An Energy-Efficiency Workshop and Exposition
Orlando, Florida

The ABCs of Energy – Part 1

Understanding Lighting Systems and Retrofits

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Linear Fluorescent Systems

Lamp Life

- Lamp type
- Starting method
- Burning hours

Lamp Types

- Existing
  - 40W and 34W T12
- New
  - 32W, 30W, 28W T8
    - Direct Retrofit
  - 54W, 28W, T5
    - New fixtures

T8 Lamps

- Standard – 32W, 2850-2950 lms, 15-20K hrs
- High lumen – 32W, 3100 lms, 15-30K hrs
- Long life – 32W, 2850-2950 lms, 20-24K hrs
- Energy-efficient – 30W, 2850-2900 lms, 15-20K hrs
  28W, 2750 lms, 15-18K hrs

T8 Lamps

- Compromises with 28W & 30W lamps
  - Not dimmable
  - Minimum starting temperature = 60°F
  - Instant start only*
  - No ANSI specification

*One manufacture allows program start

T5 Lamps

- High efficiency – 28W, 2900 lms, 20K hrs
- High output – 54W, 5000 lms, 20K hrs

How does the ballast impact lamp performance?

The Ballast and the Emitter

"Lamp mortality is a function of emitter depletion."

"When you run out of emitter, you run out of lamp life."

The Ballast and the Emitter

Four Types of Electronic Ballasts

1. Instant Start
   - Standard
   - Energy-efficient
2. Rapid Start
3. Program Rapid Start
   - Standard
   - Energy-efficient
4. Programmed Start

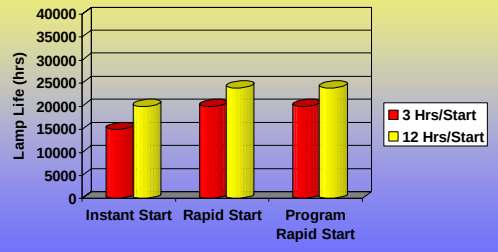
Starting Methods

- Instant Start
  - Instant on
  - Maximum energy savings
  - 10 – 15K switch cycles
- Rapid Start
  - Low voltage applied prior to lamp ignition
  - 1.5 – 2W loss per lamp
  - 15 – 20K switch cycles

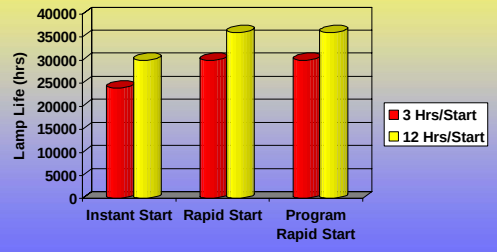
Starting Methods

- Program Rapid Start
  - Pre – heats cathodes to 650°C
  - Used with occupancy sensors
  - 30K switch cycles
- Programmed Start
  - Pre – heats cathodes to 700°C
  - Maximum lamp life
  - Up to 50K switch cycles

Lamp Burning Hours Standard T8



Lamp Burning Hours Long Life T8



Ballast Factor

- What is it?
- What does it "do"?
- Why should you care?

Ballast Factor

- Percentage of lamp lumens from a commercial ballast vs. an ANSI bench ballast
- Measure of lamp lumens when connected to the ballast

Ballast Factor

$$\text{Ballast Factor} = \frac{\text{Commercial Ballast Light Output}}{\text{Laboratory Ballast Light Output}}$$

Ballast Factor ~ 'Multiplier'

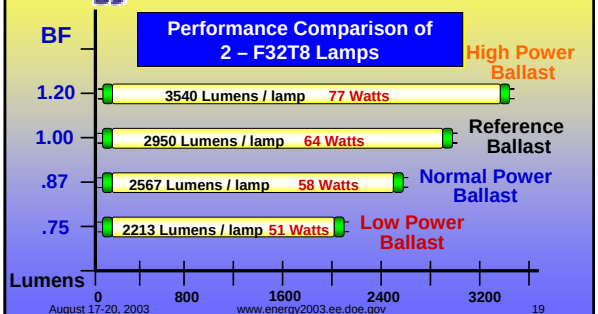
Ballast Factor and Light Output

Ballast Factor Enables "Tweaking"

- LW (.75), Std (.88), or HL (1.20)
- Use the "1 less" method*
  - I.e. Operating 3 lamps on 4 lamp ballast
- Dimming – the ultimate tweak
  - From 1.0 to .05 ballast factor

*active current regulation eliminates this option

Ballast Factor



Smart Solutions

Ballast	LAMP BALLAST COMBINATIONS			ADVANCE SMART SOLUTIONS							
	Standard, Normal Light, IS ballast	Hi-efficiency, Normal Light, IS ballast	Hi-efficiency, Low Watt, PS ballast	Standard, Normal Light, IS ballast	Standard, Low Watt, IS ballast	Standard, High Light, 1 lamp IS ballast	Standard, High Light, IS ballast	Optanium, Normal Light, IS ballast	Optanium, Low Watt, PS ballast	Optanium, Low Watt, IS ballast	Optanium, Low Watt, IS ballast
Lamp	Standard T8 lamp	30W T8 lamp	Hi-lumen T8 lamp	30W T8 lamp	Hi-lumen T8 lamp	Hi-lumen T8 lamp	Standard T8 lamp	30W T8 lamp	Hi-lumen T8 lamp	30W T8 lamp	Hi-lumen T8lamp
Lamp Rated Watts	32W	30W	32W	30W	32W	32W	32W	30W	32W	30W	32W
Initial Lumens	2850	2850	3200	2850	3200	3200	2850	2850	3200	2850	3200
Design Lumens	2710	2675	3040	2675	3040	3040	2710	2675	3040	2675	3040
Number of lamps	2	2	2	2	2	1	2	2	2	2	2
Ballast Factor	0.88	0.88	0.74	0.88	0.78	1.41	1.2	0.88	0.77	0.78	0.78
System Lumens	4770	4708	4499	4708	4742	4266	6504	4708	4682	4173	4742
Input Watts	68	52	48	54	51	49	79	52	48	45	48
Relative Light Output	Base 100%	99%	94%	99%	99%	90%	136%	99%	98%	87%	99%
LPW	81	91	94	87	93	87	82	91	98	93	99
Starting Method	Instant Start	Instant Start	Programmed Start	Instant Start	Instant Start	Instant Start	Instant Start	Instant Start	Programmed Start	Instant Start	Instant Start
Min Starting Temp.	0F	60F	0F	60F	0F	0F	0F	60F	0F	0F	0F
Lamp Dimming Capability	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Lamp Life	15,000 hr IS	15,000 hr IS	30,000 hr PS	15,000 hr IS	18,000/24,000 hrs. for IS	18,000/24,000 hrs. for IS	15,000 hrs for IS	15,000 hr IS	30,000 hr PS	15,000 hrs. for IS	18,000/24,000 hrs. for IS
Relative Cost	$	$ + $$	$ + $$$	$ + $	$ + $	$	$ + $	$ + $$	$ + $$$	$ + $$	$ + $$
Low Profile	Some	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Warranty/Service	Standard Warranty	Standard Warranty	Standard Warranty	Advance Plus 90	Advance Plus 90	Advance Plus 90	Advance Plus 90	Advance Plus 90	Advance Plus 90	Advance Plus 90	Advance Plus 90
Comments			More wires / not easily retrofittable			1 less lamp required			More wires / not easily retrofittable		

Ballast	Standard, High Light, IS ballast	Optanium, Normal Light, IS ballast	Optanium, Low Watt, PS ballast	Optanium, Low Watt, IS ballast	Optanium, Low Watt, IS ballast
Lamp	Standard T8 lamp	30W T8 lamp	Hi-lumen T8 lamp	30W T8 lamp	Hi-lumen T8lamp
Lamp Rated Watts	32W	30W	32W	30W	32W
Initial Lumens	2850	2850	3200	2850	3200
Design Lumens	2710	2675	3040	2675	3040
Number of lamps	2	2	2	2	2
Ballast Factor	1.2	0.88	0.77	0.78	0.78
System Lumens	6504	4708	4682	4173	4742
Input Watts	79	52	48	45	48
Relative Light Output	136%	99%	98%	87%	99%
LPW	82	91	98	93	99
Starting Method	Instant Start	Instant Start	Programmed Start	Instant Start	Instant Start
Min Starting Temp.	0F	60F	0F	60F	0F
Lamp Dimming Capability	Yes	No	Yes	No	Yes
Lamp Life	15,000 hr IS	15,000 hr IS	30,000 hr PS	15,000 hrs. for IS	18,000/24,000 hrs. for IS
Relative Cost	$	$ + $$	$ + $$$	$ + $$	$ + $$
Low Profile	Some	No	Yes	Yes	Yes
Warranty/Service	Standard Warranty	Advance Plus 90	Advance Plus 90	Advance Plus 90	Advance Plus 90
Comments			More wires / not easily retrofittable		

Features to watch for…

- Use ballasts with auto reset circuit
- Ballast factor and input watts differ between manufacturers
  - Use Ballast Efficiency Factor (BEF) for accurate energy efficiency comparison
  - BEF=Ballast Factor/Input Watts
  - Use lumens/watt for comparison of amount of light for energy used

Compact Fluorescent Systems

Lamp Types

- Traditional low wattage (4-pin)
  - 13W – 42W (60W – 150W Incandescent)
- New high wattage
  - 57W, 70W
    - Operate on existing CFL ballasts
  - 60W, 85W, 120W
    - Require new ballasts

High Intensity Discharge (HID) Systems

Metal Halide Lamp Types

- Pulse Start
  - Quicker start/restrike vs. traditional MH
  - Longer life (15 0K hrs)
  - Improved lumen maintenance
  - Increased efficacy (LPW)

Metal Halide Lamp Types

- Ceramic metal halide
  - Lower wattage (20W, 35W)
  - Improved color rendering (up to 92 CRI)
  - Color stability over life (±200K)
  - Increased efficacy (LPW)
  - HPS direct retrofit*

*Offered by one manufacturer

HID Ballast Trends

- Electronic
- Smaller
- Lighter
- Dimmable

Applications

- Today, multiple options for the same application
- Fixture manufacturers no longer lamp based.
  - HID
  - Fluorescent
- Fixture manufacturers now market segment based
  - i.e. Industrial

Applications

- Industrial – Low Bay
  - Metal Halide
    - Requires warm up/restrike time
    - Good cold temperature operation
  - T5/HO
    - No warm up/no restrike
    - Poor cold temperature operation
  - High wattage CFL
    - No warm up/no restrike
    - Poor cold temperature operation

What are your needs?

- Lowest energy consumption
- Maintain, increase or decrease existing light level
- Highest lumens/watt (LPW)
- Minimum upfront investment
- Longest lamp life
- Ease of Installation
- Cold temperature starting
- Lamp dimmability

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