SOLATUBE TEST REPORT NO.: *SOLATUBE40.IES – Preliminary BETA Test Report*

LUMINAIRE: Solatube 530mm SolaMaster Suspended Ceiling Unit, L/D = 6:1, Tube Length =3.2m, Infinity Tube, Optiview

Sky Condition: Clear Sky, Solar Az =00, Solar Altitude = 40

CANDLEPOWER SUMMARY

ANGLE	ALONG	22.5	45	67.5	ACROSS	OUTPUT LUMENS
0	3566	3566	3566	3566	3566	
5	3478	3460	3454	3453	3462	
10	3484	3594	3545	3594	3530	335
15	3790	3878	3550	3735	3737	
20	4119	4021	3655	3919	3946	1062
25	4216	3859	3831	3976	3863	
30	4068	3775	3789	3789	3847	1803
35	3729	3688	3680	3798	3534	
40	3376	3402	3501	3599	3544	2308
45	2926	3220	3393	3508	3456	
50	3443	3572	3616	3737	3501	2662
55	2088	2413	2548	2542	2223	
60	1585	1810	2031	2072	1987	2311
65	1294	1472	1583	1627	1561	
70	994	1104	1114	1261	1197	1516
75	570	734	781	818	817	
80	289	405	423	451	528	812
85	132	138	123	168	135	
90	0	0	0	0	0	191
95	0	0	0	0	0	
100	0	0	0	0	0	0
105	0	0	0	0	0	
110	0	0	0	0	0	0
115	0	0	0	0	0	
120	0	0	0	0	0	0
125	0	0	0	0	0	
130	0	0	0	0	0	0
135	0	0	0	0	0	
140	0	0	0	0	0	0
145	0	0	0	0	0	
150	0	0	0	0	0	0
155	0	0	0	0	0	
160	0	0	0	0	0	0
165	0	0	0	0	0	
170	0	0	0	0	0	0
175	0	0	0	0	0	
180	0	0	0	0	0	0

ZONAL LUMENS AND PERCENTAGES

Zone	LUMENS	% LAMP	% LUMINAIRE
0-30	3200	24.62	24.62
0-40	5508	42.37	42.37
0-60	10481	80.62	80.62
0-90	13000	100.00	100.00
40-90	7492	57.63	57.63
60-90	2519	19.38	19.38
90-180	0	0.00	0.00
0-180	13000	100.00	100.00

LUMINAIRE EFFICIENCY =	100.00	%

WRDC	
RCR	WRDC
1	40.07
2	37.83
3	34.67
4	31.58
5	28.80
6	26.36
7	24.23
8	22.38
9	20.75
10	19.33

Note: Modified file for total light output of 13,000 Lumens from the Solatube Lens.

LUMINANCE SUMMARY [CD / M^2]

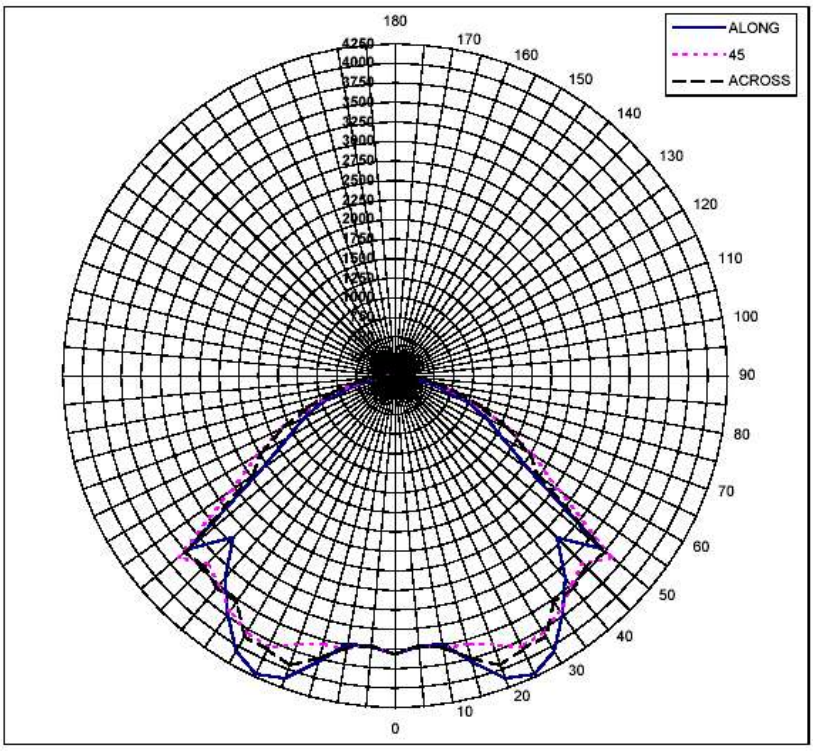
ANGLE	ALONG	22.5	45	67.5	ACROSS
45	11131.2	12249.6	12907.8	13345.3	13147.4
55	9792.5	11316.7	11949.8	11921.7	10425.6
65	8236.4	9369.4	10075.9	10356.0	9935.9
75	5924.2	7628.7	8117.2	8501.8	8491.4
85	4074.1	4259.3	3796.3	5185.2	4166.7

AVERAGE FOOTLAMBERTS

ANGLE	ALONG	22.5	45	67.5	ACROSS
45	1034.5	1138.4	1199.6	1240.3	1221.9
55	910.1	1051.7	1110.6	1108.0	968.9
65	765.5	870.8	936.4	962.5	923.4
75	550.6	709.0	754.4	790.1	789.2
85	378.6	395.8	352.8	481.9	387.2

CERTIFIED BY: N/A - Preliminary BETA Test File
DATE: 16-Sep-02
PREPARED FOR: Solatube International, Inc.

Data produced using 3M HAMSTER detailed ray trace calculations for average solar altitude input angle of 40 degrees and Solar Azimuth of 0 degrees. For use with Lighting Simulation tools only to illustrate potential lighting effect.



COEFFICIENTS OF UTILIZATION

Zonal Cavity Method — Floor Reflectance = 0.20

RC	90				80				70				50				0
RW	70	50	30	10	70	50	30	10	70	50	30	10	70	50	30	10	0
0	122	122	122	122	119	119	119	1	116	116	116	116	111	111	111	111	0
1	112	107	102	98	109	104	100	96	106	102	98	94	101	98	94	92	84
2	102	93	85	79	99	91	84	78	96	89	82	77	91	85	80	75	70
3	93	81	72	65	90	79	71	65	87	78	70	64	83	75	68	63	58
4	85	71	62	55	82	70	61	54	80	69	60	54	76	66	59	53	49
5	78	63	54	47	75	62	53	46	73	61	53	46	69	59	51	46	42
6	71	57	47	40	69	56	47	40	67	55	46	40	64	53	45	40	37
7	66	51	42	35	64	50	41	35	62	49	41	35	59	48	40	35	32
8	61	46	37	31	59	46	37	31	58	45	37	31	55	44	36	31	28
9	57	42	34	28	55	42	33	28	54	41	33	28	51	40	33	27	25
10	53	39	30	25	52	38	30	25	50	38	30	25	48	37	30	25	23

WALL EXITANCE COEFFICIENTS

Zonal Cavity Method — Floor Reflectance = 0.20

RC	90				80				70				50				0
RW	70	50	30	10	70	50	30	10	70	50	30	10	70	50	30	10	0
1	46.4	31.2	17.7	5.6	45.2	30.5	17.3	5.5	44.0	29.8	17.0	5.4	41.7	28.5	16.3	5.2	0.0
2	46.2	29.7	16.2	4.9	44.9	29.0	15.9	4.9	43.6	28.4	15.6	4.8	41.4	27.2	15.1	4.7	0.0
3	44.7	27.6	14.6	4.3	43.4	27.0	14.4	4.3	42.2	26.5	14.2	4.3	39.9	25.5	13.8	4.2	0.0
4	42.8	25.6	13.2	3.9	41.5	25.1	13.0	3.8	40.3	24.6	12.9	3.8	38.1	23.7	12.5	3.7	0.0
5	40.8	23.7	12.0	3.5	39.5	23.2	11.8	3.4	38.4	22.8	11.7	3.4	36.3	22.0	11.4	3.4	0.0
6	38.8	22.0	10.9	3.1	37.6	21.6	10.8	3.1	36.6	21.2	10.7	3.1	34.6	20.5	10.5	3.1	0.0
7	36.9	20.5	10.0	2.8	35.8	20.1	10.0	2.8	34.8	19.8	9.9	2.8	32.9	19.1	9.7	2.8	0.0
8	35.1	19.1	9.3	2.6	34.1	18.8	9.2	2.6	33.2	18.5	9.1	2.6	31.4	17.9	9.0	2.6	0.0
9	33.5	17.9	8.6	2.4	32.5	17.6	8.5	2.4	31.6	17.4	8.5	2.4	30.0	16.8	8.3	2.4	0.0
10	31.9	16.9	8.0	2.2	31.0	16.6	8.0	2.2	30.2	16.3	7.9	2.2	28.7	15.9	7.8	2.2	0.0

CEILING CAVITY EXITANCE COEFFICIENTS

Zonal Cavity Method — Floor Reflectance = 0.20

RC	90				80				70				50				0
RW	70	50	30	10	70	50	30	10	70	50	30	10	70	50	30	10	0
0	22.0	22.0	22.0	22.0	19.0	19.0	19.0	19.0	16.3	16.3	16.3	16.3	11.1	11.1	11.1	11.1	0.0
1	23.9	20.7	17.9	15.4	20.7	18.0	15.6	13.5	17.6	15.4	13.4	11.6	12.0	10.5	9.2	8.0	0.0
2	25.5	19.8	15.1	11.2	22.1	17.2	13.2	9.8	18.8	14.7	11.4	8.5	12.7	10.1	7.9	5.9	0.0
3	26.6	18.9	13.0	8.4	22.9	16.5	11.4	7.4	19.5	14.1	9.9	6.4	13.2	9.7	6.8	4.5	0.0
4	27.1	18.0	11.5	6.6	23.4	15.7	10.1	5.8	19.9	13.5	8.7	5.0	13.4	9.3	6.1	3.6	0.0
5	27.3	17.2	10.3	5.3	23.5	15.0	9.1	4.7	20.0	12.9	7.8	4.1	13.5	8.9	5.5	2.9	0.0
6	27.1	16.4	9.4	4.4	23.4	14.3	8.2	3.9	19.9	12.3	7.1	3.4	13.4	8.5	5.0	2.4	0.0
7	26.7	15.6	8.6	3.7	23.0	13.6	7.6	3.3	19.6	11.7	6.5	2.9	13.2	8.1	4.6	2.0	0.0
8	26.2	14.9	7.9	3.2	22.6	13.0	7.0	2.8	19.2	11.2	6.1	2.5	13.0	7.7	4.2	1.8	0.0
9	25.5	14.2	7.4	2.8	22.1	12.4	6.5	2.5	18.8	10.7	5.6	2.2	12.7	7.4	4.0	1.5	0.0
10	24.8	13.5	6.9	2.5	21.5	11.8	6.1	2.2	18.3	10.2	5.3	1.9	12.4	7.1	3.7	1.4	0.0

Solatube Lumen Output Use - Use of Lumen Output Tables In Conjunction With the Solatube IES File

There are two important items to consider when using the IES file:

1. The lumen output varies depending on the site location, time of day, sky condition, etc. The lumen output tables characterize the lightest 2400, 1800, and 1200 hours of the 8760 hours in a typical weather year for key cities around the world. These lumen outputs reflect the minimum, average, and maximum lumen outputs that are observed over the specified hourly period (i.e. 2400 hours) for a 3m tube length for a 530mm diameter Suspended Ceiling unit, and a 1.8m length for the 250mm diameter and 350mm diameter units. Certainly, running the simulation with the "average" lumen output will provide the user with a look at the typical illumination levels achieved for each specific modeled Solatube layout/design solution. Since daylight is a variable light source, the "minimum" and "maximum" lumen outputs for the same 2400 hours allow the designer to look at what is happening at the "worst" and "best" case scenarios as well.

2. Define the Light Loss Factor as 0.92, not the typical default light fixture value of 0.8.

SolaMaster 21-C – suspended ceiling (3 metre length)									
				2400		1800		1200	
		Max	% Eff	Ave	Min	Ave	Min	Ave	Min
Argentina	Buenos Aires	20,853	74%	11,455	4,922	13,201	7,554	15,123	11,133
Austria	Vienna	18,605	71%	7,859	2,678	9,302	4,435	11,168	6,722
Brazil	Sao Paulo	22,337	74%	10,356	5,126	11,817	6,943	13,619	9,533
Columbia	Bagota	21,509	73%	10,471	5,675	11,855	7,180	13,561	9,715
Denmark	Copenhagen	17,137	71%	6,889	2,412	8,159	3,812	9,829	6,012
France	Paris	18,329	72%	7,376	2,776	8,662	4,307	10,321	6,553
Germany	Hamburg	17,887	71%	6,721	2,361	7,951	3,821	9,531	5,810
Greece	Athens	19,275	74%	11,419	5,190	13,102	7,930	14,939	11,201
Holland	Amsterdam	18,156	72%	6,960	2,395	8,260	3,798	10,018	5,736
Isreal	Jerusalem	20,749	75%	13,464	6,947	15,155	10,058	16,790	13,517
Italy	Milan	18,528	73%	8,982	3,551	10,499	5,339	12,458	8,053
Italy	Pisa	18,815	73%	10,103	4,366	11,675	6,480	13,533	9,541
Italy	Rome	18,772	73%	10,011	4,528	11,514	6,504	13,358	9,273
Mexico	Acapulco	21,507	75%	13,830	7,855	15,508	10,264	17,251	13,753
Mexico	Mexico City	23,011	74%	12,056	6,230	13,703	8,308	15,750	11,653
Mexico	Veracruz	21,371	74%	11,330	5,876	12,820	8,019	14,748	10,426
Peru	Lima	21,622	74%	10,427	4,984	11,979	6,426	14,249	8,620
PuertoRico	San Juan	21,604	74%	12,727	7,237	14,141	9,766	15,648	12,526
Slovakia	Bratislava	18,713	71%	8,351	3,028	9,827	4,986	11,647	7,446
Spain	Madrid	18,914	74%	11,184	5,216	12,769	7,692	14,588	10,578
Switzerland	Geneva	17,964	72%	8,341	2,961	9,862	4,635	11,905	7,087
Sweden	Stockholm	16,652	71%	6,655	2,074	7,972	3,451	9,722	5,642
United Kingdom	London	18,316	72%	7,032	2,313	8,363	3,894	10,103	6,019
United States	Los Angeles	19,972	74%	12,376	6,236	13,975	9,138	15,634	12,212
United States	New York	18,874	73%	9,860	4,530	11,302	6,570	13,075	9,166
Venezuela	Caracas	21,801	74%	12,790	7,936	14,001	10,253	15,421	12,136

SolaMaster 21-O – open ceiling									
Argentina	Buenos Aires	21,400	80%	12,351	5,519	14,142	8,452	16,052	12,125
Austria	Vienna	19,601	79%	8,667	3,026	10,219	4,988	12,184	7,587
Brazil	Sao Paulo	22,432	80%	11,193	5,712	12,705	7,718	14,515	10,423
Columbia	Bagota	21,802	79%	11,341	6,344	12,784	7,984	14,516	10,645
Denmark	Copenhagen	18,071	79%	7,591	2,743	8,965	4,296	10,740	6,732
France	Paris	19,217	79%	8,111	3,122	9,495	4,824	11,245	7,299
Germany	Hamburg	18,815	79%	7,411	2,670	8,743	4,288	10,425	6,497
Greece	Athens	19,784	80%	12,311	5,857	14,034	8,817	15,856	12,187
Holland	Amsterdam	19,052	79%	7,649	2,691	9,048	4,262	10,920	6,423
Isreal	Jerusalem	21,031	80%	14,370	7,768	16,052	11,063	17,621	14,568
Italy	Milan	19,396	79%	9,797	4,016	11,407	5,994	13,425	8,957
Italy	Pisa	19,720	79%	10,977	4,938	12,613	7,287	14,497	10,516
Italy	Rome	19,687	79%	10,883	5,110	12,450	7,286	14,323	10,251
Mexico	Acapulco	21,531	80%	14,750	8,717	16,422	11,356	18,110	14,715
Mexico	Mexico City	22,981	80%	12,955	6,931	14,628	9,190	16,651	12,720
Mexico	Veracruz	21,424	80%	12,206	6,565	13,730	8,857	15,650	11,475
Peru	Lima	21,730	80%	11,211	5,596	12,813	7,131	15,136	9,556
Puerto Rico	San Juan	22,098	80%	13,658	8,136	15,078	10,704	16,548	13,518
Slovakia	Bratislava	19,717	79%	9,218	3,450	10,803	5,670	12,696	8,401
Spain	Madrid	19,556	80%	12,083	5,894	13,706	8,568	15,523	11,574
Switzerland	Geneva	18,853	79%	9,107	3,365	10,721	5,243	12,857	7,894
Sweden	Stockholm	17,603	79%	7,344	2,348	8,772	3,887	10,632	6,344
United Kingdom	London	19,212	79%	7,730	2,590	9,164	4,405	11,004	6,730
United States	Los Angeles	20,442	80%	13,312	7,044	14,929	10,132	16,563	13,261
United States	New York	19,760	79%	10,722	5,095	12,236	7,328	14,049	10,086
Venezuela	Caracas	21,848	80%	13,736	8,856	14,930	11,299	16,307	13,113

Solatube 290DS (1.8 metre length)

				2400		1800		1200	
		Max	% Eff	Ave	Min	Ave	Min	Ave	Min
Argentina	Buenos Aires	9,299	75%	5,143	2,220	5,921	3,410	6,775	5,000
Austria	Vienna	8,328	72%	3,537	1,210	4,184	2,004	5,021	3,042
Brazil	Sao Paulo	9,933	74%	4,649	2,313	5,302	3,126	6,104	4,284
Columbia	Bagota	9,575	74%	4,702	2,561	5,322	3,241	6,082	4,370
Denmark	Copenhagen	7,671	72%	3,101	1,090	3,671	1,721	4,420	2,712
France	Paris	8,199	73%	3,319	1,252	3,896	1,942	4,637	2,953
Germany	Hamburg	8,005	72%	3,025	1,066	3,578	1,723	4,286	2,621
Greece	Athens	8,597	75%	5,126	2,346	5,877	3,571	6,692	5,033
Holland	Amsterdam	8,122	73%	3,132	1,079	3,713	1,711	4,502	2,586
Isreal	Jerusalem	9,239	76%	6,036	3,132	6,788	4,531	7,511	6,069
Italy	Milan	8,285	73%	4,038	1,601	4,715	2,406	5,592	3,630
Italy	Pisa	8,416	74%	4,540	1,971	5,242	2,924	6,070	4,295
Italy	Rome	8,397	74%	4,498	2,042	5,170	2,932	5,992	4,174
Mexico	Acapulco	9,562	76%	6,199	3,537	6,945	4,620	7,717	6,169
Mexico	Mexico City	10,228	75%	5,410	2,808	6,142	3,741	7,052	5,241
Mexico	Veracruz	9,503	75%	5,084	2,650	5,749	3,604	6,606	4,690
Peru	Lima	9,617	75%	4,678	2,246	5,370	2,892	6,383	3,888
Puerto Rico	San Juan	9,631	75%	5,709	3,266	6,338	4,394	7,005	5,625
Slovakia	Bratislava	8,376	72%	3,758	1,364	4,422	2,253	5,236	3,358
Spain	Madrid	8,440	74%	5,022	2,353	5,729	3,468	6,537	4,759
Switzerland	Geneva	8,036	73%	3,752	1,343	4,431	2,093	5,347	3,197
Sweden	Stockholm	7,457	72%	2,996	937	3,588	1,558	4,372	2,545
United Kingdom	London	8,193	73%	3,164	1,043	3,762	1,760	4,541	2,715
United States	Los Angeles	8,904	75%	5,554	2,818	6,265	4,118	7,002	5,488
United States	New York	8,441	74%	4,431	2,044	5,076	2,961	5,866	4,127
Venezuela	Caracas	9,694	75%	5,737	3,578	6,275	4,614	6,905	5,447

Solatube 160DS (1.8 metre length)

Argentina	Buenos Aires	4,688	72%	2,534	1,075	2,926	1,651	3,362	2,448
Austria	Vienna	4,143	69%	1,727	584	2,045	970	2,461	1,467
Brazil	Sao Paulo	5,058	72%	2,290	1,119	2,618	1,524	3,023	2,102
Columbia	Bagota	4,862	71%	2,315	1,241	2,625	1,580	3,009	2,140
Denmark	Copenhagen	3,816	69%	1,514	526	1,794	833	2,165	1,317
France	Paris	4,089	70%	1,622	607	1,907	941	2,275	1,435
Germany	Hamburg	3,986	69%	1,477	514	1,748	836	2,099	1,272
Greece	Athens	4,332	72%	2,526	1,131	2,903	1,737	3,321	2,470
Holland	Amsterdam	4,050	70%	1,531	522	1,817	832	2,208	1,256
Isreal	Jerusalem	4,683	73%	2,987	1,512	3,370	2,209	3,745	2,989
Italy	Milan	4,137	71%	1,980	773	2,317	1,168	2,756	1,765
Italy	Pisa	4,198	71%	2,229	955	2,581	1,417	2,999	2,097
Italy	Rome	4,187	71%	2,209	988	2,545	1,425	2,960	2,031
Mexico	Acapulco	4,872	74%	3,070	1,716	3,450	2,254	3,848	3,042
Mexico	Mexico City	5,215	73%	2,672	1,364	3,042	1,826	3,507	2,571
Mexico	Veracruz	4,839	72%	2,508	1,286	2,844	1,762	3,280	2,293
Peru	Lima	4,894	72%	2,310	1,091	2,658	1,412	3,168	1,893
Puerto Rico	San Juan	4,862	73%	2,821	1,583	3,141	2,150	3,484	2,765
Slovakia	Bratislava	4,167	69%	1,834	663	2,161	1,085	2,567	1,631
Spain	Madrid	4,246	72%	2,472	1,138	2,828	1,683	3,239	2,328
Switzerland	Geneva	4,017	70%	1,839	646	2,175	1,012	2,633	1,549
Sweden	Stockholm	3,705	69%	1,461	453	1,752	753	2,140	1,232
United Kingdom	London	4,086	70%	1,546	505	1,841	847	2,228	1,310
United States	Los Angeles	4,494	72%	2,739	1,362	3,100	2,003	3,477	2,694
United States	New York	4,212	71%	2,175	990	2,497	1,436	2,895	2,014
Venezuela	Caracas	4,938	73%	2,835	1,738	3,110	2,258	3,435	2,683

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