



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

Lamp, Ballast, and Lighting Technologies

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First, a No-Brainer...

LED Technology for Exit Signs





LED Exits = \$ Savings

	LED	Fluorescent	Incandescent
Lamp Cost	N/A	7.79	6.08
No. of Lamps	2	2	2
Lamp Life	Indefinite	10,000	7,000
Labor Rate	N/A	\$20 / Hr	\$20 / Hr
Input Watts	2W (2 lamps)	18 W	40 W
Energy Costs	.09 KwH	.09 KwH	.09 KwH
Relamp Labor	N/A	\$15 / Hr	\$15 / Hr
Lamp Maint Cost	0	\$16.28	\$18.97
Annual Energy Cost	\$1.58	\$14.19	\$31.54
Annual Operating Cost	\$1.58	\$30.47	\$50.51



Next... new HID technology

- Pulse Start
- Electronic Dimming





- Versus Standard Metal Halide:
 - Higher light levels
 - More energy efficient
 - Improved lumen maintenance
 - Faster re-strike and recovery after an outage





Metal Halide Comparison

	400 watt Standard	400 Watt Pulse Start
Total Initial Lumens	36,000	42,000
Mean Lumens (@40%)	25,000	32,800
Rated Life (10 hrs/strt)	20,000	20,000
Input Watts	458	452
CRI	65	65



Higher Light Levels allow Fewer Fixtures

100,000 sq.. ft

20 Ft. Mounting Height

High Bay Fixture

50 FC Maintained

400 W. Standard:

290 Fixtures

400 W. Pulse Start:

208 Fixtures

Annual Operating Savings = \$8,942

(3800 hrs/yr @ .06kWh)



Or an Energy-Saving 1-for-1 Retrofit

Application Scenario:

100,000 sq.. ft

20 Ft. Mounting Height

High Bay Fixture

50 FC Maintained

400 W. Standard:

290 Fixtures

320 W. Pulse Start:

290 Fixtures

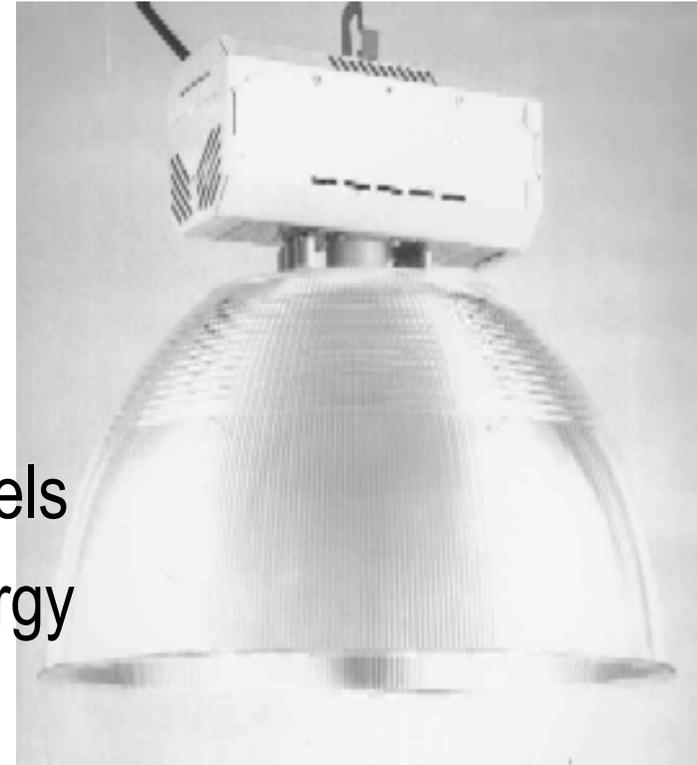
Annual Operating Savings = \$6,932

(3800 HRS/YR @ .06 kWh)



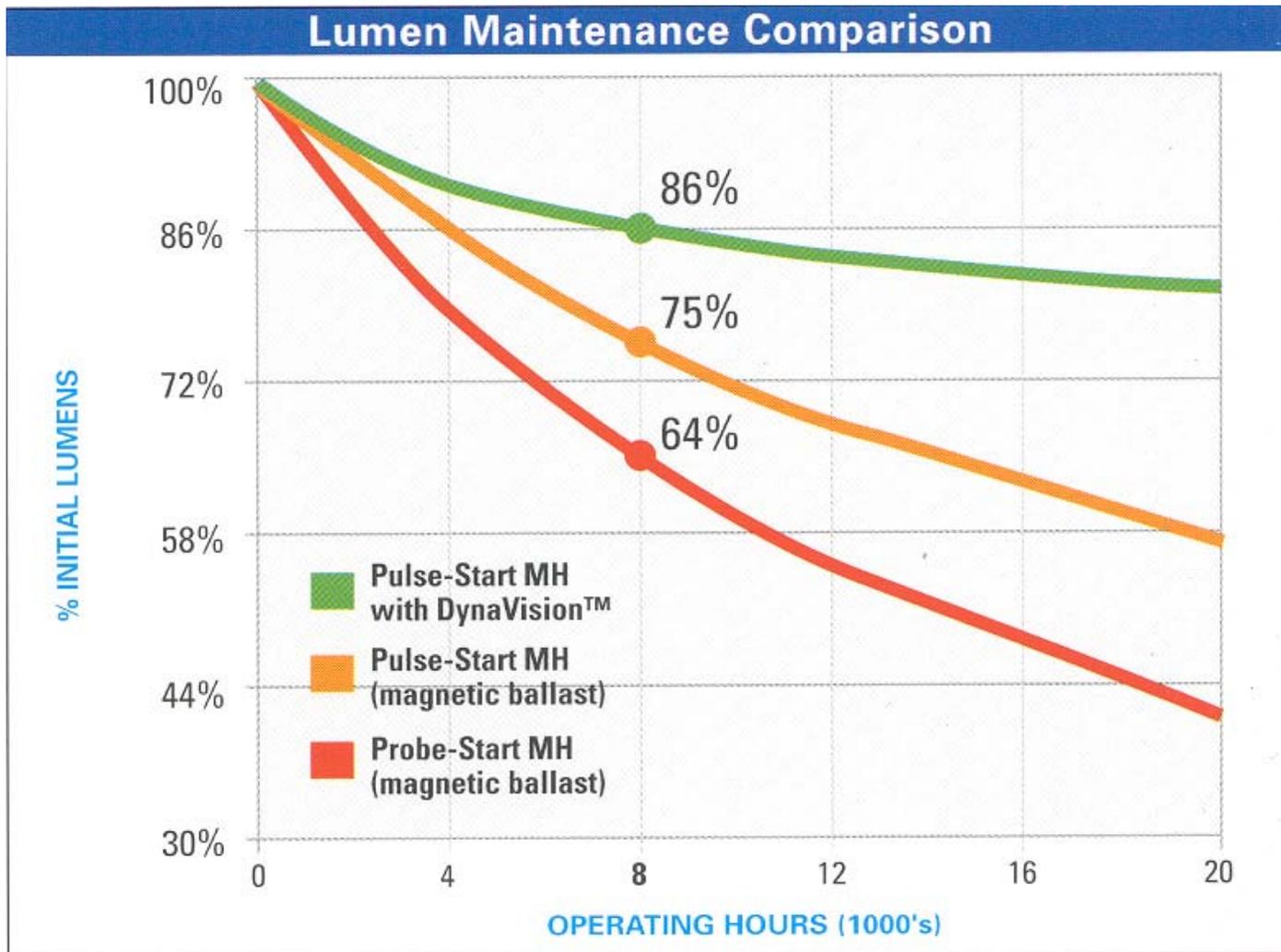
Electronic Dimming HID

- Pulse Start Technology
- Even Higher Maintained Light Levels
- 100 to 28% Dimming to Save Energy
- Inexpensive Low-Voltage Controls





Electronic Dimming HID





Electronic Dimming HID

400W Probe Start Magnetic CWA	400W Pulse-Start Magnetic SCWA	400W Pulse-Start GEB	T5HO Industrial Luminaire
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Mean Lumens/Lamp	23,000	30,240	37,000	28,440
No. Fixtures Req'd	124	100	77	100
Fixture cost ea.	\$ 101	\$ 121	\$ 295	\$ 162

Total Fixture Cost	\$ 20,526	\$ 18,600	\$ 28,440	\$ 24,200
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Annual Energy Costs	\$ 33,386	\$ 27,480	\$ 19,601	\$ 21,060
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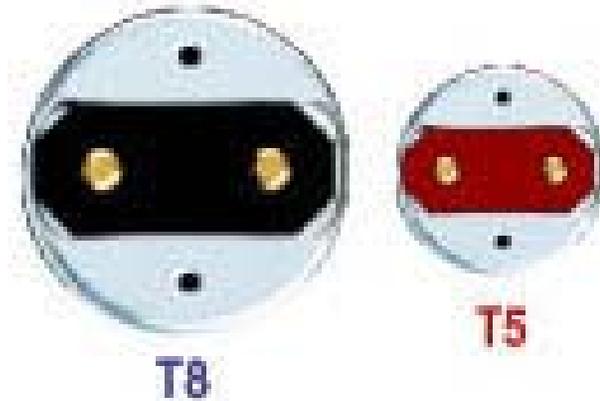
3 Year Total Cost	\$ 120,684.52	\$ 101,040.00	\$ 87,241.62	\$ 87,380.00
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Optimum Temp Range	85 C	85 C	75 C	10 C
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Introducing – Fluorescent Alternatives for Gymnasiums

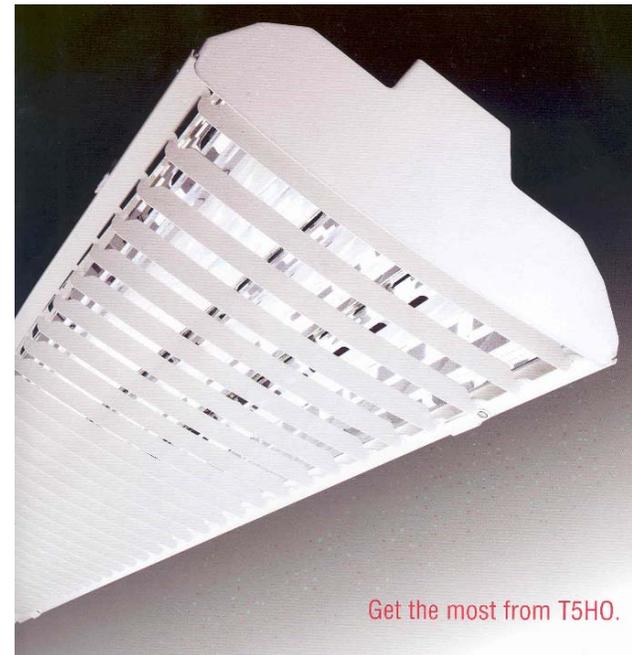
- T8
- T5HO





Fluorescent High-Bay

- Compact size for retrofit applications
- Single-point pendant mounting
- 3 to 6 to 8-lamp configurations
- Precise Optical Control
 - Narrow and wide distributions



Get the most from T5HO.



Fluorescent System Comparison

	400 watt Standard	6-Lamp T- 5 HO	4-Lamp T- 5 HO	6-Lamp T8
Total Initial Lumens	36,000	30,000	20,000	22,320
Mean Lumens (@40%)	25,000	28,500	19,000	21,204
Rated Life (10 hrs/strt)	20,000	24,000	24,000	24,000
Input Watts	458	351	234	234
CRI	65	85	85	80 - 85



400MH to T8 Fluorescent

- ◆ 400watt Metal Halide to 6lamp F32T8 Industrial.
- ◆ Increase light level from 30 to 50, one for one replacement.
- ◆ From 450 watts to 224 watts. Delayed start to instant on.
- ◆ CRI from 65 to 85, increasing color rendering dramatically.









So What Do I Use?

Important Factors to Consider

- **Required Lighting Levels**
 - Mounting Heights
 - Distribution Needs
- Ambient Temperature
- Supplemental Controls – occupancy sensors, photocells, step dimmers, dimmers
- Human Issues



Required Light Levels

IES Recommended Levels of Illuminance

Storage/Warehousing

Inactive	5 fc
Active Large Items/Labels	15 fc
Active Small Items/Labels	25 fc



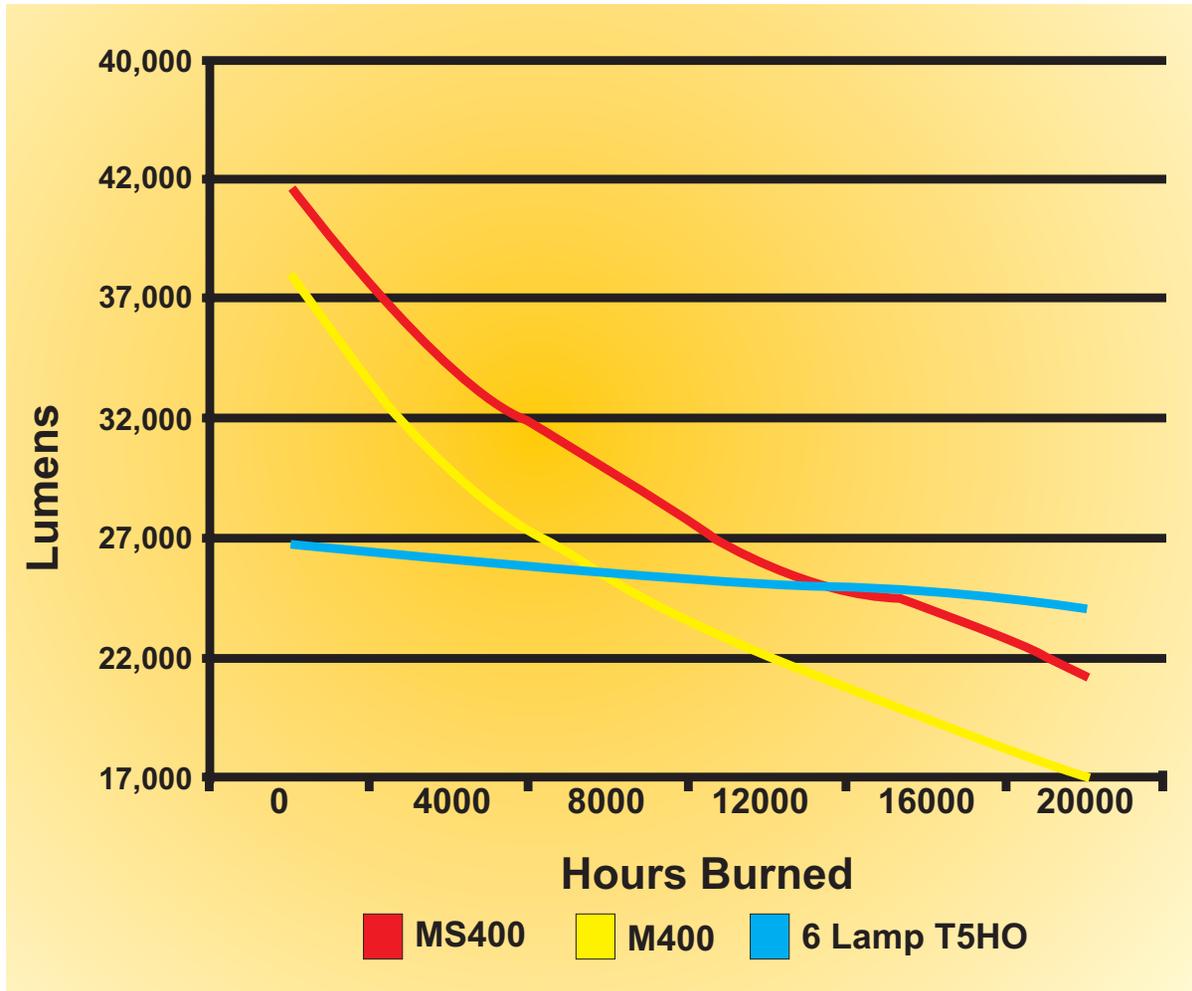
Before



After



Lumen Maintenance

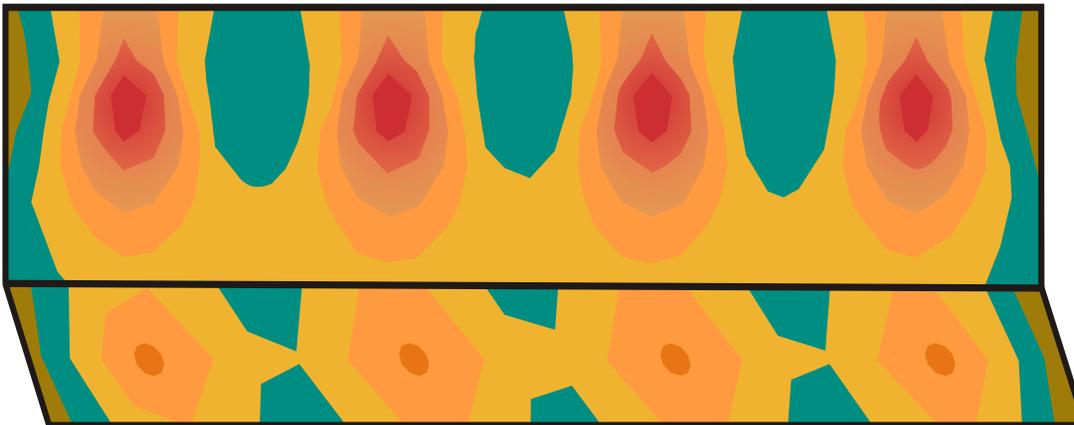




Uniformity



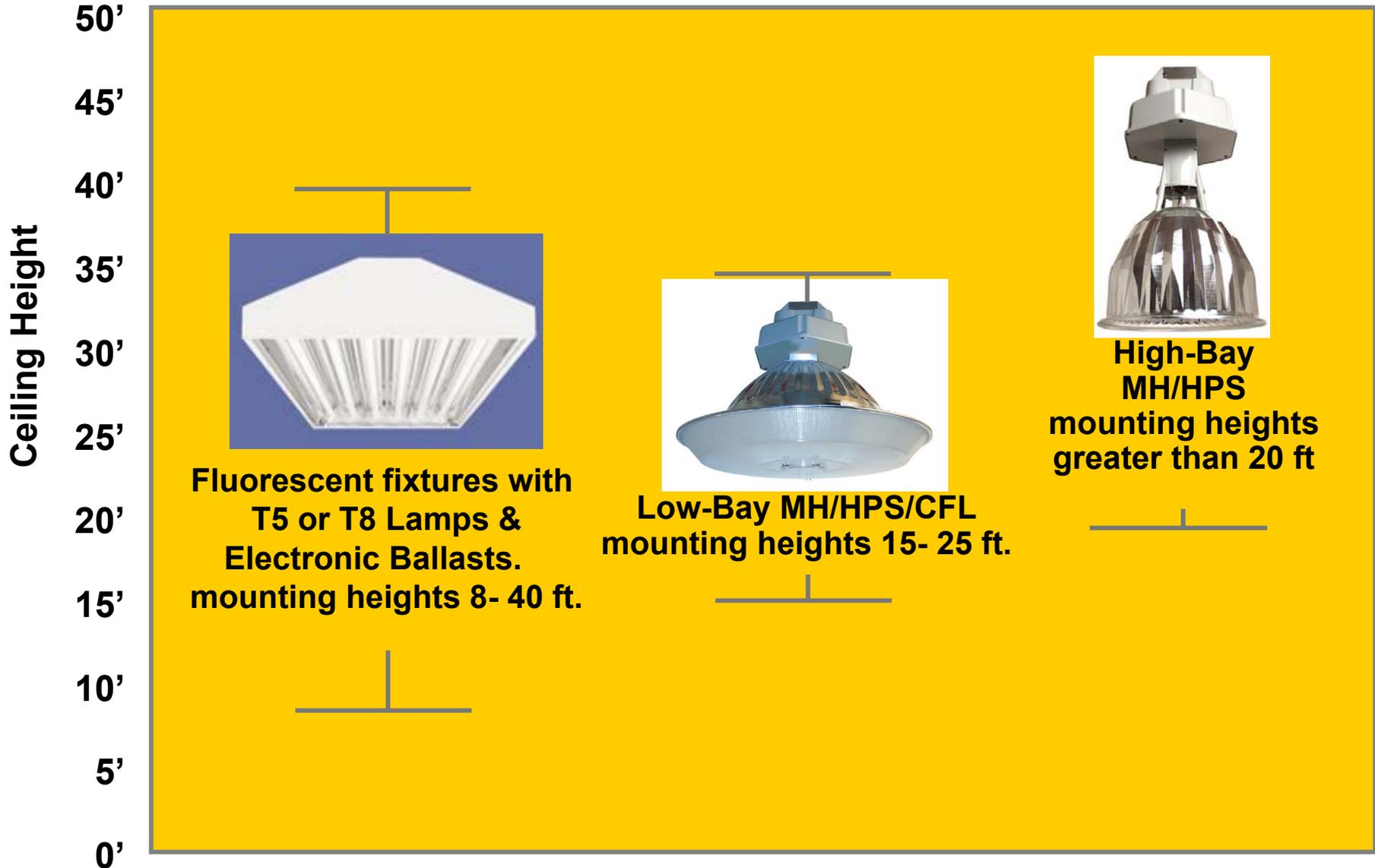
Linear T5HO



400W Metal Halide



Mounting Heights





Factors to Consider

Required Lighting Levels

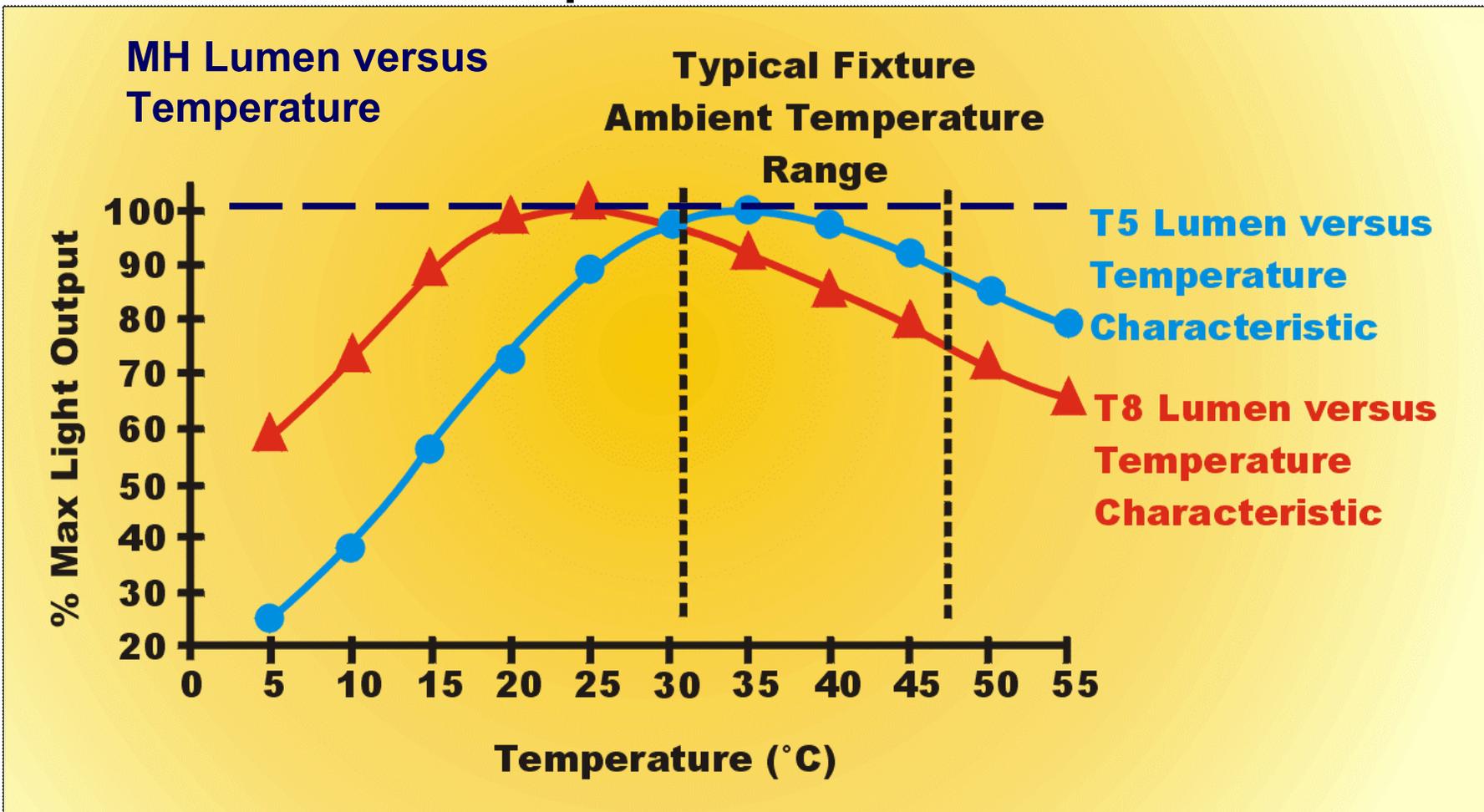
- Mounting Heights
- Distribution Needs

- **Ambient Temperature**

- Supplemental Controls – occupancy sensors, photocells, step dimmers, dimmers
- Human Issues



Ambient Temperature





Factors to Consider

- Required Lighting Levels
 - Mounting Heights
 - Distribution Needs
- Ambient Temperature
- **Supplemental Controls** – occupancy sensors, photocells, step dimmers, dimmers
- Human Issues



Supplemental Controls

- Occupancy Sensors
 - *100% Energy Savings*
 - *Improves Lamp Life (Calendar)*
- Time clocks
- Dimming
 - Fluorescent
 - HID
- Ambient Light Monitors / Daylight Harvesting



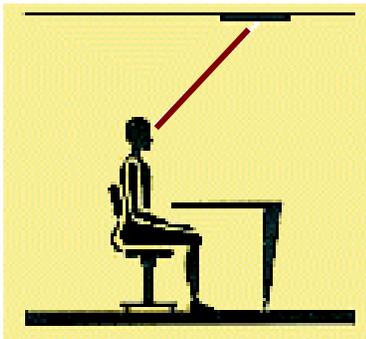
Factors to Consider

- Required Lighting Levels
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- Supplemental Controls – occupancy sensors, photocells, step dimmers, dimmers
- **Human Issues**



Human Issues

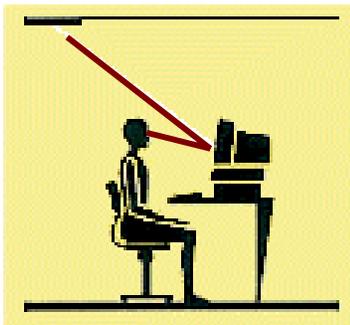
Poor lighting contributes directly to eyestrain symptoms of headaches and decreased visual efficiency.



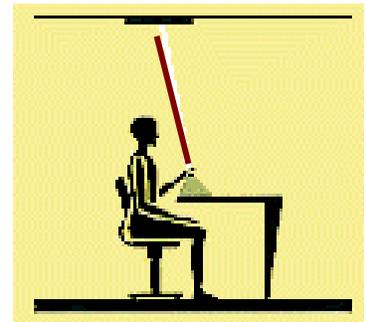
Direct Glare



Veiling Reflections



Reflected Glare



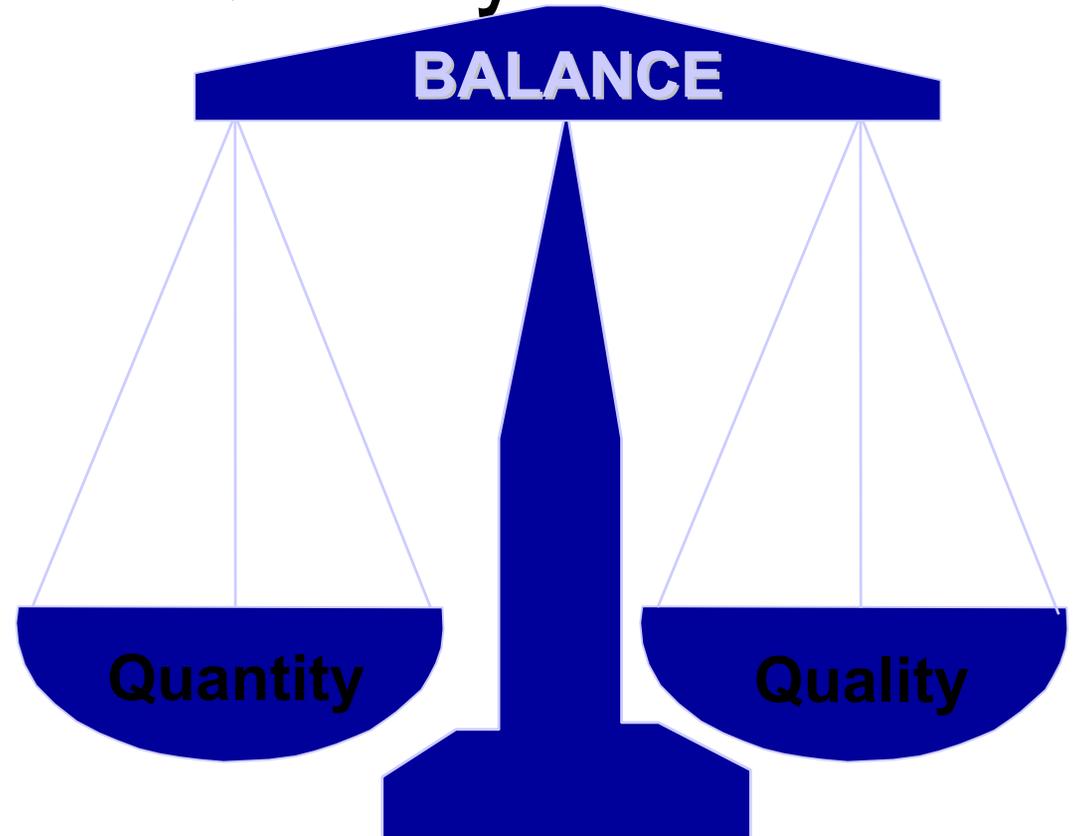
**Harsh
Shadows and
High Contrast**

Harsh, directional light can make people feel tense and nervous.



Balance Quality vs. Quantity

- Glare
- Contrast
- Shadowing
- Color Quality





Electronic T8



- Better color qualities than T12
- Easily and inexpensively dimmed
- All three and four-lamp fixtures are short payback opportunities due to the single three and four-lamp electronic ballast.
- Four lamp T-12 fixture conversion to a 3 lamp T-8 offers 50% energy Savings



T-12 VS T-8 Fixture Comparison

	T12	T8
Light Output		
# of lamps	4	3
Lumens	2650	2850
Total Lumens	10600	8550
BF	0.88	0.9
Lamp Lumen Depreciation	0.87	0.95
Fixture Efficiency	66.6	80.1
Delivered Mean Lumens	5405	5855
% Light		108.3%
Energy		
Input Watts	164	81
hours burned	3800	3800
Cost per kWh	0.06	0.06
Annual Cost per fixture per year	\$ 37.39	\$ 18.47
Savings		51%
based on T12 energy saving lamp and energy saving ballast		
25% reduction of energy		



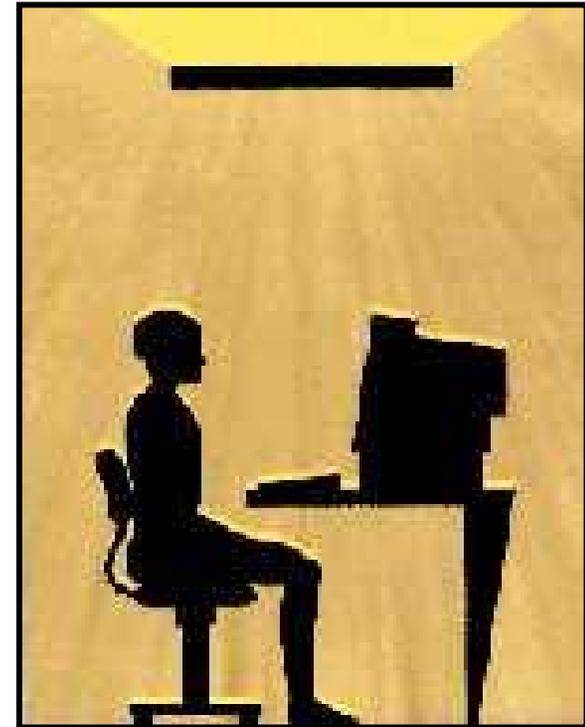
Suspended Direct/Indirect Luminaries

- High Performance with Visual Comfort
 - Even, low-glare illumination
 - Shadow-free
- Energy Savings - T8 and T5HO Lamps
- Flexibility/Fast Installation
- Value – Low Installed Cost

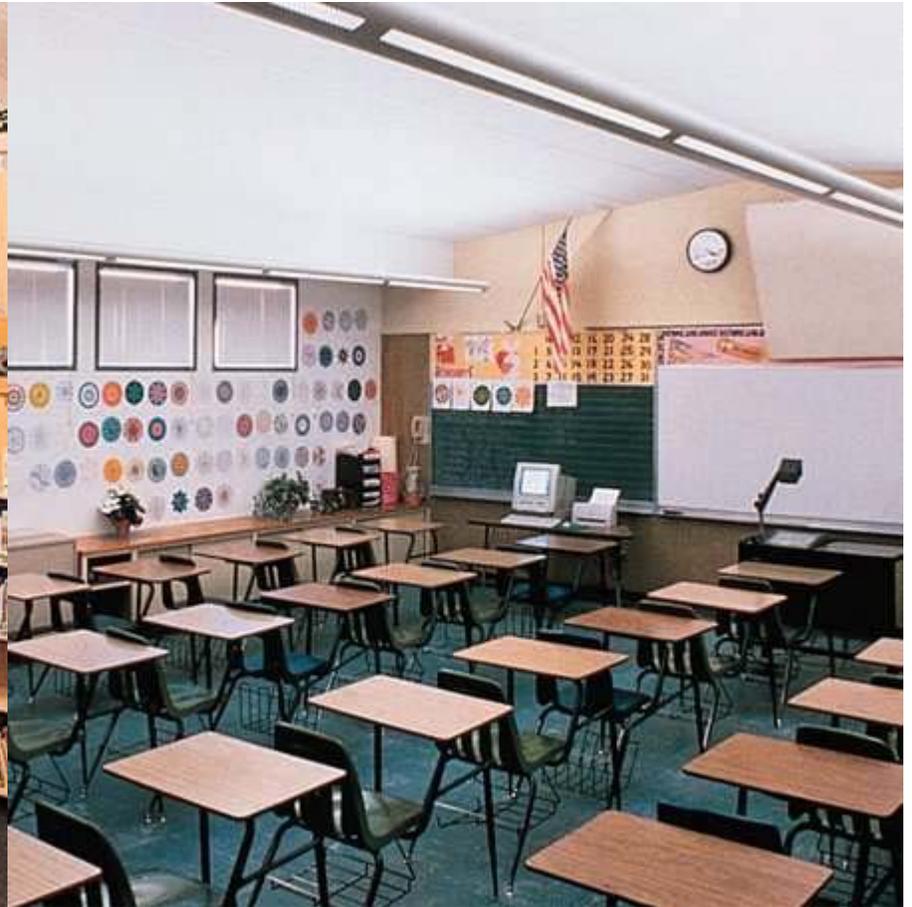


Indirect Lighting allows people to see what they are doing without physical strain.

- Reduced glare
- Minimized Shadow & Contrast
- Balanced Lighting Levels



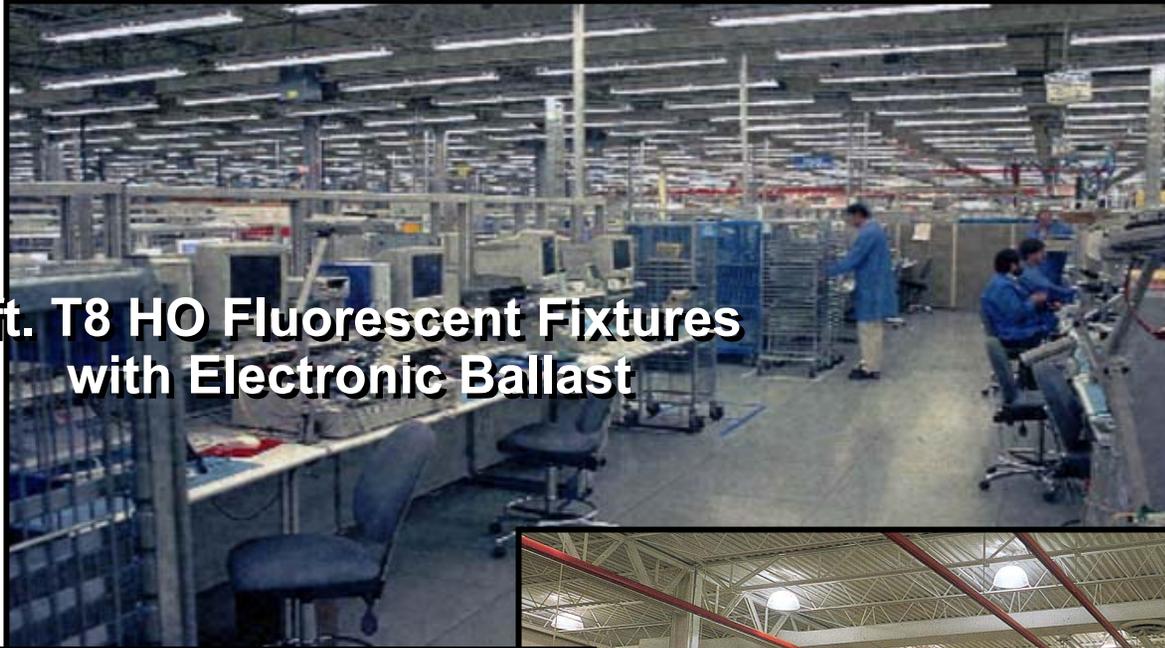






Thank You !

**3ft. T8 HO Fluorescent Fixtures
with Electronic Ballast**



High Bay Fluorescent Fixtures



PulseArc Metal Halide Fixtures

