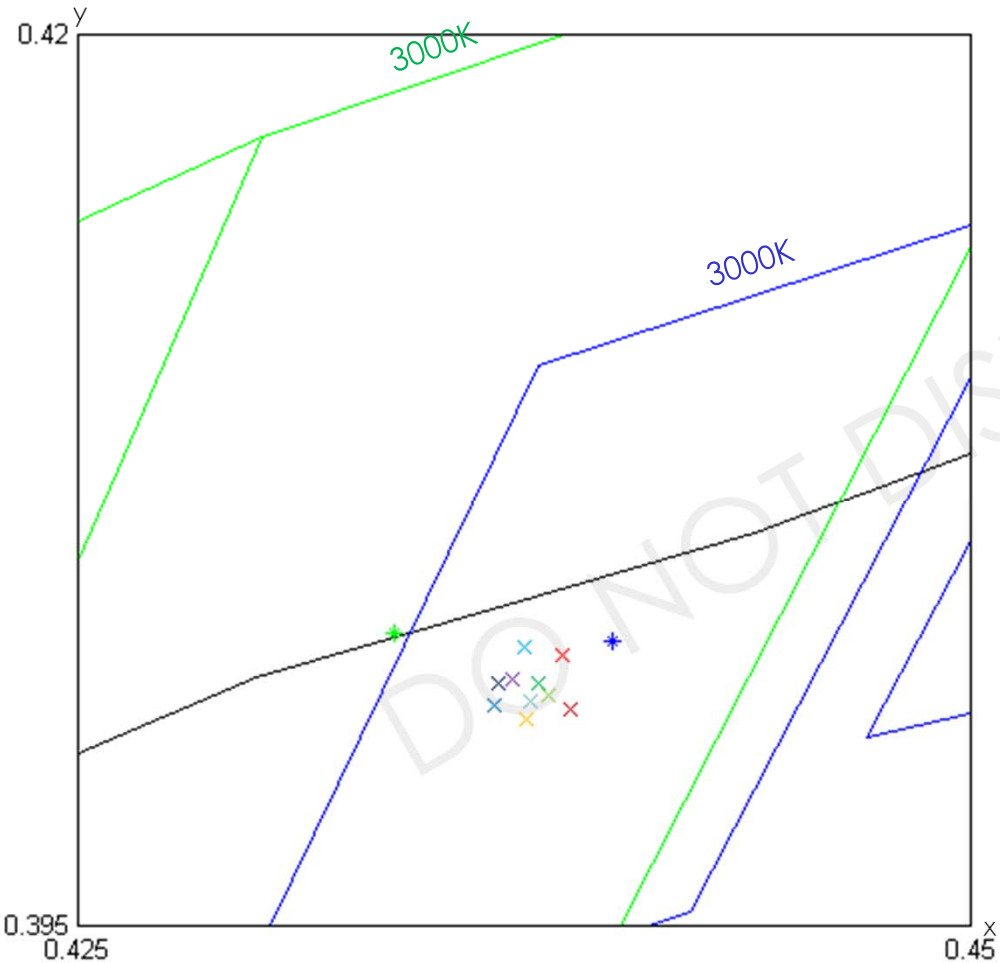
Photometric Summary: DIR-05



	DIR-05-01	CIE X	CIE Y
✖	Base-Up Closed	0.4388	0.4011
✖	Base-Up Open	0.4386	0.4026
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	DIR-05-02	CIE X	CIE Y
✖	Base-Up Closed	0.4379	0.4018
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Chromaticity Diagram CIE 1931, 2 Degree

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Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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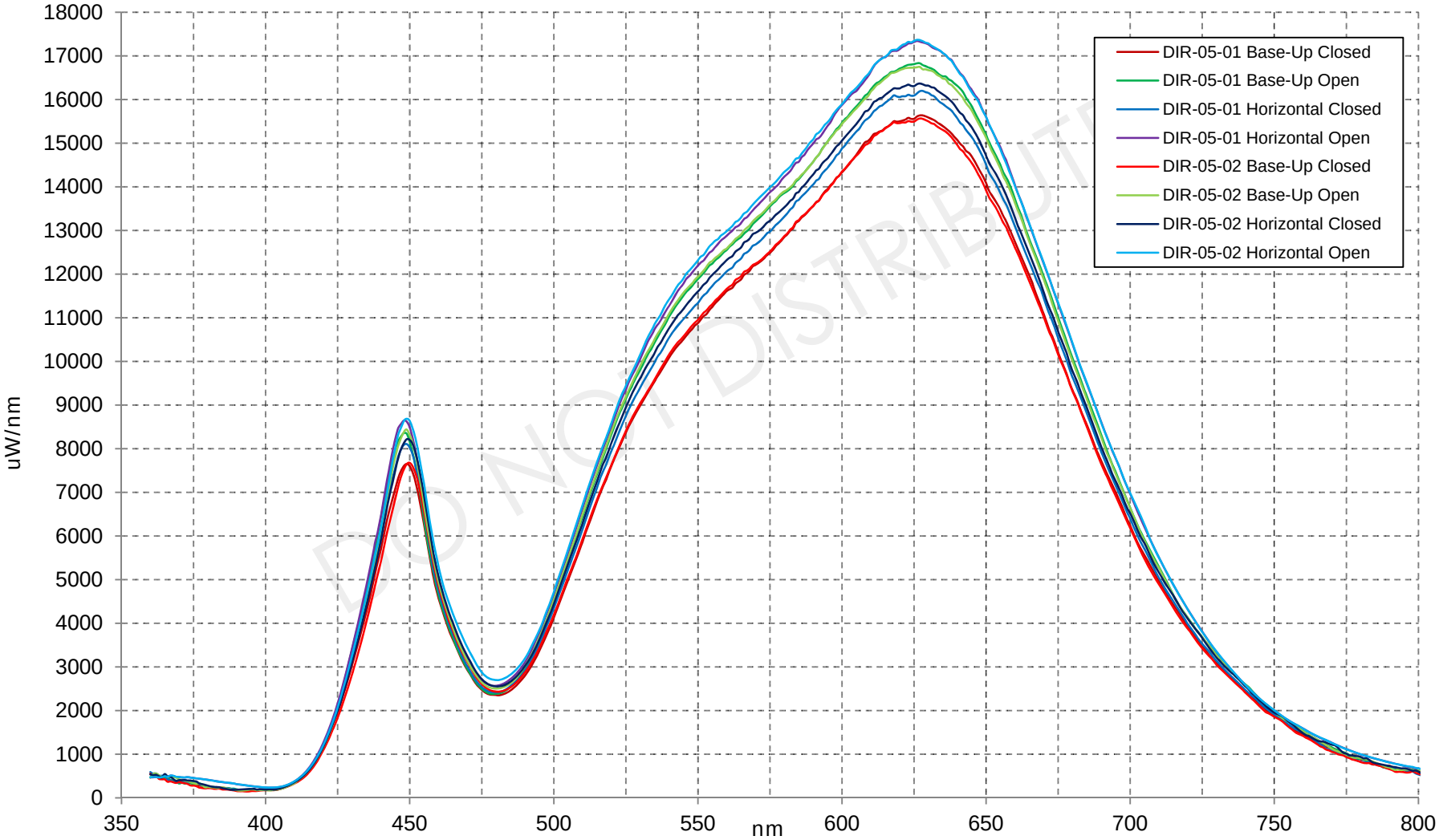
Spectral Power Distribution: DIR-05



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DIR-06

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-06-01

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	19.0	1054	3431	84.8	55.6
Base-Up Open	19.0	1144	3441	84.9	60.1
Horizontal Open	19.1	1119	3452	84.8	58.7
Horizontal Open	19.3	1175	3439	85.3	60.9
Average	19.1	1123	3441	85.0	58.8

Mfg. Rated Output (lumens): 1120

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.158	19.0	0.75	0.86	65.29
Base-Up Open	120.0	0.159	19.0	0.68	0.07	60.97
Horizontal Open	120.0	0.159	19.1	0.75	0.81	65.48
Horizontal Open	120.0	0.161	19.3	0.99	1.77	61.49
Average	120.0	0.159	19.1	0.79	0.88	63.31

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	83.6	89.4	94.0	84.6	83.5	85.7	87.7	70.2	26.8	75.0	83.6	71.9	84.5	96.4	84.8
Base-Up Open	83.9	89.1	93.2	85.2	83.7	85.4	87.9	71.1	28.3	74.3	84.5	72.1	84.6	95.9	84.9
Horizontal Open	83.6	89.2	93.6	84.9	83.5	85.5	87.8	70.6	27.3	74.6	84.0	71.9	84.5	96.1	84.8
Horizontal Open	84.2	89.5	93.6	85.3	84.1	86.0	88.1	71.4	29.4	75.2	84.6	72.6	85.0	96.1	85.3
Average	83.8	89.3	93.6	85.0	83.7	85.7	87.9	70.8	28.0	74.8	84.2	72.1	84.7	96.1	85.0

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-06-02

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	19.2	1126	3381	84.4	58.7
Base-Up Open	19.6	1205	3393	84.5	61.6
Horizontal Open	19.3	1192	3398	84.4	61.7
Horizontal Open	19.5	1251	3391	84.8	64.2
Average	19.4	1193	3391	84.5	61.5

Mfg. Rated Output (lumens): 1120

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.160	19.2	0.75	0.71	65.46
Base-Up Open	120.0	0.163	19.6	0.68	0.10	60.97
Horizontal Open	120.0	0.161	19.3	0.74	0.17	65.67
Horizontal Open	120.0	0.163	19.5	0.99	2.05	61.46
Average	120.0	0.162	19.4	0.79	0.76	63.39

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	83.4	88.9	93.2	84.4	83.3	85.2	87.0	70.0	26.7	73.9	83.7	72.7	84.2	95.9	84.4
Base-Up Open	83.7	88.6	92.5	84.9	83.6	85.0	87.1	70.8	28.0	73.3	84.7	72.7	84.3	95.4	84.5
Horizontal Open	83.5	88.7	92.8	84.6	83.4	85.0	87.1	70.3	27.0	73.5	84.2	72.7	84.2	95.7	84.4
Horizontal Open	84.0	89.0	92.9	85.1	83.9	85.4	87.3	71.1	29.0	74.1	84.7	73.3	84.7	95.6	84.8
Average	83.7	88.8	92.9	84.8	83.6	85.2	87.1	70.6	27.7	73.7	84.3	72.9	84.4	95.7	84.5

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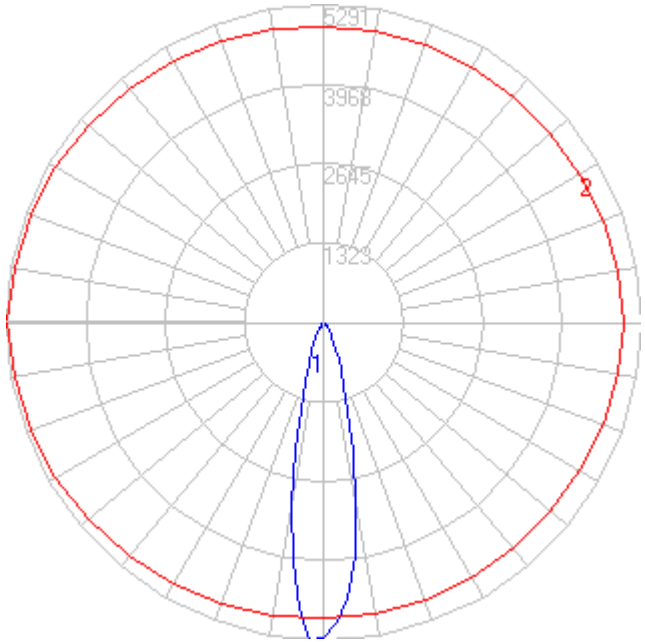
Goniophotometer Characterization: DIR-06-01

Power (W)	Gonio. Output (lm)	Beam Lumens	Center Beam Candlepower	Beam Angle	Efficacy
19.5	1111	417	5274	22.5	57



Vertical Plane Through Horizontal Angles:
Blue: 180˚ - 0˚ (Through Max Candela)

Horizontal Cone Through Vertical Angle:
Red: 2.5˚ (Through Max Candela)

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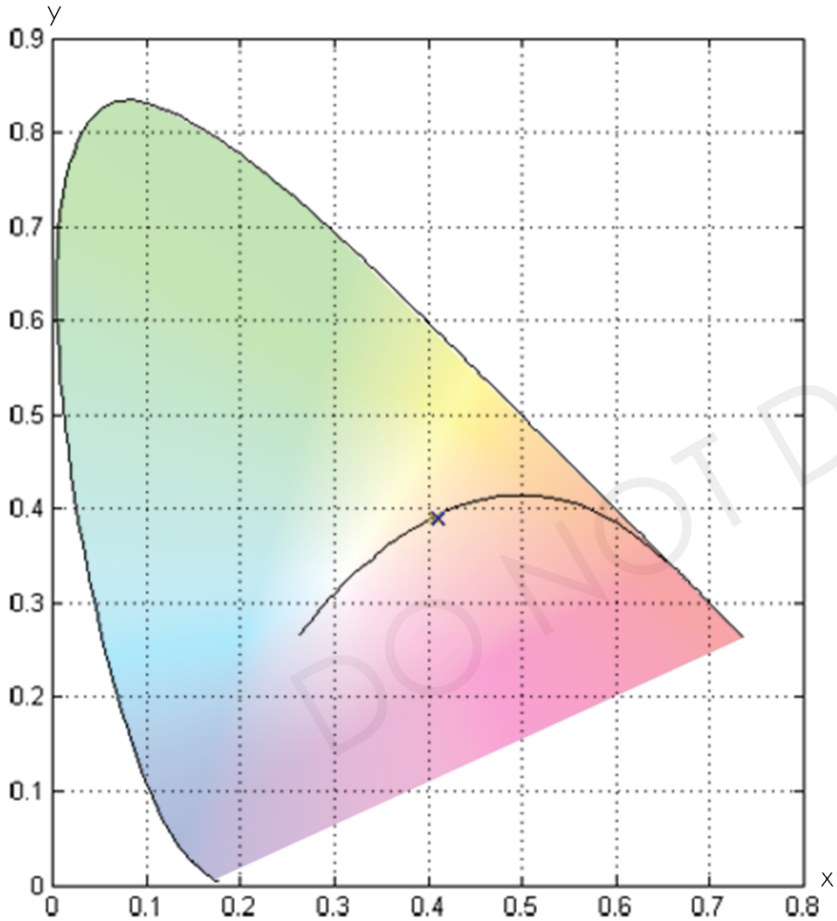
Photometric Summary: DIR-06



Chromaticity Diagram CIE 1931, 2 Degree

DIR-06-01	CIE X	CIE Y
Base-Up Closed	0.4086	0.3913
Base-Up Open	0.4083	0.3917
Base-Up Semi-Closed	0.4076	0.3911
Horizontal Open	0.4081	0.3910
Average	0.4082	0.3913

DIR-06-02	CIE X	CIE Y
Base-Up Closed	0.4105	0.3900
Base-Up Open	0.4101	0.3904
Base-Up Semi-Closed	0.4096	0.3899
Horizontal Open	0.4099	0.3898
Average	0.4100	0.3900

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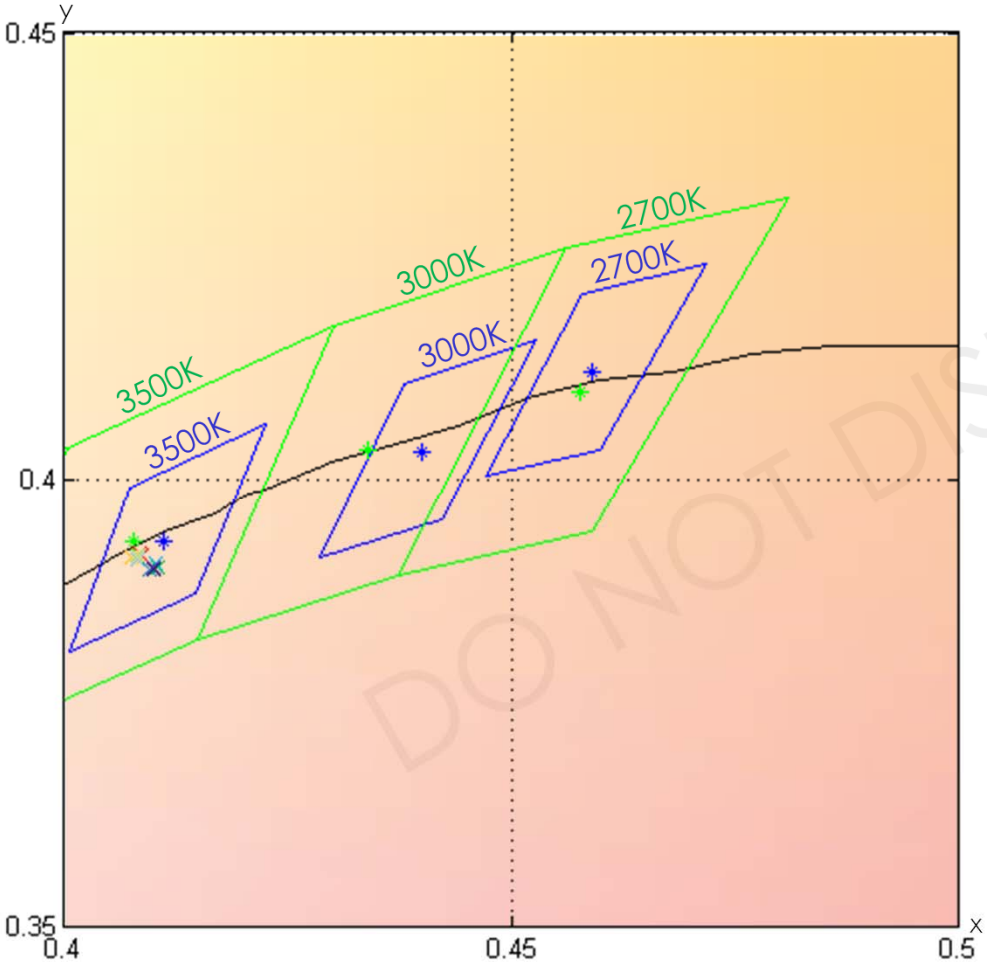
CALIFORNIA LIGHTING TECHNOLOGY CENTER

Photometric Summary: DIR-06



	DIR-06-01	CIE X	CIE Y
✖	Base-Up Closed	0.4086	0.3913
✖	Base-Up Open	0.4083	0.3917
✖	Base-Up Semi-Closed	0.4076	0.3911
✖	Horizontal Open	0.4081	0.3910
✖	Average	0.4082	0.3913

	DIR-06-02	CIE X	CIE Y
✖	Base-Up Closed	0.4105	0.3900
✖	Base-Up Open	0.4101	0.3904
✖	Base-Up Semi-Closed	0.4096	0.3899
✖	Horizontal Open	0.4099	0.3898
✖	Average	0.4100	0.3900

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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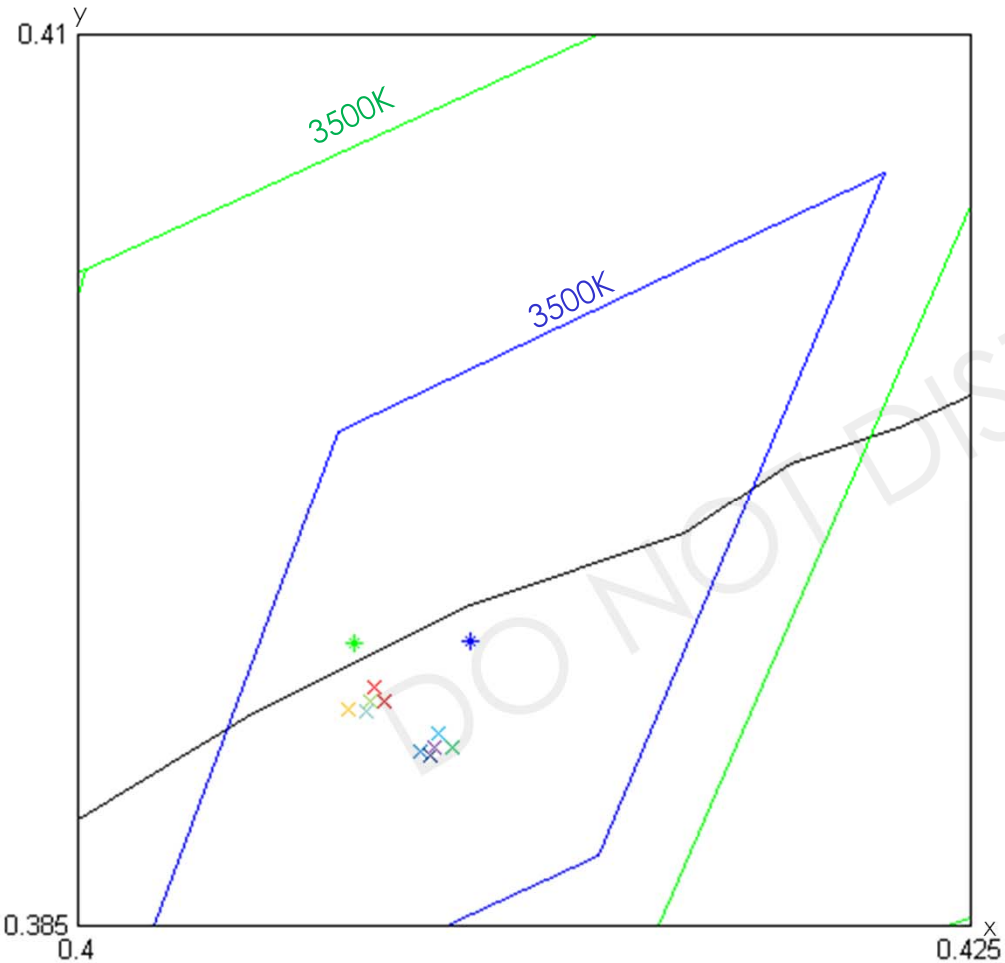
Photometric Summary: DIR-06



DIR-06-01	CIE X	CIE Y
Base-Up Closed	0.4086	0.3913
Base-Up Open	0.4083	0.3917
Base-Up Semi-Closed	0.4076	0.3911
Horizontal Open	0.4081	0.3910
Average	0.4082	0.3913

DIR-06-02	CIE X	CIE Y
Base-Up Closed	0.4105	0.3900
Base-Up Open	0.4101	0.3904
Base-Up Semi-Closed	0.4096	0.3899
Horizontal Open	0.4099	0.3898
Average	0.4100	0.3900

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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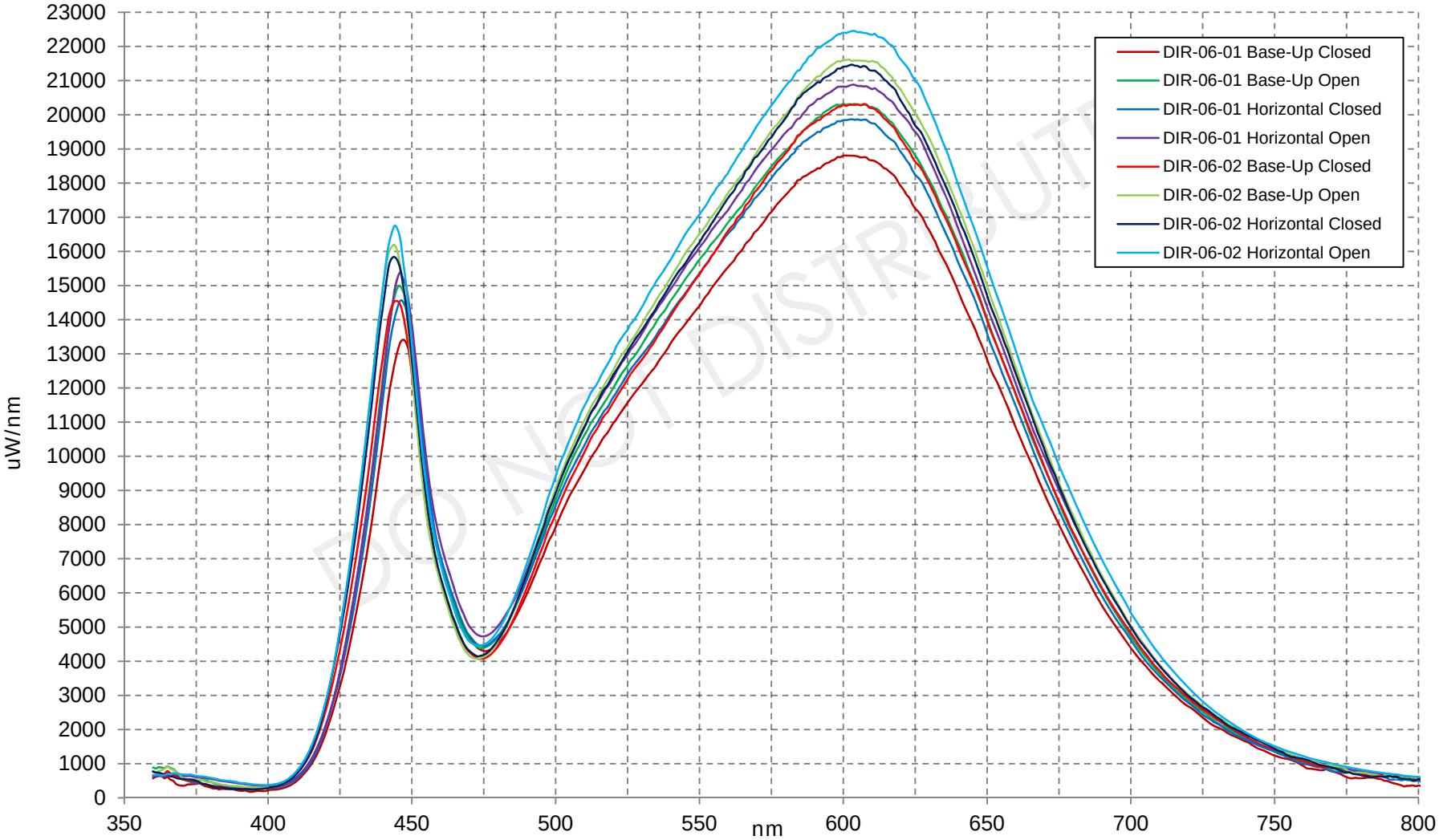
Spectral Power Distribution: DIR-06



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DIR-07

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-07-01

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	22.9	1196	4148	86.9	52.2
Base-Up Open	23.1	1318	4093	86.2	57.1
Horizontal Open	23.1	1287	4153	86.5	55.8
Horizontal Open	25.0	1435	4122	86.9	57.4
Average	23.5	1309	4129	86.6	55.6

Mfg. Rated Output (lumens): 1375

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.191	22.9	1.00	1.29	1.60
Base-Up Open	120.0	0.192	23.1	0.90	0.12	2.81
Horizontal Open	120.0	0.192	23.1	1.00	0.82	1.40
Horizontal Open	120.0	0.206	24.8	1.00	2.09	3.11
Average	120.0	0.195	23.5	0.98	1.08	2.23

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	87.1	92.2	94.3	86.8	87.1	88.0	87.4	71.9	28.4	80.3	86.7	69.1	88.7	96.9	86.9
Base-Up Open	86.4	90.8	93.1	86.8	86.4	86.8	87.6	71.7	26.4	77.3	87.0	67.7	87.6	96.0	86.2
Horizontal Open	86.9	91.3	93.5	87.0	86.8	87.3	87.6	72.1	27.7	78.5	87.1	68.2	88.2	96.3	86.5
Horizontal Open	87.2	91.7	93.8	87.2	87.1	87.7	87.8	72.5	29.0	79.2	87.3	69.0	88.5	96.4	86.9
Average	86.9	91.5	93.7	87.0	86.9	87.5	87.6	72.1	27.9	78.8	87.0	68.5	88.3	96.4	86.6

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-07-02

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	23.3	1214	4124	86.6	52.2
Base-Up Open	23.3	1333	4068	86.0	57.1
Horizontal Open	23.3	1294	4134	86.4	55.4
Horizontal Open	25.0	1435	4104	86.7	57.4
Average	23.7	1319	4108	86.4	55.5

Mfg. Rated Output (lumens): 1375

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.194	23.3	1.00	1.08	1.52
Base-Up Open	120.0	0.194	23.3	0.90	0.09	2.74
Horizontal Open	120.0	0.195	23.3	1.00	0.77	1.53
Horizontal Open	120.0	0.206	24.8	1.00	2.09	3.11
Average	120.0	0.197	23.7	0.98	1.01	2.23

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	86.8	91.7	94.0	86.6	86.8	87.6	87.3	71.6	27.4	79.4	86.5	68.8	88.2	96.7	86.6
Base-Up Open	86.3	90.5	92.8	86.7	86.2	86.6	87.5	71.6	26.0	76.8	86.9	67.8	87.4	95.8	86.0
Horizontal Open	86.6	91.1	93.4	86.8	86.6	87.1	87.5	71.8	27.0	78.0	87.0	68.3	87.9	96.2	86.4
Horizontal Open	87.0	91.4	93.6	87.1	87.0	87.5	87.7	72.3	28.6	78.7	87.2	68.9	88.3	96.3	86.7
Average	86.7	91.2	93.5	86.8	86.7	87.2	87.5	71.8	27.3	78.2	86.9	68.5	88.0	96.3	86.4

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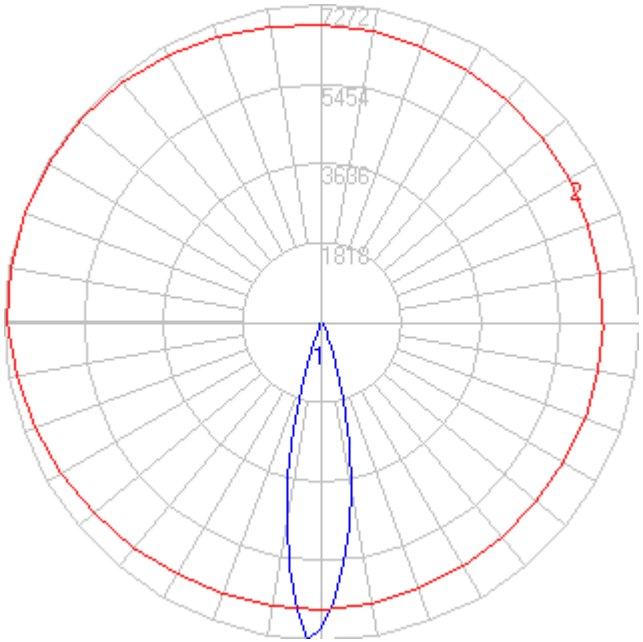
Goniophotometer Characterization: DIR-07-01

Power (W)	Gonio. Output (lm)	Beam Lumens	Center Beam Candlepower	Beam Angle	Efficacy
23.8	1417	644	7112	23.3	59.5



Vertical Plane Through Horizontal Angles:
Blue: 160˚ - 340˚ (Through Max Candela)

Horizontal Cone Through Vertical Angle:
Red: 2.5˚ (Through Max Candela)

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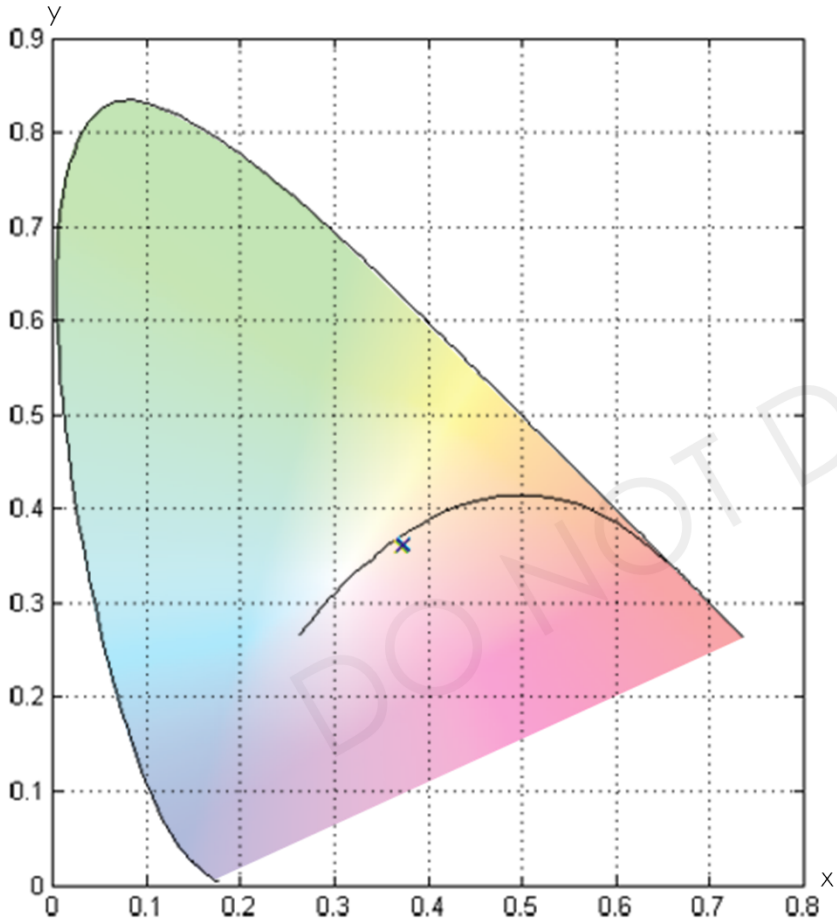
Photometric Summary: DIR-07



Chromaticity Diagram CIE 1931, 2 Degree

DIR-07-01	CIE X	CIE Y
Base-Up Closed	0.3707	0.3589
Base-Up Open	0.3737	0.3637
Base-Up Semi-Closed	0.3709	0.3605
Horizontal Open	0.3721	0.3613
Average	0.3719	0.3611

DIR-07-02	CIE X	CIE Y
Base-Up Closed	0.3718	0.3601
Base-Up Open	0.3747	0.3645
Base-Up Semi-Closed	0.3717	0.3610
Horizontal Open	0.3729	0.3619
Average	0.3728	0.3619

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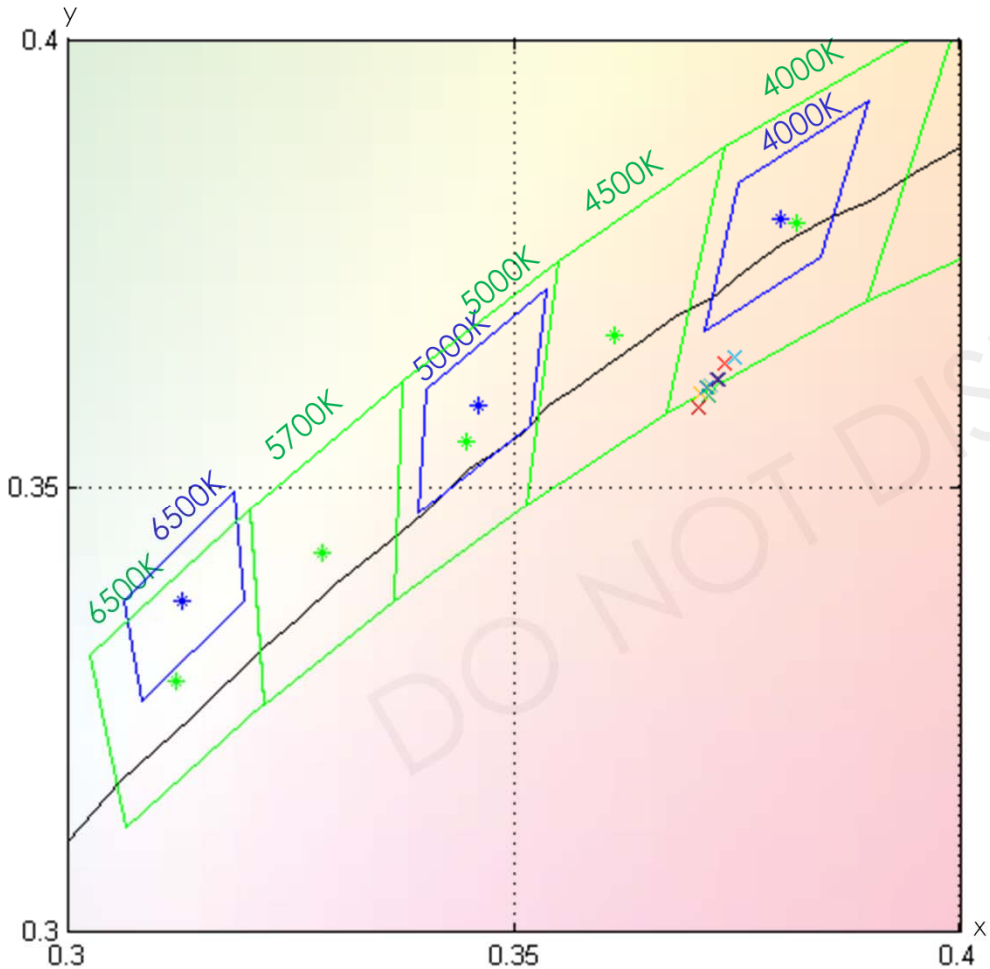
Photometric Summary: DIR-07



Chromaticity Diagram CIE 1931, 2 Degree

DIR-07-01	CIE X	CIE Y
Base-Up Closed	0.3707	0.3589
Base-Up Open	0.3737	0.3637
Base-Up Semi-Closed	0.3709	0.3605
Horizontal Open	0.3721	0.3613
Average	0.3719	0.3611

DIR-07-02	CIE X	CIE Y
Base-Up Closed	0.3718	0.3601
Base-Up Open	0.3747	0.3645
Base-Up Semi-Closed	0.3717	0.3610
Horizontal Open	0.3729	0.3619
Average	0.3728	0.3619

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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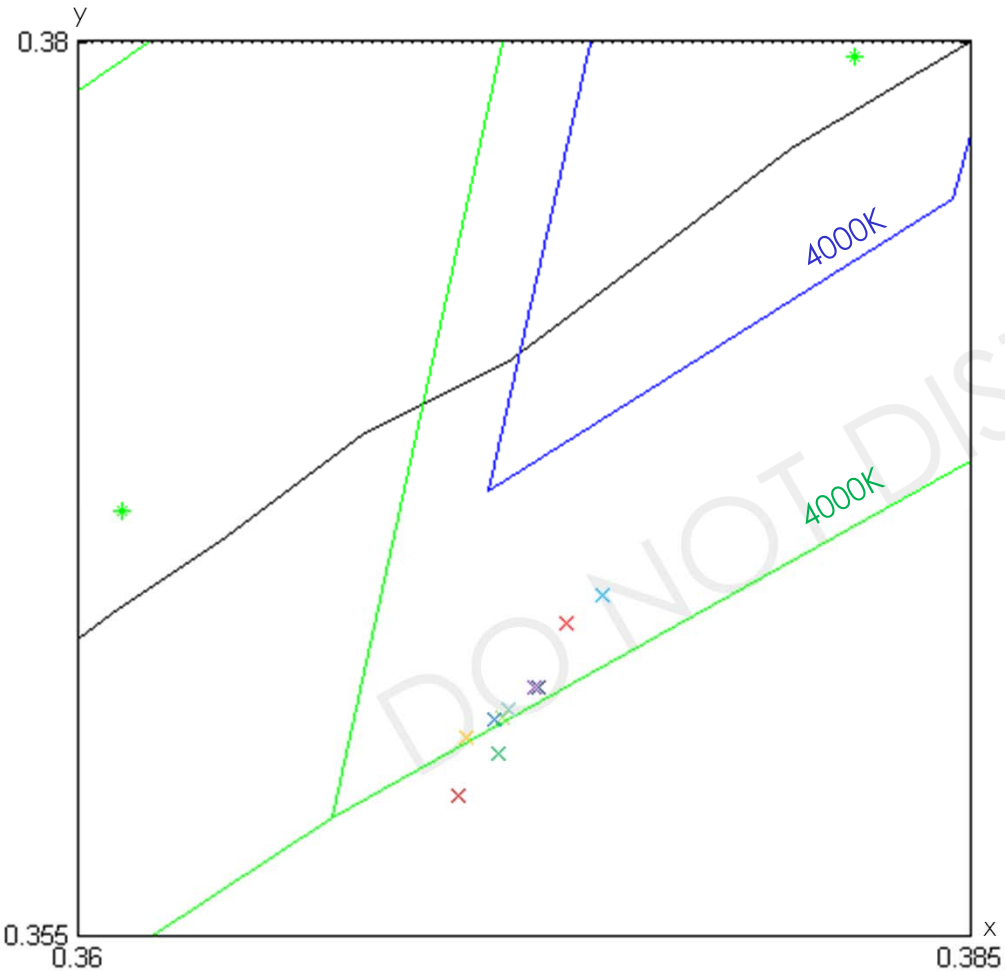
Photometric Summary: DIR-07



DIR-07-01	CIE X	CIE Y
Base-Up Closed	0.3707	0.3589
Base-Up Open	0.3737	0.3637
Base-Up Semi-Closed	0.3709	0.3605
Horizontal Open	0.3721	0.3613
Average	0.3719	0.3611

DIR-07-02	CIE X	CIE Y
Base-Up Closed	0.3718	0.3601
Base-Up Open	0.3747	0.3645
Base-Up Semi-Closed	0.3717	0.3610
Horizontal Open	0.3729	0.3619
Average	0.3728	0.3619

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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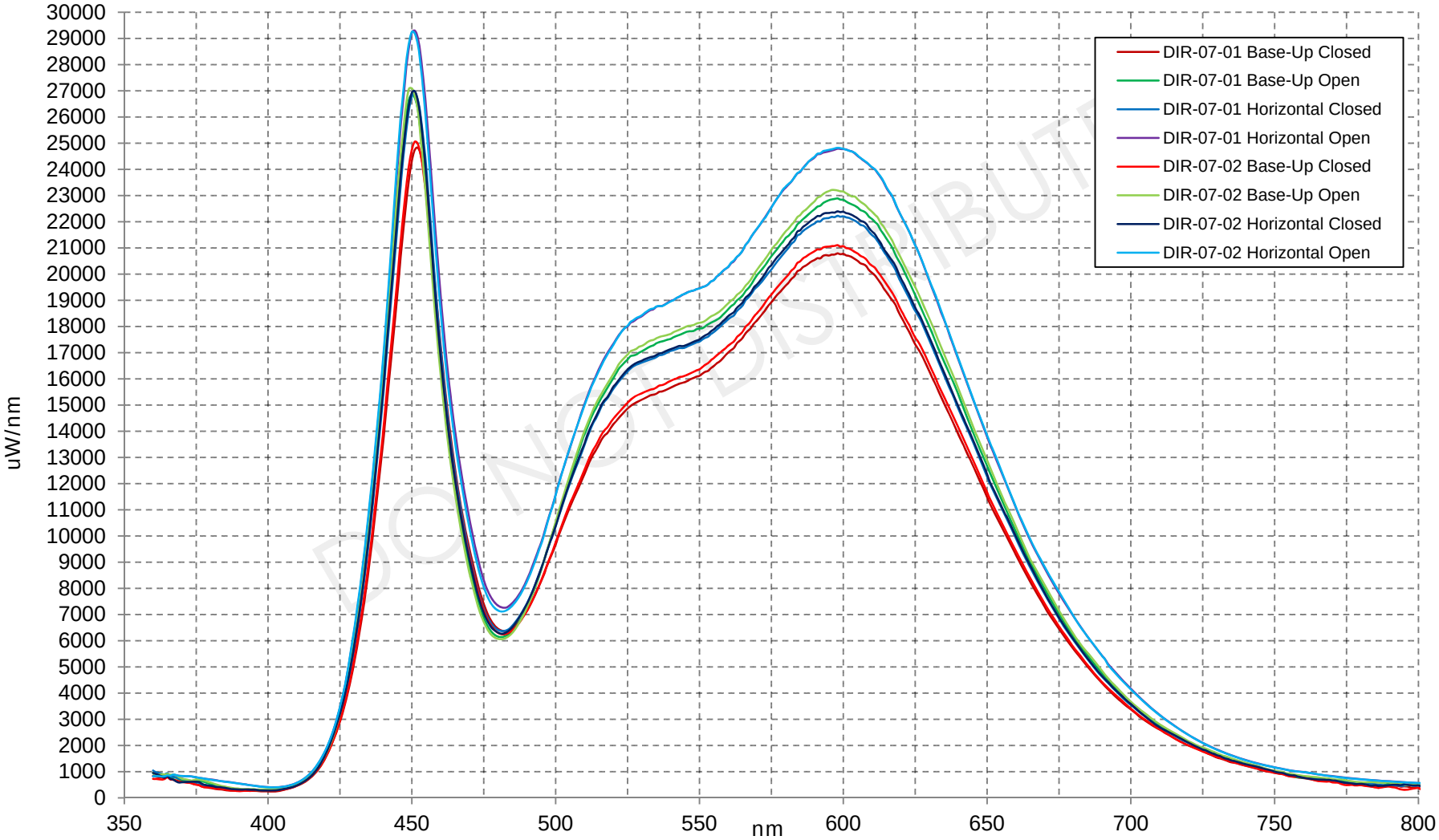
Spectral Power Distribution: DIR-07



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DIR-08

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-08-01

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	13.8	842	3936	78.2	61.2
Base-Up Open	14.0	939	3941	77.9	67.0
Horizontal Open	13.9	882	3969	78.1	63.4
Horizontal Open	13.8	937	3948	78.4	67.9
Average	13.9	900	3949	78.2	64.9

Mfg. Rated Output (lumens): 824

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.115	13.8	0.92	0.46	35.71
Base-Up Open	120.0	0.117	14.0	0.75	0.14	28.86
Horizontal Open	120.0	0.116	13.9	0.93	0.80	35.52
Horizontal Open	120.0	0.116	13.9	0.99	2.05	33.75
Average	120.0	0.116	13.9	0.90	0.86	33.46

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	76.8	82.4	85.3	78.1	75.6	74.3	86.0	67.1	10.6	56.7	73.8	51.6	77.3	91.2	78.2
Base-Up Open	76.7	81.9	84.4	78.2	75.5	73.6	85.7	67.3	10.7	55.5	74.1	50.6	77.0	90.7	77.9
Horizontal Open	76.8	82.2	84.8	78.1	75.6	73.9	85.9	67.2	10.6	56.1	73.9	51.2	77.2	91.0	78.1
Horizontal Open	77.2	82.5	85.0	78.5	75.9	74.4	86.1	67.6	11.9	56.8	74.3	51.7	77.6	91.1	78.4
Average	76.9	82.3	84.9	78.2	75.7	74.1	85.9	67.3	11.0	56.3	74.0	51.3	77.3	91.0	78.2

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-08-02

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	13.8	805	3927	79.2	58.5
Base-Up Open	14.1	901	3929	78.8	63.8
Horizontal Open	13.9	852	3947	78.9	61.4
Horizontal Open	13.8	902	3936	79.3	65.4
Average	13.9	865	3935	79.1	62.3

Mfg. Rated Output (lumens): 824

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.115	13.8	0.92	0.30	35.62
Base-Up Open	120.0	0.118	14.1	0.75	0.12	28.79
Horizontal Open	120.0	0.116	13.9	0.92	0.17	35.46
Horizontal Open	120.0	0.116	13.9	0.99	2.02	33.75
Average	120.0	0.116	13.9	0.90	0.65	33.41

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	77.9	83.5	86.3	78.8	76.7	75.7	86.6	68.0	13.8	59.1	74.5	54.0	78.4	91.8	79.2
Base-Up Open	77.7	82.9	85.3	78.8	76.4	74.9	86.2	68.1	13.5	57.7	74.7	52.7	78.1	91.2	78.8
Horizontal Open	77.7	83.1	85.6	78.8	76.6	75.2	86.3	68.1	13.7	58.2	74.6	53.2	78.2	91.4	78.9
Horizontal Open	78.2	83.5	85.8	79.2	77.0	75.7	86.6	68.6	15.1	58.9	75.0	53.9	78.7	91.5	79.3
Average	77.9	83.3	85.8	78.9	76.7	75.4	86.4	68.2	14.0	58.5	74.7	53.5	78.4	91.5	79.1

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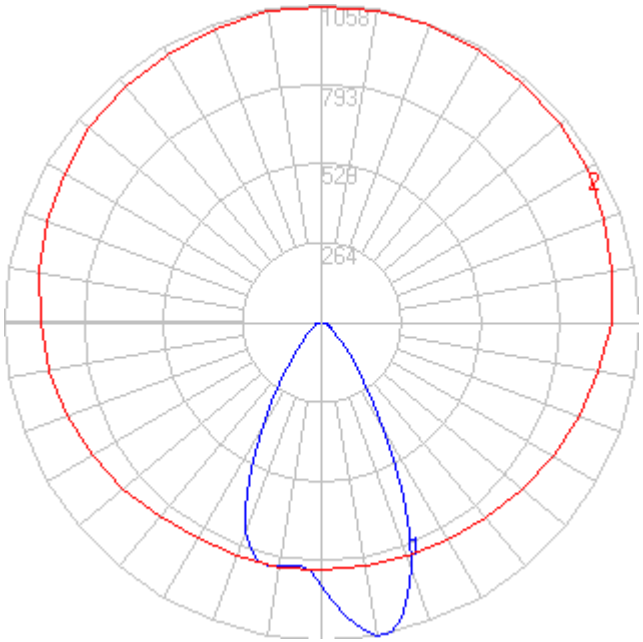
Goniophotometer Characterization: DIR-08-01

Power (W)	Gonio. Output (lm)	Beam Lumens	Center Beam Candlepower	Beam Angle	Efficacy
14	948	547	1056	50.5	67.7



Vertical Plane Through Horizontal Angles:
Blue: 70˚ - 250˚ (Through Max Candela)

Horizontal Cone Through Vertical Angle:
Red: 10˚ (Through Max Candela)

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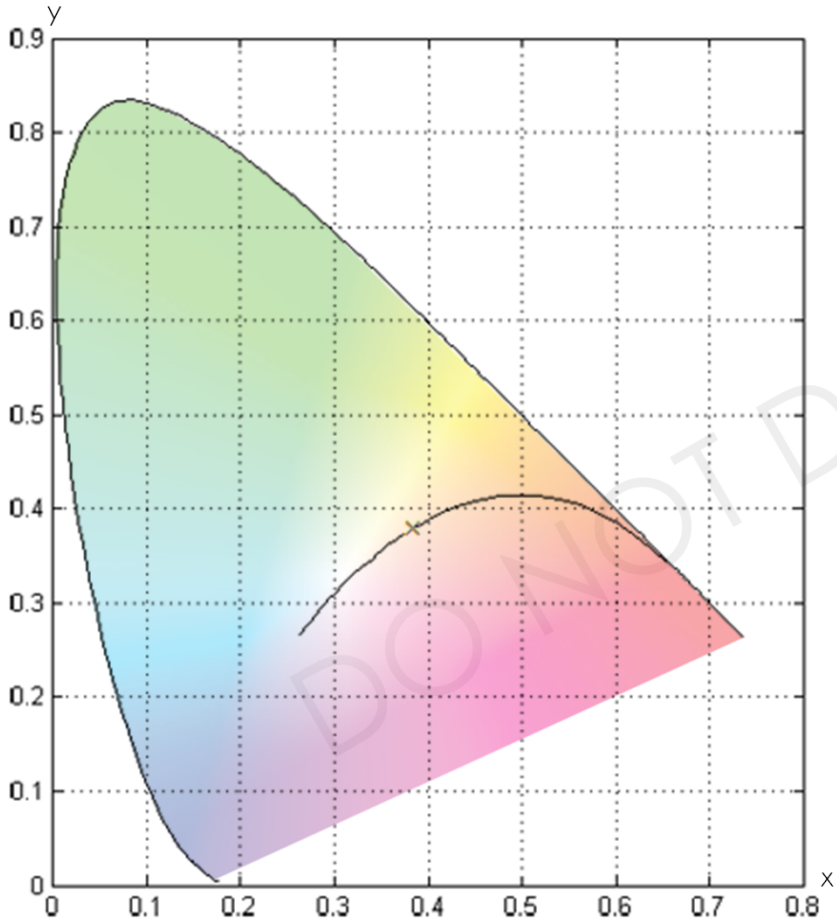
Photometric Summary: DIR-08



Chromaticity Diagram CIE 1931, 2 Degree

DIR-08-01	CIE X	CIE Y
Base-Up Closed	0.3839	0.3808
Base-Up Open	0.3837	0.3808
Base-Up Semi-Closed	0.3823	0.3797
Horizontal Open	0.3833	0.3803
Average	0.3833	0.3804

DIR-08-02	CIE X	CIE Y
Base-Up Closed	0.3838	0.3794
Base-Up Open	0.3837	0.3794
Base-Up Semi-Closed	0.3828	0.3785
Horizontal Open	0.3833	0.3789
Average	0.3834	0.3791

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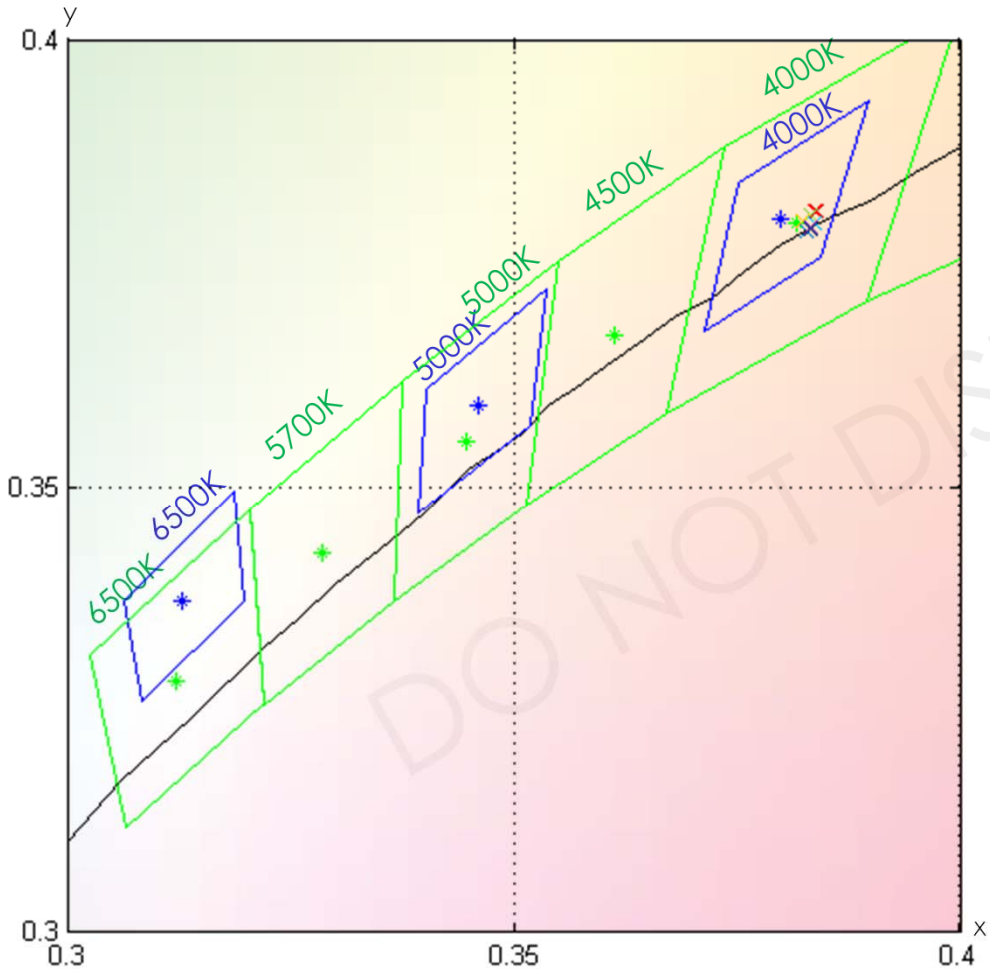
Photometric Summary: DIR-08



Chromaticity Diagram CIE 1931, 2 Degree

DIR-08-01	CIE X	CIE Y
Base-Up Closed	0.3839	0.3808
Base-Up Open	0.3837	0.3808
Base-Up Semi-Closed	0.3823	0.3797
Horizontal Open	0.3833	0.3803
Average	0.3833	0.3804

DIR-08-02	CIE X	CIE Y
Base-Up Closed	0.3838	0.3794
Base-Up Open	0.3837	0.3794
Base-Up Semi-Closed	0.3828	0.3785
Horizontal Open	0.3833	0.3789
Average	0.3834	0.3791

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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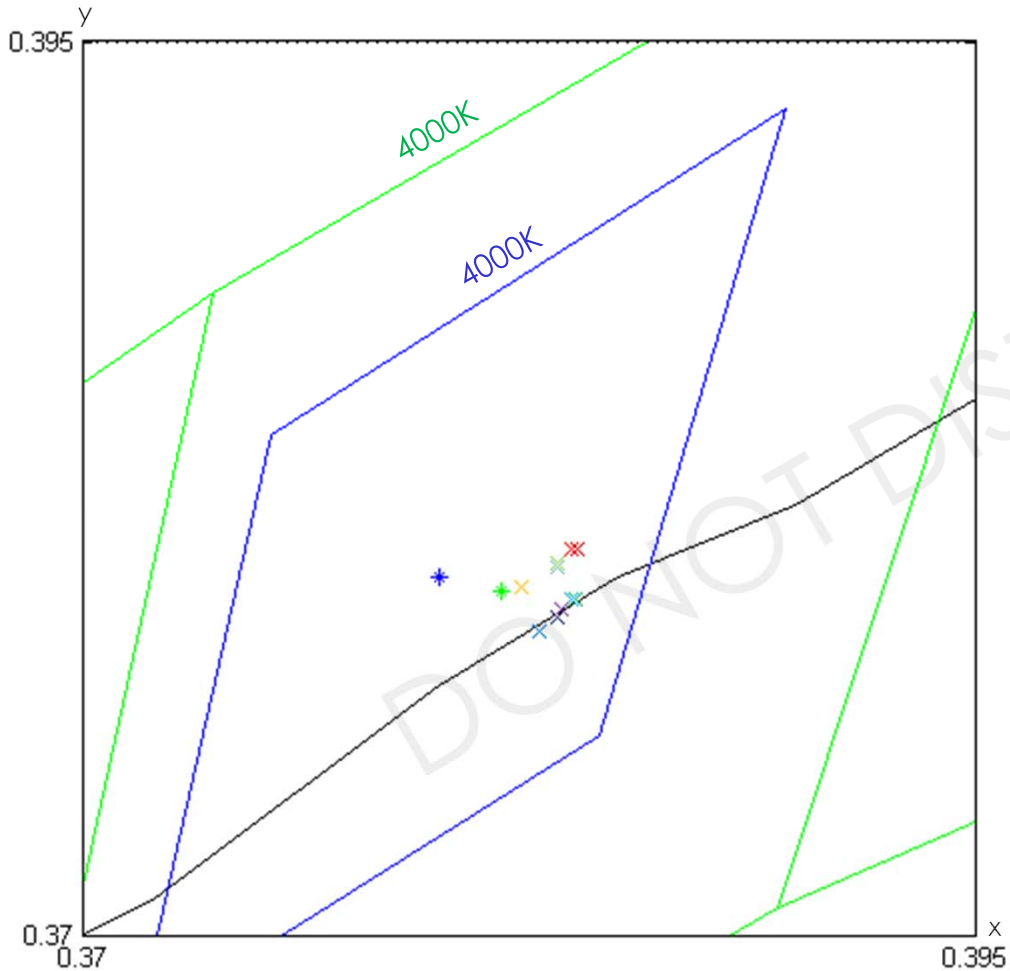
Photometric Summary: DIR-08



Chromaticity Diagram CIE 1931, 2 Degree

DIR-08-01	CIE X	CIE Y
Base-Up Closed	0.3839	0.3808
Base-Up Open	0.3837	0.3808
Base-Up Semi-Closed	0.3823	0.3797
Horizontal Open	0.3833	0.3803
Average	0.3833	0.3804

DIR-08-02	CIE X	CIE Y
Base-Up Closed	0.3838	0.3794
Base-Up Open	0.3837	0.3794
Base-Up Semi-Closed	0.3828	0.3785
Horizontal Open	0.3833	0.3789
Average	0.3834	0.3791

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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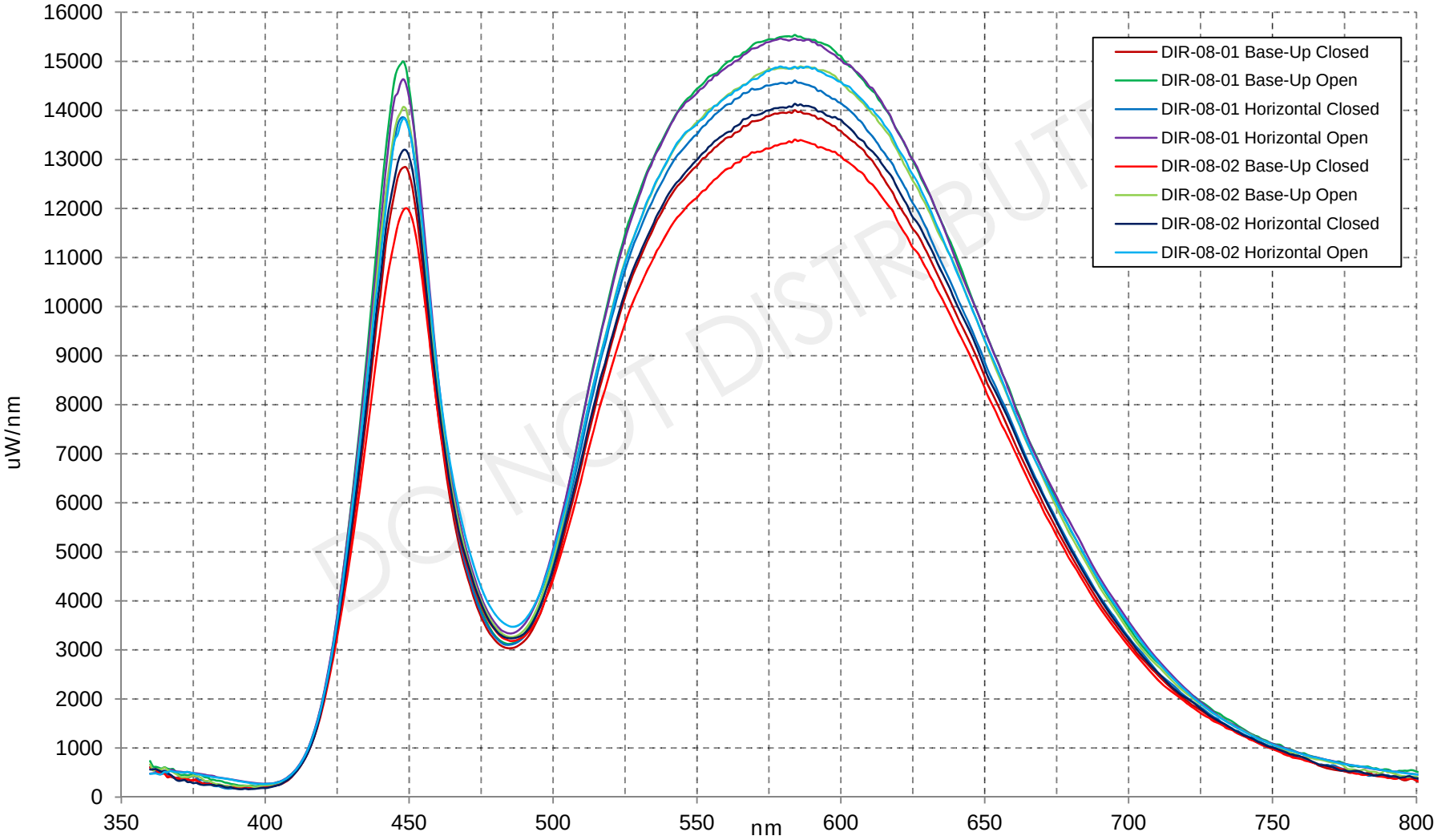
Spectral Power Distribution: DIR-08



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DIR-09

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-09-01

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	9.3	649	5177	85.1	70.2
Base-Up Open	9.2	662	5148	84.7	72.0
Horizontal Open	9.3	655	5224	85.4	70.3
Horizontal Open	9.7	716	5177	85.3	73.8
Average	9.4	670	5182	85.1	71.6

Mfg. Rated Output (lumens): 580

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.077	9.3	0.62	0.09	5.42
Base-Up Open	120.0	0.077	9.2	0.62	0.89	4.20
Horizontal Open	120.0	0.078	9.3	0.94	0.85	2.83
Horizontal Open	120.0	0.082	9.8	0.94	2.08	5.47
Average	120.0	0.078	9.4	0.78	0.98	4.48

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	85.5	88.5	89.5	86.5	85.7	83.5	88.0	73.7	24.2	71.6	86.6	64.0	86.2	94.0	85.1
Base-Up Open	85.0	88.1	89.2	86.2	85.2	83.1	87.8	73.1	22.2	70.7	86.4	63.6	85.7	93.9	84.7
Horizontal Open	85.5	89.2	90.5	86.6	85.7	84.2	88.3	73.6	24.0	73.1	86.5	63.9	86.6	94.7	85.4
Horizontal Open	85.6	88.7	89.6	86.7	85.8	83.7	88.1	74.0	24.8	71.9	86.8	64.3	86.4	94.1	85.3
Average	85.4	88.6	89.7	86.5	85.6	83.6	88.1	73.6	23.8	71.8	86.6	64.0	86.2	94.2	85.1

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-09-02

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	9.4	647	5141	85.3	68.8
Base-Up Open	9.2	663	5111	84.8	71.8
Horizontal Open	9.7	716	5177	85.3	73.8
Horizontal Open	9.9	718	5142	85.4	72.6
Average	9.6	686	5143	85.2	71.7

Mfg. Rated Output (lumens): 580

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.078	9.4	0.63	17.31	7.75
Base-Up Open	120.0	0.077	9.2	0.62	0.58	4.02
Horizontal Open	120.0	0.082	9.9	0.94	2.02	5.23
Horizontal Open	120.0	0.082	9.9	0.94	1.97	5.16
Average	120.0	0.080	9.6	0.78	5.47	5.54

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	85.3	89.0	90.4	86.4	85.5	84.1	88.2	73.2	23.3	72.8	86.3	63.8	86.3	94.6	85.3
Base-Up Open	84.8	88.5	90.1	86.1	85.0	83.6	88.0	72.6	21.3	71.6	86.1	63.2	85.7	94.4	84.8
Horizontal Open	85.6	88.7	89.6	86.7	85.8	83.7	88.1	74.0	24.8	71.9	86.8	64.3	86.4	94.1	85.3
Horizontal Open	85.5	89.2	90.6	86.6	85.6	84.3	88.3	73.4	24.0	73.1	86.5	64.1	86.5	94.7	85.4
Average	85.3	88.9	90.2	86.5	85.5	83.9	88.2	73.3	23.4	72.4	86.4	63.9	86.2	94.5	85.2

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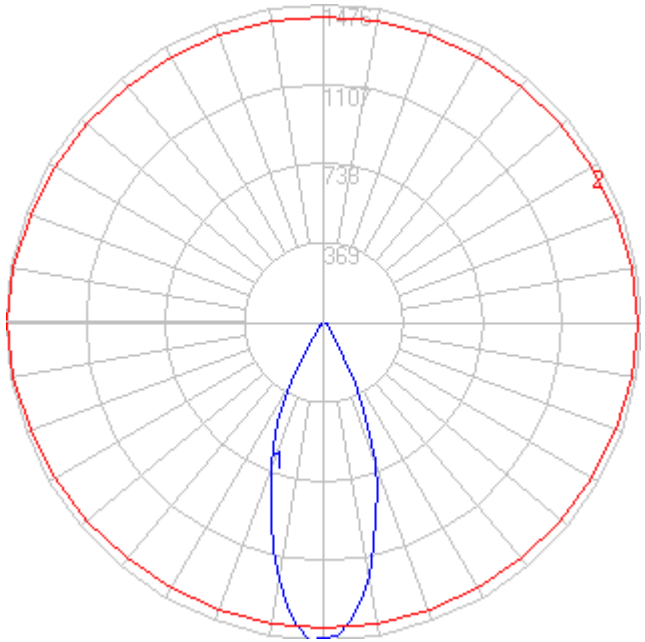
Goniophotometer Characterization: DIR-09-01

Power (W)	Gonio. Output (lm)	Beam Lumens	Center Beam Candlepower	Beam Angle	Efficacy
9.8	683	354	1471	38.8	69.7



Vertical Plane Through Horizontal Angles:
Blue: 180˚ - 0˚ (Through Max Candela)

Horizontal Cone Through Vertical Angle:
Red: 2.5˚ (Through Max Candela)

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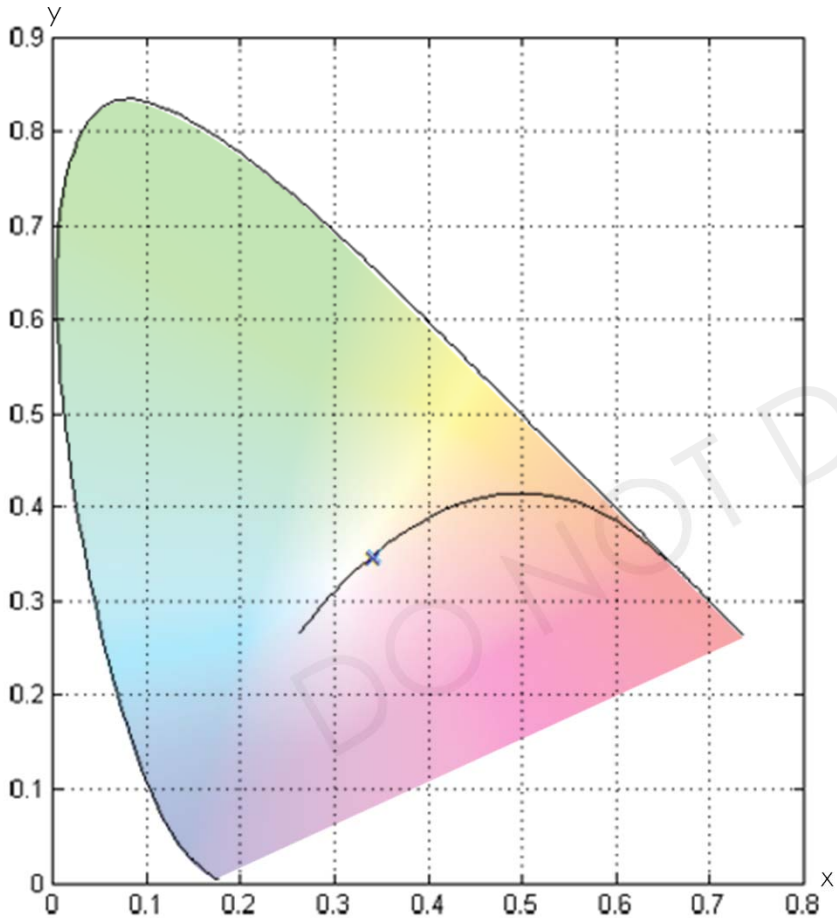
Photometric Summary: DIR-09



Chromaticity Diagram CIE 1931, 2 Degree

DIR-09-01	CIE X	CIE Y
Base-Up Closed	0.3401	0.3449
Base-Up Open	0.3409	0.3466
Base-Up Semi-Closed	0.3389	0.3447
Horizontal Open	0.3401	0.3451
Average	0.3400	0.3453

DIR-09-02	CIE X	CIE Y
Base-Up Closed	0.3411	0.3469
Base-Up Open	0.3420	0.3487
Base-Up Semi-Closed	0.3401	0.3451
Horizontal Open	0.3411	0.3471
Average	0.3411	0.3470

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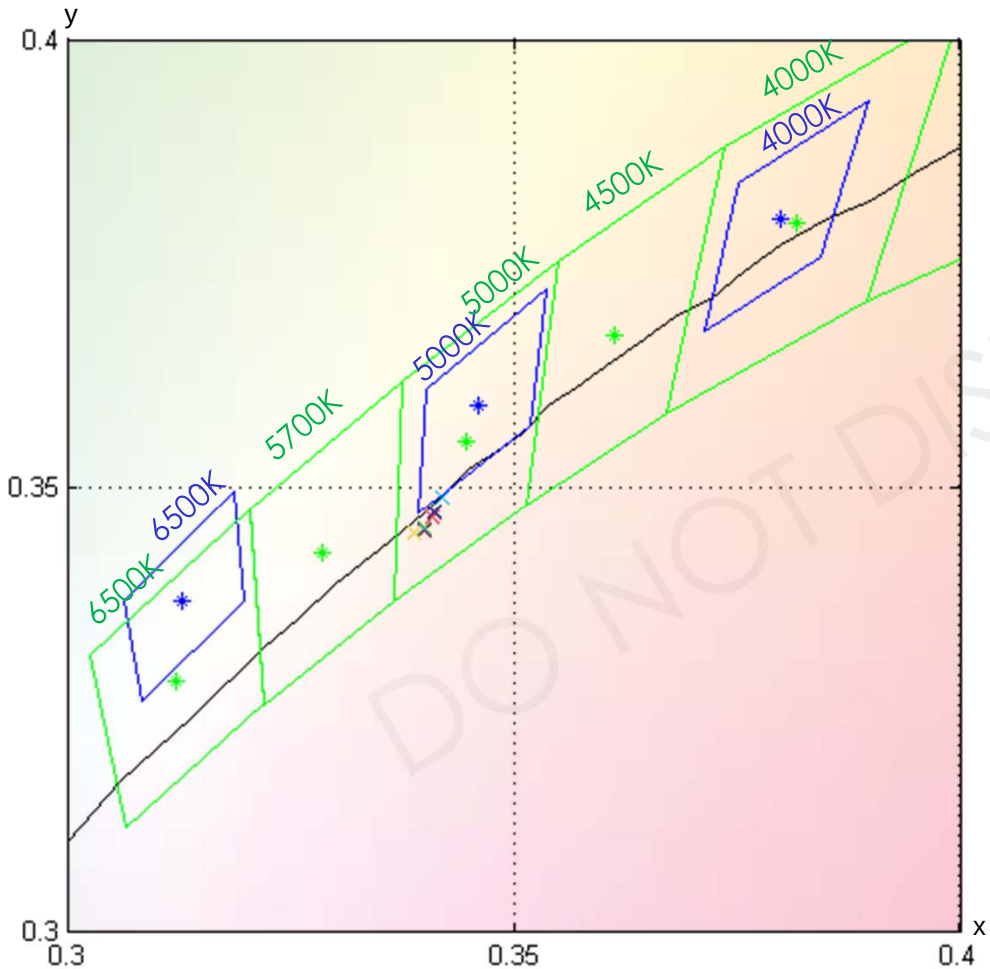
Photometric Summary: DIR-09



	DIR-09-01	CIE X	CIE Y
✖	Base-Up Closed	0.3401	0.3449
✖	Base-Up Open	0.3409	0.3466
✖	Base-Up Semi-Closed	0.3389	0.3447
✖	Horizontal Open	0.3401	0.3451
✖	Average	0.3400	0.3453

	DIR-09-02	CIE X	CIE Y
✖	Base-Up Closed	0.3411	0.3469
✖	Base-Up Open	0.3420	0.3487
✖	Base-Up Semi-Closed	0.3401	0.3451
✖	Horizontal Open	0.3411	0.3471
✖	Average	0.3411	0.3470

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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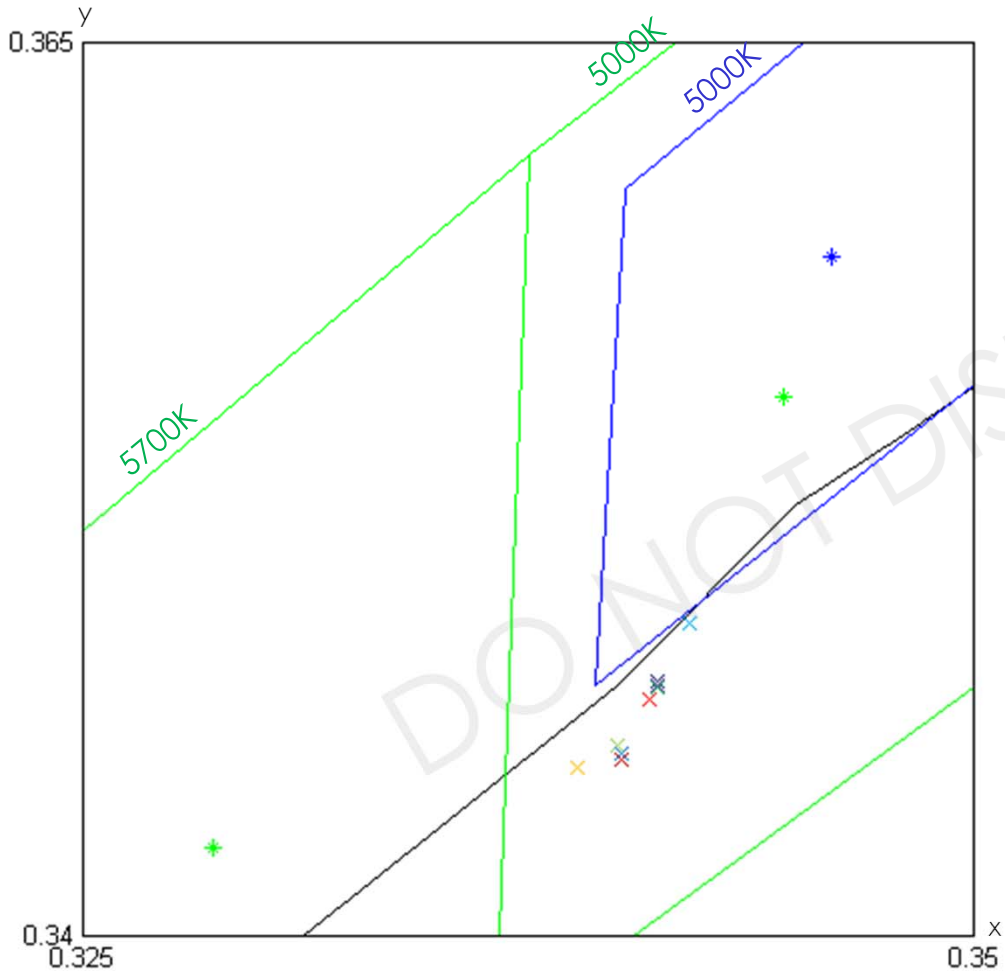
CALIFORNIA LIGHTING TECHNOLOGY CENTER

Photometric Summary: DIR-09



DIR-09-01	CIE X	CIE Y
Base-Up Closed	0.3401	0.3449
Base-Up Open	0.3409	0.3466
Base-Up Semi-Closed	0.3389	0.3447
Horizontal Open	0.3401	0.3451
Average	0.3400	0.3453

DIR-09-02	CIE X	CIE Y
Base-Up Closed	0.3411	0.3469
Base-Up Open	0.3420	0.3487
Base-Up Semi-Closed	0.3401	0.3451
Horizontal Open	0.3411	0.3471
Average	0.3411	0.3470

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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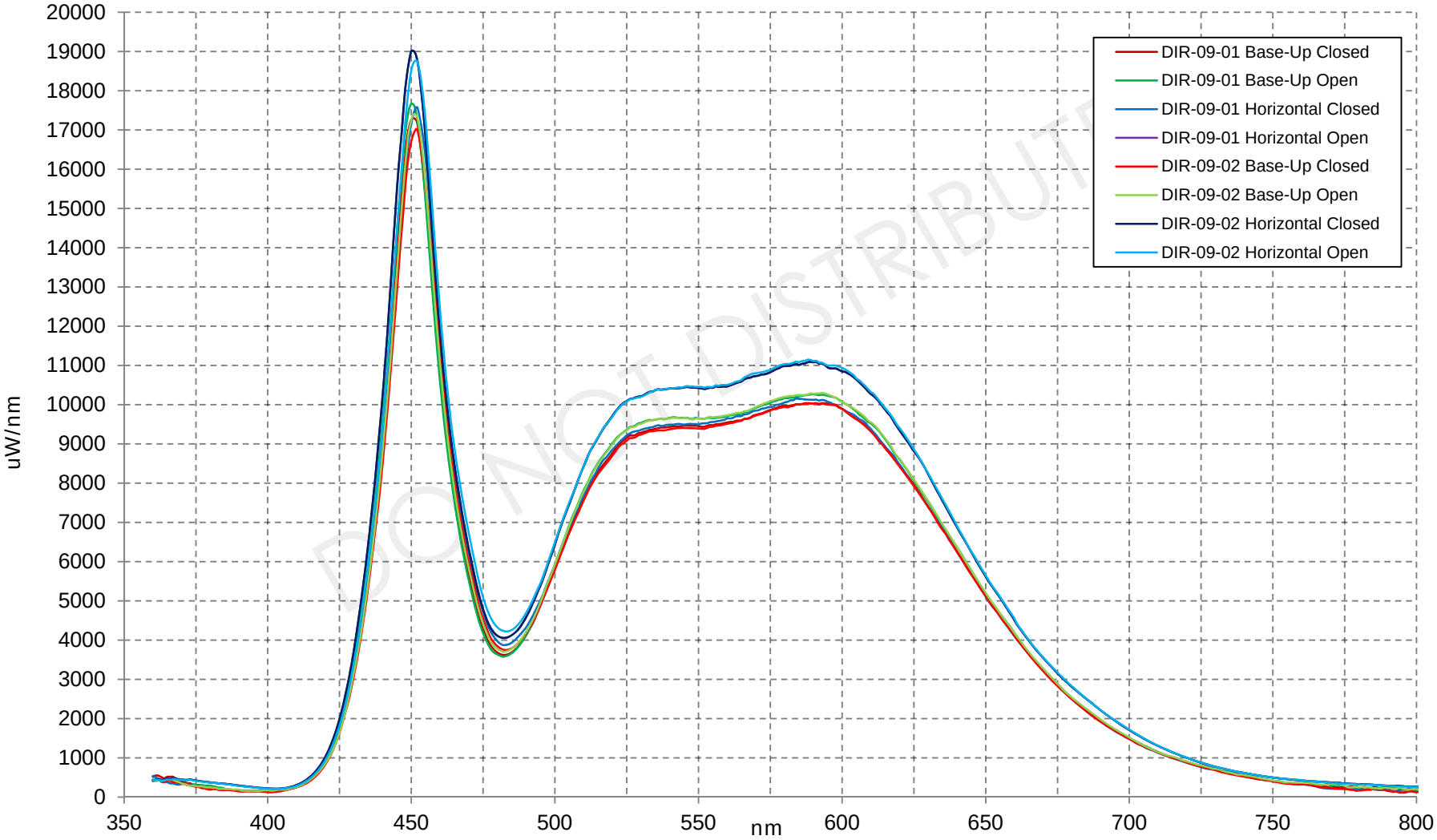
Spectral Power Distribution: DIR-09



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DIR-10

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-10-01

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	16.0	883	3076	82.9	55.3
Base-Up Open	16.3	961	3075	82.8	59.0
Horizontal Open	16.1	934	3088	82.8	57.9
Horizontal Open	16.2	1003	3079	83.0	61.9
Average	16.1	945	3080	82.9	58.5

Mfg. Rated Output (lumens): 885

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.133	16.0	0.87	0.95	40.04
Base-Up Open	120.0	0.136	16.3	0.75	1.12	34.27
Horizontal Open	120.0	0.134	16.1	0.88	0.27	39.64
Horizontal Open	120.0	0.137	16.4	0.95	2.08	40.09
Average	120.0	0.135	16.2	0.86	1.11	38.51

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	81.9	93.5	94.7	76.7	81.1	90.4	82.4	62.0	17.3	82.9	72.7	70.9	84.9	98.1	82.9
Base-Up Open	81.6	93.0	95.4	76.9	80.8	89.7	82.7	62.1	16.8	81.6	72.8	69.6	84.6	98.4	82.8
Horizontal Open	81.8	93.3	95.0	76.8	81.0	90.1	82.6	62.1	17.1	82.3	72.7	70.2	84.8	98.2	82.8
Horizontal Open	82.0	93.4	95.2	77.1	81.2	90.2	82.7	62.5	18.0	82.5	73.1	70.4	85.0	98.3	83.0
Average	81.8	93.3	95.1	76.9	81.0	90.1	82.6	62.2	17.3	82.3	72.8	70.3	84.8	98.3	82.9

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-10-02

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	16.2	878	3013	81.6	54.2
Base-Up Open	16.4	948	3017	81.6	57.8
Horizontal Open	16.2	917	3028	81.6	56.5
Horizontal Open	16.4	984	3019	81.9	60.0
Average	16.3	932	3019	81.7	57.1

Mfg. Rated Output (lumens): 885

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.135	16.2	0.86	1.20	42.78
Base-Up Open	120.0	0.137	16.4	0.74	0.35	37.02
Horizontal Open	120.0	0.135	16.2	0.86	1.28	42.99
Horizontal Open	120.0	0.138	16.6	0.95	1.98	42.99
Average	120.0	0.136	16.4	0.85	1.20	41.45

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	80.0	91.4	95.9	75.9	79.0	87.5	82.7	60.5	12.5	78.0	71.3	67.2	82.7	98.4	81.6
Base-Up Open	79.9	91.0	96.1	76.1	78.9	87.0	82.9	60.6	12.4	77.2	71.6	66.3	82.5	98.4	81.6
Horizontal Open	79.9	91.2	95.9	75.9	78.9	87.3	82.8	60.5	12.4	77.8	71.4	66.9	82.6	98.4	81.6
Horizontal Open	80.3	91.4	96.1	76.4	79.3	87.5	83.0	61.1	13.7	78.0	72.0	67.1	82.9	98.4	81.9
Average	80.0	91.3	96.0	76.1	79.0	87.3	82.9	60.7	12.8	77.8	71.6	66.9	82.7	98.4	81.7

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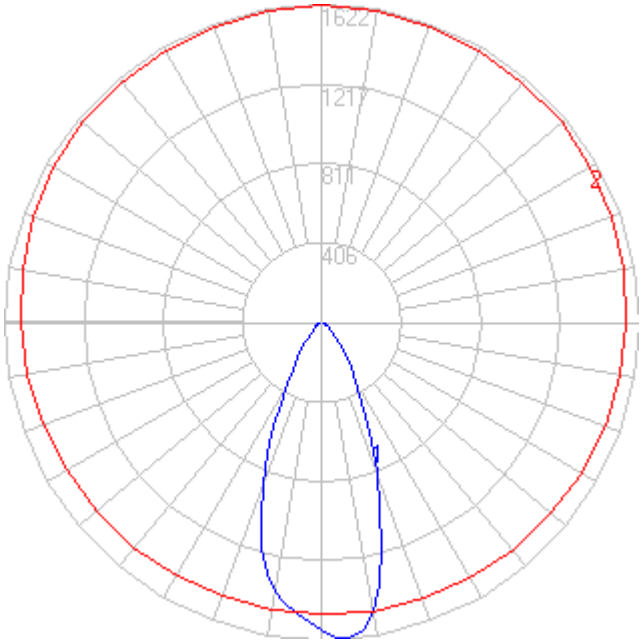
Goniophotometer Characterization: DIR-10-01

Power (W)	Gonio. Output (lm)	Beam Lumens	Center Beam Candlepower	Beam Angle	Efficacy
16.3	1007	481	1622	39.1	61.8



Vertical Plane Through Horizontal Angles:
Blue: 120˚ - 300˚ (Through Max Candela)

Horizontal Cone Through Vertical Angle:
Red: 2.5˚ (Through Max Candela)

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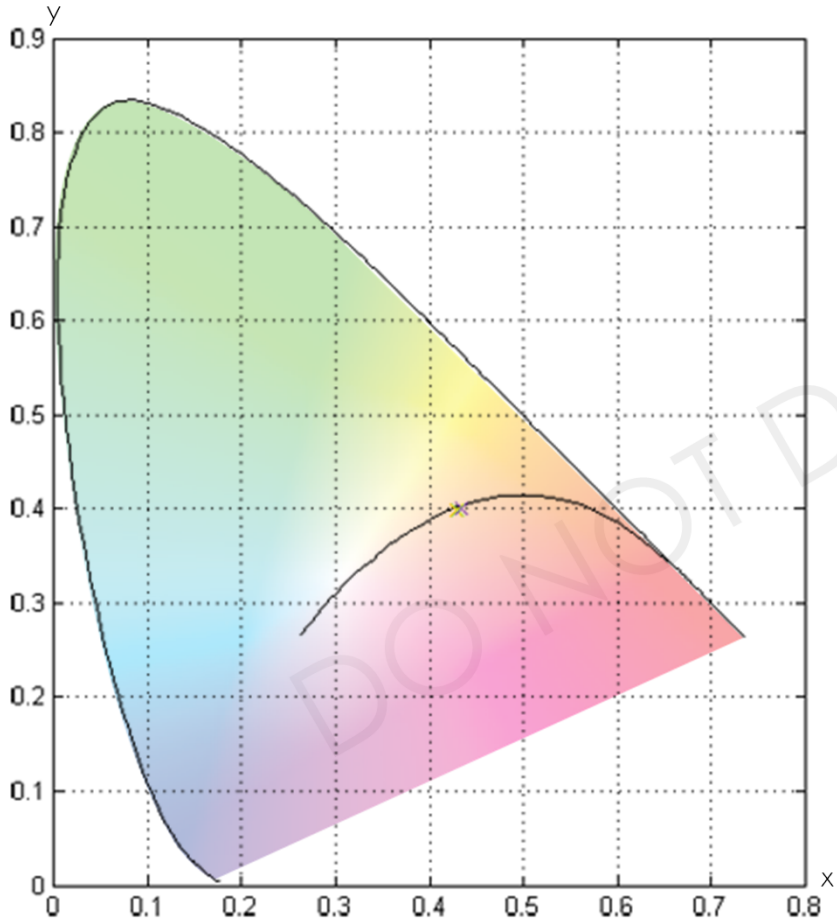
Photometric Summary: DIR-10



Chromaticity Diagram CIE 1931, 2 Degree

DIR-10-01	CIE X	CIE Y
Base-Up Closed	0.4296	0.3979
Base-Up Open	0.4299	0.3986
Base-Up Semi-Closed	0.4288	0.3977
Horizontal Open	0.4294	0.3981
Average	0.4294	0.3981

DIR-10-02	CIE X	CIE Y
Base-Up Closed	0.4342	0.4001
Base-Up Open	0.4340	0.4002
Base-Up Semi-Closed	0.4331	0.3997
Horizontal Open	0.4338	0.4001
Average	0.4338	0.4000

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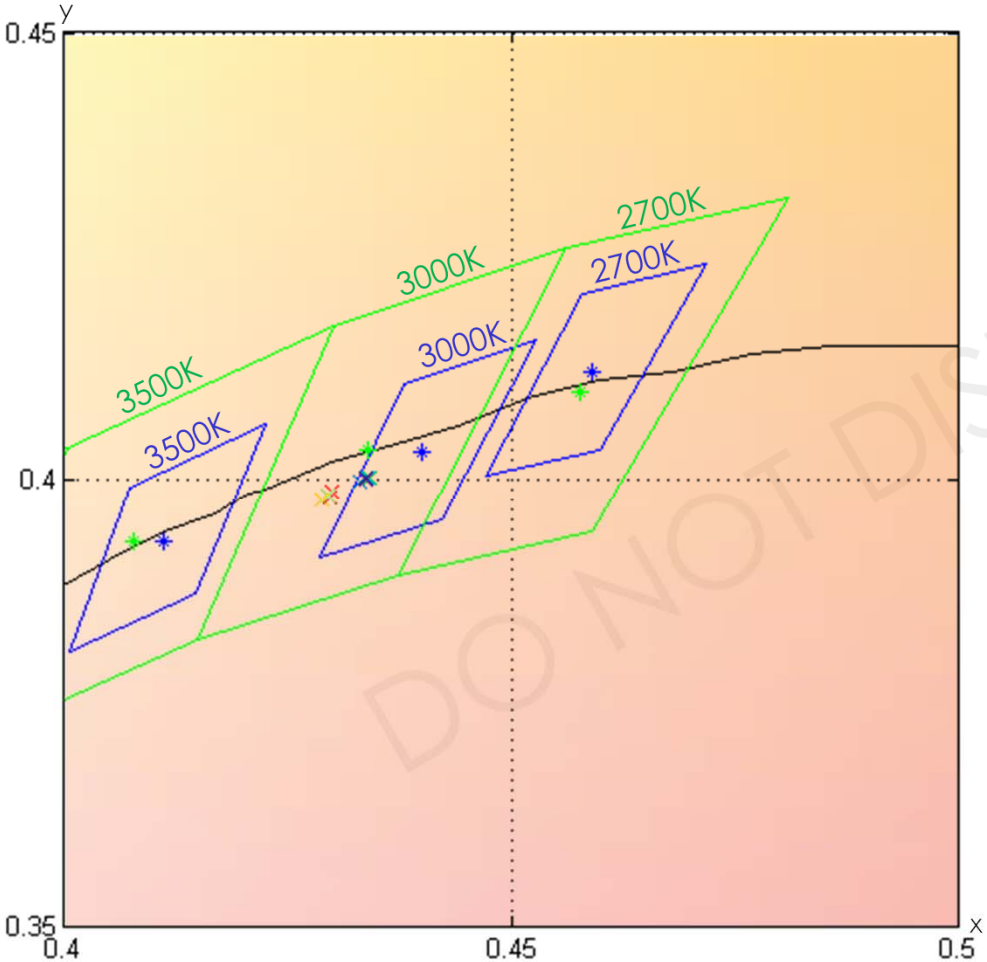
CALIFORNIA LIGHTING TECHNOLOGY CENTER

Photometric Summary: DIR-10



Chromaticity Diagram CIE 1931, 2 Degree

DIR-10-01	CIE X	CIE Y
Base-Up Closed	0.4296	0.3979
Base-Up Open	0.4299	0.3986
Base-Up Semi-Closed	0.4288	0.3977
Horizontal Open	0.4294	0.3981
Average	0.4294	0.3981

DIR-10-02	CIE X	CIE Y
Base-Up Closed	0.4342	0.4001
Base-Up Open	0.4340	0.4002
Base-Up Semi-Closed	0.4331	0.3997
Horizontal Open	0.4338	0.4001
Average	0.4338	0.4000

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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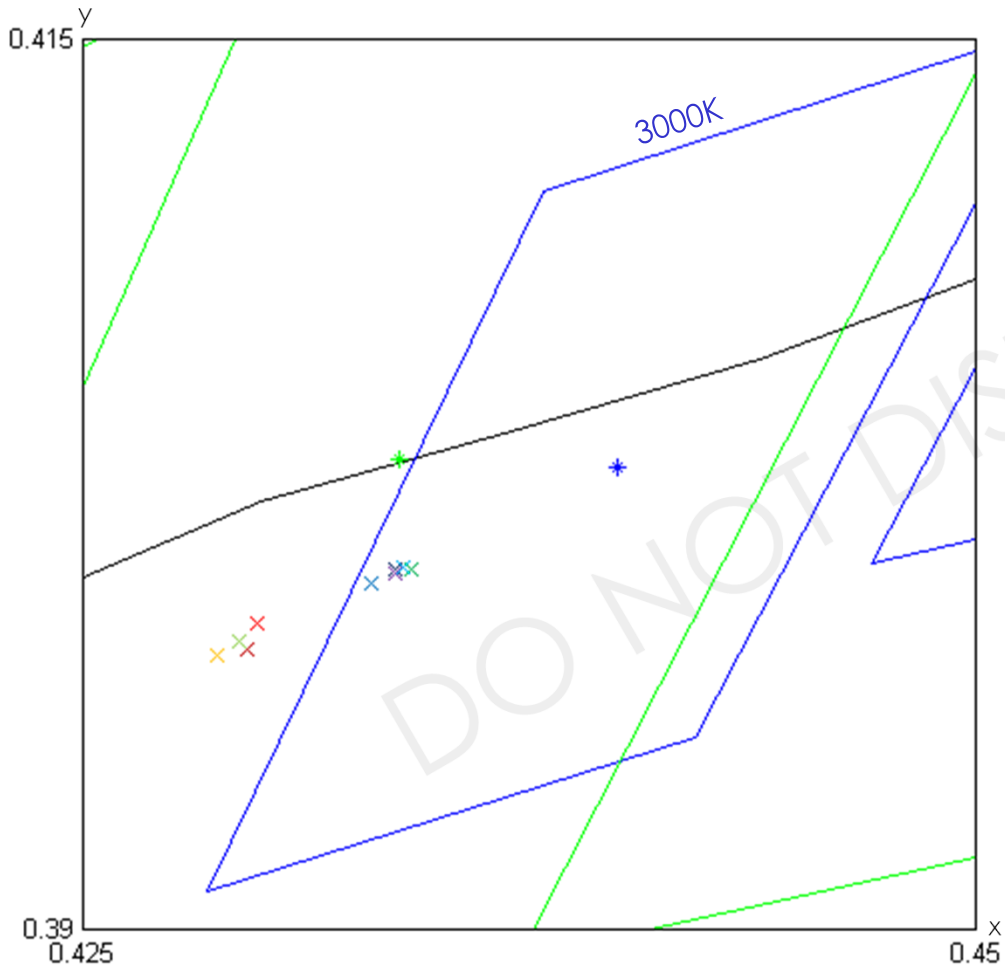
Photometric Summary: DIR-10



DIR-10-01	CIE X	CIE Y
Base-Up Closed	0.4296	0.3979
Base-Up Open	0.4299	0.3986
Base-Up Semi-Closed	0.4288	0.3977
Horizontal Open	0.4294	0.3981
Average	0.4294	0.3981

DIR-10-02	CIE X	CIE Y
Base-Up Closed	0.4342	0.4001
Base-Up Open	0.4340	0.4002
Base-Up Semi-Closed	0.4331	0.3997
Horizontal Open	0.4338	0.4001
Average	0.4338	0.4000

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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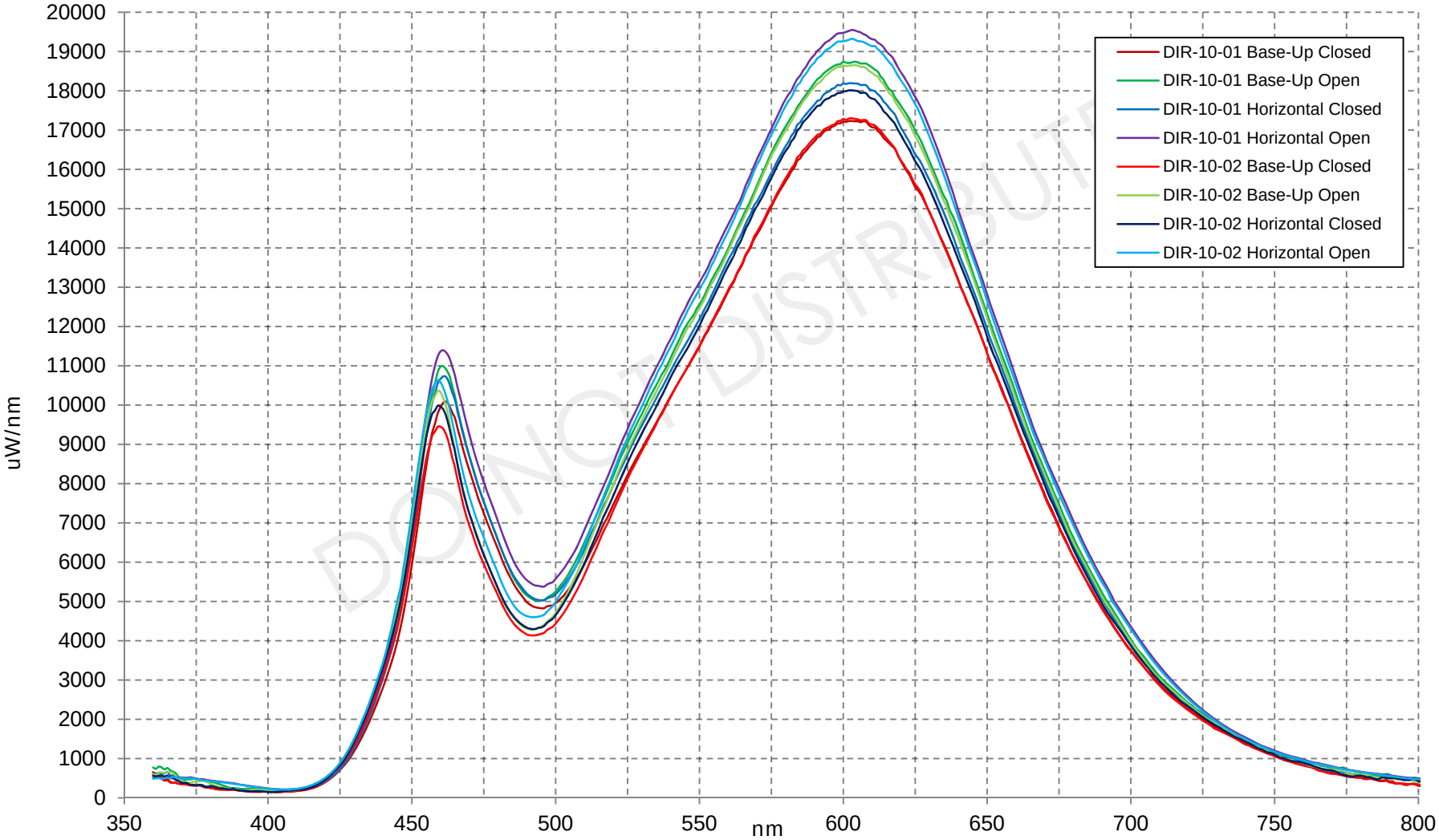
Spectral Power Distribution: DIR-10



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DIR-11

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-11-01

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	5.1	286	2828	88.1	55.7
Base-Up Open	4.9	278	2807	88.9	56.7
Horizontal Open	5.2	290	2861	87.8	56.0
Horizontal Open	4.9	276	2827	88.6	56.1
Average	5.0	282	2831	88.4	56.1

Mfg. Rated Output (lumens): 450

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.043	5.1	0.96	1.32	8.35
Base-Up Open	120.0	0.041	4.9	1.00	1.97	34.79
Horizontal Open	120.0	0.043	5.2	0.96	1.31	7.98
Horizontal Open	120.0	0.041	4.9	1.00	1.92	32.78
Average	120.0	0.042	5.0	0.98	1.63	20.98

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	93.9	89.7	78.6	90.2	87.8	84.1	92.9	87.9	63.6	66.6	86.1	53.2	91.9	84.8	88.1
Base-Up Open	94.9	90.4	79.2	90.9	88.8	85.4	93.2	88.3	64.6	68.2	87.1	55.2	92.9	85.0	88.9
Horizontal Open	93.4	89.3	78.3	89.9	87.2	83.3	92.9	88.3	64.5	65.8	85.5	52.2	91.3	84.7	87.8
Horizontal Open	94.4	90.1	78.8	90.7	88.3	84.7	93.2	88.7	65.6	67.5	86.6	54.2	92.4	84.9	88.6
Average	94.2	89.9	78.7	90.4	88.0	84.4	93.1	88.3	64.6	67.0	86.3	53.7	92.1	84.9	88.4

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-11-02

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	4.2	241	2886	88.7	57.0
Base-Up Open	4.3	245	2859	89.3	57.5
Horizontal Open	4.3	246	2899	88.5	57.7
Horizontal Open	4.3	242	2879	89.1	56.8
Average	4.3	244	2881	88.9	57.3

Mfg. Rated Output (lumens): 450

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.035	4.2	0.91	1.18	10.63
Base-Up Open	120.0	0.035	4.2	1.00	2.01	4.04
Horizontal Open	120.0	0.036	4.3	0.91	1.13	10.23
Horizontal Open	120.0	0.034	4.1	1.00	1.93	31.29
Average	120.0	0.035	4.2	0.96	1.56	14.05

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	94.5	89.7	78.3	90.8	88.5	84.1	93.0	90.3	68.9	67.0	87.1	53.5	92.3	84.7	88.7
Base-Up Open	95.4	90.4	78.7	91.3	89.5	85.2	93.2	90.9	70.6	68.5	88.0	55.4	93.2	84.9	89.3
Horizontal Open	94.3	89.6	78.1	90.7	88.3	83.8	93.0	90.5	69.5	66.7	86.9	53.1	92.1	84.7	88.5
Horizontal Open	95.0	90.1	78.4	91.1	89.1	84.6	93.2	91.3	71.6	67.9	87.6	54.6	92.8	84.8	89.1
Average	94.8	90.0	78.4	91.0	88.9	84.4	93.1	90.8	70.2	67.5	87.4	54.2	92.6	84.8	88.9

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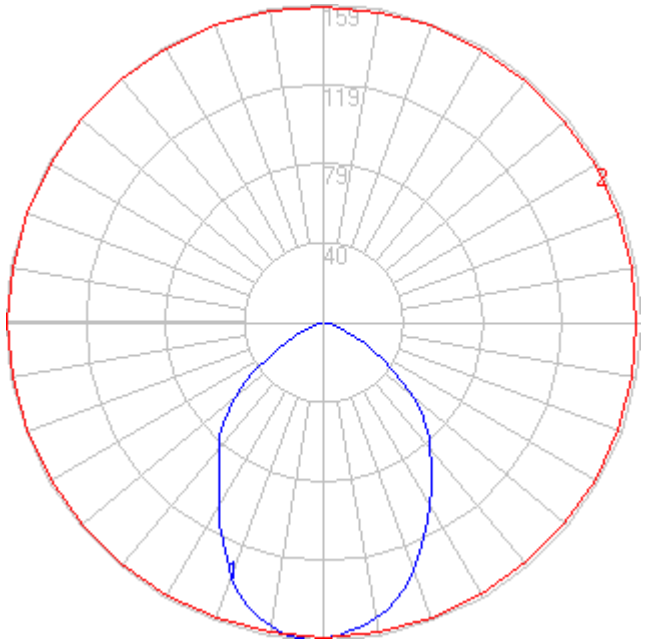
Goniophotometer Characterization: DIR-11-01

Power (W)	Gonio. Output (lm)	Beam Lumens	Center Beam Candlepower	Beam Angle	Efficacy
4.92	279.17	175	158.64	82.3	56.7



Vertical Plane Through Horizontal Angles:
Blue: 160˚ - 340˚ (Through Max Candela)

Horizontal Cone Through Vertical Angle:
Red: 2.5˚ (Through Max Candela)

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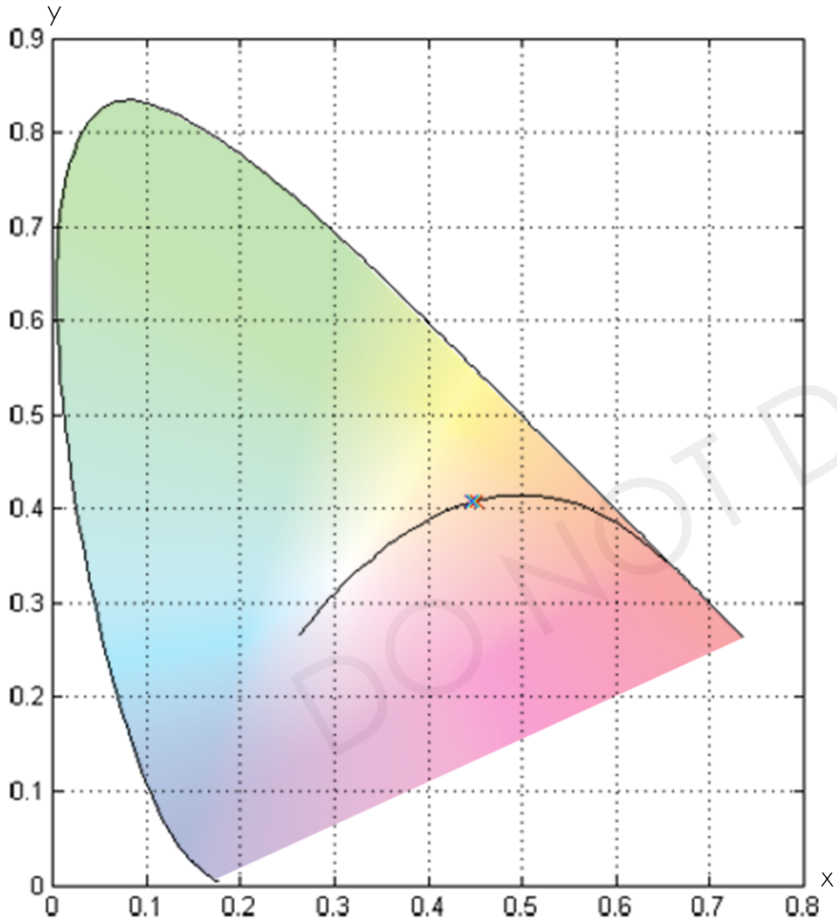
Photometric Summary: DIR-11



Chromaticity Diagram CIE 1931, 2 Degree

DIR-11-01	CIE X	CIE Y
Base-Up Closed	0.4497	0.4083
Base-Up Open	0.4509	0.4078
Base-Up Semi-Closed	0.4475	0.4083
Horizontal Open	0.4496	0.4080
Average	0.4494	0.4081

DIR-11-02	CIE X	CIE Y
Base-Up Closed	0.4460	0.4083
Base-Up Open	0.4473	0.4076
Base-Up Semi-Closed	0.4450	0.4081
Horizontal Open	0.4462	0.4079
Average	0.4461	0.4080

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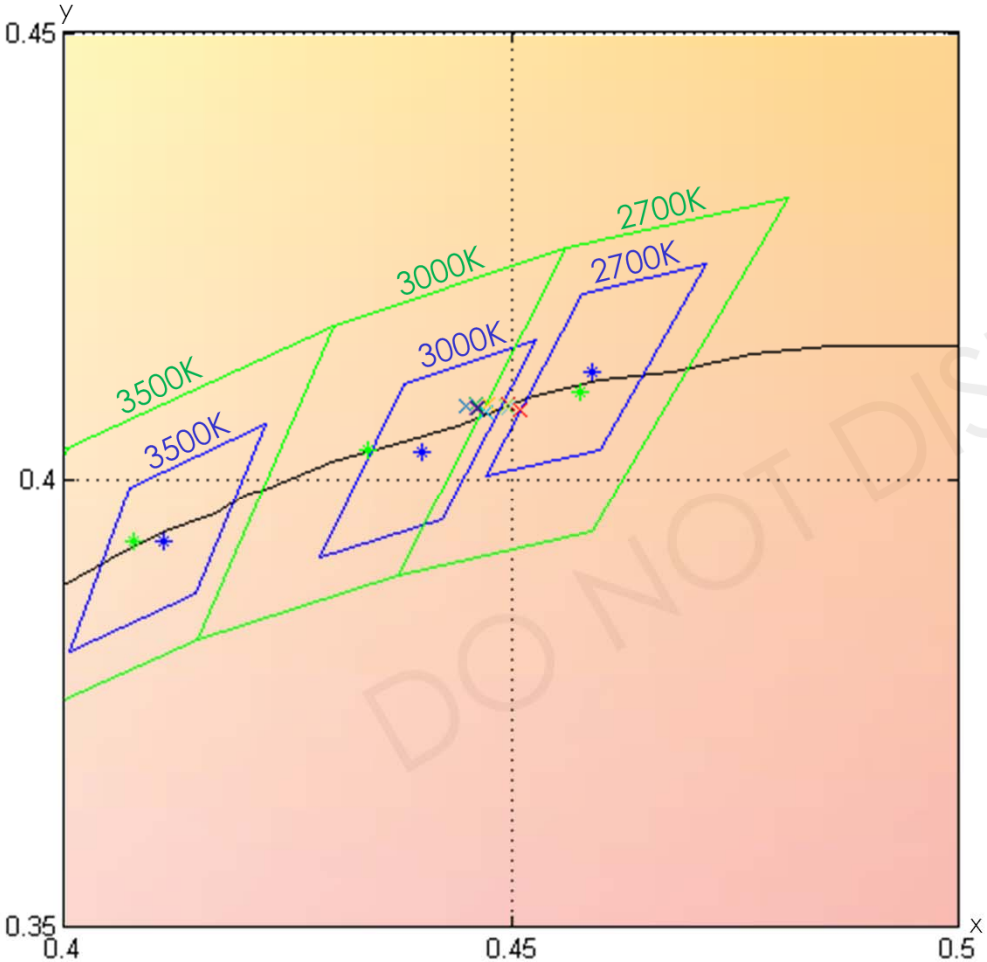
CALIFORNIA LIGHTING TECHNOLOGY CENTER

Photometric Summary: DIR-11



DIR-11-01	CIE X	CIE Y
Base-Up Closed	0.4497	0.4083
Base-Up Open	0.4509	0.4078
Base-Up Semi-Closed	0.4475	0.4083
Horizontal Open	0.4496	0.4080
Average	0.4494	0.4081

DIR-11-02	CIE X	CIE Y
Base-Up Closed	0.4460	0.4083
Base-Up Open	0.4473	0.4076
Base-Up Semi-Closed	0.4450	0.4081
Horizontal Open	0.4462	0.4079
Average	0.4461	0.4080

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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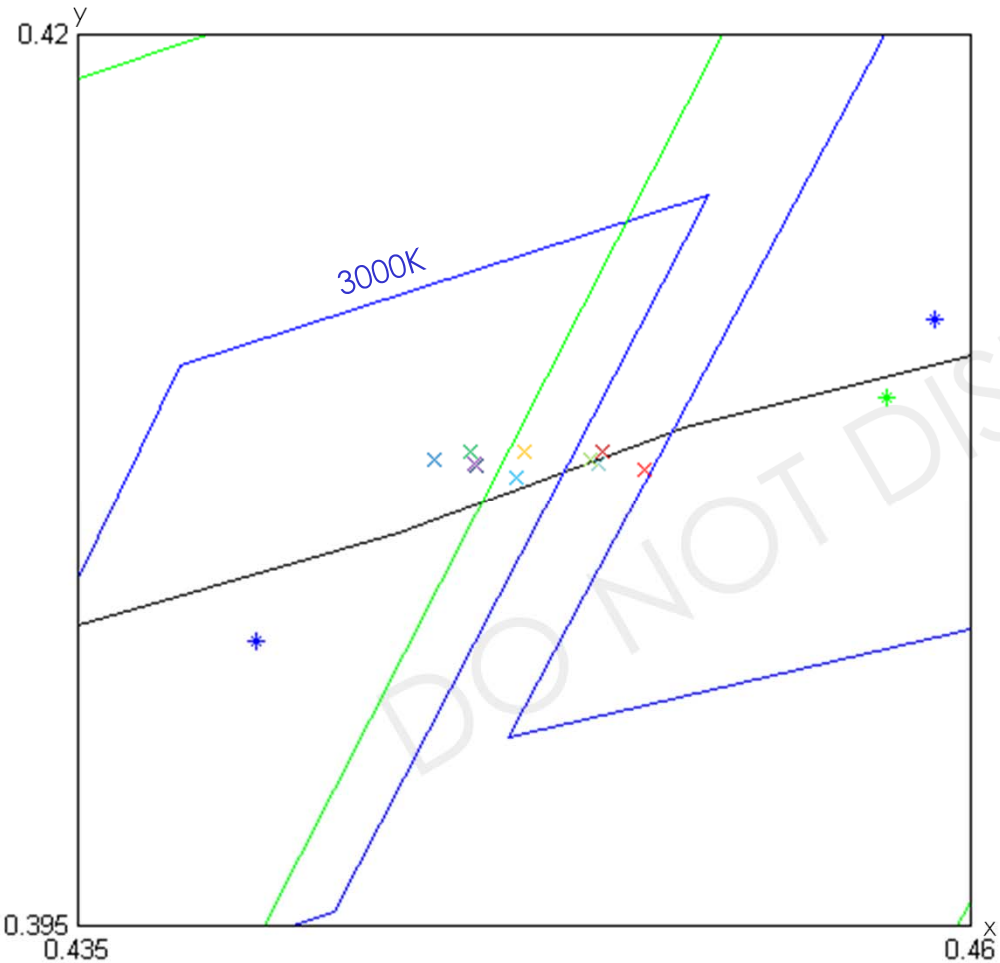
Photometric Summary: DIR-11



DIR-11-01	CIE X	CIE Y
Base-Up Closed	0.4497	0.4083
Base-Up Open	0.4509	0.4078
Base-Up Semi-Closed	0.4475	0.4083
Horizontal Open	0.4496	0.4080
Average	0.4494	0.4081

DIR-11-02	CIE X	CIE Y
Base-Up Closed	0.4460	0.4083
Base-Up Open	0.4473	0.4076
Base-Up Semi-Closed	0.4450	0.4081
Horizontal Open	0.4462	0.4079
Average	0.4461	0.4080

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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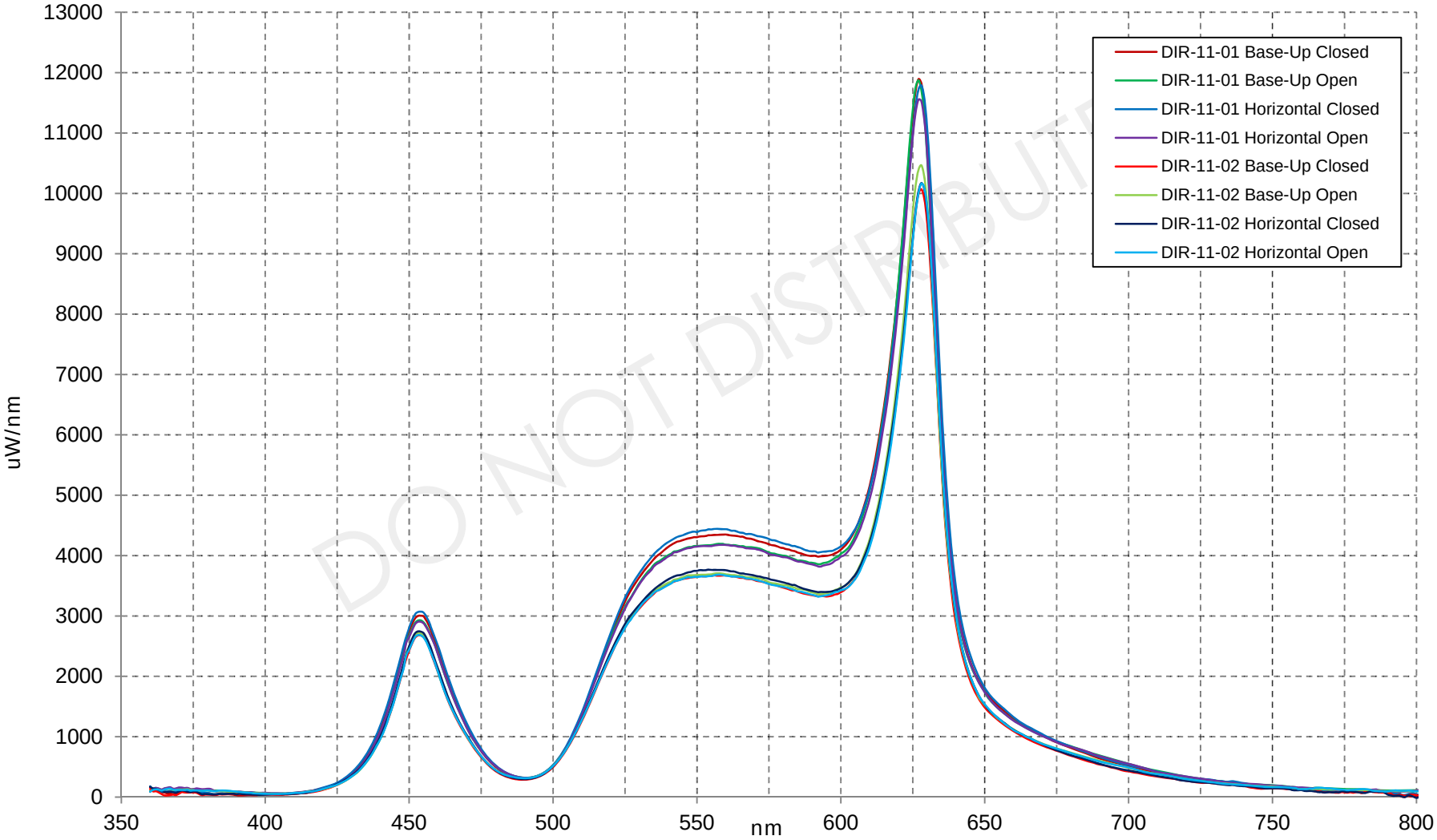
Spectral Power Distribution: DIR-11



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DIR-12

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-12-01

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	14.2	959	3153	81.7	67.6
Base-Up Open	14.2	1016	3125	81.8	71.5
Horizontal Open	14.2	994	3171	81.8	70.1
Horizontal Open	14.0	1027	3145	82.3	73.7
Average	14.1	999	3149	81.9	70.7

Mfg. Rated Output (lumens): 800

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.118	14.2	0.99	1.20	10.41
Base-Up Open	120.0	0.118	14.2	0.78	0.11	9.95
Horizontal Open	120.0	0.118	14.2	0.99	0.68	10.48
Horizontal Open	120.0	0.117	14.1	1.00	1.98	10.39
Average	120.0	0.118	14.2	0.94	0.99	10.31

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	80.0	89.9	95.8	77.3	78.8	85.3	84.4	62.3	13.1	74.6	73.1	63.4	82.3	97.6	81.7
Base-Up Open	80.2	89.7	95.6	77.9	78.9	85.0	84.7	62.6	13.8	74.0	73.8	62.8	82.3	97.3	81.8
Horizontal Open	80.0	90.0	95.8	77.3	78.9	85.4	84.4	62.4	13.3	74.7	73.0	63.5	82.3	97.7	81.8
Horizontal Open	80.7	90.2	95.7	78.2	79.5	85.7	84.8	63.4	15.7	75.1	74.2	63.9	82.9	97.5	82.3
Average	80.2	90.0	95.7	77.7	79.0	85.4	84.6	62.7	14.0	74.6	73.5	63.4	82.5	97.5	81.9

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-12-02

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	14.2	965	3137	80.9	67.9
Base-Up Open	14.3	1000	3128	81.0	69.8
Horizontal Open	14.2	1007	3157	80.9	71.1
Horizontal Open	14.0	1036	3129	81.4	74.1
Average	14.2	1002	3138	81.1	70.7

Mfg. Rated Output (lumens): 800

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.118	14.2	0.99	0.51	9.99
Base-Up Open	120.0	0.120	14.3	0.79	0.81	8.83
Horizontal Open	120.0	0.118	14.2	0.99	0.46	10.82
Horizontal Open	120.0	0.118	14.1	0.99	1.90	10.08
Average	120.0	0.118	14.2	0.94	0.92	9.93

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	78.9	88.7	95.2	77.0	77.7	83.6	84.6	61.6	10.5	71.8	72.5	61.6	81.0	97.1	80.9
Base-Up Open	79.1	88.4	94.8	77.5	77.8	83.3	84.9	61.9	10.8	71.3	73.3	60.8	81.0	96.8	81.0
Horizontal Open	78.9	88.7	95.2	77.0	77.7	83.6	84.6	61.6	10.4	71.9	72.5	61.6	81.0	97.1	80.9
Horizontal Open	79.6	88.9	95.1	77.9	78.3	84.0	85.1	62.7	12.9	72.2	73.6	61.9	81.6	96.9	81.4
Average	79.1	88.7	95.1	77.4	77.9	83.6	84.8	62.0	11.2	71.8	73.0	61.5	81.2	97.0	81.1

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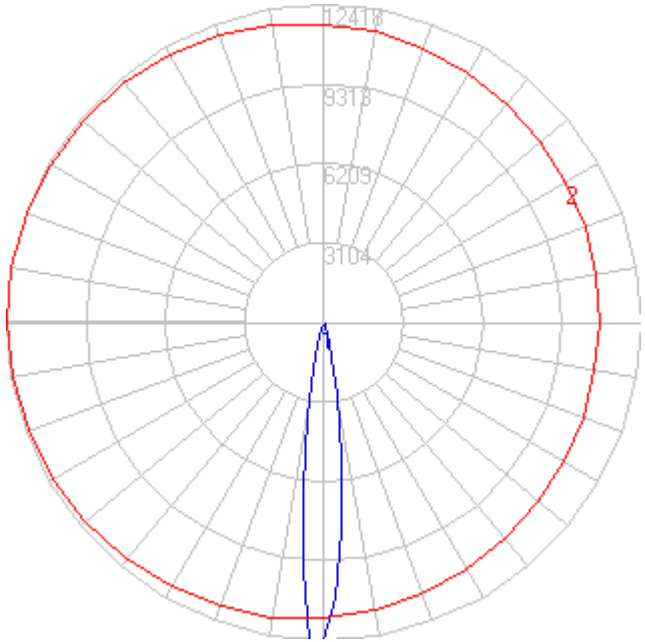
Goniophotometer Characterization: DIR-12-01

Power (W)	Gonio. Output (lm)	Beam Lumens	Center Beam Candlepower	Beam Angle	Efficacy
14	828	442	12408	14.6	59.1



Vertical Plane Through Horizontal Angles:
Blue: 160˚ - 340˚ (Through Max Candela)

Horizontal Cone Through Vertical Angle:
Red: 2.5˚ (Through Max Candela)

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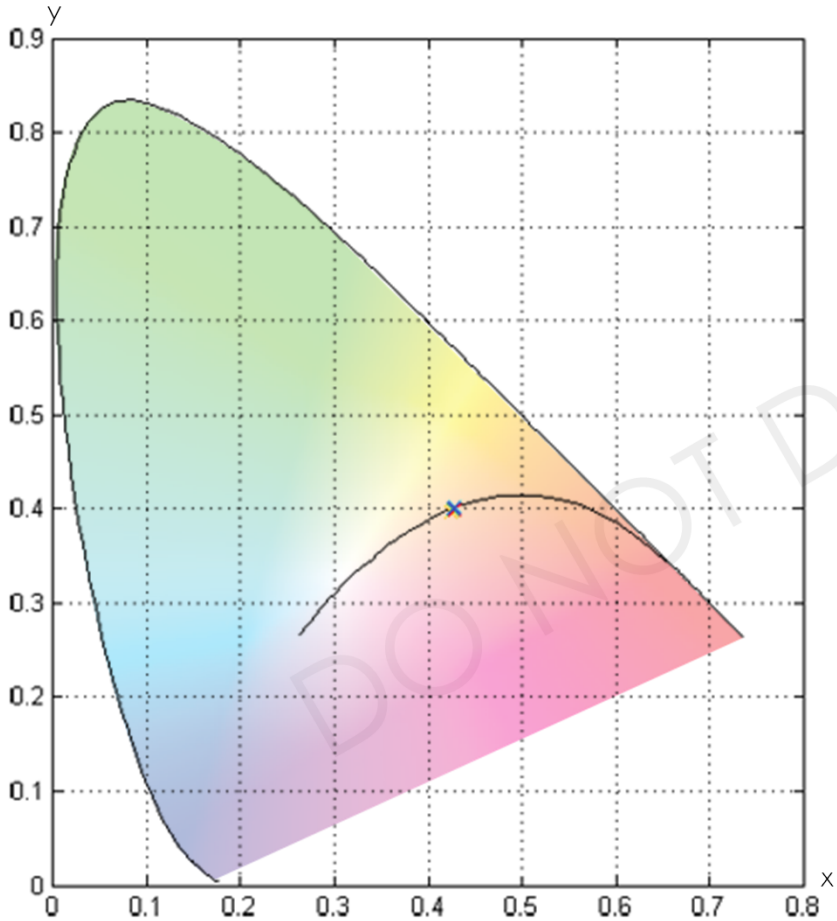
Photometric Summary: DIR-12



Chromaticity Diagram CIE 1931, 2 Degree

DIR-12-01	CIE X	CIE Y
Base-Up Closed	0.4254	0.3981
Base-Up Open	0.4273	0.3991
Base-Up Semi-Closed	0.4241	0.3973
Horizontal Open	0.4258	0.3980
Average	0.4257	0.3981

DIR-12-02	CIE X	CIE Y
Base-Up Closed	0.4275	0.4009
Base-Up Open	0.4285	0.4020
Base-Up Semi-Closed	0.4261	0.4001
Horizontal Open	0.4280	0.4010
Average	0.4275	0.4010

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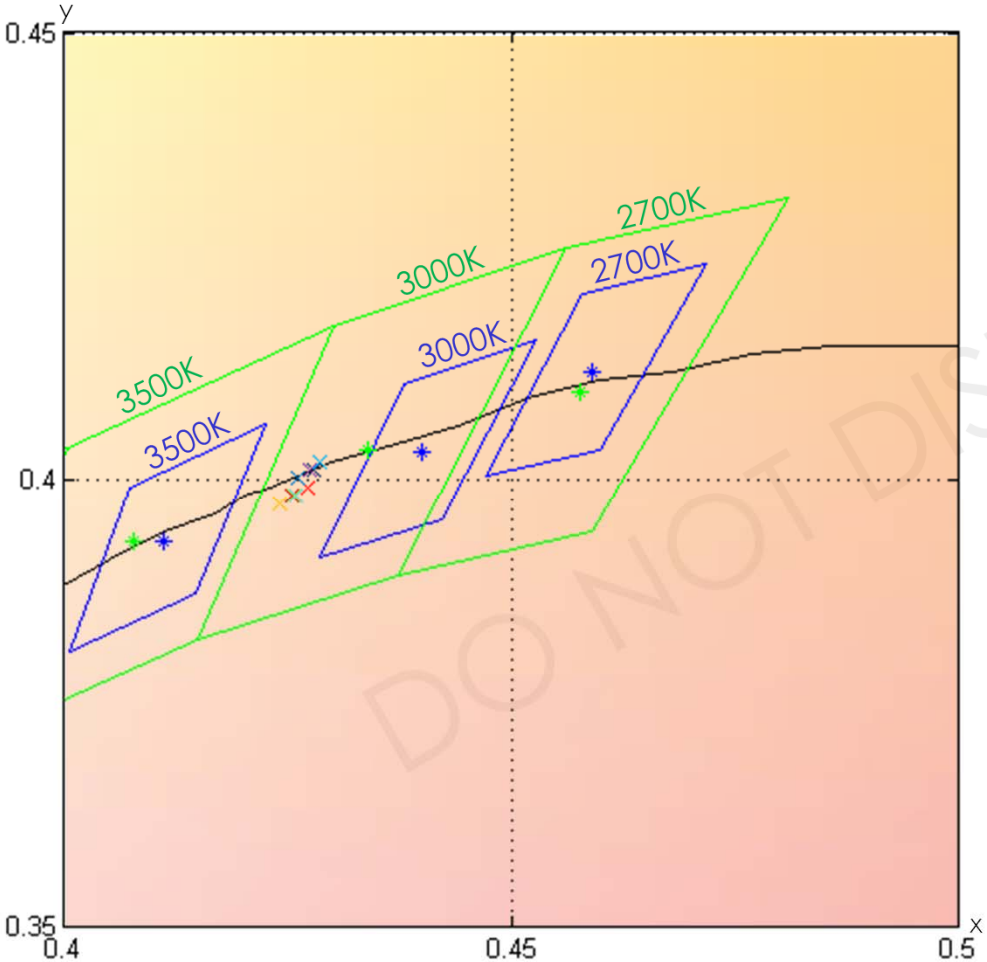
CALIFORNIA LIGHTING TECHNOLOGY CENTER

Photometric Summary: DIR-12



DIR-12-01	CIE X	CIE Y
Base-Up Closed	0.4254	0.3981
Base-Up Open	0.4273	0.3991
Base-Up Semi-Closed	0.4241	0.3973
Horizontal Open	0.4258	0.3980
Average	0.4257	0.3981

DIR-12-02	CIE X	CIE Y
Base-Up Closed	0.4275	0.4009
Base-Up Open	0.4285	0.4020
Base-Up Semi-Closed	0.4261	0.4001
Horizontal Open	0.4280	0.4010
Average	0.4275	0.4010

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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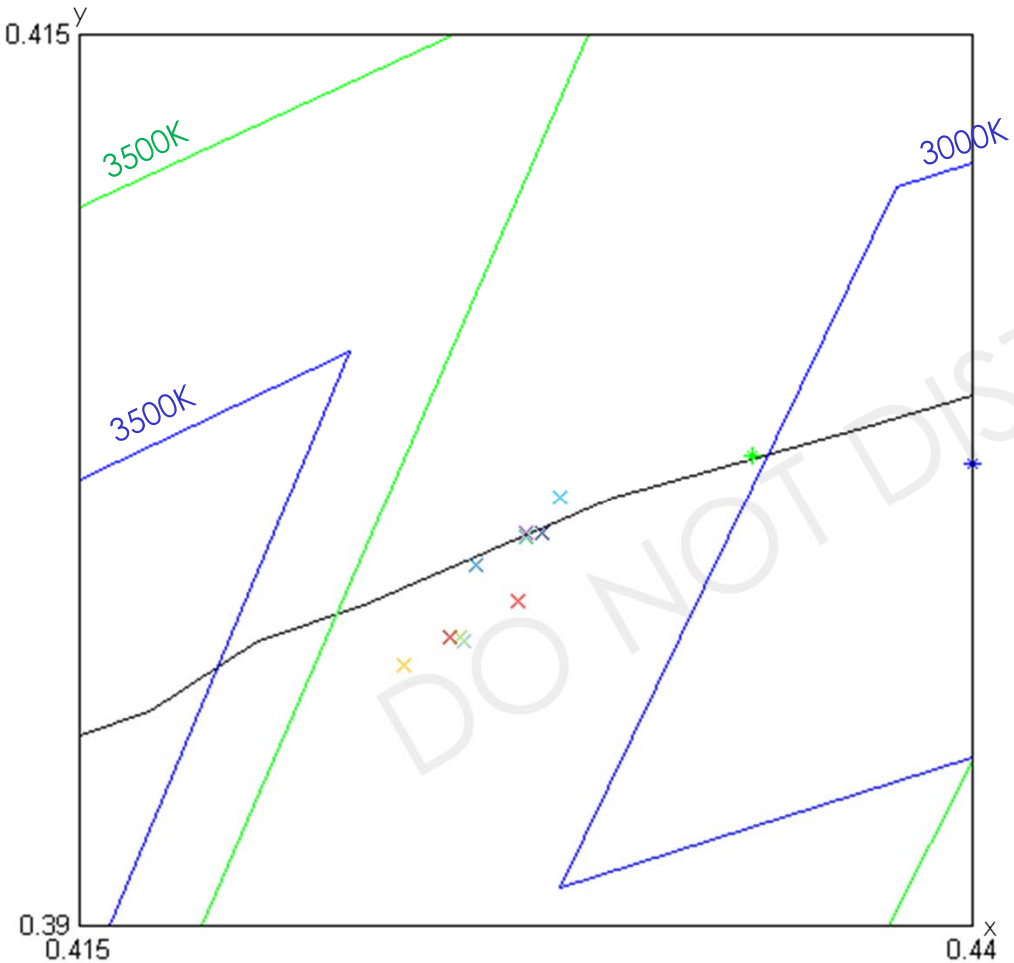
Photometric Summary: DIR-12



	DIR-12-01	CIE X	CIE Y
✖	Base-Up Closed	0.4254	0.3981
✖	Base-Up Open	0.4273	0.3991
✖	Base-Up Semi-Closed	0.4241	0.3973
✖	Horizontal Open	0.4258	0.3980
✖	Average	0.4257	0.3981

	DIR-12-02	CIE X	CIE Y
✖	Base-Up Closed	0.4275	0.4009
✖	Base-Up Open	0.4285	0.4020
✖	Base-Up Semi-Closed	0.4261	0.4001
✖	Horizontal Open	0.4280	0.4010
✖	Average	0.4275	0.4010

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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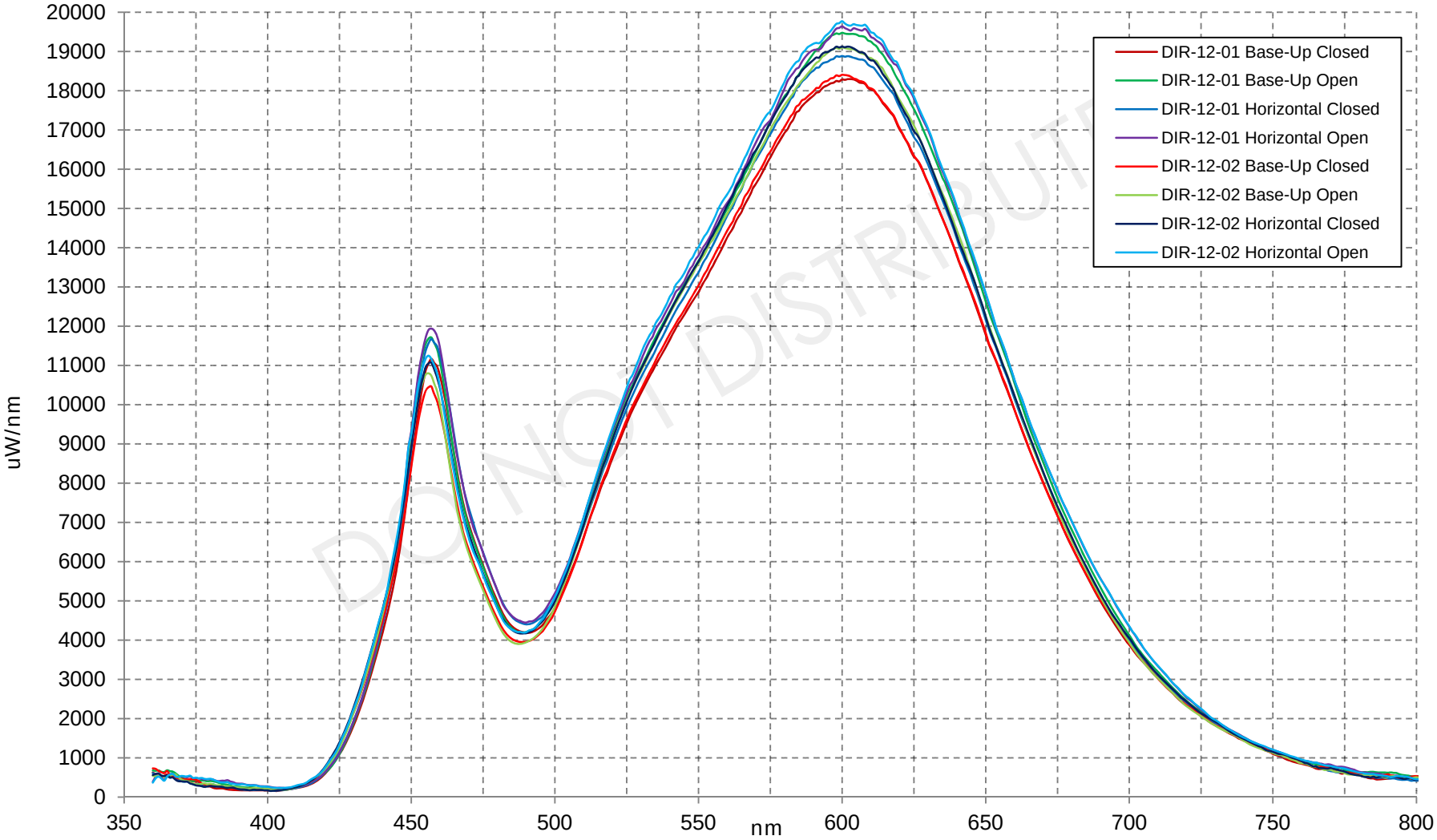
Spectral Power Distribution: DIR-12



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DIR-13

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-13-01

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	8.1	362	2846	82.6	44.7
Base-Up Open	8.0	392	2855	82.5	48.8
Horizontal Open	8.2	369	2871	82.5	45.2
Horizontal Open	8.4	409	2851	83.0	48.6
Average	8.2	383	2856	82.7	46.8

Mfg. Rated Output (lumens): 530

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.067	8.1	0.51	0.11	38.39
Base-Up Open	120.0	0.067	8.0	0.50	0.10	38.41
Horizontal Open	120.0	0.068	8.2	0.71	1.24	53.26
Horizontal Open	120.0	0.071	8.5	0.84	1.88	53.51
Average	120.0	0.068	8.2	0.64	0.83	45.89

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	80.3	89.2	96.9	80.6	79.9	86.2	85.1	62.4	15.0	75.3	78.6	70.9	81.9	98.2	82.6
Base-Up Open	80.1	89.0	96.9	80.7	79.8	85.9	85.2	62.5	14.6	74.9	78.8	70.6	81.7	98.1	82.5
Horizontal Open	80.2	89.1	96.9	80.6	79.9	86.0	85.1	62.4	14.6	75.1	78.6	70.6	81.8	98.2	82.5
Horizontal Open	80.7	89.4	96.9	81.2	80.4	86.4	85.5	63.3	16.8	75.7	79.4	71.4	82.3	98.2	83.0
Average	80.3	89.2	96.9	80.8	80.0	86.1	85.2	62.7	15.3	75.3	78.9	70.9	81.9	98.2	82.7

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-13-02

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	8.1	351	2824	82.6	43.5
Base-Up Open	8.1	388	2839	82.5	47.7
Horizontal Open	8.2	351	2849	82.5	43.0
Horizontal Open	8.5	405	2829	83.0	47.9
Average	8.2	374	2835	82.7	45.6

Mfg. Rated Output (lumens): 530

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.067	8.1	0.50	0.08	38.78
Base-Up Open	120.0	0.068	8.1	0.51	0.09	39.16
Horizontal Open	120.0	0.068	8.2	0.71	0.48	52.81
Horizontal Open	120.0	0.071	8.5	0.84	1.90	53.36
Average	120.0	0.068	8.2	0.64	0.64	46.03

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	80.4	89.4	97.0	80.5	80.1	86.5	84.7	62.3	15.3	75.9	78.6	71.7	82.1	98.3	82.6
Base-Up Open	80.2	89.2	96.9	80.6	79.9	86.2	84.9	62.3	14.9	75.4	78.7	71.3	81.8	98.2	82.5
Horizontal Open	80.2	89.3	96.9	80.5	80.0	86.3	84.8	62.3	14.9	75.6	78.6	71.6	81.9	98.2	82.5
Horizontal Open	80.8	89.6	97.0	81.1	80.6	86.8	85.1	63.0	16.8	76.3	79.4	72.4	82.5	98.3	83.0
Average	80.4	89.4	97.0	80.7	80.2	86.5	84.9	62.5	15.5	75.8	78.8	71.8	82.1	98.3	82.7

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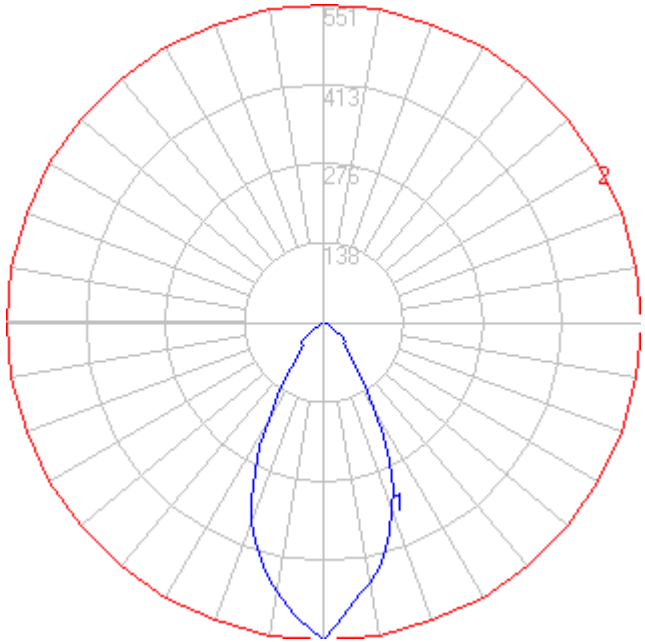
Goniophotometer Characterization: DIR-13-01

Power (W)	Gonio. Output (lm)	Beam Lumens	Center Beam Candlepower	Beam Angle	Efficacy
8.5	428	237	551	50	50.4



Vertical Plane Through Horizontal Angles:
Blue: 0˚ - 180˚ (Through Max Candela)

Horizontal Cone Through Vertical Angle:
Red: 0˚ (Through Max Candela)

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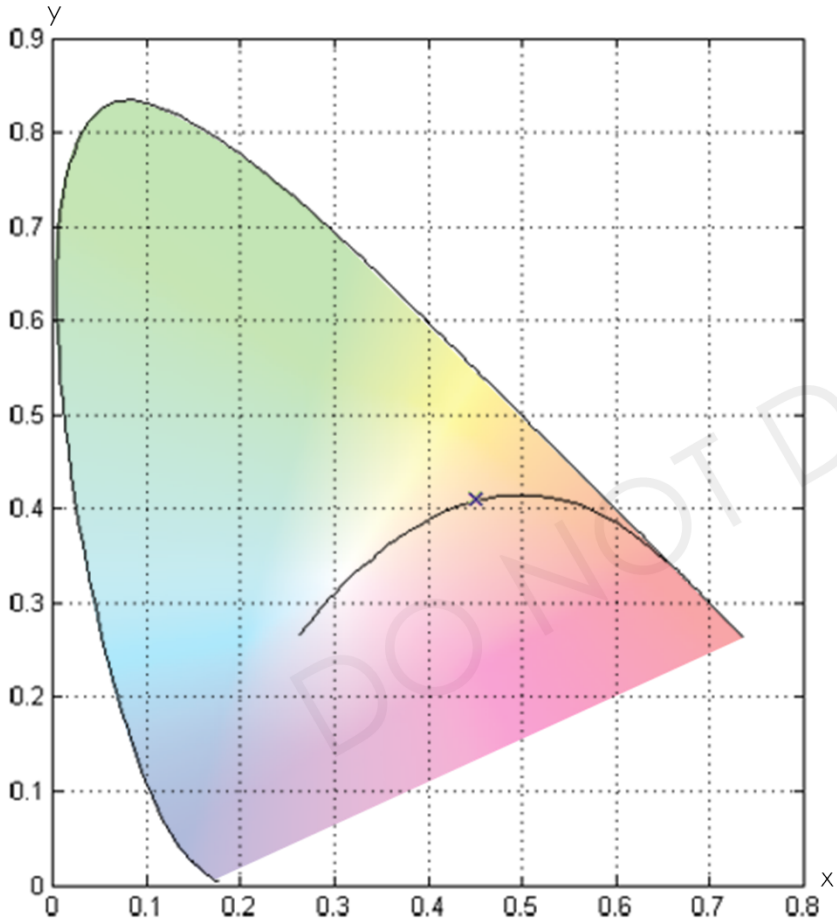
Photometric Summary: DIR-13



Chromaticity Diagram CIE 1931, 2 Degree

DIR-13-01	CIE X	CIE Y
Base-Up Closed	0.4504	0.4119
Base-Up Open	0.4502	0.4127
Base-Up Semi-Closed	0.4486	0.4116
Horizontal Open	0.4501	0.4119
Average	0.4498	0.4120

DIR-13-02	CIE X	CIE Y
Base-Up Closed	0.4511	0.4104
Base-Up Open	0.4505	0.4112
Base-Up Semi-Closed	0.4493	0.4101
Horizontal Open	0.4508	0.4105
Average	0.4504	0.4106

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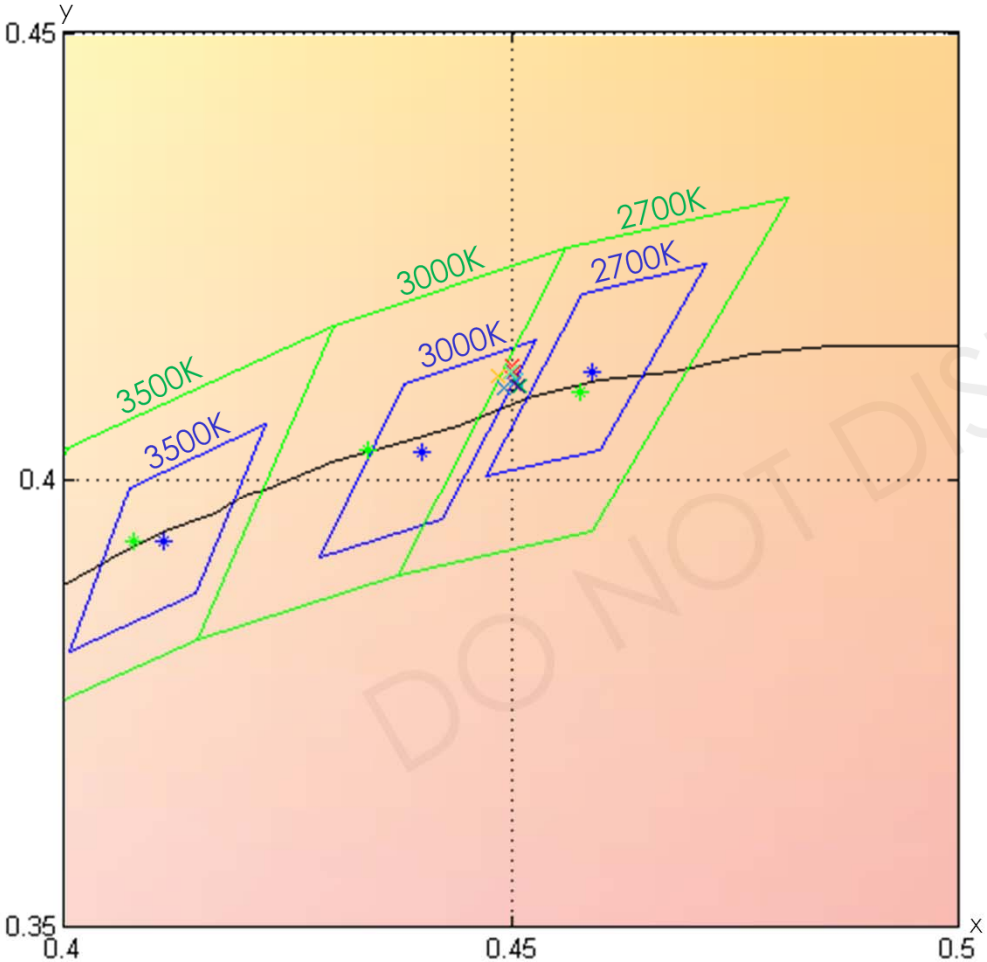
Photometric Summary: DIR-13



	DIR-13-01	CIE X	CIE Y
✖	Base-Up Closed	0.4504	0.4119
✖	Base-Up Open	0.4502	0.4127
✖	Base-Up Semi-Closed	0.4486	0.4116
✖	Horizontal Open	0.4501	0.4119
✖	Average	0.4498	0.4120

	DIR-13-02	CIE X	CIE Y
✖	Base-Up Closed	0.4511	0.4104
✖	Base-Up Open	0.4505	0.4112
✖	Base-Up Semi-Closed	0.4493	0.4101
✖	Horizontal Open	0.4508	0.4105
✖	Average	0.4504	0.4106

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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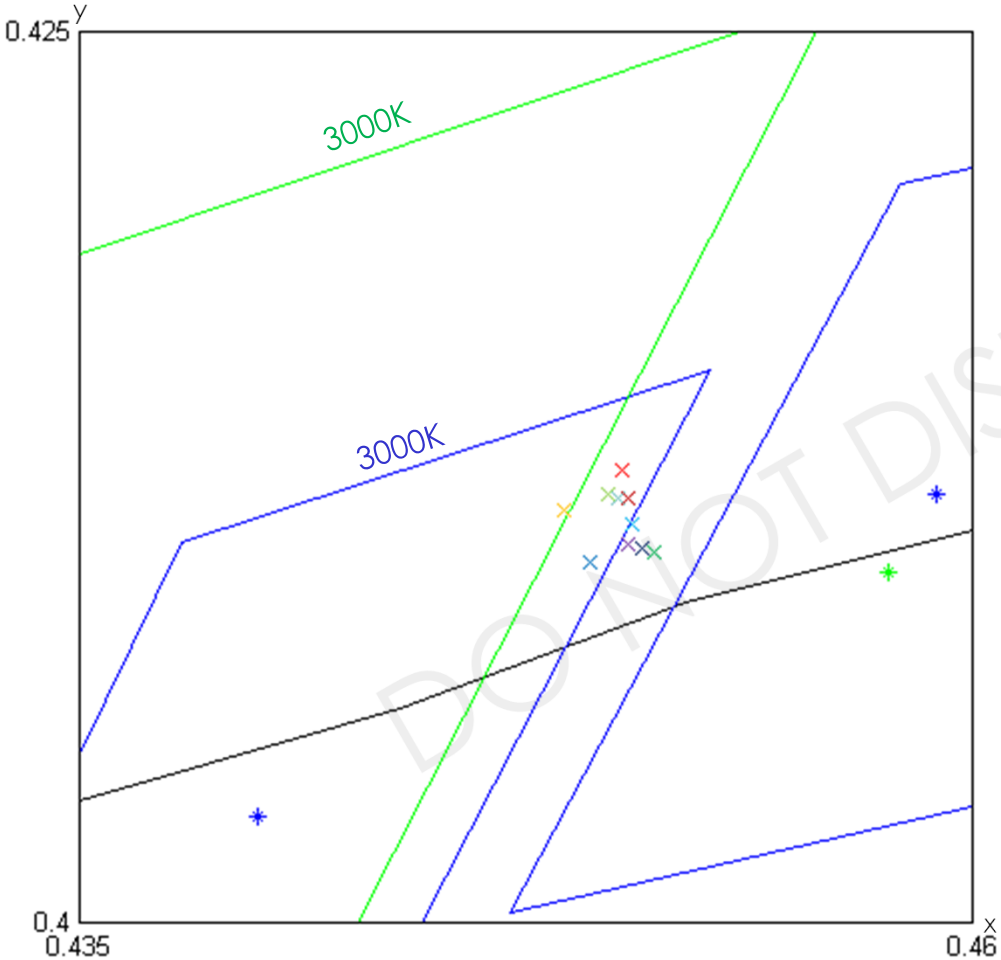
Photometric Summary: DIR-13



DIR-13-01	CIE X	CIE Y
Base-Up Closed	0.4504	0.4119
Base-Up Open	0.4502	0.4127
Base-Up Semi-Closed	0.4486	0.4116
Horizontal Open	0.4501	0.4119
Average	0.4498	0.4120

DIR-13-02	CIE X	CIE Y
Base-Up Closed	0.4511	0.4104
Base-Up Open	0.4505	0.4112
Base-Up Semi-Closed	0.4493	0.4101
Horizontal Open	0.4508	0.4105
Average	0.4504	0.4106

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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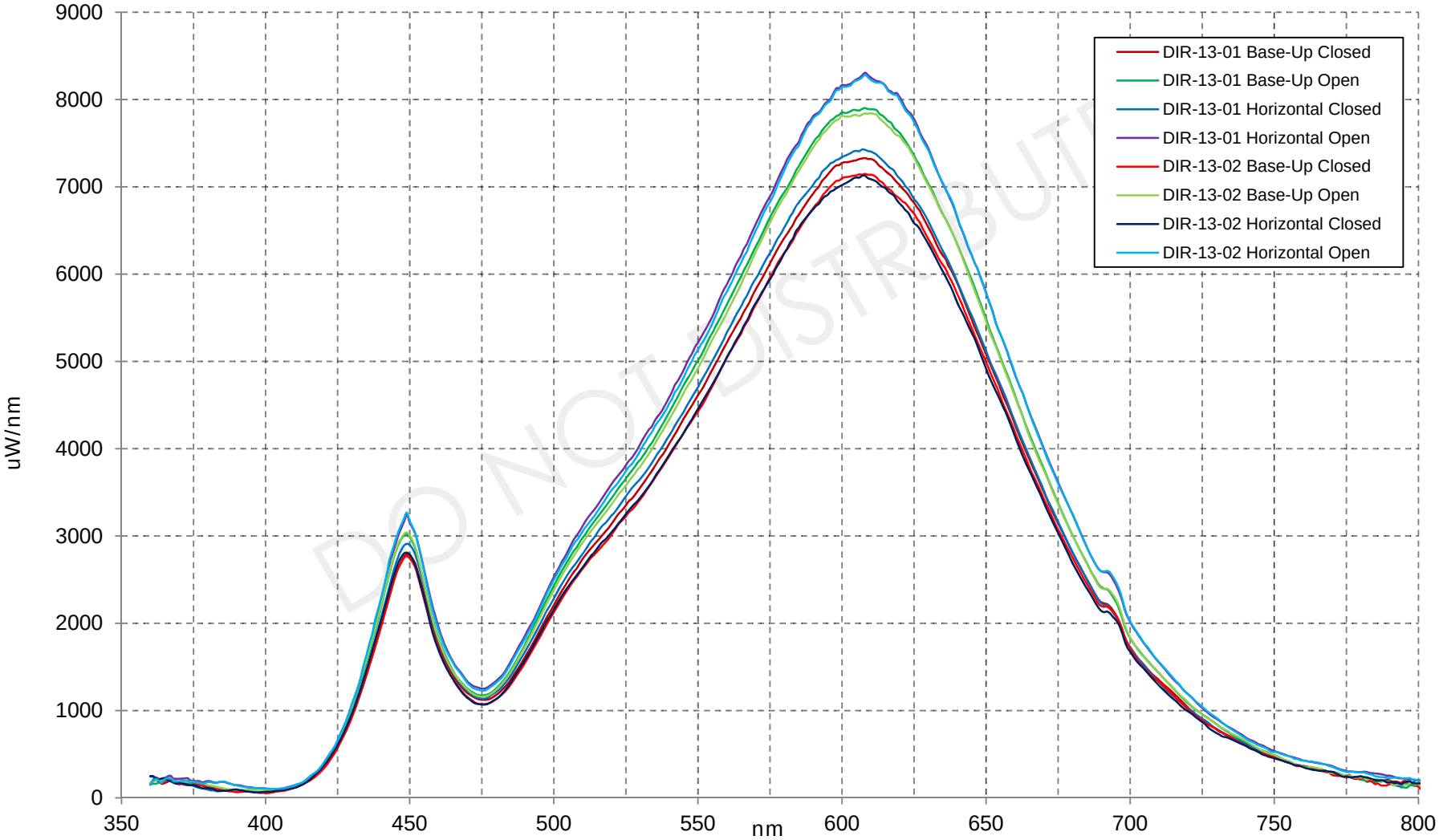
Spectral Power Distribution: DIR-13



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DIR-14

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-14-01

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	15.5	791	2739	90.8	51.2
Base-Up Open	15.5	875	2756	91.5	56.5
Horizontal Open	15.6	838	2759	91.0	53.7
Horizontal Open	15.4	864	2759	91.4	56.1
Average	15.5	842	2753	91.2	54.4

Mfg. Rated Output (lumens): 750

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.129	15.5	0.75	0.17	65.44
Base-Up Open	120.0	0.132	15.8	0.99	2.02	58.49
Horizontal Open	120.0	0.130	15.6	0.74	0.63	65.80
Horizontal Open	120.0	0.131	15.7	0.99	1.94	58.43
Average	120.0	0.130	15.6	0.87	1.19	62.04

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	92.8	99.5	93.8	88.1	92.6	95.9	86.7	76.8	54.7	98.5	88.2	83.5	95.2	97.7	90.8
Base-Up Open	93.3	99.6	95.0	89.0	92.9	96.3	87.7	78.4	57.5	97.8	89.2	83.5	95.5	98.3	91.5
Horizontal Open	92.9	99.5	94.4	88.3	92.6	96.2	87.1	77.3	55.4	97.9	88.5	83.3	95.2	98.0	91.0
Horizontal Open	93.4	99.5	94.5	88.9	93.1	96.0	87.4	78.2	57.4	98.5	89.1	83.6	95.7	98.1	91.4
Average	93.1	99.5	94.4	88.6	92.8	96.1	87.2	77.7	56.3	98.2	88.8	83.5	95.4	98.0	91.2

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-14-02

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	15.6	823	2758	90.7	52.8
Base-Up Open	15.6	912	2776	91.4	58.6
Horizontal Open	15.6	872	2778	90.9	55.7
Horizontal Open	15.5	901	2778	91.3	58.3
Average	15.6	877	2773	91.1	56.4

Mfg. Rated Output (lumens): 750

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.130	15.6	0.75	0.31	65.07
Base-Up Open	120.0	0.132	15.9	0.99	1.98	58.29
Horizontal Open	120.0	0.130	15.6	0.75	1.29	65.68
Horizontal Open	120.0	0.132	15.8	0.99	1.92	58.24
Average	120.0	0.131	15.7	0.87	1.38	61.82

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	91.5	98.2	96.2	88.0	91.1	96.8	87.8	76.4	52.0	94.1	87.7	82.7	93.5	99.0	90.7
Base-Up Open	92.0	98.0	97.2	88.9	91.4	96.8	88.8	77.9	54.5	93.5	88.6	82.2	93.8	99.6	91.4
Horizontal Open	91.5	98.0	96.6	88.2	91.1	96.7	88.1	76.8	52.4	93.6	87.9	82.2	93.5	99.3	90.9
Horizontal Open	92.0	98.2	96.7	88.8	91.6	96.9	88.5	77.7	54.5	94.1	88.5	82.7	94.0	99.4	91.3
Average	91.8	98.1	96.7	88.5	91.3	96.8	88.3	77.2	53.4	93.8	88.2	82.5	93.7	99.3	91.1

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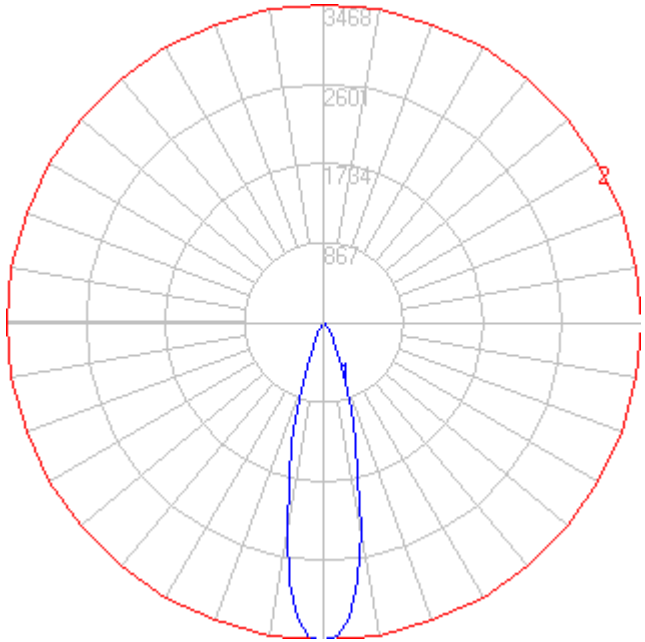
Goniophotometer Characterization: DIR-14-01

Power (W)	Gonio. Output (lm)	Beam Lumens	Center Beam Candlepower	Beam Angle	Efficacy
15.8	893.5	392	3468	25.3	56.6



Vertical Plane Through Horizontal Angles:
Blue: 0˚ - 180˚ (Through Max Candela)

Horizontal Cone Through Vertical Angle:
Red: 0˚ (Through Max Candela)

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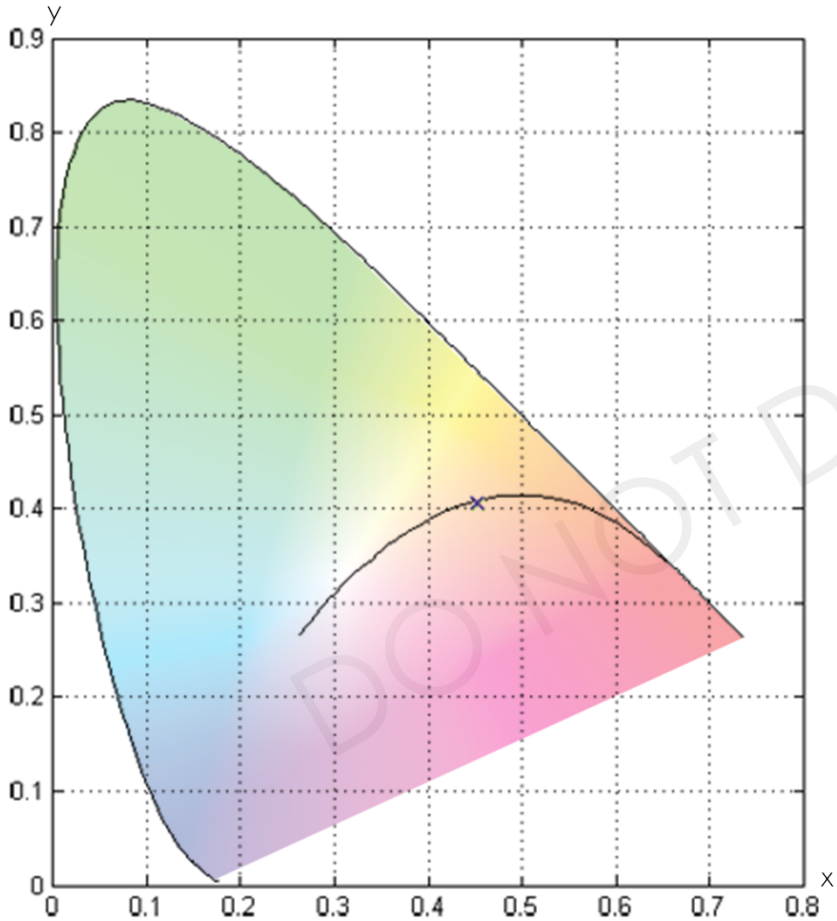
Photometric Summary: DIR-14



Chromaticity Diagram CIE 1931, 2 Degree

DIR-14-01	CIE X	CIE Y
Base-Up Closed	0.4538	0.4049
Base-Up Open	0.4530	0.4053
Base-Up Semi-Closed	0.4526	0.4051
Horizontal Open	0.4524	0.4047
Average	0.4530	0.4050

DIR-14-02	CIE X	CIE Y
Base-Up Closed	0.4533	0.4061
Base-Up Open	0.4524	0.4068
Base-Up Semi-Closed	0.4520	0.4064
Horizontal Open	0.4519	0.4060
Average	0.4524	0.4063

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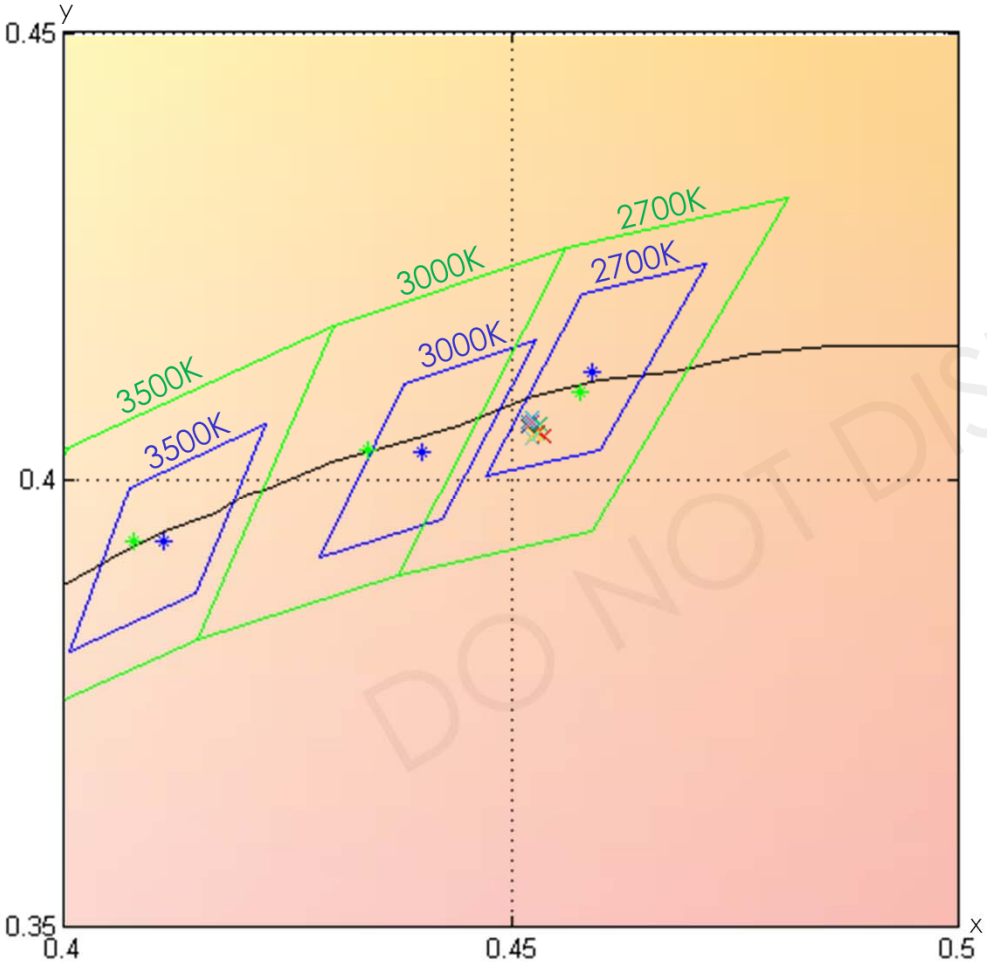
CALIFORNIA LIGHTING TECHNOLOGY CENTER

Photometric Summary: DIR-14



DIR-14-01	CIE X	CIE Y
Base-Up Closed	0.4538	0.4049
Base-Up Open	0.4530	0.4053
Base-Up Semi-Closed	0.4526	0.4051
Horizontal Open	0.4524	0.4047
Average	0.4530	0.4050

DIR-14-02	CIE X	CIE Y
Base-Up Closed	0.4533	0.4061
Base-Up Open	0.4524	0.4068
Base-Up Semi-Closed	0.4520	0.4064
Horizontal Open	0.4519	0.4060
Average	0.4524	0.4063

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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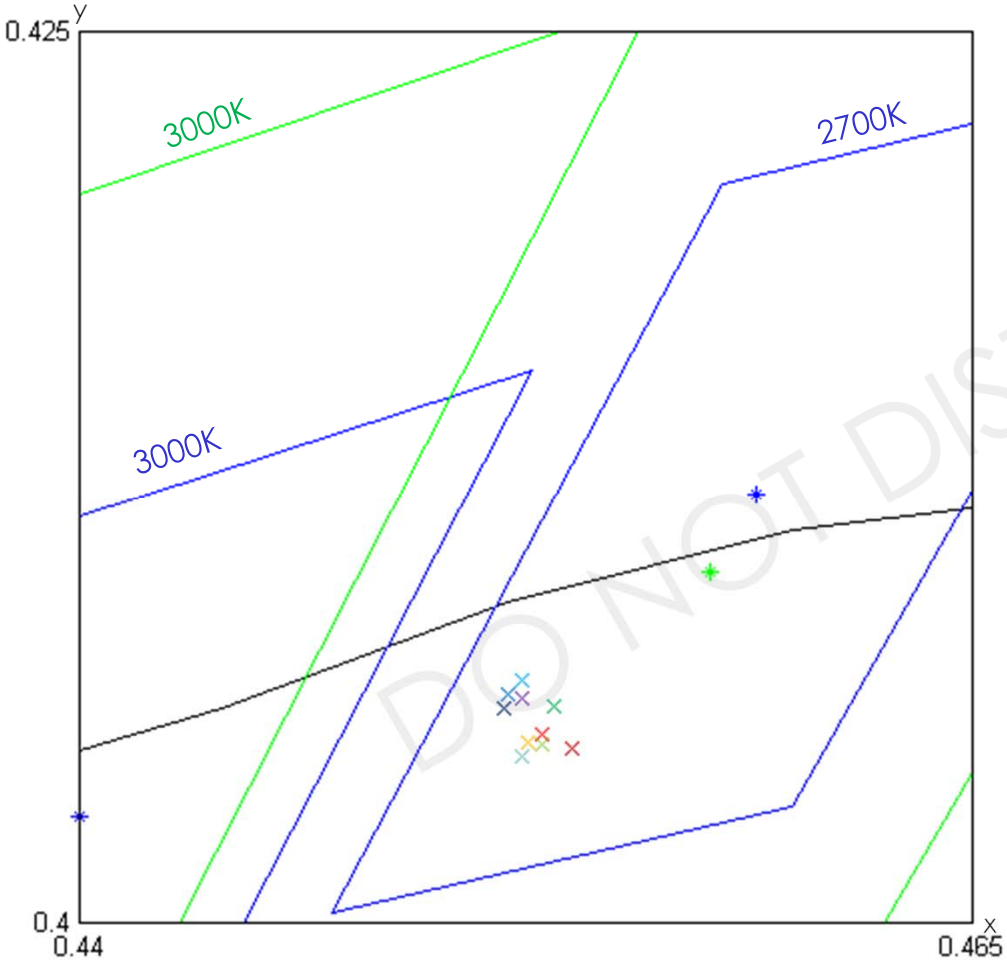
Photometric Summary: DIR-14



DIR-14-01	CIE X	CIE Y
Base-Up Closed	0.4538	0.4049
Base-Up Open	0.4530	0.4053
Base-Up Semi-Closed	0.4526	0.4051
Horizontal Open	0.4524	0.4047
Average	0.4530	0.4050

DIR-14-02	CIE X	CIE Y
Base-Up Closed	0.4533	0.4061
Base-Up Open	0.4524	0.4068
Base-Up Semi-Closed	0.4520	0.4064
Horizontal Open	0.4519	0.4060
Average	0.4524	0.4063

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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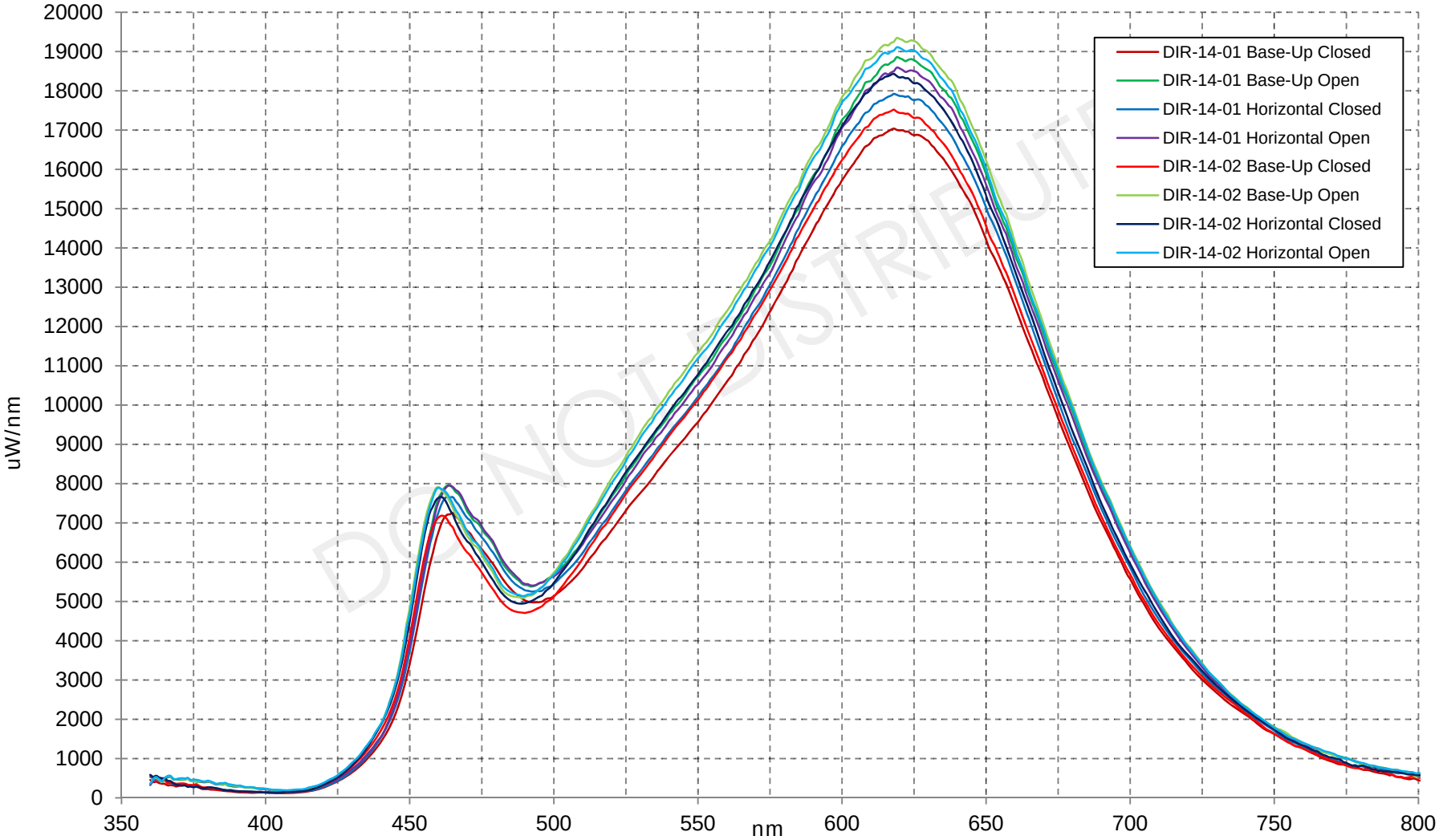
Spectral Power Distribution: DIR-14



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DIR-15

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-15-01

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	9.9	547	3009	88.9	55.5
Base-Up Open	9.9	587	3017	89.4	59.1
Horizontal Open	9.9	566	3026	89.0	57.2
Horizontal Open	9.9	589	3018	89.3	59.4
Average	9.9	572	3018	89.2	57.8

Mfg. Rated Output (lumens): 550

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.082	9.9	0.77	0.86	62.40
Base-Up Open	120.0	0.083	10.0	0.99	1.98	53.72
Horizontal Open	120.0	0.083	9.9	0.77	1.24	62.46
Horizontal Open	120.0	0.083	10.0	0.99	2.00	53.35
Average	120.0	0.083	9.9	0.88	1.52	57.98

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	88.7	95.3	97.5	85.9	87.8	93.0	88.4	74.8	45.0	86.8	84.0	76.4	90.5	98.7	88.9
Base-Up Open	89.2	95.4	97.6	86.6	88.3	93.1	88.9	75.8	47.1	87.0	84.7	76.6	90.9	98.6	89.4
Horizontal Open	88.8	95.3	97.5	86.0	87.9	93.0	88.5	75.0	45.3	86.9	84.1	76.4	90.6	98.7	89.0
Horizontal Open	89.2	95.6	97.6	86.4	88.3	93.3	88.7	75.6	46.8	87.4	84.5	76.9	91.0	98.7	89.3
Average	89.0	95.4	97.6	86.2	88.1	93.1	88.6	75.3	46.1	87.0	84.3	76.6	90.8	98.7	89.2

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-15-02

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	10.0	548	3006	88.6	55.0
Base-Up Open	10.0	565	2993	89.0	56.3
Horizontal Open	10.0	550	3007	88.7	55.1
Horizontal Open	10.0	571	3001	89.0	57.1
Average	10.0	558	3002	88.8	55.9

Mfg. Rated Output (lumens): 550

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.083	10.0	0.78	0.75	61.28
Base-Up Open	120.0	0.084	10.1	0.99	1.93	52.43
Horizontal Open	120.0	0.083	10.0	0.82	0.70	61.36
Horizontal Open	120.0	0.084	10.0	0.99	1.96	52.43
Average	120.0	0.083	10.0	0.90	1.34	56.88

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	88.4	94.7	97.2	85.8	87.4	92.1	88.5	74.7	44.4	85.4	83.8	75.3	90.1	98.2	88.6
Base-Up Open	88.8	94.9	97.2	86.4	87.9	92.4	88.8	75.5	46.1	85.9	84.4	75.9	90.5	98.2	89.0
Horizontal Open	88.4	94.8	97.2	85.9	87.5	92.2	88.5	74.8	44.6	85.6	83.8	75.6	90.2	98.3	88.7
Horizontal Open	88.8	95.0	97.2	86.2	87.8	92.4	88.8	75.4	46.0	85.9	84.2	75.9	90.5	98.2	89.0
Average	88.6	94.9	97.2	86.1	87.7	92.3	88.7	75.1	45.3	85.7	84.1	75.7	90.3	98.2	88.8

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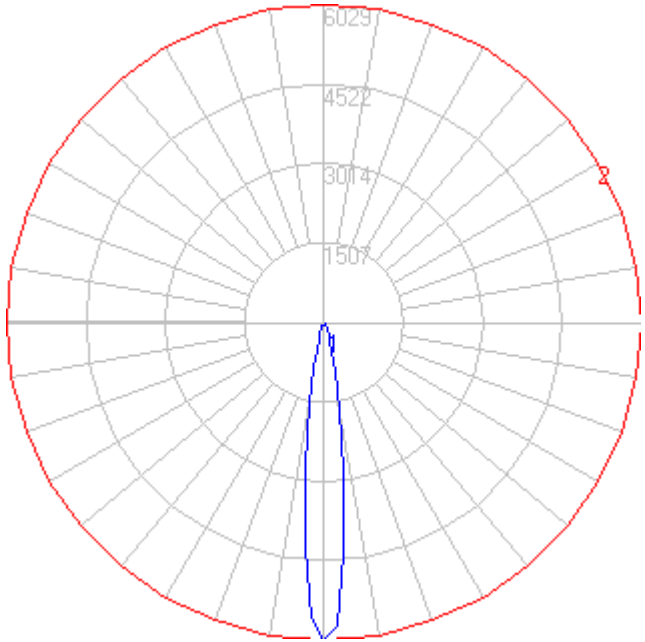
Goniophotometer Characterization: DIR-15-01

Power (W)	Gonio. Output (lm)	Beam Lumens	Center Beam Candlepower	Beam Angle	Efficacy
10.03	613.6	215	6029	14.4	61.2



Vertical Plane Through Horizontal Angles:
Blue: 0˚ - 180˚ (Through Max Candela)

Horizontal Cone Through Vertical Angle:
Red: 0˚ (Through Max Candela)

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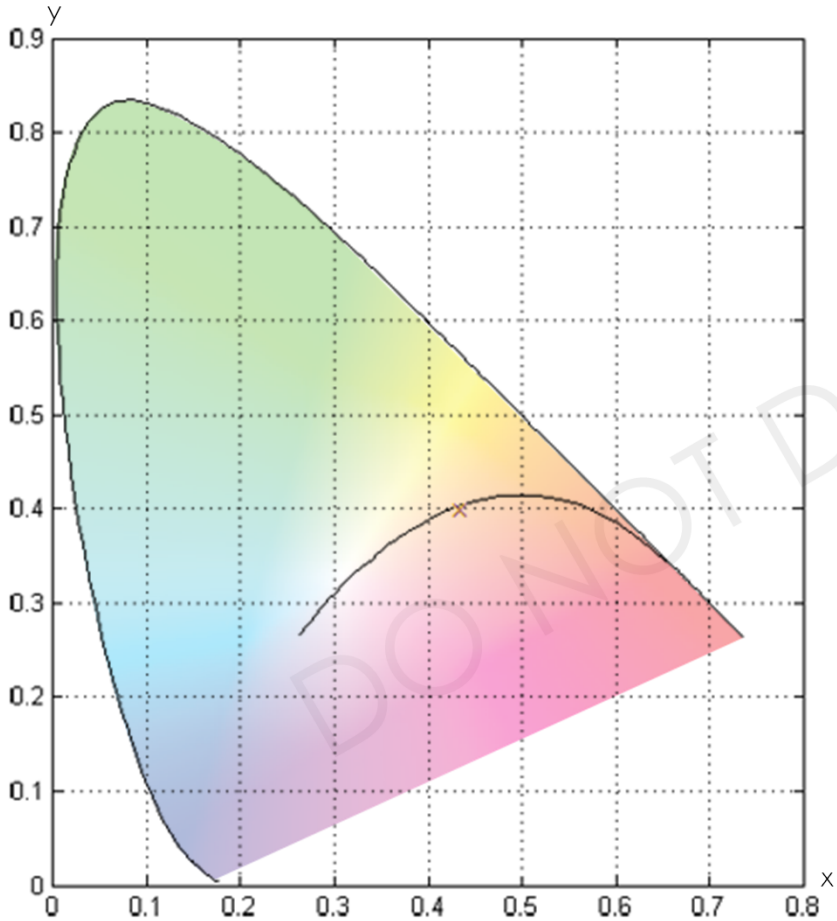
Photometric Summary: DIR-15



Chromaticity Diagram CIE 1931, 2 Degree

DIR-15-01	CIE X	CIE Y
Base-Up Closed	0.4339	0.3991
Base-Up Open	0.4333	0.3987
Base-Up Semi-Closed	0.4326	0.3984
Horizontal Open	0.4330	0.3983
Average	0.4332	0.3986

DIR-15-02	CIE X	CIE Y
Base-Up Closed	0.4336	0.3980
Base-Up Open	0.4344	0.3981
Base-Up Semi-Closed	0.4333	0.3977
Horizontal Open	0.4337	0.3978
Average	0.4338	0.3979

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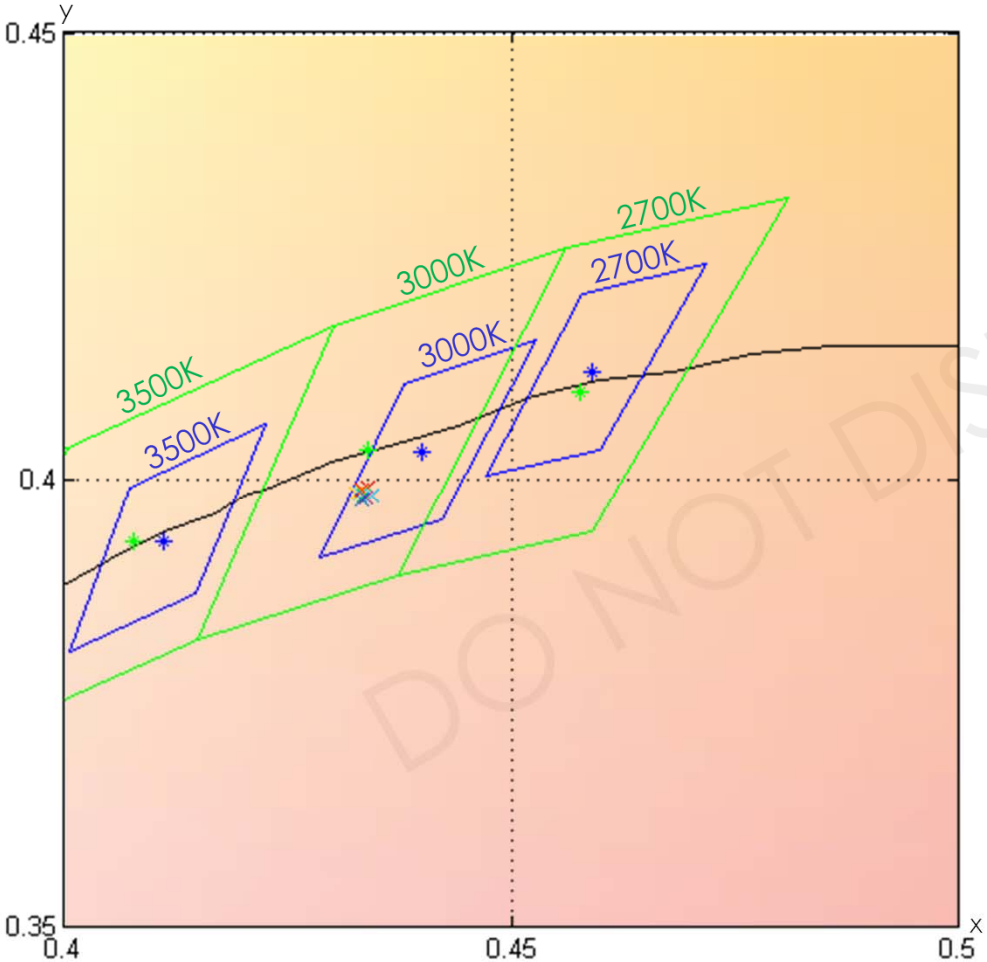
CALIFORNIA LIGHTING TECHNOLOGY CENTER

Photometric Summary: DIR-15



	DIR-15-01	CIE X	CIE Y
✖	Base-Up Closed	0.4339	0.3991
✖	Base-Up Open	0.4333	0.3987
✖	Base-Up Semi-Closed	0.4326	0.3984
✖	Horizontal Open	0.4330	0.3983
✖	Average	0.4332	0.3986

	DIR-15-02	CIE X	CIE Y
✖	Base-Up Closed	0.4336	0.3980
✖	Base-Up Open	0.4344	0.3981
✖	Base-Up Semi-Closed	0.4333	0.3977
✖	Horizontal Open	0.4337	0.3978
✖	Average	0.4338	0.3979

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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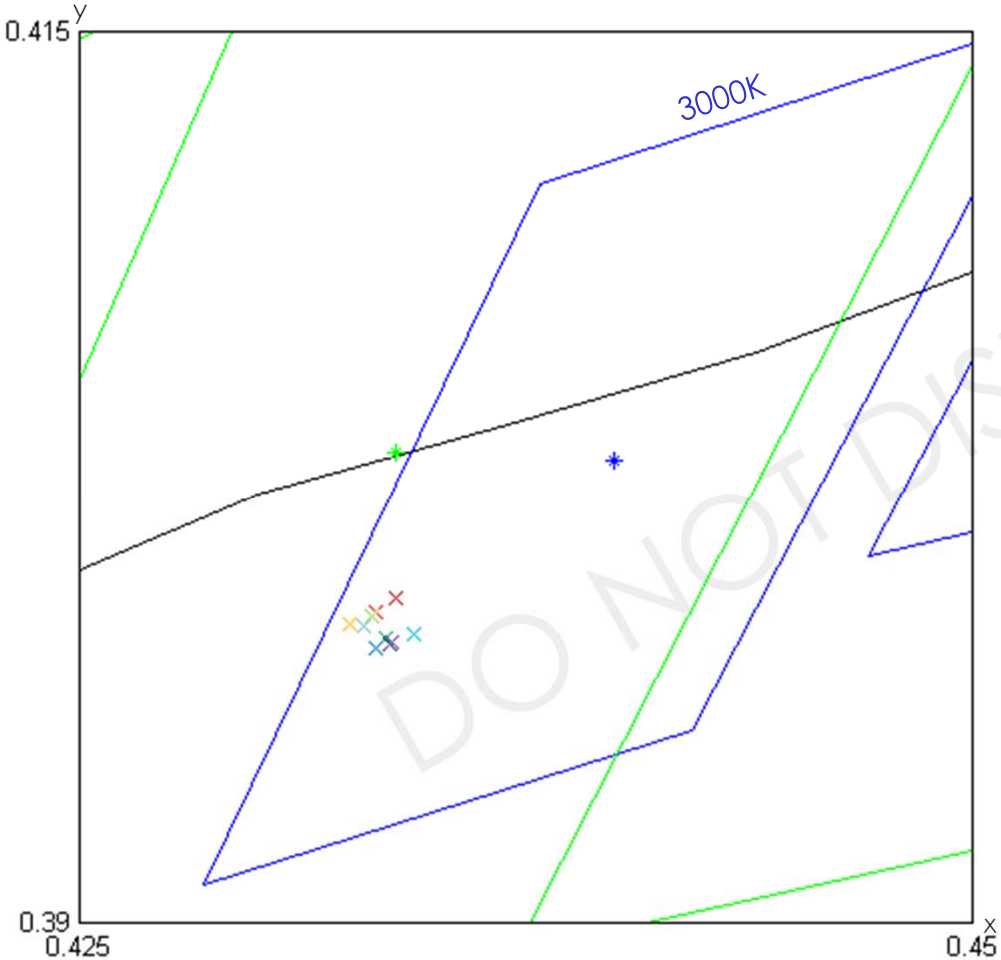
Photometric Summary: DIR-15



	DIR-15-01	CIE X	CIE Y
✖	Base-Up Closed	0.4339	0.3991
✖	Base-Up Open	0.4333	0.3987
✖	Base-Up Semi-Closed	0.4326	0.3984
✖	Horizontal Open	0.4330	0.3983
✖	Average	0.4332	0.3986

	DIR-15-02	CIE X	CIE Y
✖	Base-Up Closed	0.4336	0.3980
✖	Base-Up Open	0.4344	0.3981
✖	Base-Up Semi-Closed	0.4333	0.3977
✖	Horizontal Open	0.4337	0.3978
✖	Average	0.4338	0.3979

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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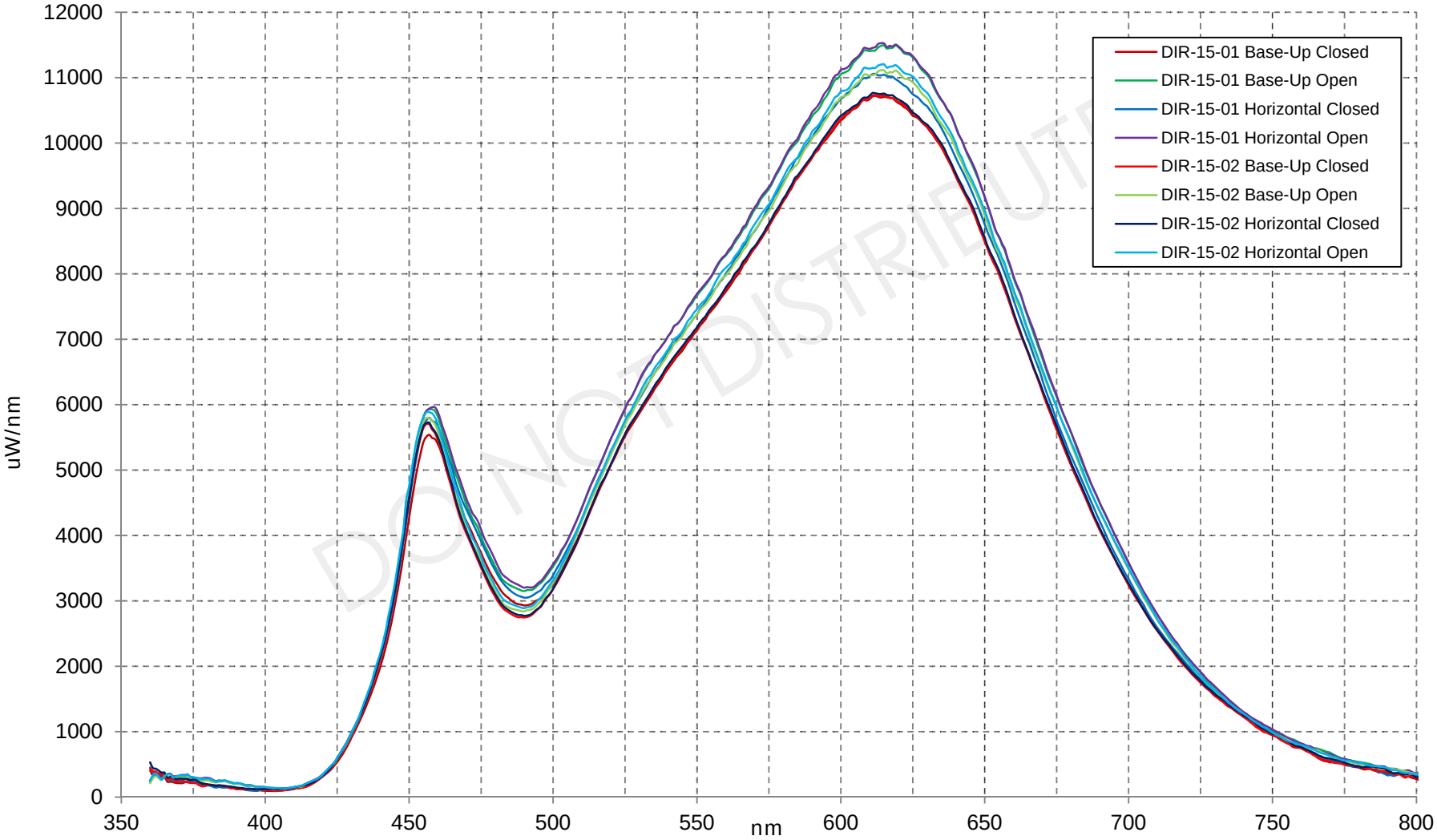
Spectral Power Distribution: DIR-15



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DIR-16

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-16-01

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	11.0	556	2728	93.7	50.6
Base-Up Open	11.1	594	2703	93.5	53.7
Horizontal Open	11.0	578	2747	93.7	52.8
Horizontal Open	11.0	599	2711	93.5	54.2
Average	11.0	582	2722	93.6	52.8

Mfg. Rated Output (lumens): 600

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.092	11.0	0.93	0.70	17.13
Base-Up Open	120.0	0.092	11.0	0.93	1.95	17.19
Horizontal Open	120.0	0.091	11.0	0.93	0.22	17.08
Horizontal Open	120.0	0.092	11.0	0.93	1.91	17.32
Average	120.0	0.092	11.0	0.93	1.20	17.18

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	92.3	98.7	85.7	88.3	95.2	96.4	95.7	97.1	92.6	90.8	86.0	90.5	94.5	88.8	93.7
Base-Up Open	92.0	98.8	86.0	88.0	94.8	95.7	95.8	97.3	91.1	91.4	85.4	91.4	94.0	88.9	93.5
Horizontal Open	92.4	98.7	85.7	88.3	95.2	96.4	95.6	97.0	92.5	90.7	86.0	90.4	94.6	88.8	93.7
Horizontal Open	92.0	98.8	85.9	88.0	94.8	95.9	95.7	97.2	91.6	91.3	85.4	91.2	94.1	88.8	93.5
Average	92.2	98.8	85.8	88.2	95.0	96.1	95.7	97.2	92.0	91.1	85.7	90.9	94.3	88.8	93.6

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CALIFORNIA LIGHTING TECHNOLOGY CENTER

Summary: DIR-16-02

Photometric:

Position	Power (W)	Sphere Output (lm)	CCT	CRI	Efficacy
Base-Up Closed	10.4	528	2717	93.7	50.6
Base-Up Open	10.5	565	2681	93.3	53.7
Horizontal Open	10.4	555	2716	93.5	53.4
Horizontal Open	10.5	570	2686	93.3	54.3
Average	10.5	555	2700	93.5	53.0

Mfg. Rated Output (lumens): 600

Electrical:

Position	Voltage	Current	Power	Power Factor	UTHD%	ITHD%
Base-Up Closed	120.0	0.087	10.4	0.93	0.14	16.31
Base-Up Open	120.0	0.087	10.5	0.92	1.96	15.97
Horizontal Open	120.0	0.087	10.4	0.92	0.91	15.87
Horizontal Open	120.0	0.087	10.5	0.93	1.95	16.02
Average	120.0	0.087	10.4	0.93	1.24	16.04

CRI:

Position	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	RA
Base-Up Closed	94.2	99.1	90.2	91.7	97.1	94.2	94.9	88.3	66.8	92.2	88.9	90.9	95.5	91.2	93.7
Base-Up Open	93.9	98.9	90.7	91.4	96.7	93.2	94.3	87.1	64.6	93.1	88.2	92.1	95.0	91.4	93.3
Horizontal Open	94.3	99.0	90.5	91.7	97.2	93.9	94.4	87.0	63.9	92.3	88.8	91.1	95.5	91.4	93.5
Horizontal Open	93.8	98.9	90.6	91.3	96.6	93.3	94.5	87.5	65.3	93.1	88.1	92.1	94.9	91.4	93.3
Average	94.1	99.0	90.5	91.5	96.9	93.7	94.5	87.5	65.2	92.7	88.5	91.6	95.2	91.4	93.5

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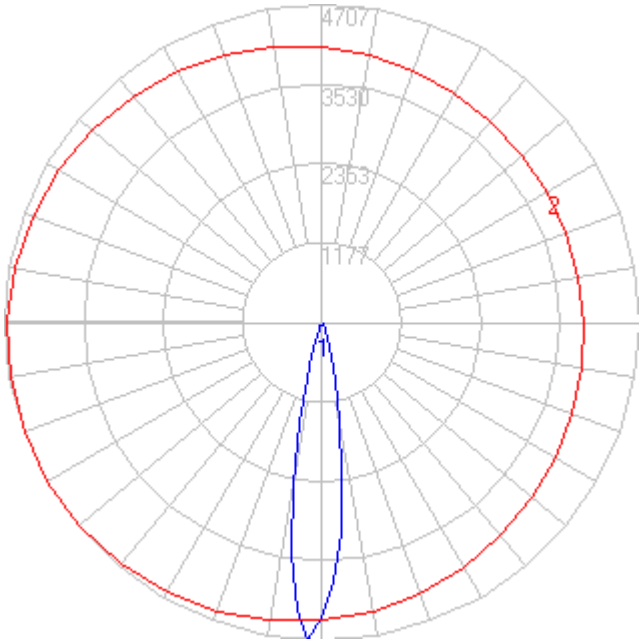
Goniophotometer Characterization: DIR-16-01

Power (W)	Gonio. Output (lm)	Beam Lumens	Center Beam Candlepower	Beam Angle	Efficacy
11.16	616.26	255	4585	18	55.2



Vertical Plane Through Horizontal Angles:
Blue: 200˚ - 20˚ (Through Max Candela)

Horizontal Cone Through Vertical Angle:
Red: 2.5˚ (Through Max Candela)

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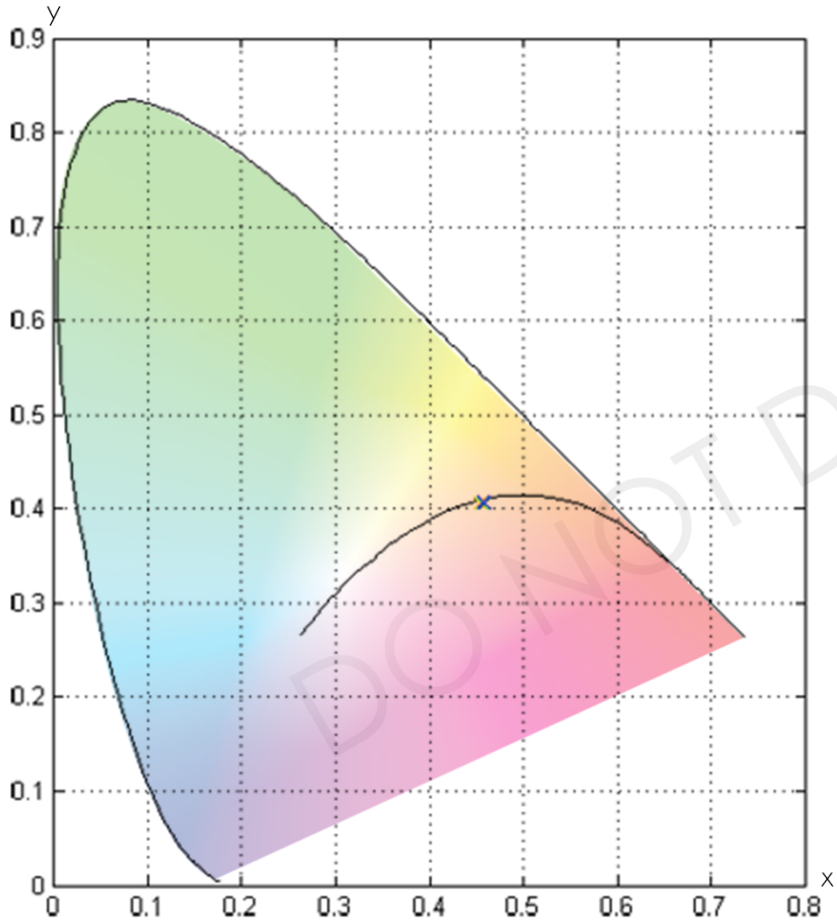
Photometric Summary: DIR-16



Chromaticity Diagram CIE 1931, 2 Degree

DIR-16-01	CIE X	CIE Y
Base-Up Closed	0.4555	0.4065
Base-Up Open	0.4571	0.4061
Base-Up Semi-Closed	0.4539	0.4059
Horizontal Open	0.4565	0.4061
Average	0.4558	0.4062

DIR-16-02	CIE X	CIE Y
Base-Up Closed	0.4570	0.4078
Base-Up Open	0.4592	0.4072
Base-Up Semi-Closed	0.4568	0.4073
Horizontal Open	0.4589	0.4073
Average	0.4580	0.4074

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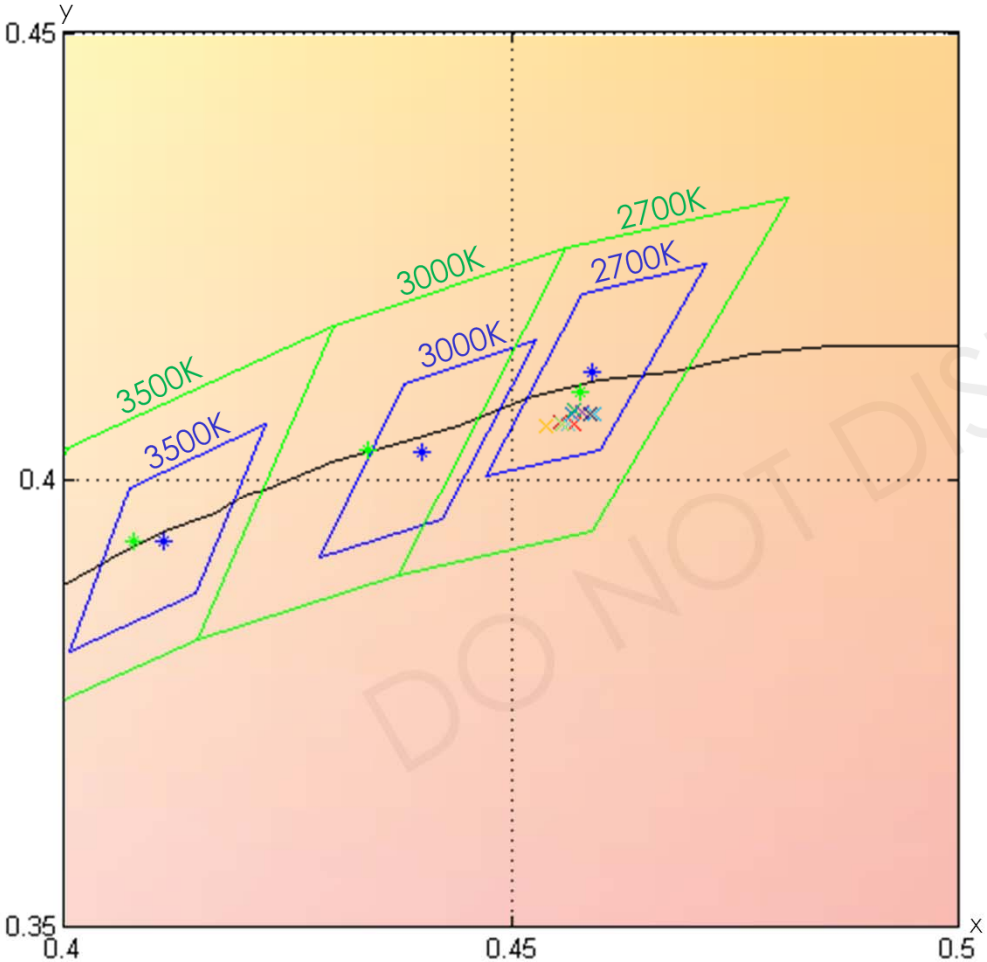
CALIFORNIA LIGHTING TECHNOLOGY CENTER

Photometric Summary: DIR-16



	DIR-16-01	CIE X	CIE Y
✖	Base-Up Closed	0.4555	0.4065
✖	Base-Up Open	0.4571	0.4061
✖	Base-Up Semi-Closed	0.4539	0.4059
✖	Horizontal Open	0.4565	0.4061
✖	Average	0.4558	0.4062

	DIR-16-02	CIE X	CIE Y
✖	Base-Up Closed	0.4570	0.4078
✖	Base-Up Open	0.4592	0.4072
✖	Base-Up Semi-Closed	0.4568	0.4073
✖	Horizontal Open	0.4589	0.4073
✖	Average	0.4580	0.4074

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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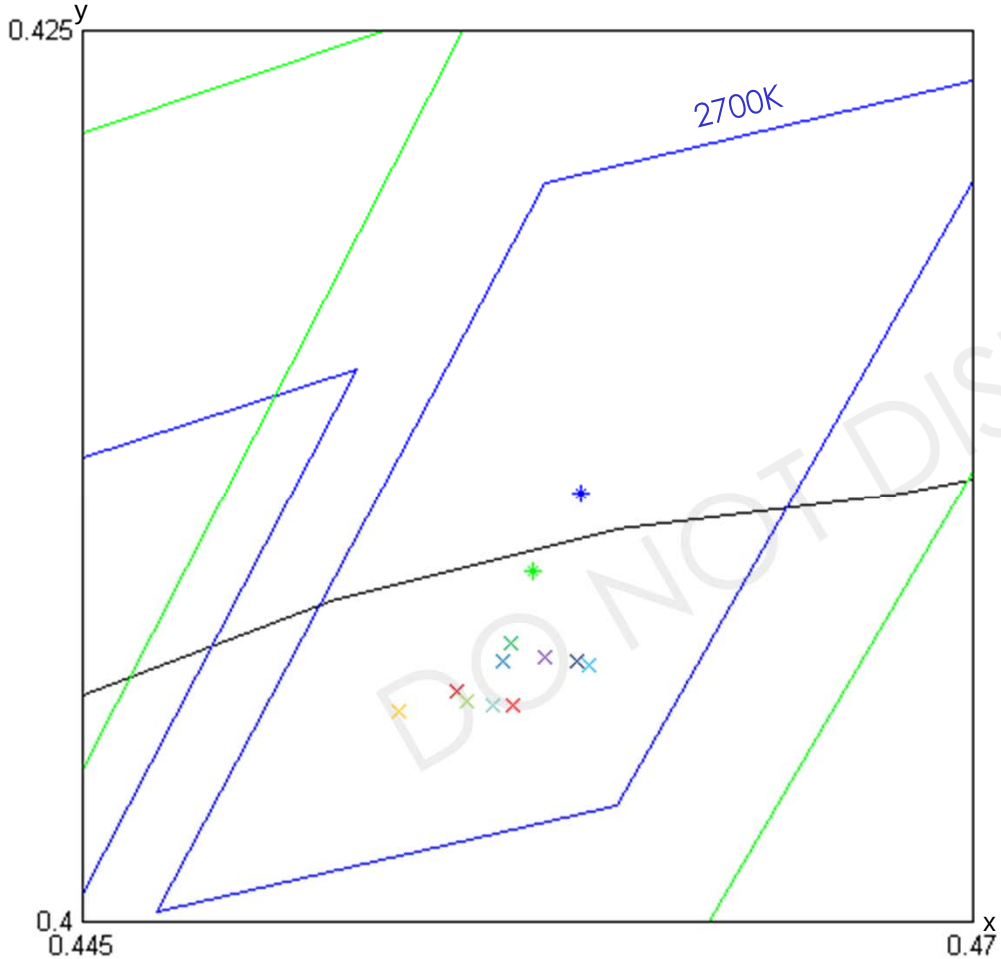
Photometric Summary: DIR-16



DIR-16-01	CIE X	CIE Y
Base-Up Closed	0.4555	0.4065
Base-Up Open	0.4571	0.4061
Base-Up Semi-Closed	0.4539	0.4059
Horizontal Open	0.4565	0.4061
Average	0.4558	0.4062

DIR-16-02	CIE X	CIE Y
Base-Up Closed	0.4570	0.4078
Base-Up Open	0.4592	0.4072
Base-Up Semi-Closed	0.4568	0.4073
Horizontal Open	0.4589	0.4073
Average	0.4580	0.4074

Chromaticity Diagram CIE 1931, 2 Degree

Green Quadrangles: 7-Step MacAdam Ellipse Equivalent
Blue Quadrangles: 4-Step MacAdam Ellipse Equivalent

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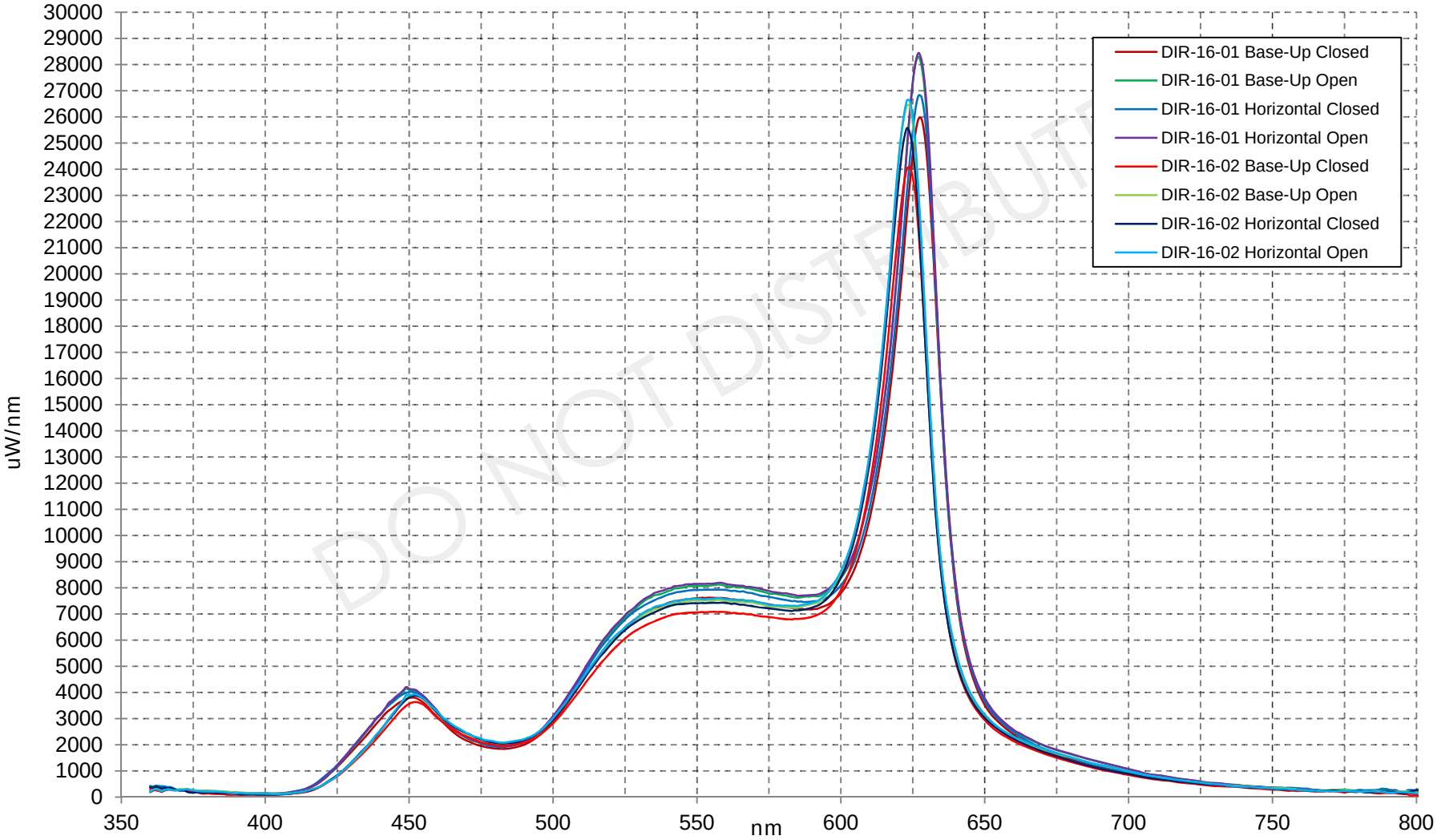
Spectral Power Distribution: DIR-16



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