

# **BRING YOUR LIGHTING TO THE NEXT LEVEL**

**STAN WALERCZYK, LC**

**representing**

**AFTERIMAGE + SPACE**

**[www.ainspace.com](http://www.ainspace.com)**

# BIO

- 19 years experience
  - Distribution, maintenance, installer, retrofit contractor, consultant, designer, researcher
- 500+ projects
- 30+ published articles
- 400+ seminars
- IESNA member
  - Effects of Lamp Spectral Distribution Committee
  - Served on Energy Management Committee
    - Past chair of Retrofit/Upgrade Subcommittee
- CLEP by AEE
- Lighting Certified by NCQLP
- Project manager for California Lighting Technology Center
- Assisted Brian Liebel at AfterImage+Space on spectrally enhanced lighting research for the DOE
- Consultant for PG&E on California Title 20
- Several IIDA Awards

# SO MUCH INFO SO LITTLE TIME

- Please hold questions and comments until end or after seminar
- If no handouts or if some tables are too small, email me at [stan@lightingwizards.com](mailto:stan@lightingwizards.com) and I will send them
- Background info available by emailing me
  - Best Practice Report
  - MH vs. FLUORESCENT - 10 Rounds In The Hibay Arena
- Background info at [www.lightingwizards.com](http://www.lightingwizards.com)
  - DOE Reports on Spectrally Enhanced Lighting
  - Dimming Ballasts - Buyer Beware
  - and more

# NO ENDORSEMENTS

- Although several manufacturers and models are listed, none are endorsed
- Easier to talk about specifics than generalities

**SWITCHING TO HIGH-  
KELVIN HIGH-LUMEN  
SUPER T8s & EXTRA-  
EFFICIENT BALLASTS IS  
A VERY GOOD WAY TO  
THE NEXT LEVEL**

**PLEASE RAISE YOUR HAND  
IF YOU KNOW ABOUT  
SPECTRALLY  
OR  
SCOTOPICALLY  
ENHANCED LIGHTING?**

# SPECTRALLY ENHANCED LIGHTING

- The use of high Kelvin lamps, especially 5000K and higher, for energy savings has been traditionally called 'scotopically enhanced lighting', and the new name is 'spectrally enhanced lighting', because of newly discovered photoreceptor, melanopsin
- Based on Dr. Sam Berman's long research, Brian Liebel's studies for Jim Brodrick at the DOE, numerous of my and other people's projects, spectrally enhanced lighting can save significant wattage
- I have done up to a 4 hour seminar just on this topic, but do not have the time for it now.

## S/P Benefits of 5000K 3000+ Lumen F32T8s

lamp	mean photopic (catalog) lumens	S/P ratio	brightness	paper	computer	
			$P(S/P)^{.5}$	$P(S/P)^{.78}$	$P(S/P)^{1.0}$	
F34T12 CW	2300	1.50	2817	3156	3450	
F34T12 WW	2350	1.00	2350	2350	2350	
F32T8 730	2650	1.19	2891	3035	3154	
F32T8 735	2650	1.30	3021	3252	3445	
F32T8 741	2650	1.56	3310	3749	4134	
F32T8 830 2nd	2800	1.29	3180	3415	3612	
F32T8 835 2nd	2800	1.41	3325	3661	3948	
F32T8 841 2nd	2800	1.62	3564	4079	4536	
F32T8 830 3rd	2950	1.29	3351	3598	3806	
F32T8 835 3rd	2950	1.41	3503	3857	4160	
F32T8 841 3rd	2950	1.62	3755	4298	4779	
F32T8 850 3rd	2860	1.95	3994	4815	5577	
Increase of energy efficiency of 3000+-initial-photopic-lumen 850 3rd generation F32T8s when considering full field of view compared to			<b>CW</b>	<b>42%</b>	<b>53%</b>	<b>62%</b>
			<b>WW</b>	<b>70%</b>	<b>105%</b>	<b>137%</b>
			<b>730</b>	<b>38%</b>	<b>59%</b>	<b>77%</b>
			<b>735</b>	<b>32%</b>	<b>48%</b>	<b>62%</b>
			<b>741</b>	<b>21%</b>	<b>28%</b>	<b>35%</b>
			<b>830 2nd</b>	<b>26%</b>	<b>41%</b>	<b>54%</b>
			<b>835 2nd</b>	<b>20%</b>	<b>32%</b>	<b>41%</b>
			<b>841 2nd</b>	<b>12%</b>	<b>18%</b>	<b>23%</b>
			<b>830 3rd</b>	<b>19%</b>	<b>34%</b>	<b>47%</b>
			<b>835 3rd</b>	<b>14%</b>	<b>25%</b>	<b>34%</b>
<b>841 3rd</b>	<b>6%</b>	<b>12%</b>	<b>17%</b>			

notes : Lumens and S/P ratios can vary among lamps and manufacturers.

Prepared by Stan Walerczyk, [www.lightingwizards.com](http://www.lightingwizards.com), 4/9/06 version

## INCREASED EFFICIENCY & ENERGY SAVINGS

If the increase in efficiency is:	The energy savings are:
10%	9%
20%	17%
30%	23%
40%	29%
50%	33%
75%	43%
100%	50%
200%	67%
300%	75%

Increased efficiency = (improved lumen per watt / base case lumens per watt) - 1

Energy savings = (base case KWH - improved KWH) / base case KWH

For increases in energy efficiency, the low number is base case, working from low to high.

For energy efficiency, the high number is base case, working from high to low.

Prepared by Stan Walerczyk of Lighting Wizards, based on the work of Brian Liebel of AfterImage+Space.

## S/P Info for 32W F32T8s and 34W F34T12s

lamp	mean photopic (catalog) lumens	S/P ratio	brightness	paper	computer
			$P(S/P)^{.5}$	$P(S/P)^{.78}$	$P(S/P)^{1.0}$
F34T12 CW	2300	1.50	2817	3156	3450
F34T12 WW	2350	1.00	2350	2350	2350
F32T8 730	2650	1.19	2891	3035	3154
F32T8 735	2650	1.30	3021	3252	3445
F32T8 741	2650	1.56	3310	3749	4134
F32T8 830 2nd	2800	1.29	3180	3415	3612
F32T8 835 2nd	2800	1.41	3325	3661	3948
F32T8 841 2nd	2800	1.62	3564	4079	4536
F32T8 830 3rd	2950	1.29	3351	3598	3806
F32T8 835 3rd	2950	1.41	3503	3857	4160
F32T8 841 3rd	2950	1.62	3755	4298	4779
F32T8 850 3rd	2860	1.95	3994	4815	5577
F32T8 865	2750	2.20	4079	5087	6050
F32T8 880	2518	2.50	3981	5146	6295

*notes : Lumens and S/P ratios can vary among lamps and manufacturers.*

*Listed F32T8 865 is Sylvania XPS. Listed F32T8 880 is Sylvania Skywhite XP.*

*Prepared by Stan Walerczyk, [www.lightingwizards.com](http://www.lightingwizards.com), 10/24/07 version*

# SOME U.S. GOVERNMENT FACILITIES THAT HAVE OR ARE GOING WITH HIGH KELVIN

- 5000K
  - Naval Base Ventura County (Port Hueneme)
    - Tom Santoianni
  - NAB
  - Pendleton
  - NASNI
  - NADEP
  - DLA
  - NBSD
- 6500K
  - Fort Huachaca
    - Bill Stein

# ABOUT 6500K

- If you are not aware, 6500K lamps are very common world-wide
  - Very prevalent in China, India, Japan, Australia, Indonesia, and some parts of the Middle East and Africa
  - Most of those 6500K lamps are single phosphor with low CRI (color rendering index)
- Recommended 6500K and other lamps are tri-phosphor that have very good CRI

# POTENTIAL ADDITIONAL BENEFIT

- In addition to saving energy, high Kelvin lamps with significant blue content can effect circadian rhythms, which may help workers and soldiers keep more alert during the night
- Sylvania and Lighting Research Center is currently testing if Sylvania's new 8000K T8s are helping night-shift hospital workers' productivity

**WHY SUPER 32W F32T8s  
INSTEAD OF  
25-30W F32T8s,  
T5s or T5HOs**

## 4' LINEAR FLUORESCENT EFFICACY TABLE

<i>4' lamp type</i>	<i>lamp lumens</i>	<i>lamp watts</i>	<i>lamp lumens per lamp watts</i>	<i>lamp quant</i>	<i>ballast type</i>	<i>standard ballast factor</i>	<i>system watts</i>	<i>initial system lumens</i>	<i>initial system lumens per watt</i>	<i>mean or 8000 hour lumen maintenance</i>	<i>mean or 8000 hour system lumens</i>	<i>mean or 8000 hour system lumens per watt</i>
high performance F32T8	3100	32	96.9									
	3100	32	96.9									
	3100	32	96.9									
extra long life 2950 lumen F32T8	2950	32	92.2									
	2950	32	92.2									
basic grade F32T8	2800	32	87.5									
	2800	32	87.5									
30W F32T8	2850	30	95.0									
	2850	30	95.0									
28W F32T8	2750	28	98.2									
	2750	28	98.2									
25W F32T8	2440	25	97.6									
	2440	25	97.6									
extra long life 25W F32T8	2400	25	96.0									
	2400	25	96.0									
high lumen F28T5	3050	28	108.9									
typical F28T5	2900	28	103.6									
26W F28T5	2900	26	111.5									
26W high lumen F28T5	3050	26	117.3									
51W F54T5HO	5000	51	98.0									
typical F54T5HO	5000	54	92.6									
F34T12 800	3100	34	91.2									
F34T12 CW	2650	34	77.9									

notes: Lumens, lumen maintenance, ballast factors and wattages may vary among various manufacturers.

In enclosed fixtures, since reduced wattage F32T8s consume less heat they can often operate closer to optimal 77 degrees F temperature, so may provide more light than this table shows compared to full wattage.

Although efficacy can be improved with IS and RS ballasts with T5s and T5HOs, lamp life can be greatly reduced and lamp manufacturers may not warranty lamps.

93% is used as an average EOL lumen maintenance for T5HOs. 90% - 94% range among manufacturers.

All wattages based on 277V. EE IS is extra efficient instant start. G IS is generic instant start. EE PS is extra efficient program start. PS is program start. RS E is rapis start electronic. RS M is rapid start magnetic.

Extra long life is 36,000 hours with IS and 40,000 hours with PS ballasts at 3 hour cycles.

Prepared by Stan Walerczyk of Lighting Wizards [www.lightingwizards.com](http://www.lightingwizards.com) 11/1/07 versior

## 4' LINEAR FLUORESCENT EFFICACY TABLE

4' lamp type	lamp lumens	lamp watts	lamp lumens per lamp watts	lamp quant	ballast type	standard ballast factor	system watts	initial system lumens	initial system lumens per watt	mean or 8000 hour lumen maintenance	mean or 8000 hour system lumens	mean or 8000 hour system lumens per watt
high performance F32T8	3100	32	96.9	2	EE IS	0.87	53	5394	101.8	95%	5124	96.7
	3100	32	96.9	2	EE IS	1.20	73	7440	101.9	95%	7068	96.8
	3100	32	96.9	2	G IS	0.87	58	5394	93.0	95%	5124	88.4
extra long life 2950 lumen F32T8	2950	32	92.2	2	EE IS	0.87	53	5133	96.8	95%	4876	92.0
	2950	32	92.2	2	G IS	0.87	58	5133	88.5	95%	4876	84.1
basic grade F32T8	2800	32	87.5	2	EE IS	0.87	53	4872	91.9	95%	4628	87.3
	2800	32	87.5	2	G IS	0.87	58	4872	84.0	95%	4628	79.8
30W F32T8	2850	30	95.0	2	EE IS	0.87	51	4959	97.2	95%	4711	92.4
	2850	30	95.0	2	G IS	0.87	55	4959	90.2	95%	4711	85.7
28W F32T8	2750	28	98.2	2	EE IS	0.87	48	4785	99.7	95%	4546	94.7
	2750	28	98.2	2	G IS	0.87	51	4785	93.8	95%	4546	89.1
25W F32T8	2440	25	97.6	2	EE IS	0.87	42	4246	101.1	95%	4033	96.0
	2440	25	97.6	2	G IS	0.87	47	4246	90.3	95%	4033	85.8
extra long life 25W F32T8	2400	25	96.0	2	EE IS	0.87	42	4176	99.4	95%	3967	94.5
	2400	25	96.0	2	G IS	0.87	47	4176	88.9	95%	3967	84.4
high lumen F28T5	3050	28	108.9	2	EE PS	0.95	58	5795	99.9	92%	5331	91.9
typical F28T5	2900	28	103.6	2	PS	1.00	64	5800	90.6	92%	5336	83.4
26W F28T5	2900	26	111.5	2	EE PS	0.95	55	5510	100.2	92%	5069	92.2
26W high lumen F28T5	3050	26	117.3	2	EE PS	1.15	67	7015	104.7	92%	6454	96.3
51W F54T5HO	5000	51	98.0	2	EE PS	1.00	108	10000	92.6	92%	9200	85.2
typical F54T5HO	5000	54	92.6	2	PS	1.00	117	10000	85.5	92%	9200	78.6
F34T12 800	3100	34	91.2	2	RS E	0.85	60	5270	87.8	92%	4848	80.8
F34T12 CW	2650	34	77.9	2	RS M	0.88	72	4664	64.8	87%	4058	56.4

notes: Lumens, lumen maintenance, ballast factors and wattages may vary among various manufacturers.

In enclosed fixtures, since reduced wattage F32T8s consume less heat they can often operate closer to optimal 77 degrees F temperature, so may provide more light than this table shows compared to full wattage.

Although efficacy can be improved with IS and RS ballasts with T5s and T5HOs, lamp life can be greatly reduced and lamp manufacturers may not warranty lamps.

93% is used as an average EOL lumen maintenance for T5HOs. 90% - 94% range among manufacturers.

All wattages based on 277V. EE IS is extra efficient instant start. G IS is generic instant start. EE PS is extra efficient program start. PS is program start. RS E is rapis start electronic. RS M is rapid start magnetic.

Extra long life is 36,000 hours with IS and 40,000 hours with PS ballasts at 3 hour cycles.

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## 4' T8 LAMP LIFE, LUMENS, CRI & MERCURY

LAMP	WATTS	4100K		5000K		MAX MG OF MER- CURY	LAMP LIFE HOURS WITH VARIOUS BALLASTS & CYCLES					
		CATA- LOG LUMENS	CRI	CATA- LOG LUMENS	CRI		INSTANT START		RAPID START		PROGRAM START	
							3 HR	12 HR	3 HR	12 HR	3 HR	12 HR
1st GENERATION - GENERIC - LOW MERCURY	32	2800	75-78	2800	75-78	1.7 - <10	15,000 - 20,000	20,000 - 28,000	20000 - 25,000	24,000 - 28,000	20000 - 25,000	24,000 - 28,000
2nd GENERATION - GENERIC - LOW MERCURY	32	2950	81-85	2800 - 2950	80-85	1.7 - <10	15,000 - 20,000	20,000 - 28,000	20000 - 25,000	24,000 - 28,000	20000 - 25,000	24,000 - 28,000
<b>GE HL</b>	<b>32</b>	<b>3100</b>	<b>82</b>	<b>3000</b>	<b>80</b>	<b>3.95</b>	<b>24,000</b>	<b>29,000</b>	<b>24,000</b>	<b>29,000</b>	<b>24000+</b>	<b>29000+</b>
<b>PHILIPS ADVANTAGE</b>	<b>32</b>	<b>3100</b>	<b>85</b>	<b>3100</b>	<b>85</b>	<b>1.7</b>	<b>24,000</b>	<b>30,000</b>	<b>30,000</b>	<b>36,000</b>	<b>30,000</b>	<b>36,000</b>
<b>PHILIPS PLUS</b>	<b>32</b>	<b>2950</b>	<b>85</b>	<b>2850</b>	<b>85</b>	<b>1.7</b>	<b>30,000</b>	<b>36,000</b>	<b>36,000</b>	<b>42,000</b>	<b>36,000</b>	<b>42,000</b>
<b>PHILIPS EXTRA LONG LIFE 32W</b>	<b>32</b>	<b>2950</b>	<b>85</b>	<b>2850</b>	<b>85</b>	<b>1.7</b>	<b>36,000</b>	<b>40,000</b>	<b>NA</b>	<b>NA</b>	<b>40,000</b>	<b>46,000</b>
<b>SYLVANIA XPS</b>	<b>32</b>	<b>3100</b>	<b>85</b>	<b>3000</b>	<b>85</b>	<b>3.5</b>	<b>24,000</b>	<b>36,000</b>	<b>36,000</b>	<b>42,000</b>	<b>36,000</b>	<b>42,000</b>
<b>SYLVANIA XP XL</b>	<b>32</b>	<b>2950</b>	<b>85</b>	<b>2900</b>	<b>85</b>	<b>3.5</b>	<b>36,000</b>	<b>40,000</b>	<b>40,000</b>	<b>46,000</b>	<b>40,000</b>	<b>46,000</b>
<b>GE WM</b>	<b>30</b>	<b>2850</b>	<b>81</b>	<b>2750</b>	<b>80</b>	<b>3.95</b>	<b>20,000</b>	<b>24,000</b>	<b>NA</b>	<b>NA</b>	<b>20000+</b>	<b>24000+</b>
<b>GE XL WM</b>	<b>30</b>	<b>2800</b>	<b>81</b>	<b>2700</b>	<b>80</b>	<b>3.95</b>	<b>24,000</b>	<b>29,000</b>	<b>NA</b>	<b>NA</b>	<b>24000+</b>	<b>29000+</b>
<b>PHILIPS ADV EW</b>	<b>30</b>	<b>2850</b>	<b>85</b>	<b>2850</b>	<b>85</b>	<b>3.5</b>	<b>24,000</b>	<b>30,000</b>	<b>NA</b>	<b>NA</b>	<b>30,000</b>	<b>36,000</b>
<b>SYLVANIA FO30 SS</b>	<b>30</b>	<b>2850</b>	<b>85</b>	<b>2800</b>	<b>85</b>	<b>3.5</b>	<b>24,000</b>	<b>36,000</b>	<b>36,000</b>	<b>42,000</b>	<b>36,000</b>	<b>42,000</b>
<b>SYLVANIA FO28 SS</b>	<b>28</b>	<b>2725</b>	<b>85</b>	<b>2650</b>	<b>80</b>	<b>3.5</b>	<b>24,000</b>	<b>36,000</b>	<b>36,000</b>	<b>42,000</b>	<b>36,000</b>	<b>42,000</b>
<b>GE F28</b>	<b>28</b>	<b>2750</b>	<b>82</b>	<b>2650</b>	<b>80</b>	<b>3.95</b>	<b>18,000</b>	<b>24,000</b>	<b>NA</b>	<b>NA</b>	<b>18000+</b>	<b>24000+</b>
<b>PHILIPS ENERGY ADV 28W</b>	<b>28</b>	<b>2725</b>	<b>85</b>	<b>2650</b>	<b>85</b>	<b>1.7</b>	<b>24,000</b>	<b>30,000</b>	<b>NA</b>	<b>NA</b>	<b>30,000</b>	<b>36,000</b>
<b>GE F32T8/25W/SPX/ECO</b>	<b>25</b>	<b>2400</b>	<b>85</b>	<b>2350</b>	<b>80</b>	<b>3.95</b>	<b>36,000</b>	<b>40,000</b>	<b>40,000</b>	<b>46,000</b>	<b>40,000</b>	<b>46,000</b>
<b>PHILIPS ENERGY ADV 25W</b>	<b>25</b>	<b>2475</b>	<b>85</b>	<b>2400</b>	<b>85</b>	<b>1.7</b>	<b>24,000</b>	<b>30,000</b>	<b>NA</b>	<b>NA</b>	<b>30,000</b>	<b>36,000</b>
<b>PHILIPS EXTRA LONG LIFE 25W</b>	<b>25</b>	<b>2400</b>	<b>85</b>	<b>2300</b>	<b>85</b>	<b>1.7</b>	<b>36,000</b>	<b>40,000</b>	<b>NA</b>	<b>NA</b>	<b>40,000</b>	<b>46,000</b>
<b>SYLVANIA FO32/25W SS</b>	<b>25</b>	<b>2475</b>	<b>85</b>	<b>2350</b>	<b>85</b>	<b>3.5</b>	<b>24,000</b>	<b>36,000</b>	<b>36,000</b>	<b>42,000</b>	<b>36,000</b>	<b>42,000</b>
<b>F34T12CW</b>	<b>34</b>	<b>2650</b>	<b>60</b>	<b>NA</b>	<b>NA</b>	<b>4.4-10</b>	<b>NA</b>	<b>NA</b>	<b>20,000</b>	<b>27,000+</b>	<b>NA</b>	<b>NA</b>
<b>F28T5</b>	<b>26-28</b>	<b>2900+</b>	<b>85</b>	<b>2750+</b>	<b>85</b>	<b>1.4 - 5.0</b>	<b>*</b>	<b>*</b>	<b>*</b>	<b>*</b>	<b>20,000 - 30,000</b>	<b>25000 - 36,000</b>
<b>F54T5HO</b>	<b>51-54</b>	<b>5000</b>	<b>85</b>	<b>4800+</b>	<b>85</b>	<b>1.4 - 5.0</b>	<b>*</b>	<b>*</b>	<b>*</b>	<b>*</b>	<b>20,000 - 30,000</b>	<b>25000 - 36,000</b>

Lamp manufacturers may alter rated lamp life and lumen specifications, so get updates from manufacturers.

Some manufacturers may have higher ratings for basic and mid grade T8s.

GE lamp life may be as good as equivalent lamps from Philips and Sylvania with program start ballasts, but GE is being conservative at this time.

Program start ballasts include fixed output and most dimming ballasts. All ballasts, except for T12, are electronic.

Even though listed as NA (not applicable/available) some rapid start & program start ballasts can operate some 25-30W lamps.

Prepared by Stan Walercyk of Lighting Wizards 11/1/07 version. [www.lightingwizards.com](http://www.lightingwizards.com)

**25 - 32W F32T8 LAMP AND ELECTRONIC BALLAST WATTAGE TABLE**

ballast type >>>>>>>>>		GEB IS										EE IS										EE PS										GEB RS or PS										
lamp type >>>>>>>>>>>>		32W			30W			28W				25W				32W			30W			28W				25W				32W												
system wattage >>>		X	X				X					X				X				X				X				X				X										
system W saved >>>>				X				X					X				X				X				X				X				X									
lamp W saved >>>>>>>>>>					X				X					X				X				X				X				X				X								
BF																																										
SUPER LOW BF																																										
1	number of lamps	0.60																																								
2																																										
3																																										
4																																										
EXTRA LOW BF																																										
1	number of lamps	0.71																																								
2																																										
3																																										
4																																										
LOW BF																																										
1	number of lamps	.75 - .78	29	28	1	1.0	26	3	3.0	23	6	6.0	25	24	1	1.0	22	3	3.0	21	4	4.0	25	24	1	1.0	22	3	3.0	21	4	4.0	25	24	1	1.0	22	3	3.0	21	4	4.0
2			51	48	3	1.5	45	6	3.0	41	10	5.0	48	45	3	1.5	42	6	3.0	38	10	5.0	48	45	3	1.5	42	6	3.0	38	10	5.0	46	43	3	1.5	40	6	3.0	38	8	4.0
3			76	70	6	2.0	67	9	3.0	61	15	5.0	72	67	5	1.7	64	8	2.7	57	15	5.0	72	67	5	1.7	64	8	2.7	57	15	5.0	71	66	5	1.7	62	9	3.0	56	15	5.0
4			98	90	8	2.0	86	12	3.0	78	20	5.0	95	88	7	1.8	84	11	2.8	75	20	5.0	95	88	7	1.8	84	11	2.8	75	20	5.0	91	86	5	1.3	80	11	2.8	73	18	4.5
STANDARD BF																																										
1	number of lamps	.87 - .90	31	29	2	2.0	28	3	3.0	25	6	6.0	28	27	1	1.0	25	3	3.0	23	5	5.0	28	27	1	1.0	25	3	3.0	24	4	4.0	28	27	1	1.0	25	3	3.0	24	4	4.0
2			58	55	3	1.5	51	7	3.5	47	11	5.5	53	51	2	1.0	48	5	2.5	42	11	5.5	53	51	2	1.0	48	5	2.5	42	11	5.5	55	52	3	1.5	48	7	3.5	44	11	5.5
3			86	81	5	1.7	76	10	3.3	69	17	5.7	80	76	4	1.3	71	9	3.0	64	16	5.3	80	76	4	1.3	71	9	3.0	64	16	5.3	81	76	5	1.7	71	10	3.3	66	15	5.0
4			112	105	7	1.8	98	14	3.5	90	22	5.5	106	100	6	1.5	95	11	2.8	85	21	5.3	106	100	6	1.5	95	11	2.8	85	21	5.3	108	100	8	2.0	96	12	3.0	87	21	5.3
REFERENCE BF																																										
1	number of lamps	.96 - 1.04	36	34	2	2.0	33	3	3.0	30	6	6.0	34	32	2	2.0	30	4	4.0	29	5	5.0	34	32	2	2.0	30	4	4.0	29	5	5.0	34	32	2	2.0	30	4	4.0	29	5	5.0
2			66	62	4	2.0	59	7	3.5	52	14	7.0	62	59	3	1.5	55	7	3.5	50	12	6.0	62	59	3	1.5	55	7	3.5	50	12	6.0	62	59	3	1.5	55	7	3.5	50	12	6.0
3			92	87	5	1.7	81	11	3.7	73	19	6.3	89	84	5	1.7	78	11	3.7	73	16	5.3	89	84	5	1.7	78	11	3.7	73	16	5.3	89	84	5	1.7	78	11	3.7	73	16	5.3
HIGH BF																																										
1	number of lamps	1.15 - 1.20	41	39	2	2.0	36	5	5.0	34	7	7.0	38	36	2	2.0	33	5	5.0	32	6	6.0	38	36	2	2.0	33	5	5.0	32	6	6.0	74	70	3	1.5	64	9	4.5	60	13	6.5
2			78	73	5	2.5	68	10	5.0	62	16	8.0	73	70	3	1.5	64	9	4.5	60	13	6.5	73	70	3	1.5	64	9	4.5	60	13	6.5	108	104	5	1.7	97	12	4.0	93	16	5.3
3			111	105	6	2.0	97	14	4.7	88	23	7.7	109	104	5	1.7	97	12	4.0	93	16	5.3	109	104	5	1.7	97	12	4.0	93	16	5.3	144	136	7	1.8	128	15	3.8	122	21	5.3
4			144	135	9	2.3	123	21	5.3	143	136	7	1.8	128	15	3.8	122	21	5.3	143	136	7	1.8	128	15	3.8	122	21	5.3	144	136	7	1.8	128	15	3.8	122	21	5.3			
average W reduction with .71 - .90 BF			1.7			3.2			5.5			1.3			2.8			5.0			1.6			3.1			4.7															

Footnotes for this table are listed in next sheet of this file.

Prepared by Stan Walerczyk, principal of Lighting Wizards, www.lightingwizards.com, 9/5/06 version

# EXTRA EFFICIENT T8 BALLASTS

- Instant start
  - Advance Optanium IS
  - GE Ultramax
  - Sylvania QHE
  - Universal ULTim8
- Program start
  - Advance Optanium PS
  - GE Ultrastart (parallel wired)
  - Sylvania PSX

**RETROFIT, RELAMP, RELIGHT & REDESIGN OPTIONS FOR TYPICAL INDIVIDUAL OFFICE WITH 2X4 18 CELL PARABOLIC 3F32T8-700 TROFFERS**

\$0.15		blended KWH rate		3600		annual hours		\$0.05 utility or 3rd party incentive for first year KWH reduction			15		number of years for cumulative long term benefit		
existing					18 options to consider (shorter paybacks do not always provide better long term benefits)										
fixture type	quan - tity	total watts	annual elect'l cost	lamp life @ 3 hour cycles	#	4R	quan - tity	products	total watts	annual elect'l savings	incentive	appr. installed cost	simple payback in years	lamp life @ 3 hour cycles	long term benefit
2x4 18 cell parabolic troffers each with 3 F32T8 735s or 741 lamps and 3-lamp .88 BF generic instant start electronic ballast (originally inboard/outboard switching)	2	172	\$92.88	18,000 average (15,000 to 20,000 range)	1A	retrofit	2	3 32W F32T8 850s & .6 BF EE PS ballast	114	\$34.45	\$10.44	\$120.00	3.2	24K	\$429.72
					1B	retrofit	2	3 32W F32T8 850s & TW .6 BF PS ballasting	91	\$48.11	\$14.58	\$140.00	2.6	30K	\$618.79
					2A	retrofit	2	3 32W F32T8s & .77 BF EE IS ballast	144	\$16.63	\$5.04	\$100.00	5.7	24K	\$177.02
					2B	retrofit	2	3 32W F32T8s & TW .77 BF EE IS ballasting	115	\$33.86	\$10.26	\$120.00	3.2	24K	\$420.63
					3A	retrofit	2	3 28W F32T8s & .87 EE IS ballast	142	\$17.82	\$5.40	\$100.00	5.3	18 - 24K	\$172.70
					3B	retrofit	2	3 28W F32T8s & TW .87 BF EE IS ballasting	114	\$34.45	\$10.44	\$120.00	3.2	19 - 24K	\$407.22
					4A	retrofit	2	3 25W F32T8 850s & .87 EE IS ballast	126	\$27.32	\$8.28	\$110.00	3.7	20 - 24K	\$308.14
					4B	retrofit	2	3 25W F32T8 850s & TW .87 EE IS ballasting	101	\$42.17	\$12.78	\$130.00	2.8	21 - 24K	\$515.39
					5A	retrofit	2	3 25W F32T8 835/841s & 1.0 BF EE IS ballast	144	\$16.63	\$5.04	\$110.00	6.3	22 - 24K	\$144.52
					5B	retrofit	2	3 25W F32T8 835/841s & TW 1.0 BF EE IS ballasting	115	\$33.86	\$10.26	\$130.00	3.5	23 - 24K	\$388.13
					6A	relamp	2	3 28W F32T8s & use existing ballast	155	\$10.10	\$3.06	\$25.00	2.2	24 - 24K	\$109.53
					6B	relamp	2	3 25W F32T8 850s & use existing ballast	140	\$19.01	\$5.76	\$30.00	1.3	25 - 24K	\$230.88
					7A	upscale retrofit	2	ALP RDI ACR type of kit with 2 32W F32T8 850s & .77 BF EE IS ballast	96	\$45.14	\$13.68	\$250.00	5.2	24K	\$1,235.84
					7B	upscale retrofit	2	ALP RDI ACR kit with 2 32W F32T8 841s & .87 BF EE IS ballast	106	\$39.20	\$11.88	\$250.00	6.1	24K	\$1,144.94
					7C	upscale retrofit	2	ALP RDI ACR type of kit with 2 32W F32T8 835s & 1.0 BF EE IS ballast	130	\$24.95	\$7.56	\$250.00	9.7	24K	\$926.78
					8A	redesign	1	new 8' suspended indirect fixture with good batwing distribution, 2 32W F32T8 850s & 1.15 BF IS ballast	73	\$58.81	\$17.82	\$480.00	7.9	24K	\$4,237.41
					8B	redesign	1	new 8' suspended indirect fixture with good batwing distribution, 2 32W F32T8 841s & 1.32 BF EE IS ballast	85	\$51.68	\$15.66	\$480.00	9.0	24K	\$4,128.33
					8C	redesign	1	new 8' suspended indirect fixture with good batwing distribution, 4 32W F32T8 835s & .77 BF IS ballast	96	\$45.14	\$13.68	\$480.00	10.3	24K	\$4,028.34

notes: Prepared by Stan Walerczyk, LC, Principal of Lighting Wizards. February 20, 2006 version

Delamping these parabolic troffers is not an option, because it ruins proper cut-off angles, which can greatly increase direct, indirect and overhead glare.

Listed 32W F32T8s are high performance ones that are rated for 3100 catalog lumens, 82 - 86 CRI and 24,000 hour rating with IS ballasts at 3 hour cycles

25W F32T8s may not be recommended with occupancy sensors or other short cycle applications, especially with existing ballasts.

EE = extra efficient. BF = ballast factor. IS = instant start. PS = program start. TW = tandem wiring using 1 2-lamp & 1 4-lamp per fixture pair to allow for board/outboard switching.

Wattages are based on 277V line voltage and may be higher with 120V. Lower wattages with higher Kelvin lamps are based on scotopically enhanced lighting.

With some states' prevailing wages and union rates, can be considerably less labor costs to retrofit than replace fixtures.

In options, total watts is reduced 20% in options that inboard/outboard switching is re-introduced, because not all lamps will be on all of the time.

Annual electrical savings include 10% for reduced air conditioning load. In some areas this would be higher, and in other areas this would be lower.

Although this table includes an incentive for 25W and 28W F32T8s with new EE ballasts, some programs do not include them, because long term savings cannot be guaranteed.

long term benefit = (annual elect. savings x number of years) + incentive - initial installed cost. Small adder for 24,000 hour rated lamps and using fewer lamps. Because of increased productivity, \$50/year for baskets and \$150 - \$250/year added for suspended indirects. \$250 is 1/2 of 1% improvement on \$50,000 salary. 0.05% is not wasting 2.5 minutes/day.

Regarding long term benefits, cost of money is considered to be offset by increases in electricity, majority of maintenance savings and increases in worker salaries.

KWH rate, annual hours, incentive rate, and length of long term benefit can all be easily changed in colored/shaded boxes. Ballasts are typically rated for 15 years, fixtures much longer.

**HOW DO YOU  
GET THE  
BIGGEST BANG  
FOR THE BUCK?**

# BANG FOR THE BUCK

- It is my experience that numerous ESCOs and lighting retrofit contractors like 25W and 28W F32T8s, because easy lamp for lamp retrofits and seams to work for their financial models
- I have always been able to provide better solutions with Super 32W F32T8s, usually delamping and often with kits or new fixtures
  - Often without ESCOs, my recommendations are cost effective, but with ESCO mark-ups, often not

# BANG FOR THE BUCK

- Although it is often easiest and sometimes the best to go with the Super ESCO program, there are non-ESCO alternatives
  - For example, Ken Patterson at Advanced Energy Innovations ([www.aeiconsultant.com](http://www.aeiconsultant.com)) has been able to get several U.S. military facilities retrofitted very cost effectively without ESCOs
- Especially if lighting, why involve an ESCO that will broker out the lighting work anyway?
- If your ESCO, lighting consultant, lighting retrofitter, etc. does not give you options with detailed pros and cons of each option, find another firm

# ***THAT'S ALL FOLKS***

- **For further information**
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    - **www.lightingwizards.com**
- **Thanks for coming**