



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

NEW LIGHTING FIXTURES

STAN
WALERCZYK

AEM and SUN ENERGY SOLUTIONS





Terminology

- Although '**luminaire**' is the technical term, I will use '**lighting fixture**' or '**fixture**'
 - Because that is what I am most, and people that I deal with, are most used to
- If I use any terms that you are not familiar with, please ask me to use 'English' instead of 'lighting'



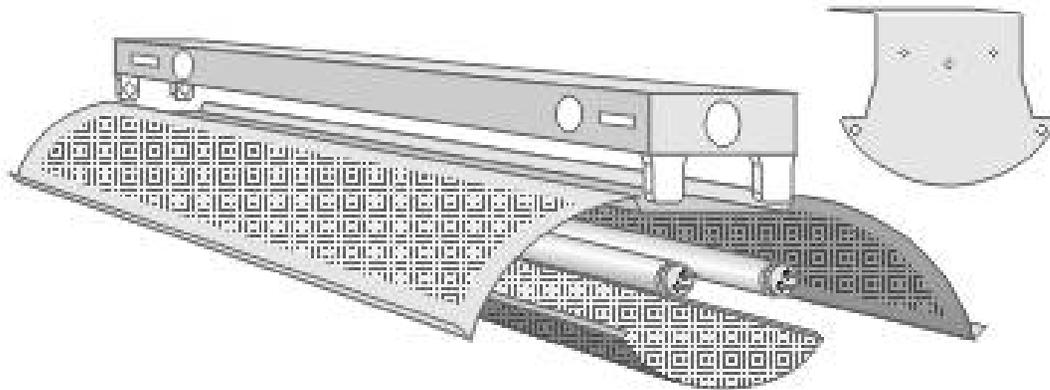
No Intention To Promote Any Manufacturer

- But more useful to focus specific products and manufacturer websites than generalities
 - Other manufacturers may have similar products
- I am not associated with or receive any compensation from any listed manufacturer



New Fixtures

- 3Rs
 - Retrofit
 - Only include kits with relight quality in this seminar
 - For example – retrofit strip fixtures with low glare kits
 - ALP's Urbanus www.alplighting.com





New Fixtures

- 3Rs
 - Relight
 - One for one replacement in same location
 - For example – replace each 2x2 direct troffer with a new 2x2 indirect basket troffer
 - Numerous manufacturers





New Fixtures

- 3Rs
 - Redesign
 - Complete new lighting layout
 - For example replacing 2x4 18 cell parabolic troffers with rows of suspended indirects
 - Many manufacturers





New Fixtures

- New construction
 - Similar to redesign, but much more flexibility, since starting from scratch



Focus

- 8 – 12 foot high ceilings
- Typical office and school applications



Main Types of Linear Fluorescent Fixtures

- Direct
 - Recessed
 - For example, 2x4 lensed or louvered troffer
 - Surface
 - For example, wrap around
- Basket
 - Mainly indirect
 - Recessed or surface



Main Types Of Linear Fluorescent Fixtures

- Suspended (a.k.a. pendant)
 - Indirect
 - 90-100% uplight
 - Typical for mainly computer work
 - Semi-indirect
 - 60-90% uplight
 - Typical for significant paper tasks along with computer tasks
 - I like max 15% downlight for mainly computer work
 - Direct/Indirect
 - 40-60 uplight
 - Less popular than indirect or semi-indirect



Advantages of Suspended Indirect & Semi-indirect

- Quality of light
 - Reduced glare
 - Including overhead
 - Eliminate cave effect
 - Better uniformity
- Improved worker satisfaction
- Improved worker productivity
- Improved performance in schools



Advantages of Suspended Indirect & Semi-indirect

- Good websites
 - www.lighthouse.org
 - www.nlb.org/high-benefit-lighting.html
 - www.designlights.org



Advantages of Suspended Indirect & Semi-indirect

- Installation savings
 - Fewer fixtures
 - Especially in high ceilings
 - Can get up to 12' long fixtures
 - One power feed per row
 - Parts may cost more, but considerable lower labor costs
 - **So totally less project cost**
 - Some contractors that have not installed suspended before tend to overbid for CYA



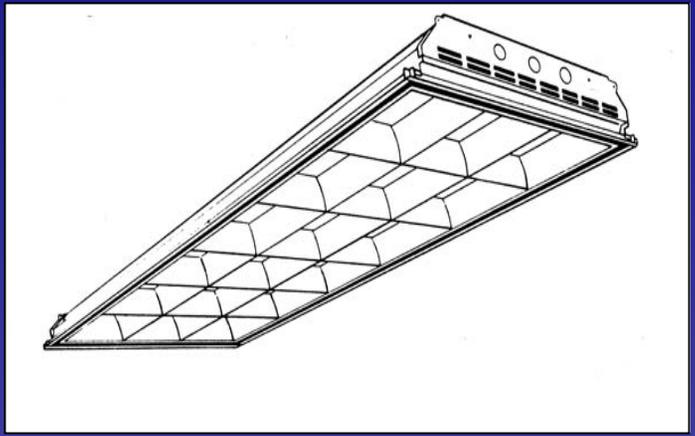
Advantages of Suspended Indirect & Semi-indirect

- Wattage savings
 - Can save more wattage with these than with direct
 - Often people prefer lower light levels because
 - Better uniformity
 - Lighter ceiling
 - Lighter upper walls



Comparisons

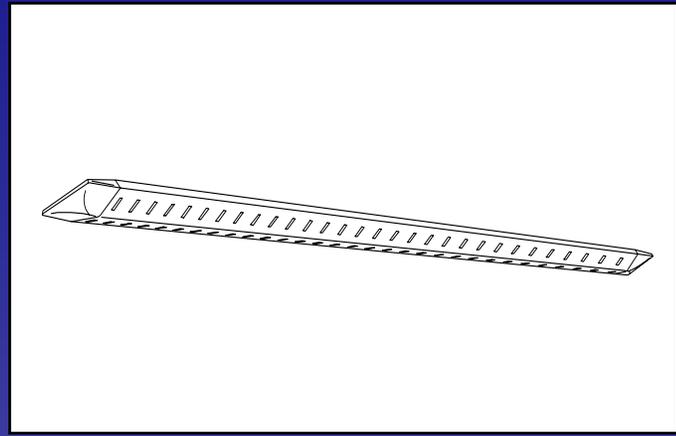
Downlight (aka Direct)



Luminaire Luminance
Bare Lamp of 6000->25,000 cd/m²

Efficiency: 65 to 70%

Uplight (aka Indirect)



Ceiling Luminance
Ceiling : 450 cd/m²

Efficiency: 80%



Need Good Ceiling Reflectance

- Don't use upright if dark and dirty ceiling
 - Unless gull wing, like H.E. Williams XT-DIPRF
 - <http://www.infinitylighting.com/williams/>
- White ceiling tiles
 - Typical 75-80% reflectance
 - Can get up to 90% reflectance in tiles specially designed for suspended upright fixtures
 - <http://www.armstrong.com/commceilingsna/index.html>
 - Can reduce wattage by fewer
 - Fixtures, lamps per fixture and/or BF (ballast factor)



Where would you rather be?





Before

- Spotty lighting distribution due to occupants pulling out lamps.
- Ceiling is dark.
- People **HATED** the lighting





After

- Uniform ceiling, and much more pleasant atmosphere.
- Lighting more uniform on tasks and vertical surfaces.
- Employee attitude is greatly improved.





What Brian Liebel and I do at the Pacific Energy Center

- Direct
 - Read glossy paper
 - Work with a lap top computer
- Indirect
 - Same tasks
- Ask some questions
- Light cycle costing even as a relight

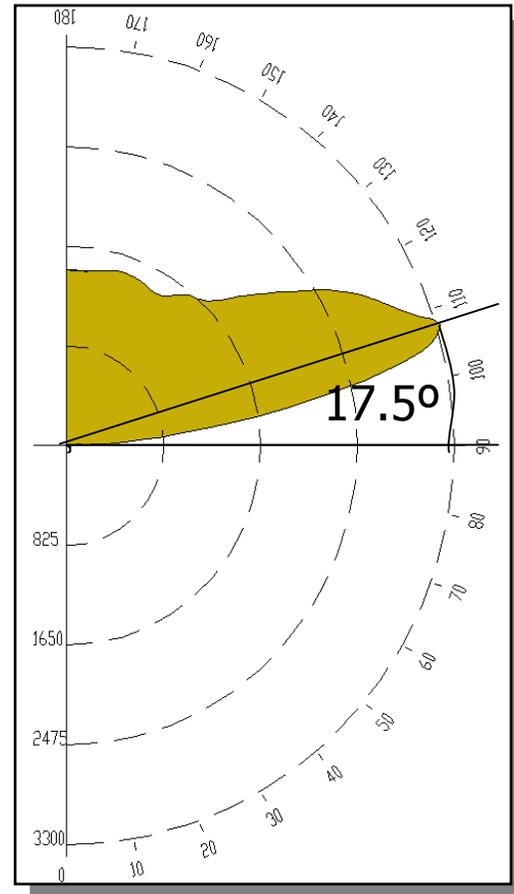
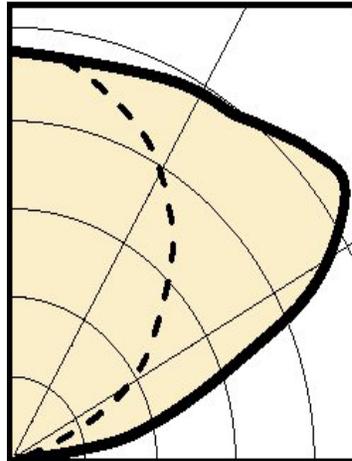
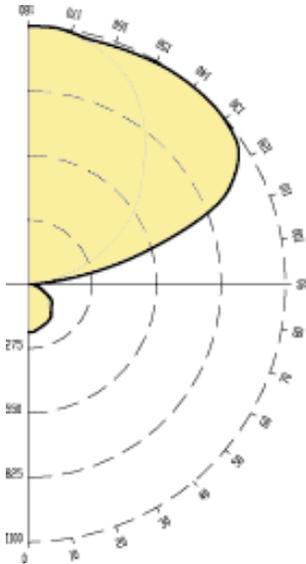


Not All Suspended Indirects Are Created Equally

- A blob of light directed up can create zebra stripes
 - Not good
 - Very bright ceiling above fixtures
 - Dim between
- Want even lighting on entire ceiling



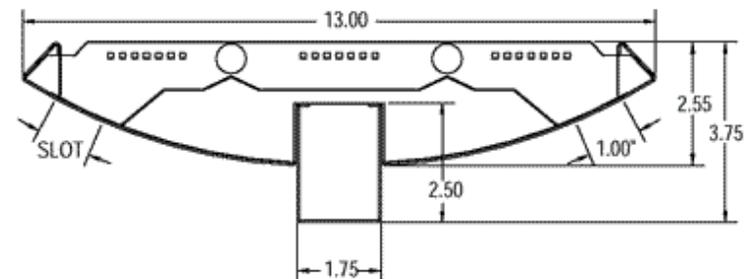
Not All Suspended Indirects Are Created Equally





Some Very Good Suspended Indirects and Semi-indirects

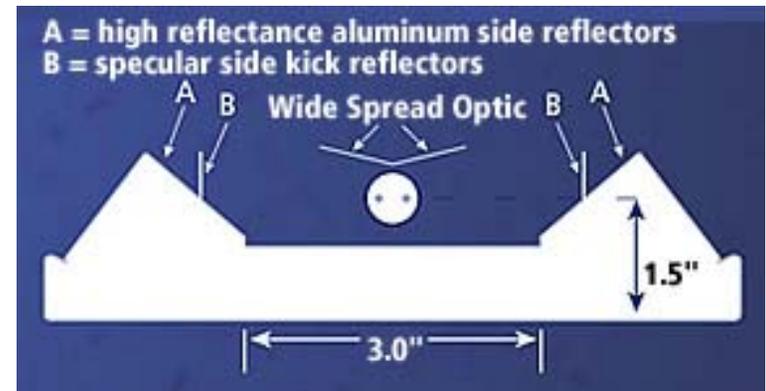
- Lightolier Lytespread
 - Awesome bat-wing distribution
 - As shown on right hand side of previous slide
 - Almost same uniformity with right or left side lamp on
 - At 11' ceilings, can have 20' wide rows
 - www.lightolier.com





Some Very Good Suspended Indirects and Semi-indirects

- Finelite Series 14
 - For most fixtures should have at least 18" drop for decent ceiling uniformity
 - This can be mounted as close to 6" from the ceiling with still good uniformity
 - So could install in as low as 8' ceilings
 - <http://www.finelite.com/content/productset.html?56,43>





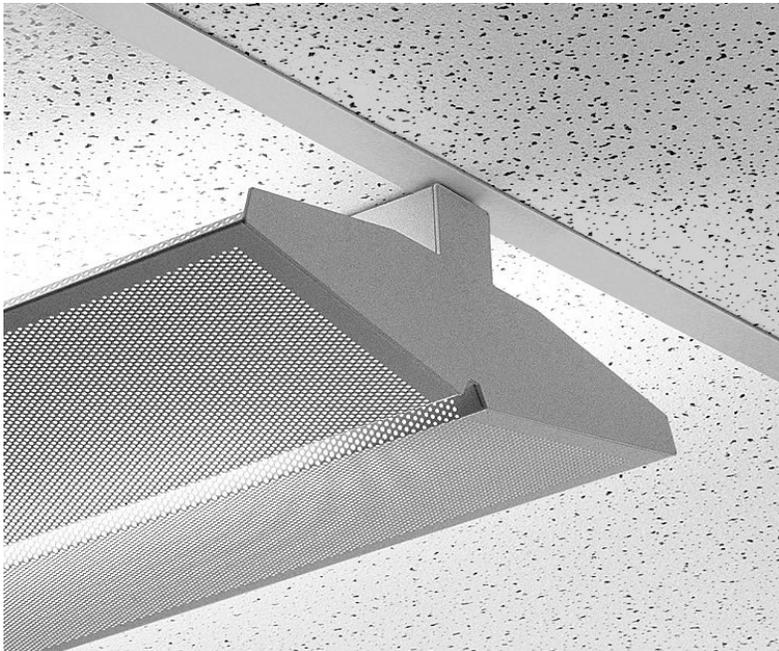
Some Very Good Suspended Indirects and Semi-indirects

- Finelite Series 15
 - For most fixtures should have at least 18” drop for decent ceiling uniformity
 - This can be mounted directly to ceiling, and ceiling uniformity is still very good
 - Would have not believed with out seeing
 - So could install in as low as 8’ ceilings
 - <http://www.finelite.com/prodinfo/s15/s15directset.html>



Some Very Good Suspended Indirects and Semi-indirects

- Finelite Series 15





Some Very Good Suspended Indirects and Semi-indirects

- Finelite's California Energy Commission Pier Program School System
 - www.finelite.com
 - Described in following three slides



General Classroom Lighting

- Light walls uniformly
- Light teacher's face
- Follow RP3 & CHPS fixture guidelines
- S10 Indirect / direct fixtures w/ 96% CCO option
- Super T8 lamps w/ 1.18 BF ballasts
- 0.95 watts / square foot
- 30 – 50 FC on student's desks





Lighting for AV Presentations

- Screens and TVs look sharp
(Veiling reflections reduced)
- Desks remain lighted
- Switch at front of classroom
- 0.45 watts / square foot
- Excellent lighting for reading





Teacher Controls Classroom Mode

Switch “Up” = general classroom mode

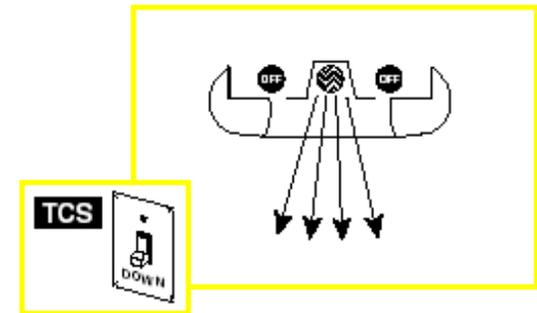
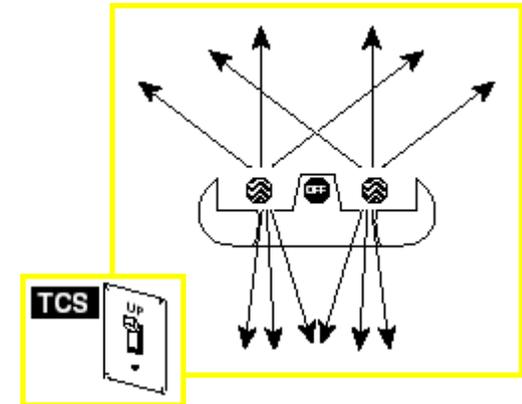
Switch “Down” = A/V or reading mode

Switch in the front of classroom

Easy to use

No class disruption

NOTE: All 3 lamps can not be on at the same time.





Probably Least Expensive Suspended Indirects

- Inverted hooded industrials
 - If at least 24” drop for decent uniformity
 - Can be less than \$10 per linear foot
 - Works very good in ‘industrial’ type offices
 - Vents that are usually for upright provide a little down light in inverted position
 - An example is Wellmade’s 407INV
 - <http://www.wlmd.com/>



Cleaning Suspended Indirects

- Although it is recommended to clean lensed and parabolic down light fixtures, like 2x4 troffers, they will provide sufficient light after many years, even if not cleaned
- But suspended indirects, especially 100% upright ones really should be cleaned once a year
- If proper cleaning will probably not happen, consider fixtures with louvers on the bottom



Four Foot Fluorescent Lamps & 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
MID GRADE	32	18,000	24,000	24,000	30,000	24,000	30,000
GE HL	32	24,000	30,000	24,000	30,000	30,000	36,000
PHILIPS PLUS & 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	20,000	24,000	NA	NA	NA	NA
GE XL WM	30	24,000	29,000	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	24,000	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
F28T5	28	*	*	*	*	20,000	25,000
F54T5HO	54	*	*	*	*	20,000	25,000

notes

Rated hours provided by lamp manufacturers betw een 12/13/02 and 11/19/03.

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

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

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

Program start ballasts include fixed output and most dimming ballasts.

All ballasts, except for T12, are electronic.

* is for most manufacturers do not w arranty their lamps w ith rapid or instant start ballasts. Life significantly reduced.

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



4' LINEAR FLUORSCENT 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>ballast factor</i>	<i>system watts</i>	<i>initial system lumens</i>	<i>initial system lumens per watt</i>	<i>end of life lumen maintenance</i>	<i>end of life system lumens per watt</i>
high perform. F32T8	3100	32	96.9	2	EE IS	0.87	53	5394	101.8	92%	93.6
F28T8	2750	28	98.2	2	EE IS	0.87	48	4785	99.7	92%	91.7
energy saver F32T8	2850	30	95.0	2	EE IS	0.87	52	4959	95.4	92%	87.7
F28T5	2900	28	103.6	2	PS	1.00	64	5800	90.6	94%	85.2
basic grade F32T8	2850	32	89.1	2	EE IS	0.87	53	4959	93.6	90%	84.2
F54T5HO	5000	54	92.6	2	PS	1.00	117	10000	85.5	94%	80.3
F34T12 CW	2650	34	77.9	2	RS	0.88	72	4664	64.8	78%	50.5

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

All wattages based on 277V. EE IS is extra efficient instant start. PS is program start. RS is rapid start.



But T5s, T5HOs & T8s Have Their Applications

- T5s
 - Limited, like low profile under cabinet task fixtures
- T5HOs
 - Small diameter allows for high performance suspended indirects & semi-indirects and hibays
- T8s
 - Wide open market -especially high performances ones
 - If do not specify the lamps in prelampped fixtures, typically basic grade



Make Sure You Get The Best Ballasts

- T8s
 - If you order fixtures without specifying the ballasting
 - Typically generic standard BF (ballast factor)
 - Most fixture manufacturers will allow for specific BF and type ballast
 - Can often use lower BF with high lumen T8s
 - Saves considerable wattage
 - Extra-efficient ballasts
 - Can save 3 – 6 watts without sacrificing light-output
 - Can save \$30 over ballast life
 - Usually only costs \$1 to \$3 extra
 - Only fixed output ballasts that I recommend



Make Sure You Get The Best Ballasts

- T8s (cont'd)
 - Extra-efficient T8 ballasts
 - All major manufactures make them
 - **Instant start**
 - » **Advance Optanium**
 - » **GE Ultramax**
 - » **Howard Hex**
 - » **Universal ULTim8**
 - » **Sylvania HE**
 - **Program start (good for short cycles)**
 - » **Advance Optanium**
 - » **Sylvania PSX**



Make Sure You Get The Best Ballasts

- T5s and T5HOs
 - Rated for 20,000 hours with program start ballasts
 - Some fixtures manufacturers may use instant start or rapid start ballasts, which saves a few bucks
 - Lamp life can be significantly reduced
 - Lamp manufacturers may not warranty their lamps
 - Highly recommend only program start ballasts



Dimming Ballasts

- Dimming ballasts can be very useful for personal dimming
- But dimming ballasts considerably less efficacious (lumens/watt) than extra efficient instant start ballasts
 - For the same light level dimming ballasts require considerably more wattage
 - What can gain during daylight harvesting, can lose at other times
- DALI (digital addressable lighting interface)



Ambient – Task Lighting

- Reducing ambient light (from the ceiling fixtures) and including good task lighting can
 - Substantially reduce wattage
 - Give workers some control
 - Which there is not a lot of control in modular office cubicles
 - Can help worker satisfaction
 - Provides fine tuned lighting for specific tasks
 - Task lights can be off for mainly computer work
 - Task lights can be on and often aimed at paper tasks
- Avoid glare bomb task lights



If Running Out Of Time

- Please look at the following hibay slides at your own convenience
- My contact information is listed after the hibay slides
- Please call or email me if with questions or comments
- I have written over 15 published lighting articles, most of which are available at Sun's website
- Also other article and links at that website



Hibays

- Please help me eliminate
 - HPS (high pressure sodium)
 - Who wants to work or hang around the ugly yellow color?
 - Standard MH (metal halide)
 - Pulse start MH is so much better
 - Basic grade spun aluminum domes
 - Only about 75% luminaire efficiency



HOW CAN FLUORESCENTS WITH HALF THE INITIAL LUMENS REPLACE HID?

Following are some examples

lamp & hibay fixture type	initial lamp lumens	BF	actual lamp lumens	EOL lamp lumen depreciation	EOL lamp lumens	luminaire efficiency	EOL luminaire lumens	system watts	EOL luminaire lumens per watt	S/P ratio	EOL lamp luminaire task modified lumens	EOL lamp luminaire task modified lumens per watt
spun aluminum reflector with 400W 41K 65-CRI standard MH	38,000	1.00	38,000	42%	22,040	75%	16,530	455	36	1.49	22,561	50
spun aluminum reflector with 400W 22-CRI standard HPS	50,000	1.00	50,000	30%	35,000	75%	26,250	465	56	0.62	18,080	39
enhanced aluminum reflector with (4) 850 85-CRI F54T5HOs	20,000	1.00	20,000	6%	18,800	92%	17,296	235	74	1.86	28,065	119
enhanced aluminum reflector with (6) 3100 lumen 850 85-CRI F32T8s	18,600	1.18	21,948	8%	20,192	92%	18,577	226	82	1.86	30,132	133

Notes

BF stands for ballast factor and EOL stands for end of life.

Fluorescent lamp lumens are based on optimal temperatures & can be adjusted with lumen/temp tables provided by manufacturers.

Luminaire dirt depreciation could be included if you know it.

HID have magnetic ballasts.

Fluorescents have electronic ballasts.

End of life luminaire task modified lumens = end of life lamp luminaire lumens x (S/P)^{.78} [.78 exponent]

Although the T8s look better than the T5HOs, the T5HOs have more long range 'punch', which is important for high mountings.





Hibays

- Although many people are jumping on the T5HO bandwagon, often the following can be better for many applications
 - T8
 - Pulse start MH with electronic ballast
 - Induction (100,000 hour rated life)



Hibays

- If choose T5HO, be aware of ballast case temperature rating
 - If this temperature rating is exceeded
 - Voids ballast manufacturer warranty
 - Can reduce ballast life by 50%
 - In applications that can get hot, I specify that the hibay manufacturer guarantees that the ballast case temperature will not exceed 70° C (158° F) when ambient temperature is 52° C (125° F)
 - Many T5HO hibay manufacturers have a small ballast compartment, do not vent ballasts and use steel instead of aluminum



That's all folks

- Stan Walerczyk, LC, CLEP
 - Director of Lighting
 - Sun Energy Solutions
 - AEM (East Coast)
 - Sun Industries (West Coast)
 - 925-944-9481 (California)
 - Lightingwizard@sbcglobal.net
 - www.sunenergysolutionsllc.com
 - Many downloadable articles and links
- Thanks for coming