

Light Sources for Street Lighting

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OSRAM SYLVANIA



A Quick bit about Bill

- Optical Engineer by training
- 16 years with SYLVANIA
- 2 year in current job
- Focus on
 - Specifications
 - Technical assistance
 - Street Lighting
 - Utility Incentives



The Subject List

- HID Lamps
 - Lumalux Plus Sodium Lamps
 - Lumalux Standby Sodium Lamps
 - Pulse Start HID Lamps
 - Ceramic Metal Halide
- ICETRON Systems
- LED Systems
 - What is an LED anyway?
 - Two fixtures
- Decision Factors

HID & High Pressure Sodium



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LUMALUX PLUS®/ECO®

- 40,000+ Hour Rated Life
- Better Light Output
- Non-Cycling- Lamps shuts off at end of life
 - Reduced service & maintenance costs -- no wasted trips
- Environmentally Friendlier
 - Pass Federal TCLP*
 - 90% less Hg than standard lamps
 - Lead-free, welded base
 - Reduced base failures

50W – 1000W**



* Based on NEMA LL Series Standards

What makes LU PLUS non-cycling?

- High Pressure Rare Fill gas to lower arc tube wall operating temperature
 - Xe-Ar Fill vs. Ar only (std)
- Patented material BSY₂ (Barium Strontium Yittrate)
 - Emissive coating on electrode
- 90% Less mercury content than that of standard Lumalux®
 - Ignition Aide required

LUMALUX® STANDBY



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LUMALUX® STANDBY

- Dual arc tube construction
- Second arc tube ignites when there is a momentary power interruption
- Extremely long life of 40K hours
- Similar lamp performance as the standard HPS
- Full Range available 70W-1000W
- Direct retrofit for standard HPS lamps
 - Wattages need to be the same
 - Always check ANSI codes
- Applications
 - Parking lots/garages
 - Security lighting
 - Street and tunnel lighting
 - Disney



METALARC®
PULSE START

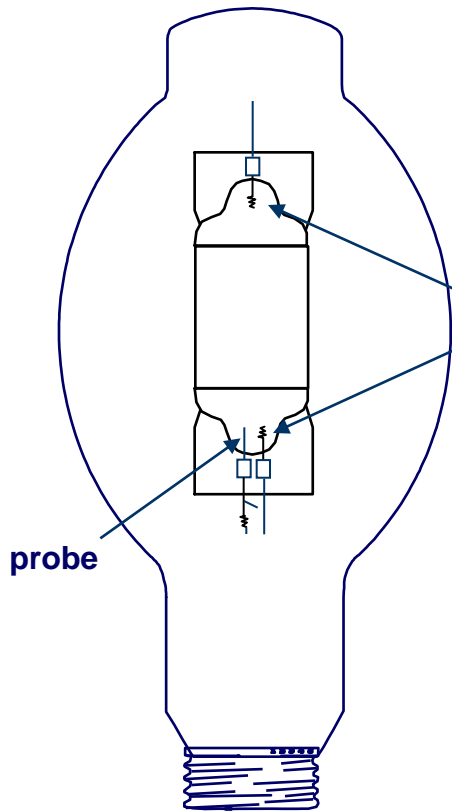


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SYLVANIA

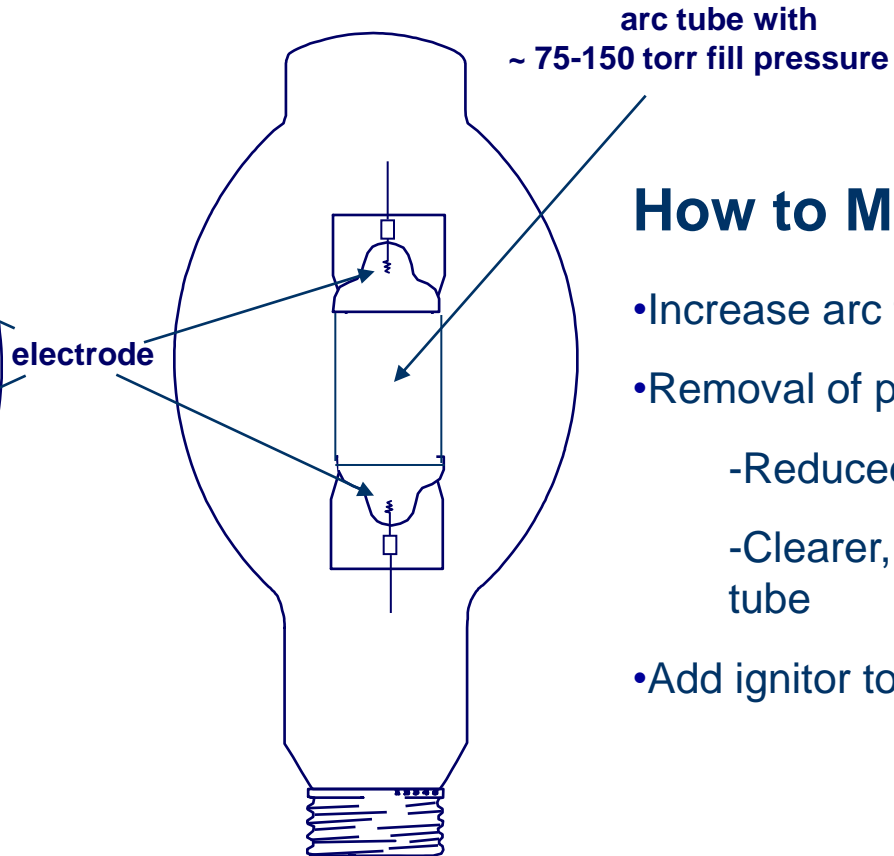


What is METALARC[®] PULSE START?

Probe Start (Standard)



Pulse Start



How to Make Pulse Start:

- Increase arc tube fill pressure
- Removal of probe:
 - Reduced tungsten evaporation
 - Clearer, more transparent arc tube
- Add ignitor to ballast

Federal Energy Independence and Security Act of 2007 (EISA):

Covers

- New metal halide luminaires operated with lamps $\geq 150\text{W}$ but $\leq 500\text{W}$
- These luminaires shall contain one of the following:
 - A pulse-start metal halide ballast with a minimum ballast efficiency of 88%
 - A magnetic probe-start ballast with a minimum ballast efficiency of 94%
 - A non-pulse-start electronic ballasts with
 - A minimum ballast efficiency of 92% for wattages $> 250\text{W}$
 - A minimum ballast efficiency of 90% for wattages $\leq 250\text{W}$

Exclusions

- Luminaires with regulated lag ballasts
- Luminaires with electronic ballasts to operate at 480V
- Luminaires that
 - Are only rated for 150W lamps, and
 - Are rated for use in wet locations, and
 - Contain a ballast that is rated to operate at ambient air temperatures above 50°C

Effective Date

- Applies to luminaires manufactured on or after 1/1/2009
- State laws with earlier effective dates will remain in effect until the Federal standards become effective

METALARC[®] PULSE START: *Benefits*

- Improved lumen maintenance
- Reduced color shift
- More light output over life
- Faster re-strike time
- Potentially longer life

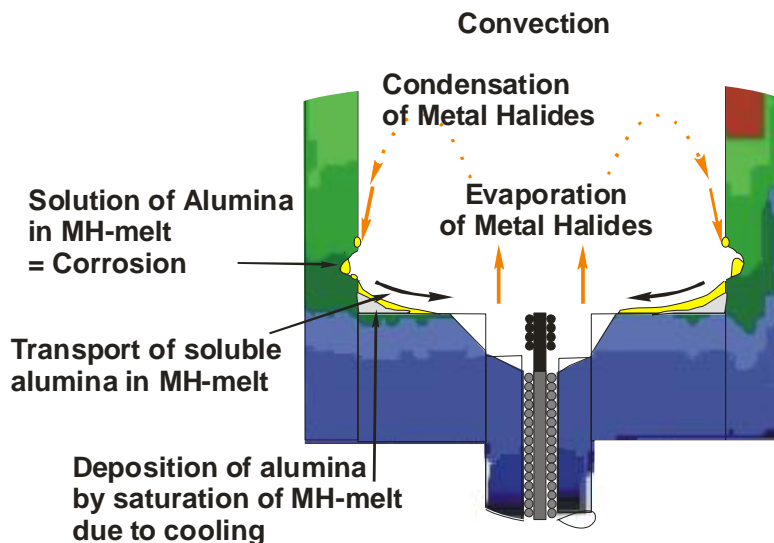


Advanced Ceramic Arc Technology

The POWERBALL® Difference

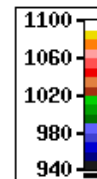
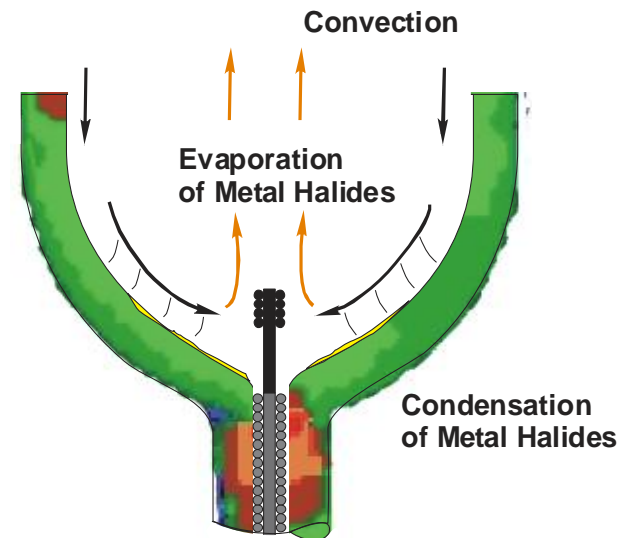
Design Advantage

Cylindrical arc tube (SYLVANIA, 1999)



- Varying wall thickness
- Square end-bell geometry
 - » Heat loss
 - » MH condensation

Spherical arc tube (SYLVANIA, today)

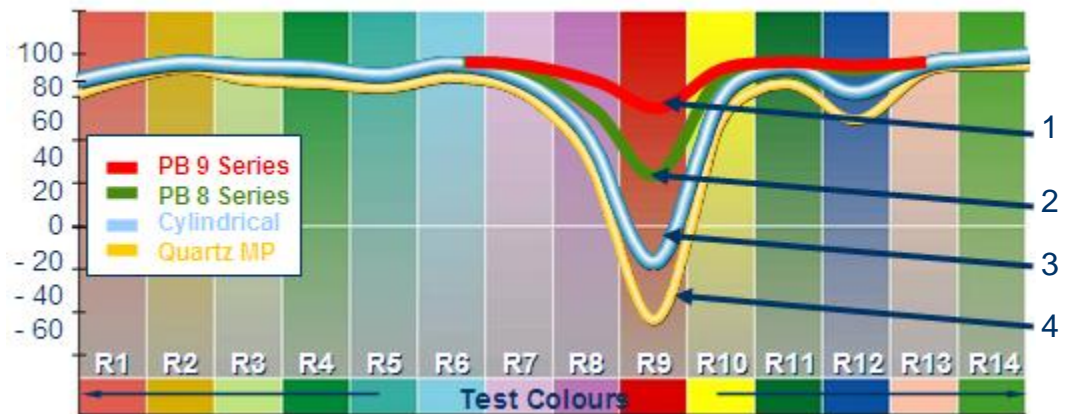


- Consistent arc tube wall thickness
- Optimal end bell geometry
 - » Uniform arc tube temperatures
 - » Full MH Evaporation

Advantages of POWERBALL® Technology

Design Advantage

- Longer life than standard lamps
 - 12,000 vs. 9,000 avg. rated life (PAR & T/TC types)
- Reduced color shift
 - Less than $\pm 100K$
- Better color rendering
 - 82 to 94 CRI
- Best red rendering (R9)



1. POWERBALL® “930”
2. POWERBALL® “830”
3. Ceramic Cylindrical
4. Quartz MH

METALARC POWERBALL® Enclosed Rated E17/Medium Base

Product Features & Benefits

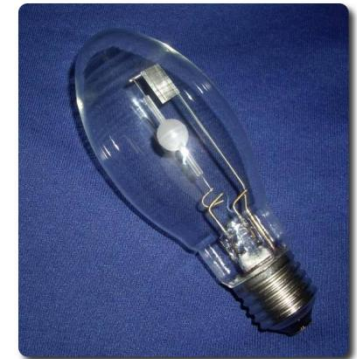
Economical, energy efficient lamp for enclosed fixtures

Performance

- 70W, 100W and 150W
- Coated & uncoated
- 12,000 hrs
- 3000K
- 85 CRI

Features

- Exclusive POWERBALL® Ceramic Arc Tube Accurate “Red” rendering (R9)
 - Consistent color
 - Long life
- Pulse-Start Arc tube technology
- Medium base
- Universal operating position
- Enclosed rated
- UV-Stop technology



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ICETRON® QUICKTRONIC® SYSTEMS



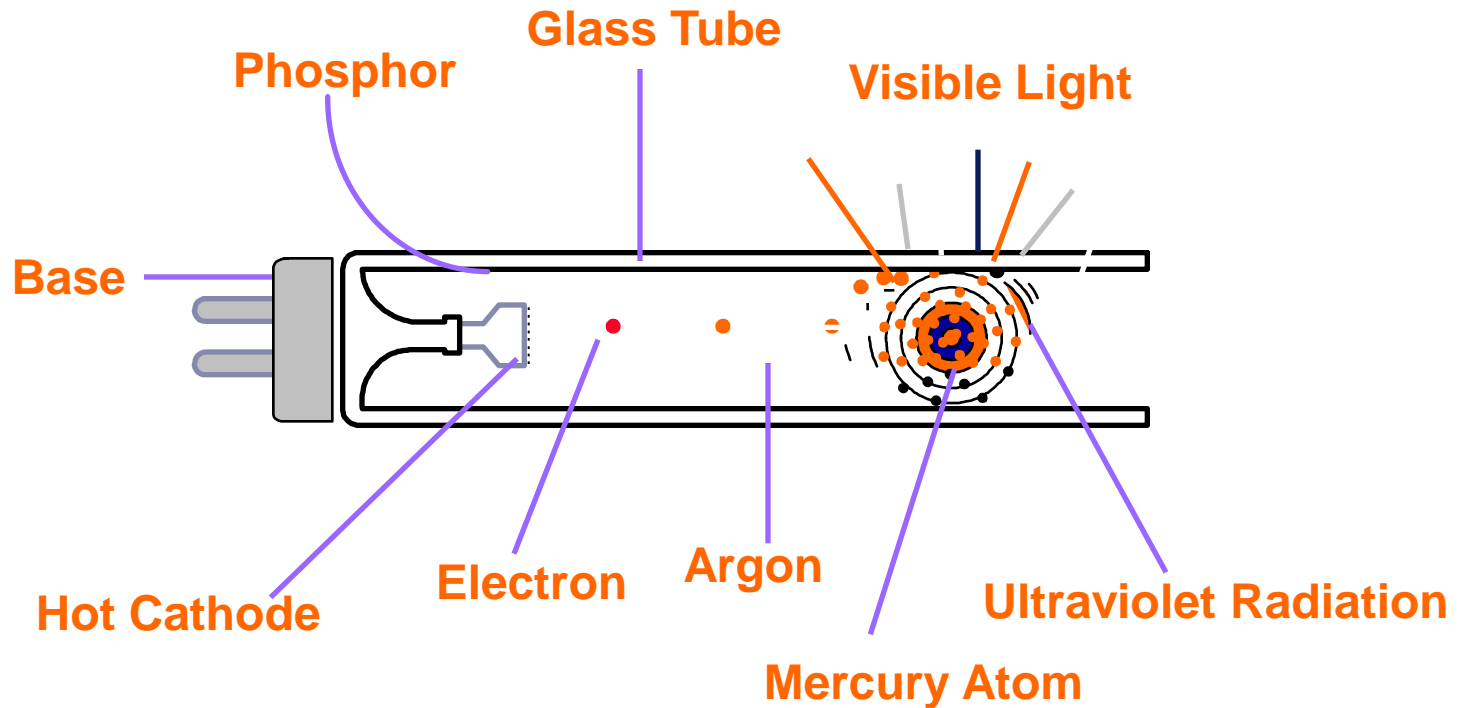
*Inductively **C**oupled
Electrodeless
Elec**TRON**ic System*



PRODUCT FIRST 1997

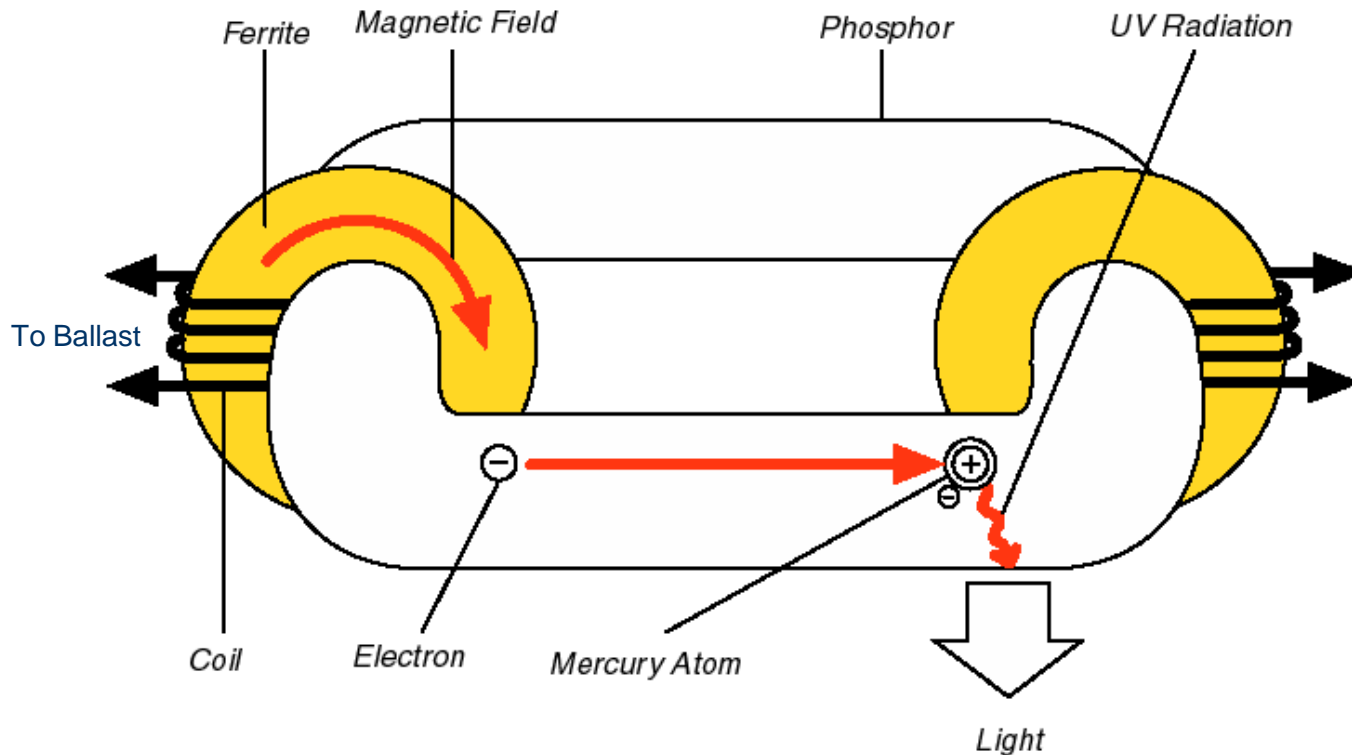
ICETRON® QUICKTRONIC® SYSTEMS

Typical Fluorescent Construction & Operation



ICETRON® QUICKTRONIC® SYSTEMS

ICETRON Operating Principle



ICETRON® QUICKTRONIC® SYSTEMS



100,000 hour system life

70W, 100W, & 150W

“White Light”

- 3500K, 4100K & 5000K
- 80 CRI

Amalgam technology

Lamp to Lamp color consistency

70% lumen maintenance at 60,000 hours

QUICKTRONIC® ballasts

QUICK 60+® system warranty

- Covers lamps & ballasts



QUICKTRONIC® ICETRON® SYSTEMS

Ballast	Lamp	System Lumens	Input Watts (120V/277V)
QT1x70-100/UNV-T	ICE70/2P/ECO®	6,500	79/77
QT1x70-100/UNV-T	ICE100/2P/ECO®	8,000	106/103
QT1x100-150/UNV-T	ICE100/2P/ECO®	11,000	154/149
QT1x100-150/UNV-T	ICE150/2P/ECO®	12,000	161/156

5000K systems lumens slightly lower (3-5%)

ICETRON® QUICKTRONIC® SYSTEMS



Arizona Public Service
← ICETRON

Application: residential
street lighting

Before with HPS →



Cobra Head Featuring ICETRON

- Lamp & Ballast System Rated at 100,000 Hours
- 5 Year Warranty From Manufacturer
- 33-67% Energy Savings Over HID Equivalent
- High Color Rendition - 80+ CRI - Better Light
- Available with Drop or Full Cut Off Flat Lens
- Instant On - Immediate Re-Strike Down to -40°F



Shoebox Featuring ICETRON

- Lamp & Ballast System Rated at 100,000 Hours
- Sylvania ICETRON -5 Year Quick 60+ Warranty
- 33-67% Energy Savings Over HID Equivalent
- Ideal for Parking Areas, car Lots or Buildings
- High Color Rendition - 80+ CRI - Better Light
- Instant On - Immediate Re-Strike - No Warm Up Period
- Excellent Lumen Maintenance - Long Initial Lumen Output
- Install and Remove from Maintenance Schedule
- 6,200 to 12,000 Lumen Packages Available



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What is an LED?

Definition:

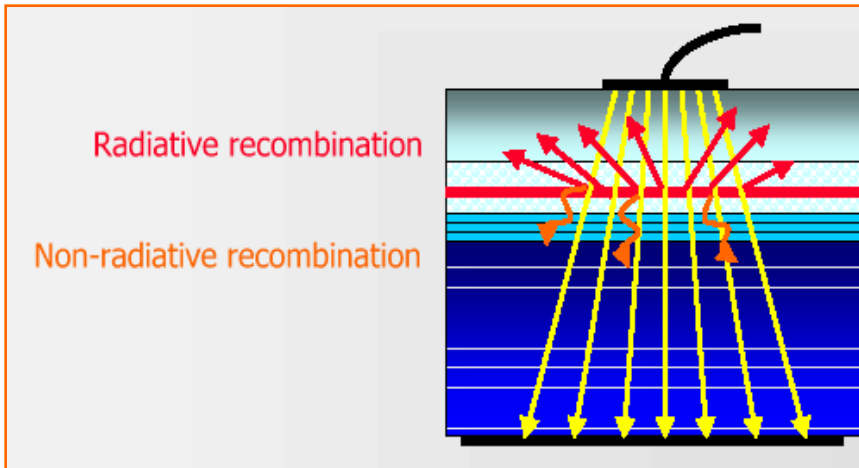
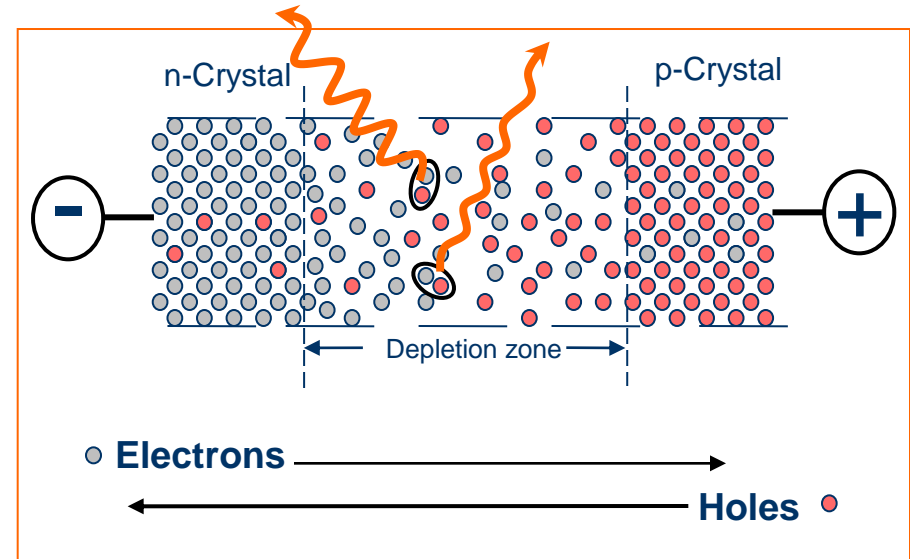
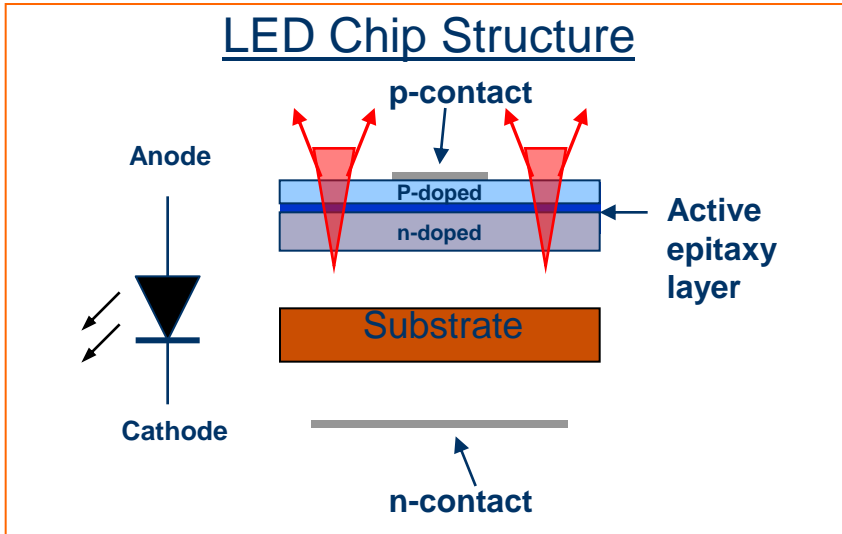
„An LED, or light-emitting diode, is a semiconductor device that emits narrow-spectrum light when electrically biased in the forward direction.“



A Brief History of LEDs

- **1907:** Henry Joseph Round reports light emission from a SiC crystal
→ the first LED is born.
- **Early 1950's:** the era of III-V semiconductors begins.
- **Early 1960's:** first discovery of IR LED.
- **1962:** Nick Holonyak introduces the first red GaAsP LED @\$260/LED.
- **1968:** First commercial introduction of a red LED, offered by the Monsanto Corporation, followed by HP.
- **1971:** Green, orange and yellow LEDs are available.
- **1970s:** LEDs flourish as numeric displays in pocket calculators, wrist-watches.
- **1993:** Shuji Nakamura achieves major improvements in green and blue LEDs
→ paving the road for white light LEDs.
- **1995:** The first white light LED is introduced.
- **Early 2000's:** Evolution of high power LEDs.

How Does an LED Emit Light?



- With an applied forward voltage, LED chip's p-n junction is biased in a forward direction;
- Free charge is forced into the depletion zone, where electrons recombine with holes.
- Some of these recombinations, the radiative recombinations of electrons and holes emit light.

Lighting Essentials: Solid State Lighting Light Source Performance through the Ages



CCT: 2000°K – 6500°K
CRI: 100
Lum. Efficacy: 93 LPW



CCT: 1700°K – 1900°K
CRI: 100
Lum. Efficacy: 0.3 LPW



CCT: 2600°K – 3400°K
CRI: 96 – 100
Lum. Efficacy: 9 – 25 LPW



CCT: 2700°K – 8000°K
CRI: 52 – 90
Lum. Efficacy: 60 – 109 LPW



CCT: 1800°K – 6000°K
CRI: -45 – 94
Lum. Efficacy: 30 – 170

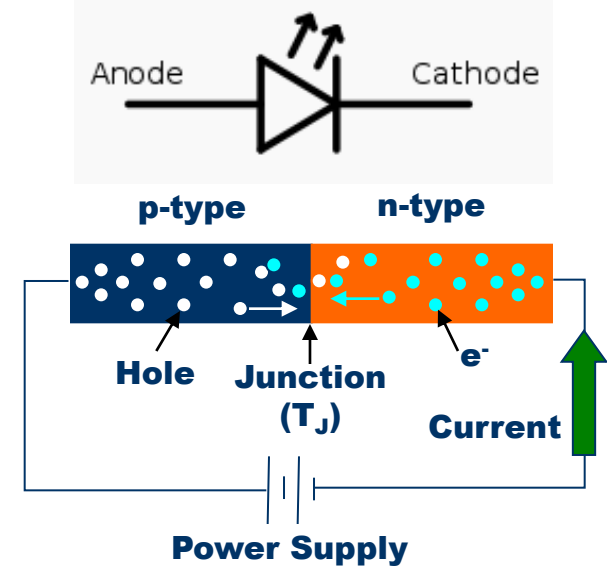


CCT: 2700°K – 8800°K
CRI: 20 – 90+
Lum. Efficacy: 20 – 60+ LPW

Lighting Essentials: Solid State Lighting

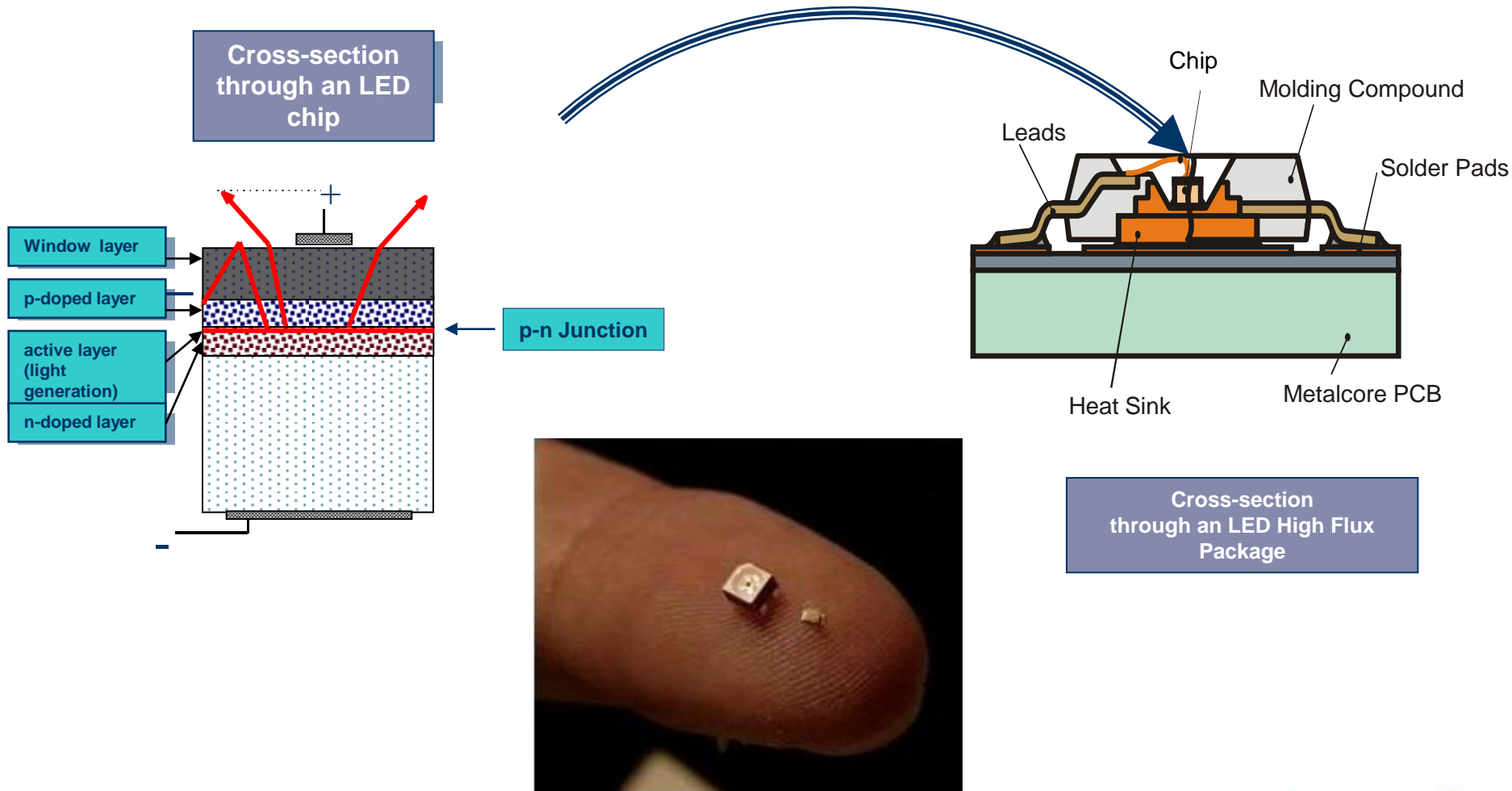
LED Basic Operation

- Diode
 - An electronic “check valve” that allows current to flow in one direction and blocks current trying to flow in the opposite direction
- Light Emitting Diode
 - Light is generated when the diode is *forward biased*
 - P-type Material
 - » Has a slight “deficiency” of electrons for molecular bonding when forming a crystal
 - N-type Material
 - » Has excess electrons left over left over from the crystal bonding process that can move and carry current
 - Photons are generated when the positive and negative charges recombine

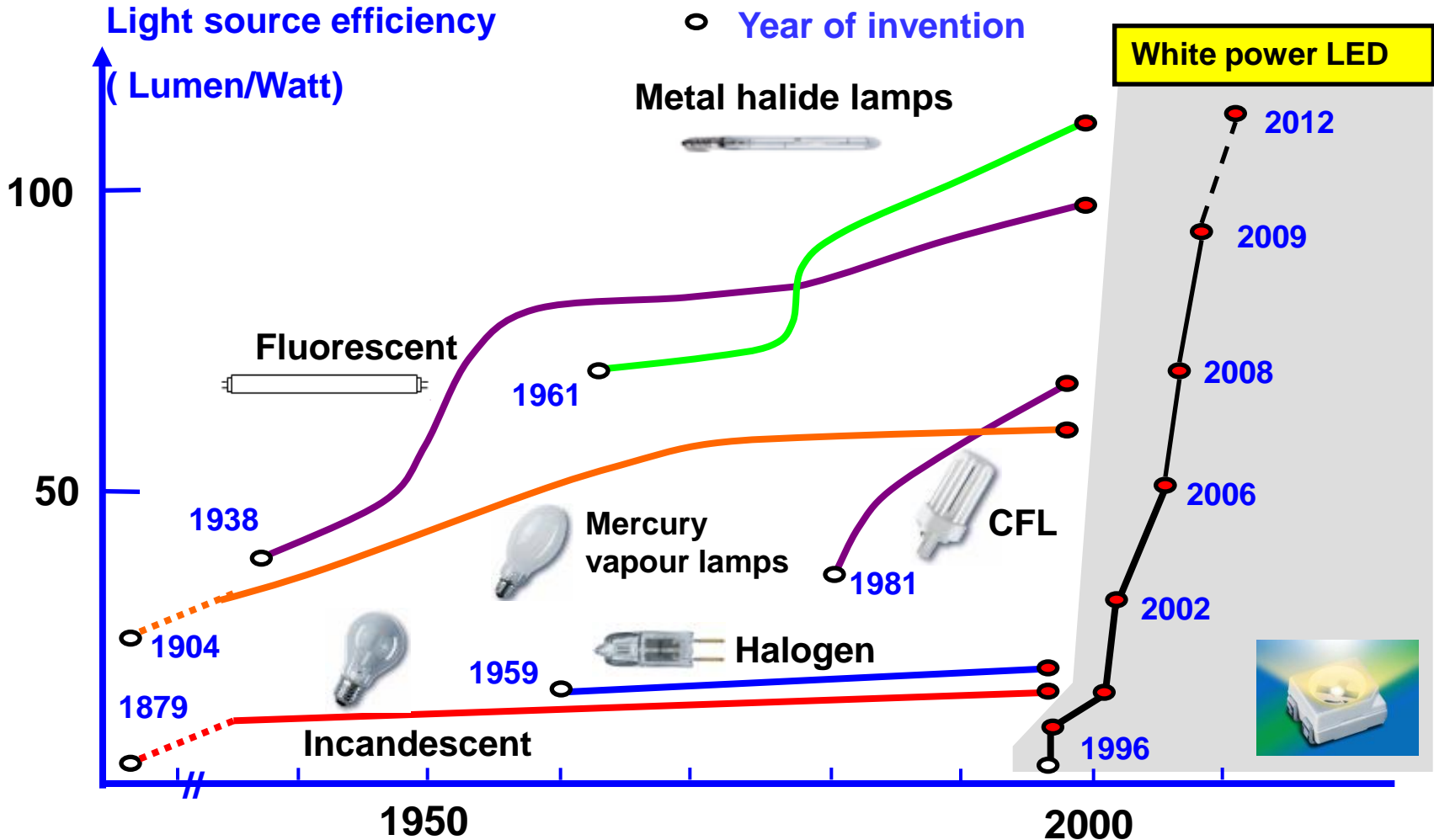


Lighting Essentials: Solid State Lighting

Anatomy of a Light Emitting Diode



Lighting Essentials: Solid State Lighting Light Source Efficiency vs. Time

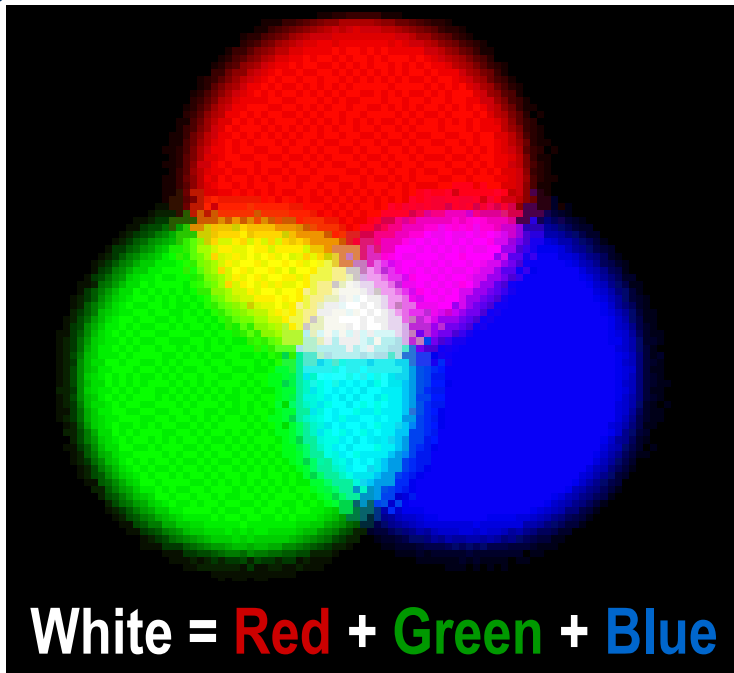


How many ways can you make White Light?

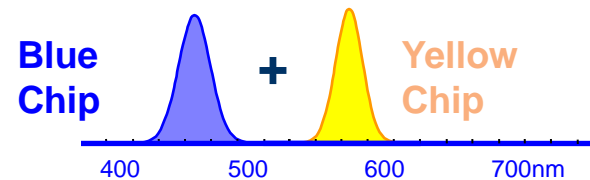
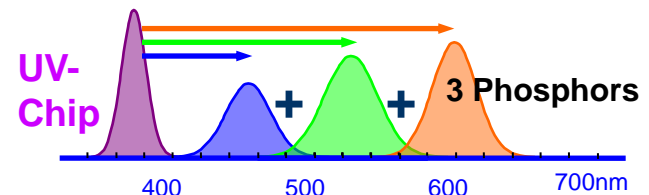
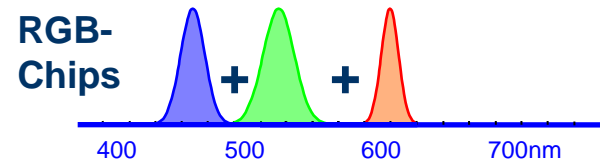
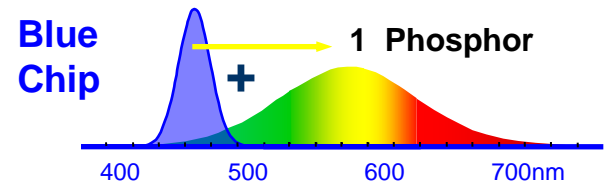
Tri-Color Colorimetry

Red/ Green/ Blue – primary colors

White – mixture of 3 primary colors



White LED Approaches



Emission Wavelength

LED Street Lighting Products

LED folio

cobraLux



LED Street Lighting Products



Hybrid Fixture with 2 Light sources. SSL/HPS SSL/IND SSL/MH

DARK-SKY FRIENDLY

The **Polera** is certified by the International Dark-Sky Association to restrict light trespass, glare and light pollution for neighborhood-friendly roadway lighting.

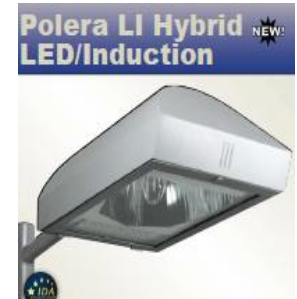
Promoted by International Astronomer's Association

Commercial Hours Dusk to 11PM SSL 11PM to dawn HPS

SSL 50,000 Hrs. HPS 40,000 with Standby

Also Induction Fixture

100,000 Hrs Life



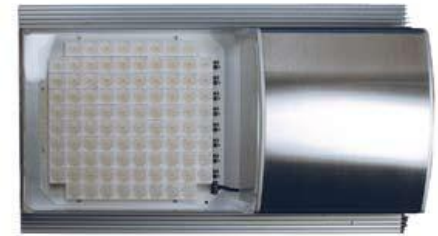
LED Street Lighting Products

esco
LIGHTING, INC.

affineon™
LIGHTING



EvoLucia
Next Generation LED Lighting



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Light Source Decision Factors

- Real Maintenance Costs
 - Police details
 - Number of people
 - Time per lamp
- Reliability vs. Innovation & Energy
 - Has the product been run to end of life?
 - Do we know all the relationships between environment and life / light?
- Lifetime Costs
 - Initial
 - Energy
 - Maintenance
 - Disposal

Street and Area Lighting– Light Source Comparison

Light Source	Typical Wattage	Typical Life	Typical CCT	Typical CRI
Sodium	175W to 1000W	20,000 to 40,000 hrs	2100	22
Metal Halide	175W to 1000W	7,500 to 20,000 hrs	3600K to 4200K	65 to 70
Ceramic Metal Halide	100W to 400W	20,000 hrs typical	3000K to 4100K	80 to 95
Induction	70W to 150W	100,000 hrs	3500K to 5000K	75 to 85
LED	40W to 200W	50,000 hrs	4100K to 8000K+	60 to 90

Street and Area Lighting– Light source pros / cons

Light Source	Advantages	Disadvantages
Sodium	Low cost, long life, established technology, highest LPW	Extremely low color rendering, typically reported as people feeling less secure in this lighting, restrike time
Metal Halide	Still comparatively low initial cost, whiter light	Significantly shorter life than other light sources, restrike time
Ceramic Metal Halide	EXCELLENT color rendition, longer useful life than traditional metal halide	Still a shorter life than LED and induction with a higher cost than standard metal halide, restrike time
Induction	100,000 hour life is the best in class. Good color properties. Instant restrike.	Initial cost is significantly higher than that of the HID technologies, though less than LED. Only competes with Sodium and MH systems up to ~ 250W. Waiting for higher wattage sources to appear on market
LED	50,000 hour life, good color, instant on, instant restrike	Highest initial cost. Not significantly longer life than Sodium, new technology with unknowns, most products on the market today only replace up to 400W sodium and MH systems

QUESTIONS

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