

# SOLATUBE TEST REPORT NO.: SOLATUBE40.IES - Preliminary BETA Test Report

**LUMINAIRE:** Solatube 21" SolaMaster Suspended Ceiling Unit, L/D = 6:1, Tube Length =126", Infinity Tube, Optiview

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

CANDLEPOWER SUMMARY						OUTPUT LUMENS
ANGLE	ALONG	22.5	45	67.5	ACROSS	
0	3566	3566	3566	3566	3566	335
5	3478	3460	3454	3453	3462	
10	3484	3594	3545	3594	3530	
15	3790	3878	3550	3735	3737	
20	4119	4021	3655	3919	3946	
25	4216	3859	3831	3976	3863	1062
30	4068	3775	3789	3789	3847	
35	3729	3688	3680	3798	3534	
40	3376	3402	3501	3599	3544	
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	
65	1294	1472	1583	1627	1561	
70	994	1104	1114	1261	1197	
75	570	734	781	818	817	2311
80	289	405	423	451	528	
85	132	138	123	168	135	
90	0	0	0	0	0	
95	0	0	0	0	0	
100	0	0	0	0	0	191
105	0	0	0	0	0	
110	0	0	0	0	0	
115	0	0	0	0	0	
120	0	0	0	0	0	
125	0	0	0	0	0	0
130	0	0	0	0	0	
135	0	0	0	0	0	
140	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	
165	0	0	0	0	0	
170	0	0	0	0	0	
175	0	0	0	0	0	0
180	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 <sup>2</sup> ]					
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

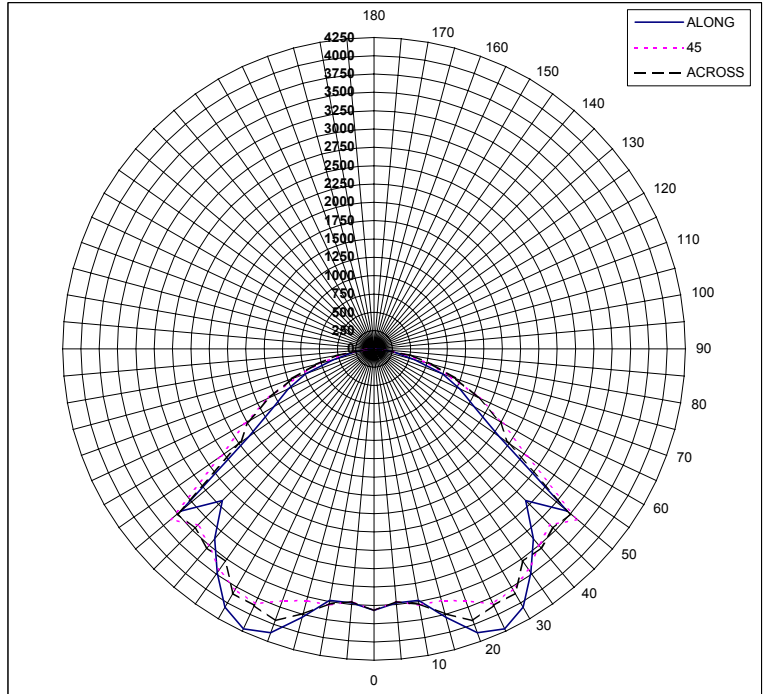
AVERAGE FOOTLAMBERTS					
ANGLE	ALONG	22.5	45	67.5	ACROSS
45	1034.5	1138.4	1199.6	1240.3	1221.9
55	910.1	1051.7	1110.6	1108.0	968.9
65	765.5	870.8	936.4	962.5	923.4
75	550.6	709.0	754.4	790.1	789.2
85	378.6	395.8	352.8	481.9	387.2

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.



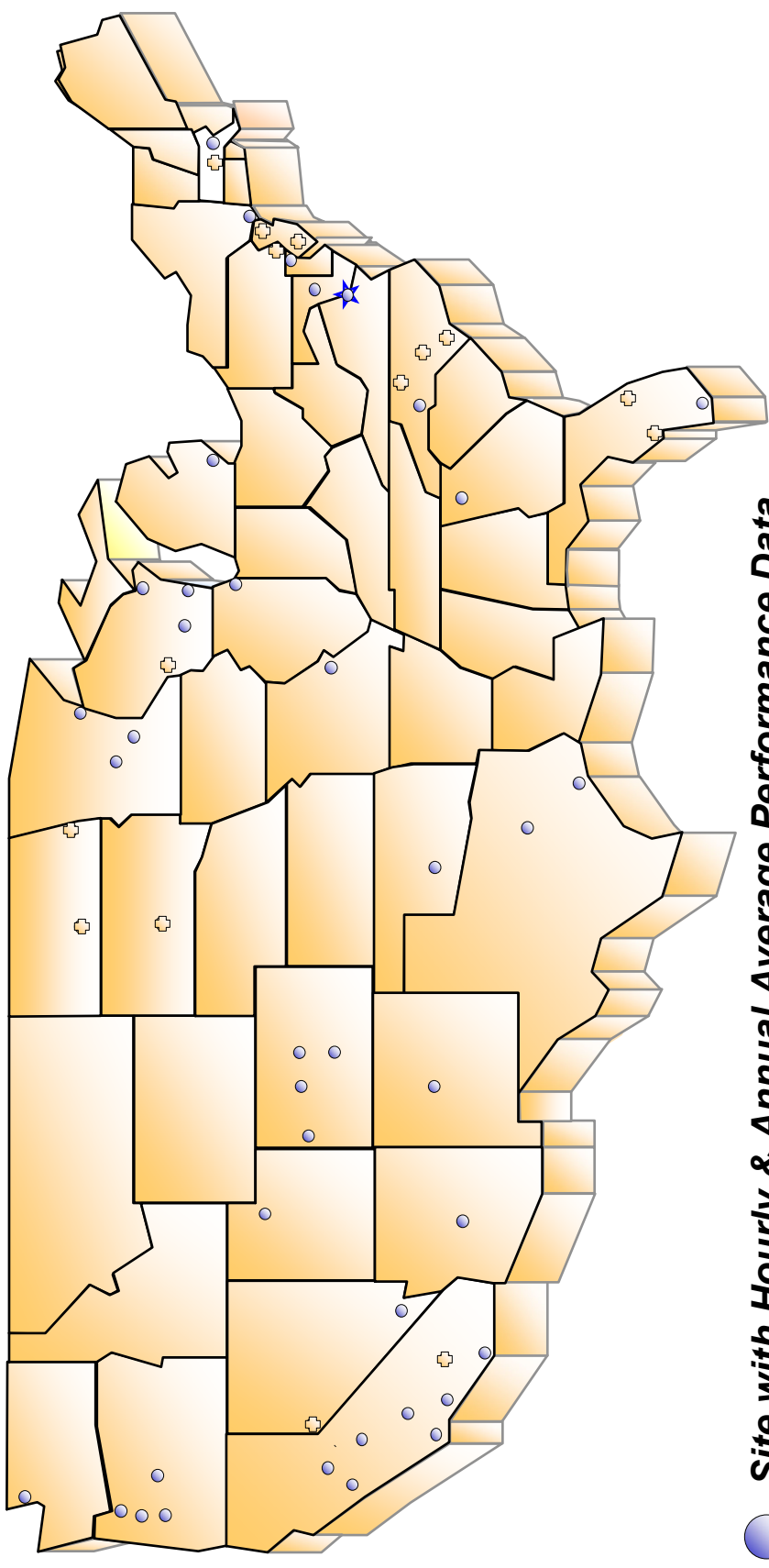
COEFFICIENTS OF UTILIZATION																	
Zonal Cavity Method									Floor Reflectance = 0.20								
RC	90				80				70				50		0		
RW	70	50	30	10	70	50	30	10	70	50	30	10	70	50	30	10	0
0	122	122	122	122	119	119	119	1	116	116	116	116	111	111	111	111	0
1	112	107	102	98	109	104	100	96	106	102	98	94	101	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

**Disclaimer: The above product information is believed to be reliable and correct. It is presented without guarantee or warranty and the user shall employ such information at his or her own discretion and risk.**

# U.S. Sites for Solatube Lumen Output Data



## Solatube Lumen Output Use

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

The attached IES file represents a typical Solatube 21"-diameter skylight, and is suitable for use in any standard simulation/design tool (i.e. LumenMicro, Lumen Designer, AGI, etc.). 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 10' tube length for a 21" diameter Suspended Ceiling unit, and a 6' length for the 10" diameter and 14" 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. To change the light/lumen output in your simulation tool, just change the "lumens/lamp" setting in the software design tool to the appropriate tabulated lumen output value for your site location and product configuration. **DO NOT change these values in the IES file itself**; the design tool will automatically scale the representative candela values accordingly.

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

	21" Suspended-Ceiling Product (10-Foot Length)							
	Max	% Eff.	2400		1800		1200	
			Ave	Min	Ave	Min	Ave	Min
AZ - Phoenix	20,434	75%	14,162	8,073	15,655	11,279	17,049	14,091
CA - Bakersfield	19,822	75%	12,931	6,642	14,566	9,656	16,250	12,739
CA - Fresno	19,643	75%	12,927	6,436	14,587	9,599	16,294	12,700
CA - Los Angeles	19,972	74%	12,376	6,236	13,975	9,138	15,634	12,212
CA - Sacramento	19,257	74%	12,257	5,810	13,931	8,744	15,691	11,962
CA - San Diego	20,124	75%	12,756	6,427	14,371	9,496	16,016	12,796
CA - San Francisco	19,369	74%	12,006	5,668	13,658	8,581	15,405	11,725
CA - Santa Maria	19,643	75%	13,029	6,651	14,615	9,884	16,201	12,935
CO - Colorado Springs	19,937	74%	11,833	6,091	13,304	8,594	14,884	11,563
CO - Denver	20,030	74%	11,589	5,779	13,109	8,357	14,754	11,282
CO - Eagle	19,465	74%	11,600	5,885	13,087	8,427	14,684	11,356
CO - Grand Junction	19,847	74%	12,311	6,381	13,857	9,201	15,460	12,043
DC - Washington	19,430	73%	10,196	4,699	11,679	6,863	13,445	9,671
DE - Wilmington	18,860	73%	10,174	4,696	11,675	6,725	13,500	9,584
FL - Miami	20,559	74%	11,896	6,320	13,365	8,828	14,924	11,646
GA - Atlanta	21,151	74%	11,560	5,449	13,179	7,986	14,883	11,664
IL - Chicago	18,937	73%	9,775	4,179	11,315	6,260	13,189	8,982
MA - Boston	18,550	73%	9,872	4,378	11,370	6,559	13,160	9,186
MI - Detroit	18,983	73%	9,394	4,055	10,879	5,967	12,742	8,609
MD - Baltimore	19,175	73%	10,194	4,468	11,746	6,650	13,582	9,819
MN - Duluth	18,511	73%	9,217	4,186	10,612	5,973	12,407	8,207
MN - Minneapolis	19,547	73%	9,934	4,554	11,412	6,511	13,212	9,383
MN - Saint Cloud	19,021	73%	9,733	4,525	11,168	6,361	13,007	8,871
MO - St. Louis	19,331	73%	10,568	4,743	12,127	7,052	13,925	10,227
NC - Charlotte	19,689	74%	11,166	5,323	12,733	7,716	14,416	10,998
NM - Albuquerque	20,725	75%	13,791	7,670	15,311	10,998	16,801	13,743
NV - Las Vegas	20,219	75%	13,810	7,940	15,280	10,838	16,720	13,776
NY - New York	18,874	73%	9,860	4,530	11,302	6,570	13,075	9,166
OK - Oklahoma City	19,883	74%	11,782	5,914	13,347	8,425	15,013	11,789
OR - Eugene	18,955	73%	9,470	3,743	11,066	5,766	13,103	8,458
OR - Portland	18,635	73%	8,946	3,599	10,452	5,427	12,400	7,774
OR - Redmond	19,626	74%	11,002	5,093	12,608	7,416	14,512	10,443
OR - Salem	19,149	73%	9,399	3,832	10,957	5,676	12,961	8,349
TX - Dallas-Ft Worth	20,641	74%	12,181	5,936	13,802	8,708	15,498	12,140
TX - Houston	20,523	74%	10,917	5,183	12,492	7,314	14,275	10,653
UT - Salt Lake City	19,545	74%	11,627	5,393	13,263	8,126	15,030	11,411
WA - Seattle	20,170	73%	8,644	2,962	10,256	4,770	12,384	7,417
WI - Green BaY	18,878	73%	9,480	4,251	10,929	6,080	12,751	8,586
WI - Madison	18,851	73%	9,845	4,223	11,369	6,400	13,225	9,125
WI - Milwaukee	19,013	73%	9,830	4,301	11,356	6,233	13,231	9,207
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 - Bogota	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
Israel - 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
Puerto Rico - San Juan	21,604	74%	12,727	7,237	14,141	9,766	15,648	12,526
Russia - Moscow	17,487	71%	6,836	2,465	8,071	3,904	9,695	5,805
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 Arab Emirates - Dubai	21,389	76%	14,942	8,584	16,388	12,417	17,702	15,433
Venezuela - Caracas	21,801	74%	12,790	7,936	14,001	10,253	15,421	12,136

	21" Open-Ceiling Product							
	Max	% Eff.	2400		1800		1200	
			Ave	Min	Ave	Min	Ave	Min
AZ - Phoenix	20,875	80%	15,110	9,026	16,591	12,300	17,928	15,103
CA - Bakersfield	20,567	80%	13,839	7,465	15,476	10,630	17,124	13,755
CA - Fresno	20,533	80%	13,855	7,248	15,520	10,601	17,193	13,697
CA - Los Angeles	20,442	80%	13,312	7,044	14,929	10,132	16,563	13,261
CA - Sacramento	20,158	80%	13,171	6,581	14,863	9,691	16,601	12,966
CA - San Diego	20,601	80%	13,673	7,247	15,297	10,445	16,907	13,790
CA - San Francisco	20,214	80%	12,906	6,403	14,579	9,518	16,311	12,742
CA - Santa Maria	20,483	80%	13,954	7,478	15,542	10,854	17,086	13,990
CO - Colorado Springs	20,869	80%	12,721	6,892	14,210	9,515	15,775	12,512
CO - Denver	20,999	80%	12,480	6,532	14,023	9,263	15,657	12,256
CO - Eagle	20,112	80%	12,476	6,637	13,981	9,297	15,566	12,295
CO - Grand Junction	20,767	80%	13,228	7,171	14,788	10,143	16,367	13,046
DC - Washington	20,466	79%	11,086	5,291	12,631	7,634	14,427	10,615
DE - Wilmington	19,818	79%	11,041	5,329	12,603	7,501	14,457	10,544
FL - Miami	21,138	80%	12,826	7,106	14,317	9,733	15,859	12,672
GA - Atlanta	21,943	80%	12,482	6,092	14,140	8,900	15,839	12,634
IL - Chicago	19,813	79%	10,622	4,734	12,233	6,994	14,146	9,904
MA - Boston	19,462	79%	10,737	4,920	12,304	7,343	14,129	10,102
MI - Detroit	19,921	79%	10,221	4,554	11,780	6,697	13,690	9,474
MD - Baltimore	20,037	79%	11,054	5,060	12,667	7,408	14,528	10,763
MN - Duluth	19,422	79%	10,062	4,738	11,521	6,698	13,370	9,127
MN - Minneapolis	20,447	79%	10,811	5,146	12,350	7,290	14,182	10,355
MN - Saint Cloud	19,898	79%	10,597	5,085	12,094	7,110	13,973	9,795
MO - St. Louis	20,212	79%	11,452	5,395	13,061	7,856	14,875	11,193
NC - Charlotte	20,363	80%	12,066	6,019	13,671	8,581	15,359	11,977
NM - Albuquerque	21,404	80%	14,738	8,548	16,249	12,056	17,689	14,806
NV - Las Vegas	20,949	80%	14,756	8,869	16,220	11,858	17,610	14,820
NY - New York	19,760	79%	10,722	5,095	12,236	7,328	14,049	10,086
OK - Oklahoma City	20,425	80%	12,699	6,664	14,288	9,354	15,944	12,754
OR - Eugene	19,839	79%	10,293	4,215	11,961	6,473	14,042	9,364
OR - Portland	19,594	79%	9,751	4,050	11,337	6,126	13,344	8,661
OR - Redmond	20,673	80%	11,891	5,769	13,542	8,300	15,457	11,403
OR - Salem	20,041	79%	10,227	4,328	11,861	6,400	13,914	9,255
TX - Dallas-Ft Worth	21,368	80%	13,115	6,738	14,759	9,667	16,434	13,203
TX - Houston	21,113	80%	11,795	5,824	13,413	8,178	15,201	11,621
UT - Salt Lake City	20,607	80%	12,530	6,085	14,199	9,030	15,962	12,364
WA - Seattle	21,324	79%	9,419	3,350	11,133	5,370	13,340	8,271
WI - Green BaY	19,815	79%	10,324	4,799	11,841	6,810	13,708	9,535
WI - Madison	19,791	79%	10,717	4,788	12,312	7,157	14,210	10,080
WI - Milwaukee	19,908	79%	10,686	4,842	12,286	6,976	14,195	10,147
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
Russia - Moscow	18,419	79%	7,539	2,780	8,875	4,393	10,607	6,516
Slovakia - Bratislava	19,717	79%	9,218	3,450	10,803	5,670	12,696	8,401
Spain - Madid	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 Arab Emirates - Dubai	21,488	80%	15,835	9,559	17,236	13,505	18,464	16,444
Venezuela - Caracas	21,848	80%	13,736	8,856	14,930	11,299	16,307	13,113



	14" Product (6-Foot Length)							
	Max	% Eff.	2400		1800		1200	
			Ave	Min	Ave	Min	Ave	Min
AZ - Phoenix	9,108	76%	6,349	3,638	7,012	5,073	7,629	6,326
CA - Bakersfield	8,839	75%	5,798	2,996	6,526	4,347	7,273	5,727
CA - Fresno	8,783	75%	5,801	2,913	6,537	4,320	7,294	5,704
CA - Los Angeles	8,904	75%	5,554	2,818	6,265	4,118	7,002	5,488
CA - Sacramento	8,605	75%	5,500	2,623	6,246	3,939	7,027	5,373
CA - San Diego	8,964	75%	5,722	2,899	6,441	4,276	7,170	5,743
CA - San Francisco	8,644	75%	5,389	2,563	6,123	3,868	6,901	5,275
CA - Santa Maria	8,754	75%	5,844	2,997	6,549	4,447	7,252	5,806
CO - Colorado Springs	8,916	75%	5,310	2,751	5,965	3,872	6,667	5,195
CO - Denver	8,960	75%	5,203	2,609	5,880	3,776	6,610	5,071
CO - Eagle	8,686	75%	5,206	2,652	5,868	3,796	6,576	5,098
CO - Grand Junction	8,856	75%	5,523	2,881	6,213	4,144	6,923	5,403
DC - Washington	8,694	74%	4,582	2,119	5,245	3,091	6,031	4,353
DE - Wilmington	8,438	74%	4,570	2,120	5,242	3,033	6,056	4,316
FL - Miami	9,170	75%	5,339	2,851	5,994	3,974	6,686	5,236
GA - Atlanta	9,445	74%	5,190	2,456	5,912	3,596	6,669	5,239
IL - Chicago	8,468	74%	4,392	1,887	5,081	2,823	5,916	4,044
MA - Boston	8,298	74%	4,436	1,972	5,106	2,956	5,904	4,134
MI - Detroit	8,492	74%	4,221	1,829	4,886	2,694	5,719	3,875
MD - Baltimore	8,574	74%	4,578	2,015	5,273	2,997	6,091	4,417
MN - Duluth	8,281	73%	4,145	1,892	4,768	2,693	5,571	3,704
MN - Minneapolis	8,742	74%	4,465	2,058	5,125	2,937	5,926	4,223
MN - Saint Cloud	8,506	74%	4,374	2,041	5,016	2,866	5,836	3,993
MO - St. Louis	8,644	74%	4,748	2,143	5,443	3,176	6,243	4,598
NC - Charlotte	8,789	74%	5,014	2,404	5,712	3,475	6,462	4,945
NM - Albuquerque	9,248	76%	6,185	3,463	6,860	4,953	7,519	6,171
NV - Las Vegas	9,026	76%	6,192	3,580	6,847	4,871	7,483	6,185
NY - New York	8,441	74%	4,431	2,044	5,076	2,961	5,866	4,127
OK - Oklahoma City	8,868	75%	5,288	2,666	5,986	3,793	6,727	5,288
OR - Eugene	8,477	74%	4,255	1,689	4,969	2,603	5,878	3,801
OR - Portland	8,338	74%	4,021	1,622	4,696	2,446	5,565	3,502
OR - Redmond	8,783	74%	4,941	2,302	5,658	3,342	6,505	4,696
OR - Salem	8,564	74%	4,223	1,727	4,921	2,564	5,815	3,763
TX - Dallas-Ft Worth	9,215	75%	5,467	2,682	6,190	3,928	6,942	5,456
TX - Houston	9,155	74%	4,901	2,340	5,604	3,297	6,399	4,791
UT - Salt Lake City	8,749	75%	5,219	2,433	5,949	3,662	6,735	5,130
WA - Seattle	9,031	74%	3,886	1,338	4,608	2,153	5,559	3,342
WI - Green BaY	8,446	74%	4,261	1,919	4,909	2,743	5,722	3,872
WI - Madison	8,433	74%	4,425	1,908	5,106	2,887	5,934	4,111
WI - Milwaukee	8,504	74%	4,417	1,945	5,101	2,815	5,936	4,144
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 - Bogota	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
Israel - 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
Russia - Moscow	7,827	72%	3,077	1,114	3,632	1,759	4,361	2,620
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 Arab Emirates - Dubai	9,513	76%	6,693	3,872	7,333	5,580	7,913	6,920
Venezuela - Caracas	9,694	75%	5,737	3,578	6,275	4,614	6,905	5,447

	10" Product (6-Foot Length)							
	Max	% Eff.	2400		1800		1200	
			Ave	Min	Ave	Min	Ave	Min
AZ - Phoenix	4,601	74%	3,142	1,767	3,481	2,481	3,801	3,119
CA - Bakersfield	4,458	73%	2,866	1,451	3,235	2,119	3,619	2,816
CA - Fresno	4,390	73%	2,864	1,408	3,239	2,107	3,628	2,806
CA - Los Angeles	4,494	72%	2,739	1,362	3,100	2,003	3,477	2,694
CA - Sacramento	4,325	73%	2,714	1,270	3,091	1,921	3,491	2,642
CA - San Diego	4,537	73%	2,826	1,406	3,191	2,083	3,566	2,830
CA - San Francisco	4,347	73%	2,658	1,237	3,030	1,883	3,427	2,585
CA - Santa Maria	4,423	73%	2,887	1,453	3,246	2,168	3,608	2,860
CO - Colorado Springs	4,450	72%	2,619	1,328	2,950	1,885	3,309	2,558
CO - Denver	4,467	72%	2,564	1,265	2,905	1,834	3,279	2,489
CO - Eagle	4,369	72%	2,566	1,281	2,902	1,851	3,265	2,508
CO - Grand Junction	4,455	73%	2,725	1,392	3,074	2,020	3,436	2,653
DC - Washington	4,336	71%	2,249	1,023	2,580	1,499	2,978	2,126
DE - Wilmington	4,217	71%	2,246	1,023	2,580	1,473	2,991	2,108
FL - Miami	4,620	72%	2,632	1,377	2,963	1,934	3,318	2,569
GA - Atlanta	4,740	72%	2,556	1,190	2,920	1,749	3,306	2,572
IL - Chicago	4,227	71%	2,157	911	2,500	1,367	2,922	1,974
MA - Boston	4,137	71%	2,177	956	2,512	1,434	2,914	2,015
MI - Detroit	4,234	71%	2,072	885	2,403	1,306	2,821	1,892
MD - Baltimore	4,282	71%	2,250	974	2,597	1,456	3,011	2,158
MN - Duluth	4,129	70%	2,031	912	2,341	1,305	2,744	1,800
MN - Minneapolis	4,363	71%	2,190	995	2,521	1,422	2,926	2,055
MN - Saint Cloud	4,246	71%	2,146	988	2,465	1,392	2,879	1,946
MO - St. Louis	4,316	71%	2,334	1,034	2,683	1,546	3,088	2,254
NC - Charlotte	4,417	72%	2,467	1,161	2,820	1,688	3,201	2,427
NM - Albuquerque	4,660	73%	3,058	1,679	3,402	2,421	3,744	3,039
NV - Las Vegas	4,542	73%	3,062	1,733	3,396	2,383	3,725	3,049
NY - New York	4,212	71%	2,175	990	2,497	1,436	2,895	2,014
OK - Oklahoma City	4,471	72%	2,606	1,291	2,958	1,845	3,336	2,598
OR - Eugene	4,230	71%	2,089	817	2,445	1,259	2,903	1,854
OR - Portland	4,154	71%	1,972	786	2,307	1,186	2,744	1,705
OR - Redmond	4,373	72%	2,430	1,110	2,791	1,621	3,221	2,298
OR - Salem	4,274	71%	2,073	835	2,420	1,240	2,870	1,827
TX - Dallas-Ft Worth	4,629	72%	2,695	1,300	3,061	1,914	3,446	2,678
TX - Houston	4,611	72%	2,414	1,133	2,767	1,603	3,170	2,344
UT - Salt Lake City	4,359	72%	2,571	1,175	2,939	1,782	3,340	2,513
WA - Seattle	4,491	71%	1,906	648	2,263	1,043	2,739	1,625
WI - Green BaY	4,208	71%	2,090	926	2,413	1,330	2,822	1,881
WI - Madison	4,204	71%	2,171	923	2,511	1,395	2,928	2,002
WI - Milwaukee	4,242	71%	2,168	939	2,509	1,367	2,930	2,019
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
Russia - Moscow	3,895	69%	1,502	538	1,775	853	2,136	1,273
Slovakia - Bratislava	4,167	69%	1,834	663	2,161	1,085	2,567	1,631
Spain - Madid	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 Arab Emirates - Dubai	4,840	74%	3,323	1,877	3,653	2,740	3,958	3,421
Venezuela - Caracas	4,938	73%	2,835	1,738	3,110	2,258	3,435	2,683