

IES Montreal Section

Martyn K Timmings LC

VP Market Development

***Canlyte a Philips Professional
Luminaires Brand***

Industrial Application of Hi Bays

Sorting out the options



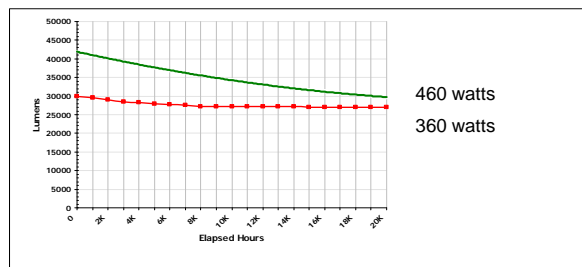
Today's "HiBay" Technology –

- 6 54Watt T5 HO fluorescents equal a pulse start 400 watt Metal Halide ?
- 6 - 5000 lumen lamps = 30000 lumens
- 1 - 400MH Probe Start = 42000 lumens
- Its all in the lumen maintenance



Compare Pulse Start to T5

- Lumens end up the same, so fewer initial lumens needed
- End of life LLD T5 = .92
- End of life MH400 pulse start .7 (Probe start EOL .55)



So Lets Light a Warehouse Aisle



Analyze the Space

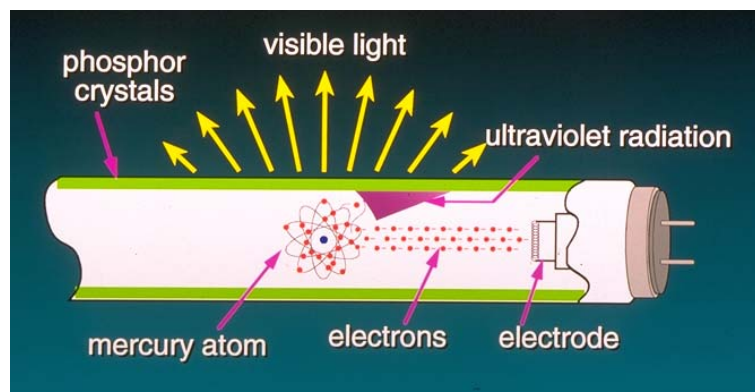
- 100 foot Aisle 8 feet wide
- Light to 30 FC, reflectance's 50/30/20
- Annual operating hours 6000
- Energy cost \$.08 KWhr
- Spot lamp replacement cost \$10
- Normal environmental conditions, 20'C, clean area

Why bother about environmental conditions?

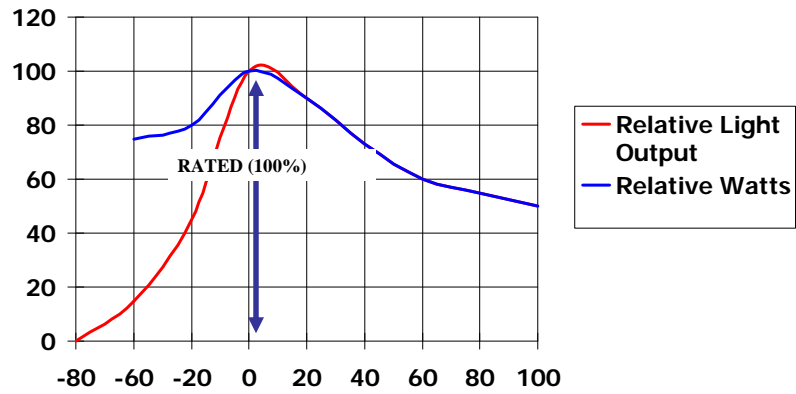
- Selection of the appropriate lighting fixture
- Determine light loss factors for calculations
- All fluorescent lamps are sensitive to the temperature they operate in



Fluorescent Lamp Performance

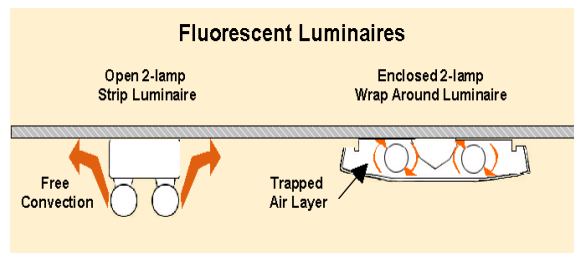


PERCENT OUTPUT AND WATTS



BULB WALL
TEMPERATURE ABOVE
AND BELOW OPTIMUM

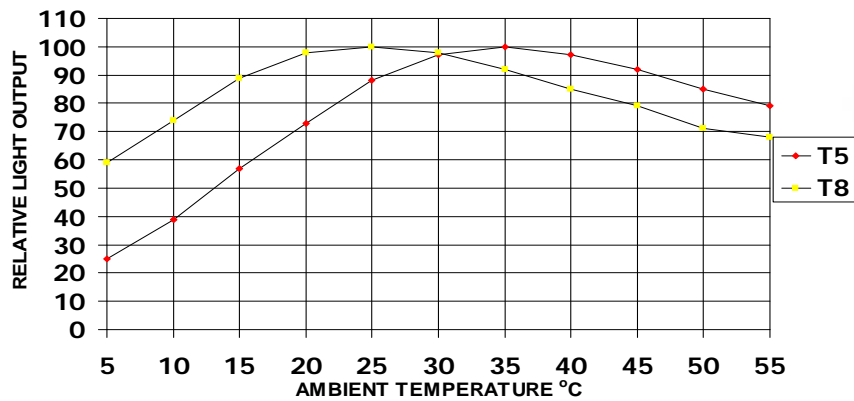
Light output vs. Operating Temp.



- Input Wattage to lamp/ballast system
 - Separate Wattages are meaningless
 - Often different wattages for same lamp/ballast system
 - Open luminaire
 - Enclosed luminaire
- ANSI

T5 Light Output Comparison another factor!

LUMEN OUTPUT VS. TEMPERATURE T8/T5



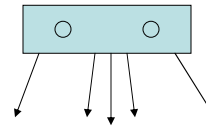
Fluorescent Photometry

- IES LM 91 – 98 Governs fluorescent lamp photometry
- Standard procedure:
 - Bare lamp measured at 25C ambient
 - Lamp data used to scale tested lamp to rated output – relative photometry
 - Luminaire data gathered in 25 C ambient



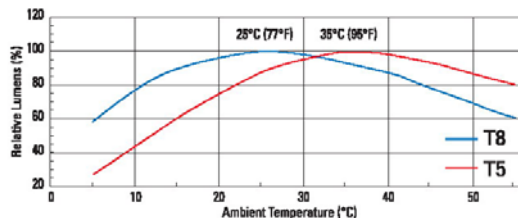
Relative Photometry

- Measured lamp on free air rack 25C = 4200 lumens
- Lamp “catalog” is listed 4400 lumens @25C (4%)
- Measured intensity at angle X
 - = 2000 cd
 - = 600 lumens
- Apply scale factor
 - Reported intensity at angle = $2000 \times 1.04 = 2080$
 - Reported lumens = $600 \times 1.04 = 624$
- Create photometric report based on scaled output



Enter T5 lamps peak output @35C

- Lumens can change from 4400 to 5000 lumen output if the luminaire is optimized for temperature
 - Some photometric reports > 100% eff.
 - We've been taught + 100% must be magic
 - Luminaire Efficiency is both Thermal and Optical
- What is really reported is “photometric efficiency”
 - Losses due to physical barriers and thermal energy differences

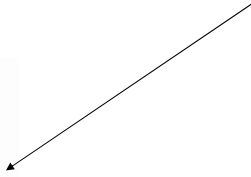


Back to our Warehouse

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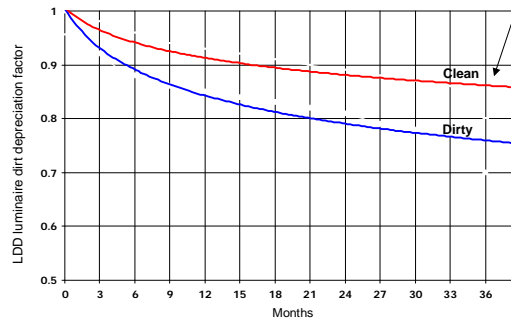
Check out the options in HiBay Lighting

- Need to gather data
- Check IES Dirt Depreciation charts



HID HIBay 3 year spot = .85 LDD

IES Luminaire Dirt Depreciation Category 11,
Generic HID HI- BAY



Lighting Data for PS MH HID

- Initial Lumens PS 44000
- End of Life Lumens 29400*
- Lamp Lumen Depreciation Factor .7
- Dirt depreciation @ 36 months .85
- Total Light Loss Factor $.7 \times .85 = .6$



* Catalogs publish mean lumens @ 40% rated life, in this application its unrealistic to use mean, as when a lamp goes out a large area is affected

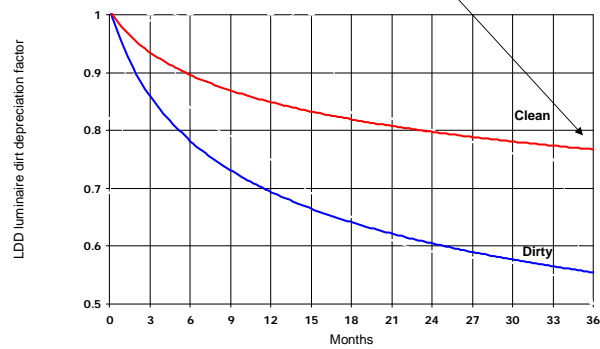
Alternate Design T5 HiBay

- Check IES Dirt Depreciation charts again



IES Luminaire Dirt Depreciation Generic Industrial Fluorescent Category V

36 Months T5 LDD = .78

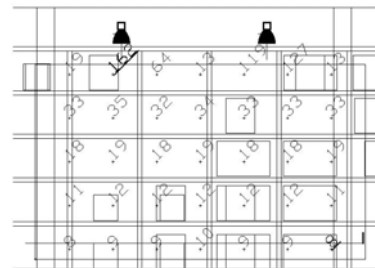
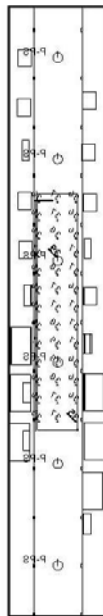


Lighting Data 6 lamp T5 HiBay

- 6 lamps 5000 lumens = 30000
- End of life lumens = 27000
- Lamp lumen depreciation factor .92
- Dirt Depreciation at 3 years = .78
- Total Light Loss Factor = .71



Layout Design



The Results T5 Wins

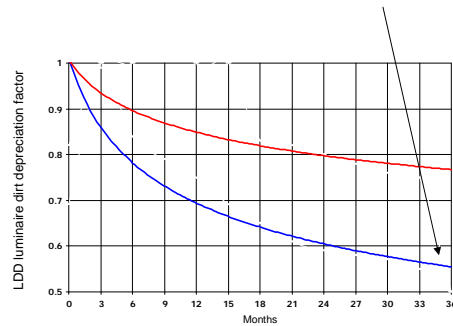
	6 lamp T5 Hi Bay	MH reflector 400 PS
# Fixtures Required	6	6
# watts per aisle	2160	2760
Annual Energy cost @ \$.08 kwhr	1036	\$1324
Annual Spot Maintenance cost	\$194	\$81
Total Annual operating cost	\$1231	\$1405
Foot-candles Hor	30	30
Foot-candles Vert.	16	15
Total Light Loss factor used	.76	.60

To Summarize

- Nice tidy job,
- Favorable dirt and ambient temperature conditions
- Lets change the environmental conditions

Non air conditioned space or industrial facility with contributed dirt

- Lamp lumen depreciation is the same
- LDD for Fluorescent now .55

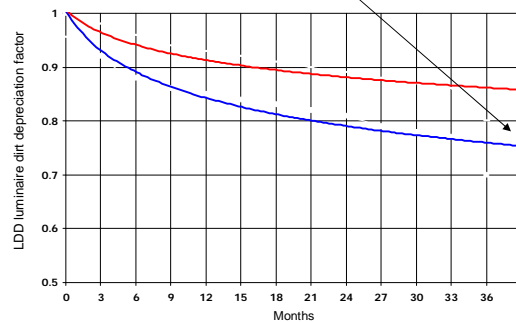


Graphs from IES handbook



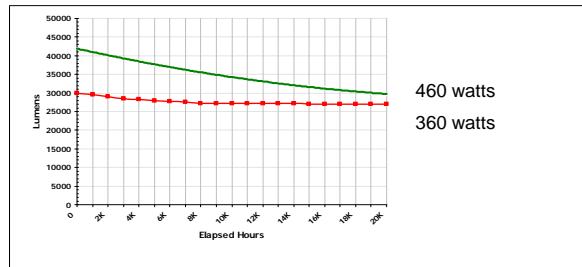
Non air conditioned space or industrial facility with contributed dirt

- Lamp lumen depreciation is the same
- LDD for Fluorescent now .55
- **How about the HID .78**



Compare LLD Pulse Start to T5

- Lumens end up the same, so fewer initial lumens needed
- End of life LLD T5 = .92
- End of life MH400 pulse start .7

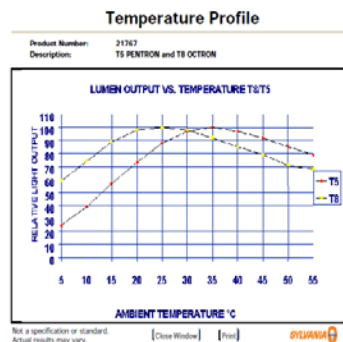


Typical Industrial is a hot place at the fixture mounting Height

- But fluorescents don't like the heat, the IES indicates temperature factor should be used any time the ambient temp. is outside 20C

IES Light Loss Factors

- LLD
- LDD
- TF
- BF
- RSDD



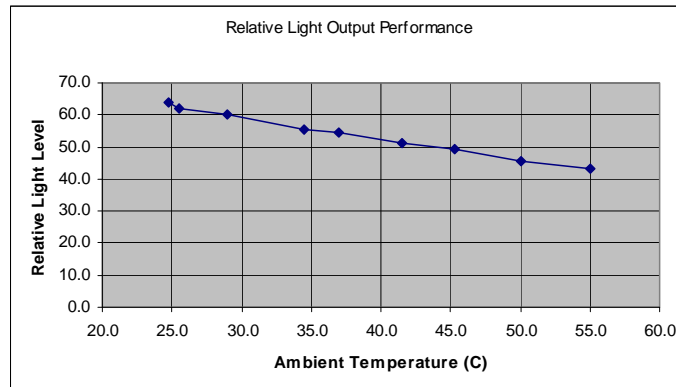
Application of test temperature factors

- Luminaire temperature tests over a 12 hour period
- Static test room with variable temperature from 25C to 55C
- Measurements of lumen output taken as ambient temperature increased

Real World Application

Measurement	Day	Time	Ambient Temperature ©				Ave. Temp.	Relative Light Level	Light Loss Factor
			Temp. #1	Temp. #2	Temp. #3	Temp #4			
1	04/24/2006	3:41pm	24	25	25	25	24.8	63.9	1.01
2	04/25/2006	8:42am	25	25	26	26	25.5	61.8	0.98
3	04/25/2006	3:28pm	29	29	29	29	29.0	60.2	0.95
4	04/26/2006	3:33pm	34	34	35	35	34.5	55.6	0.88
5	04/26/2006	8:55am	37	37	37	37	37.0	54.3	0.86
6	04/27/2006	8:42am	41	41	42	42	41.5	51.0	0.81
7	04/27/2006	12:01pm	45	45	46	45	45.3	49.3	0.78
8	04/28/2006	8:50am	50	50	50	50	50.0	45.8	0.72
9	04/28/2006	3:21am	55	55	55	55	55.0	43.0	0.68
Interpolated Light level at 25 deg. C							25.0	63.2	

T5 in Hi-Bays – not for every application



At 55C
illuminance
was
reduced by
30%

Non air conditioned space or industrial facility with contributed dirt

- Lamp lumen depreciation is the same .92
- LDD for Fluorescent now .55
- LDD for the HID .78
- But fluorescents don't like the heat, the IES indicates temperature factor should be used any time the ambient temp. is outside 20C
- Revised Data =
- **LLD .92 LDD .55 TF .7 Total LLF = .34**

Back to a lighting layout



Accounting for the Environmental Issues 55C and Dirty Conditions

	<i>6 lamp T5 Hi Bay</i>	<i>MH reflector 400PS</i>	
# Fixtures Required	12	6	
# watts per aisle	4320	3220	
Annual Energy cost	\$2073	\$1324	
Annual Spot Maintenance cost	\$388	\$81	
Total Annual operating cost	\$2462	\$1405	
Foot-candles Hor	30	32	
Foot-candles Vert.	15	16	
Total Light Loss factor used	.34	.54	

Lighting System Performance

- Related to environmental conditions
- Some lighting more susceptible to accumulating dirt and to poor performance due to temperature
- Operating conditions directly influence performance

Analyze the Data

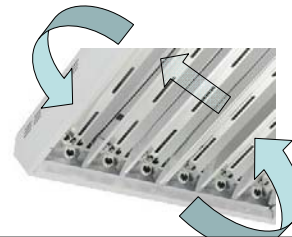
- YES! Fluorescent Hi Bays can be warranted to work in a 55C ambient
- Tests show ballast and lamps can “survive”
- Tests show performance (light output) suffers
- Know the application
- Select appropriate fixtures

Temperature is a ballast killer

- Case hot spot temperature fluorescent typically 70C (60000 hrs) 80C 30000 hrs
- Some newer HiTemp designs becoming available
- HID ballasts (mag) 90C core temp

Comparing Systems

- LUMENS are meaningless
- Consider
 - Quality of Light
 - Environmental Factors
 - Maintenance
- What about cold!!
 - Many successful arena applications – internal lamp compartment temperature is the deciding factor
 - Not suitable for freezers



Basic Systems Comparison

- HID
 - Not Temperature Sensitive
 - Some types self cleaning or dust tight in dirty areas
 - Cant be switched with sensors other than HiLo
 - Easier cleaning
 - 75% fewer lamps to maintain
- T5 HO (T8 in many apps)
 - On/Off for Occ. sensor application
 - Step or Continuous Dim for Daylight control
 - Good to excellent colour
 - Lowest installed watts



Nothing is forever!

- T5 Lamp watts changing
- T5 Amalgam lamps
- T8 high output systems
- New 315 watt CMH 34000 lumens 90CRI, 20000+ hrs
- Electronic HID ballasts

Ask for Data and Analyze Analyze

