



U.S. Department of Energy  
Energy Efficiency and Renewable Energy

# T8, T5 & T5HO LAMP & BALLAST ADVANCEMENTS

PRESENTED BY

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# MOSTLY BASED ON

- WATT'S THE WORD ON T8s RETROFITS?
  - Published in Energy User News, April 2003
  - Some information updated since publication
  - Written by Stan Walerczyk of Sun Energy Solutions



# ALL F32T8s NOT CREATED EQUALLY

- 2800 – 3100+ initial lumens
- 15,000 – 24,000 hour rated life
  - Based on 3 hour cycles with instant start ballasts
- 75 – 98 CRI (color rendition index)
- Also 28 & 30W energy savers



# SUCH A DIFFERENCE

- The difference is so dramatic that with optimal electronic ballasts, described later, that many fixtures with basic grade F32T8s and generic ballasts can be cost effectively retrofitted or replaced with high performance F32T8s.



# SUCH A DIFFERENCE

- With high performance F32T8s and optimal electronic ballasts the savings are so significant that:
  - There is no reason to keep T12 lamps and magnetic ballasts.
  - Often cost effective to retrofit fixtures that currently have basic grade T8s and generic ballasts.



# Types of F32T8s

- There are numerous types of F32T8s.
- Useful narrowed-down categories are:
  - Basic grade -- SP/700
  - 28-30W energy saving
  - 2950-3000 lumen extended-life -- SPX/800
  - 3100+ lumen extended-life -- SPX/800



# Lamp Life Issue With All Types

- T8s that can be operated with rapid start ballasts are usually tested with them.
- 90% of electronic ballasts are instant start because of cost and efficacy.
- Many lamps have about 25% less rated life with instant start ballasts.
  - 20,000 hour rated lamp really lasts 15,000 hours
  - 24,000 hour rated lamp really lasts 18,000 hours
- Some lamps do not suffer as much reduced hours with instant start ballasts.
  - Some same listing as in catalogs
- Industry standard is 3 hour cycles.



# Basic Grade – 700 Series

- 2800 – 2850 lumens
- 88 – 92% EOL lumen maintenance
- Most 15,000 hour rating with IS ballasts
- 75 – 78 CRI
- Least expensive
- Highest volume
- Worst value
- Never recommend them



# 28-30W Energy Saving

- All three manufacturers make 30W F32T8s.
- GE and Sylvania also have 28W versions.
- All of these save considerable energy and having about the same performance as basic grade SP/700 series 32W F32T8s.
- But there are some limitations.
  - Lamp life because mainly instant start ballasts
    - 15,000 hour rating with standard & 20,00 hour rating with extended life versions based on industry standard 3 hour cycles
    - Check footnotes in lamp catalogs for cycle lengths
  - Minimum 60 degrees F operating temperature
  - Cannot be used with dimming and many rapid start ballasts



# 28-30W Energy Saving

- When there are unheated areas and/or conference rooms with dimming ballasts, I always ask a customer if okay to have two types of F32T8s in the facility.
  - Guess what the answer is!
- For some applications the extended-life versions of these lamps can be good for relamping.
  - The energy savings over the life of the lamp covers the parts and labor cost.
- I usually find that a retrofit, re-retrofit or relighting with high-lumen extended-life 32W F32T8s a better solution.



# 2950 – 3000 Lumen 800 Series

- These used to be my favorite lamps before the 3100+ lumen lamps came out.
- Now hardly use these anymore.



# 3100+ Lumen 800 Series

- Favorite lamp type
- Provides most flexibility with regard to:
  - Delamping
  - Ballast factor
  - Lamp life
  - CRI
  - Instant, rapid & program start and dimming ballasts
  - Temperature
- Include in alpha order
  - GE HL
  - Philips Advantage
  - Sylvania XPS (but only 15,000 hour rated life with instant start ballasts)



## HIGH PERFORMANCE F32T8 LAMP LIFE

LAMP	WATTS	LAMP LIFE HOURS WITH VARIOUS BALLASTS & CYCLES					
		INSTANT START		RAPID START		PROGRAM START	
		3 HR	12 HR	3 HR	12 HR	3 HR	12 HR
BASIC GRADE	32	15,000	20,000	20,000	24,000	20,000	24,000
GE HL	32	24,000	30,000	24,000	30,000	30,000	36,000
PHILIPS ADV	32	24,000	30,000	30,000	36,000	30,000	36,000
SYLVANIA XPS	32	15,000	24,000	20,000	28,000	30,000	34,000
SYLVANIA XP	32	18,000	26,000	24,000	30,000	24,000	30,000
GE WM	30	15,000	20,000	NA	NA	NA	NA
GE XL WM	30	20,000	25,000	NA	NA	NA	NA
PHILIPS ADV EW	30	15,000	20,000	NA	NA	NA	NA
SYLVANIA SS	30	18,000	26,000	NA	NA	24,000	TBD
SLVANIA FO28	28	18,000	TBD	NA	NA	24,000	TBD
GE F28	28	18,000	24,000	NA	NA	NA	NA
F34T12 & mag ballast	34	NA	NA	20,000	27,000+	NA	NA

notes

Rated hours provided by lamp manufacturers between 12/13/02 and 7/17/03.

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

Please be aware that some manufacturers are more conservative than others on some products.

Sylvania lamp life with program start ballast is based on Sylvania PSX ballast, and may be less with other ballasts.

Program start ballasts include fixed output and most dimming ballasts.

All ballasts are electronic.

Even though listed as NA (not applicable) some rapid start & program start ballasts can operate some 28-30W lamps.



**Based on previous table, if you do not select the proper T8 lamps and electronic ballasts, you can have shorter lamp life than what you had with T12s and magnetic ballasts**



# Barriers

- Public agencies in some states have state contracts that mandate purchases of basic grade, 700 series lamps.
- Corporate policies and specifications are sometimes mandatory and are often not kept up to date.



# 8' F96T8s

- In the past avoided 8' T8s like the plague
  - 15,000 hour rated life
  - 5800 initial lumens
- But recent improvements have changed that
  - 18,000 – 24,000 hour rating
  - 5900 – 6200 initial lumens



# WHICH LAMP REALLY HAS BEST EFFICACY?

<i>4' lamp type</i>	<i>lumens</i>	<i>lamp W</i>	<i>ballast</i>	<i>lamp life</i>	<i>EOL LM</i>	<i>EOL LPW</i>
<b>F54T5HO</b>	<b>5000</b>	<b>54</b>	<b>PS</b>	<b>20,000</b>	<b>94%</b>	<b>80 (appr)</b>
<b>F28T5</b>	<b>2900</b>	<b>28</b>	<b>PS</b>	<b>20,000</b>	<b>94%</b>	<b>88 (appr)</b>
<b>F32T8 8XX UNIV.</b>	<b>3100</b>	<b>32</b>	<b>EE IS</b>	<b>24,000</b>	<b>92%</b>	<b>91 (appr)</b>

## Notes

Based on one lamp sharing a two lamp ballast.

EOL stands for end of rated life.

LM stands for lumen maintenance. LPW stands for lumens per watt.

PS stands for program start. EE IS stands for extra efficient instant start.

Lamp life is rated in hours based on 3 hour starts, the industry standard.

Lamp life is based on specified ballast.

Based on photopic (lamp catalog) lumens.



# Lamp & Ballast Performance

- The previous table is one example showing that just looking at lamp lumens and wattage is flawed.
  - So often customers think that they want to retrofit with F28T5s because over 100 lumens/watt, which looks better than F32T8s.
- Ballast part of the system needs to be included
  - Mainly 1.0 BF program start ballasts for T5s & T5HOs (without PS ballasts, only 16,000 hours)
  - Many ballast types for T8s



# Each lamp type has its place

- Each of these lamp types is best for specific applications
  - T5s – limited, like small undercabinet
  - T5HOs – very high hights and high performance suspended indirects
  - T8s – wide open market
- Really one grade of T5s and T5HOs



# Ballast Factors for T8 Ballasts

- Low Power ballasts (.71 to .78 BF): Consider for lamp for lamp retrofits
- Standard power ballasts (.87 to .90 BF): Typically ones in new fixtures
- Reference and High Power ballasts (1.00 to 1.20 BF) are often good for delamping retrofits
- Initial lamp lumens in lamp catalogs are based on a 1.0 BF (ballast factor) reference ballast
- 1.0 BF can also be attained a three lamp standard output ballast driving two lamps



# Advantages of New Generation Ballasts

- Many manufacturers have low and standard power instant start ballasts that consume about 3 to 6 less watts than generic low and standard BF ballasts usually without sacrificing light output.
  - Instant start
    - Advance Optanium
    - GE Ultramax (better than Ultras)
      - Only one with low, standard and high BF
    - Howard Hex
    - Universal ULTim8
    - Sylvania will be introducing theirs soon



# Advantages of New Generation Ballasts

- Program start (Usually less light but longer lamp life)
  - Advance Optanium
  - Sylvania PSX



# Advantages of New Generation Ballasts

- Electrical savings over the ballast life dwarfs the extra initial cost.
- This is described in detail in 'Penny Wise and Dollar Foolish' published in LD+A and also available on Sun's website listed later.



<b>LAMP FOR LAMP TABLE (photopic lumens)</b>											
lamp & ballast type	catalog lamp lumens	EOL lumen maintenance	CRI	ballast factor	EOL lamp lumens	# of lamps	EOL lumens	EOL lumens compared to basic & standard	system wattage	wattage savings compared to basic & standard	EOL lumens per watt
F34T12CW & energy saving magnetic	2650	78%	62%	0.89	1840	1	1840	82%	44	-47%	42
						2	3680	82%	72	-24%	51
						3	5520	82%	116	-33%	48
						4	7360	82%	142	-24%	51
Basic 32W T8 & Standard	2850	90%	77%	0.88	2257	1	2257	100%	30	0%	75
						2	4514	100%	58	0%	78
						3	6771	100%	87	0%	78
						4	9028	100%	114	0%	79
<b>Option 1 Instant Start &amp; 32W Lamps</b>	3100	92%	86%	0.87	2481	1	2481	110%	28	9%	89
						2	4962	110%	53	9%	94
						3	7443	110%	80	9%	93
						4	9924	110%	107	9%	93
<b>Option 2 Instant Start &amp; 32W Lamps</b>	3100	92%	86%	0.77	2196	1	2196	97%	25	17%	88
						2	4392	97%	48	17%	92
						3	6588	97%	72	16%	92
						4	8784	97%	96	15%	92
<b>Option 3 Program Start &amp; 32W Lamps</b>	3100	92%	86%	0.71	2025	1	2025	90%	25	17%	81
						2	4050	90%	46	21%	88
						3	6075	90%	71	18%	86
						4	8100	90%	91	20%	89
<b>Option 4 Instant Start &amp; 30W Lamps</b>	2850	92%	86%	0.87	2281	1	2281	101%	27	10%	85
						2	4562	101%	52	10%	88
						3	6843	101%	77	10%	89
						4	9124	101%	103	9%	90
<b>Option 5 Program Start &amp; 30W Lamps</b>	2850	92%	82%	0.71	1862	1	1862	83%	24	20%	78
						2	3722	83%	43	26%	87
						3	5583	83%	67	23%	83
						4	7444	83%	86	25%	87
<b>Option 6 Instant Start &amp; 28W Lamps</b>	2750	92%	82%	0.77	1948	1	1948	86%	22	23%	89
						2	3896	86%	44	26%	89
						3	5844	86%	65	25%	90
						4	7792	86%	86	22%	91
notes:											
EOL stands for end of life											
Lamp life is estimated on 3 hour starts with listed ballast.											
System wattages are based on 277V and may be slightly higher for 120V.											
Basic and Standard has typical basic 700 series F32T8 lamps and generic standard-power electronic ballast.											
All options have F32T8 lamps and optimal fixed output electronic ballasts.											
The higher CRI of the options can help offset the less EOL lumens.											
Many of above numbers are based on composites and extrapolations, so do not be concerned about small differences, like a difference of one or two in EOL lumens/watt.											
Information on the 28W F32T8s is preliminary, and may change											
It is highly recommended to do your own calculations with specific lamps and ballasts.											



# Out of Time, but so much more

- Please look over additional slides at your convenience
- I think that you will find them helpful



# For Further Info

- If you would like information on other subjects, not included in any of my slides, including:
  - Dimming electronically ballasts for high wattage HID
  - Scotopically enhanced lighting
    - How extra wattage can be saved with high Kelvin temperature lamps
  - Hibay applications
  - And anything else on energy efficient and effective lighting



# For Further Info

- Please contact me at later today or at
  - 413-298-3400
  - [sglick@appliedenergy.com](mailto:sglick@appliedenergy.com)
- Also several downloadable articles available at
  - [www.sunenergysolutionsllc.com](http://www.sunenergysolutionsllc.com)



# Dimming Ballast Applications

- Compare with cost of changing out reflectors in the case of parabolics in overlit spaces
- In areas where building management is important for control and monitoring (load shed, for example)
- Daylight harvesting and peak load shedding are difficult to be cost effective without substantial incentives.



# Types of Electronic Dimming Ballasts

- Continuous and staged dimming ballasts.
- Localized manual controls or networked control systems
- Control Protocols:
  - DALI
  - 0-10 volts
  - Proprietary
    - Lutron, EasyLite, etc.
  - Check compatibility with BMS, if one exists



# More on DALI

- DALI is digital addressable lighting interface
- Universal protocol
  - So hopefully pricing will come down
- Two way communication
  - Maintenance
- Dim many ways
  - Through Internet Explorer in individual offices
- For T8s and T5HOs, like many other dimming ballasts



# Dimming Ballast Example

- Existing
  - Office space with fixtures spaced 8' x 10'
  - 18 cell parabolic 2x4s, dual switching
    - 3 F40T12 CW lamps and magnetic ballasting
      - 108-118W
    - 3 F32T8 735 lamps and electronic ballasting
      - 78-88W
    - 3 28-30W F32T8 35K lamps and extra-efficient low BF ballasts
      - 61-68W
- Retrofit with:
  - Electronic dimming ballast
  - 3 F32T8 850 lamps



# Dimming Ballast Example

- Installation Benefits of using dimming:
  - No socket rewiring
  - No reflectors or additional hardware
- End Customer Benefits:
  - Energy Savings: Dim to 50%, consumes 40-45 watts
    - Substantial energy savings (61W best with fixed)
    - Often cost effective
  - Lamp brightness is lower, reducing glare
  - Continuous dimming



# Efficacy Includes More Than Just Lamps & Ballasts

- Although the 28W F32T8s with extra-efficient ballasts will have the best lumens/watt in the T8 world, there is more to the big picture.
- Need to consider heat and photometrics in the fixture.
- For example 2x4 lensed troffer
  - 4 28-30W F32T8s & Low BF extra-efficient ballast
  - 2 32W 3100 lumen F32T8s & 1.15 BF ballast



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# How Useful Are Reflectors?



## 7 Step Program of Reflector Anonymous

- *Example:* 2x4 troffer, 4 old 34W F40T12 CW lamps, 2 magnetic ballasts, dirty housing and prismatic lens
1. Measure light levels directly below and 4' around fixture at about 30" above floor
  2. Clean housing & lens and install new 34W F40T12 lamps
  3. Measure light levels exactly as before, which should increase 20-40% depending how dirty the fixture was and how depreciated the lamps were
  4. Install 2 32W F32T8s and standard BF electronic ballast
  5. Measure light levels, which usually like original
  6. Install white or specular reflector
  7. Measure light light levels. How compare to #5



## 7 Step Program of Reflector Anonymous

- If fixture has angled interior sides and cleanable good white coating that has about 85% reflectivity, a reflector typically provides insubstantial benefit, like 5 to 10%
- If fixture has vertical sides and/or bad white coating, then a reflector can be very beneficial
- Reflectors also helpful making strips into hooded industrial if up light is not important
- Reflectors also useful retrofitting U-bend 2x2s with T17T8s

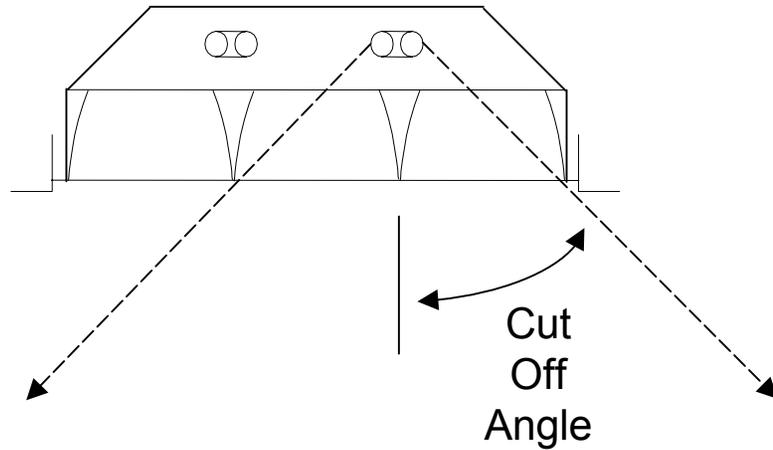
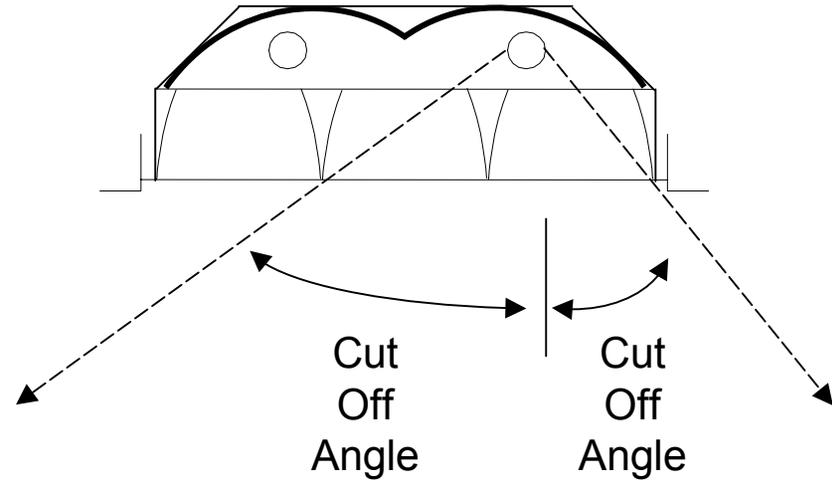
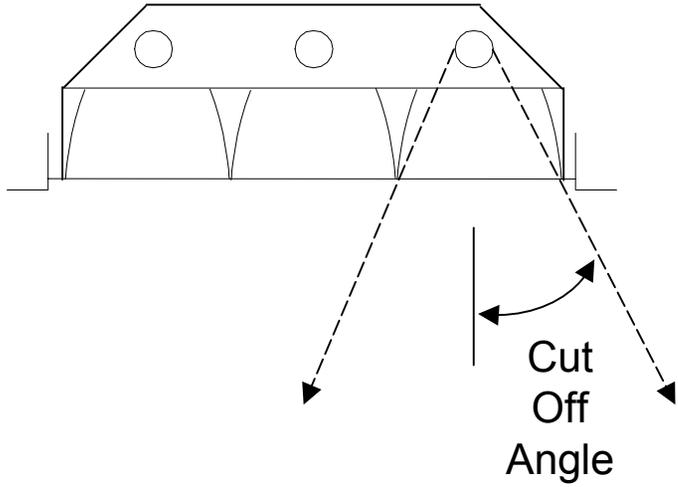


# Reflectors

- Delamping without a reflector improves luminaire efficiency.
  - Reduce light bouncing into adjacent lamps
    - Check luminaire manufacturers' luminaire efficiencies for same fixtures with 4, 3 and 2 F40T12s or F32T8s
  - Improve lamp/ballast temperature coefficient
- Important to maintain proper cut-off angles.
  - Do not delamp and reposition lamps in 18 cell parabolic troffers
    - GLARE, GLARE, GLARE



# CUT OFF ANGLES





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# OPTIMAL LAMPS AND BALLASTS CAN OFTEN MAKE REPLACING TROFFERS WITH SUSPENDED INDIRECTS COST EFFECTIVE



# Where Would You Rather Work?

