



INDUCTION LIGHTING SYSTEMS



AN INTRODUCTION TO **INDUCTION LIGHTING**

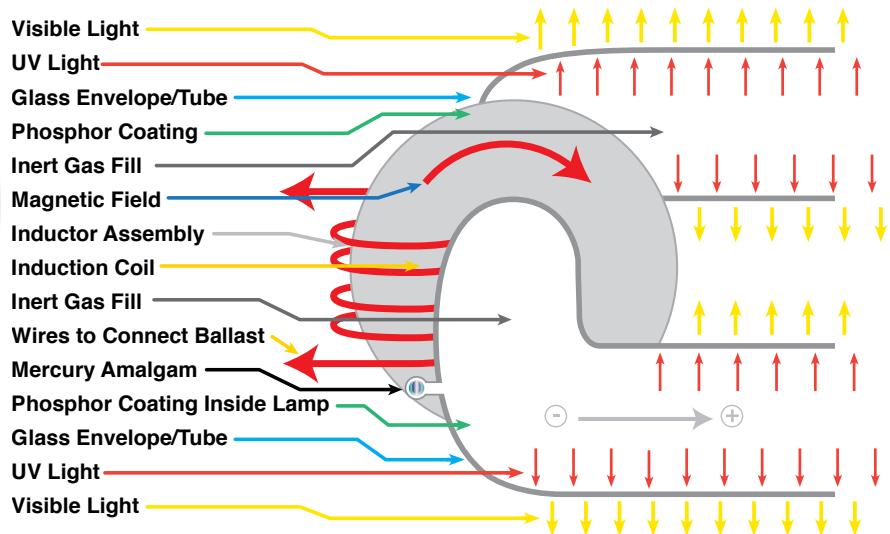
WHAT IS INDUCTION LIGHTING?

A hybrid fluorescent lamp technology that eliminates the need for electrodes and filaments; generating light by means of a high frequency transmission of energy combined into a gas discharge.

As with conventional fluorescent lamps, varying the composition of the phosphors coated onto the inside of induction lamps, allows for models with different color temperatures. Unlike conventional fluorescent technology there are no failures caused by filament erosion, vibration, or seal breach.



EXTERNAL INDUCTOR LAMP



HOW DOES INDUCTION LIGHTING WORK?

EXTERNAL INDUCTOR LAMPS

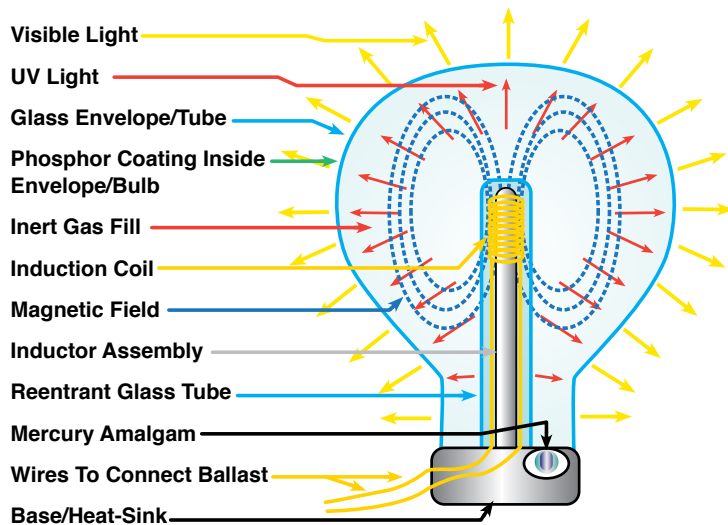
External magnetic induction lamps are essentially fluorescent lamps with electromagnets wrapped around a section of the lamp tube. High frequency energy, from the electronic ballast (generator), is sent through wires, which are wrapped in a coil around the ferrite inductor, creating a powerful magnet.

The induction coil produces a very strong magnetic field which travels through the glass and excites the mercury atoms in the interior which are provided by a pellet of amalgam (a solid form of mercury). The mercury atoms emit UV light and, just as in a fluorescent tube, the UV light is up-converted to visible light by the phosphor coating on the inside of the tube. The system can be considered as a type of transformer where the inductor is the primary coil while the mercury atoms within the envelope/tube form a single-turn secondary coil.

INTERNAL INDUCTOR LAMPS

In a variation of this technology, Internal magnetic induction lamps use a light bulb shaped glass lamp, which has a test-tube like re-entrant central cavity. This cavity is coated with phosphors on the interior, filled with inert gas and a pellet of mercury amalgam. The induction coil is wound around a ferrite shaft which is inserted into the central test-tube like cavity. The inductor is excited by high frequency energy provided by an external electronic ballast (generator) causing a magnetic field to penetrate the glass and excite the mercury atoms, which emit UV light, that is converted to visible light by the phosphor coating.

INTERNAL INDUCTOR LAMP



HOW LONG WILL AN INDUCTION LAMP & BALLAST OPERATE?

External induction lamps manage heat either by convection through the air or conduction into the fixture. HighHorse internal induction lamps operate with a higher internal temperature and must cool by conduction to the base heat sink and by radiation through the glass walls. With both lamp types a small percentage of mercury ions are absorbed by the phosphor coating over time; once the mercury ions inside the envelope are depleted, the lamp emits only a very dim light and has to be replaced.

HighHorse Electronic Ballasts (generators) are warranted for five years. (Actual life expectancy can be significantly longer with proper thermal management.)

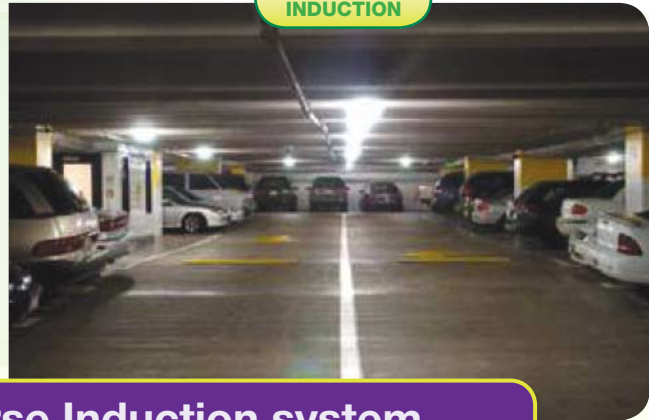


LOWER WATTAGE - SUPERIOR LIGHTING **BETTER LIGHT**

150W
HPS



85W
INDUCTION



How is it that an 85w HighHorse Induction system can replace a 150w HID system and the visual acuity is improved with the Induction system?

The answer is found in how the human eye responds to light and how lighting sources affect vision.

To better understand consider the following scientific terms and how they relate to vision:

SCOTOPIC VISION

The scientific term for human visual perception in low light (night vision); directed by rod cells in the human eye.

PHOTOPIC VISION

The scientific term for human color vision under normal conditions during the day, directed by cone cells in the human eye.

MESOPIC VISION

The scientific term for the combination between Photopic and Scotopic vision taking into account the total sensitivity of the rod cells in the eye for the blue range, with the color perception of the cone cells.

VISUAL CONCLUSION

Extensive research has been conducted to better understand Mesopic vision; more specific how "Scotopic" vision which stimulates the photoreceptors called rods in the human eye to cause pupil contraction and increased visual acuity. It was found that scotopically enhanced light appeared brighter even when light levels were reduced; thus the potential to reduce wattage and improve lighting.

The ratio of Scotopic light vs. Photopic light in a lamp is called the S/P ratio. This ratio determines the apparent visual brightness of a light source. Induction lighting produces a high S/P ratio and this is why the 85w lamp appears as bright or brighter to the human eye than a sodium vapor or metal halide of twice the wattage. **Visual Effective Lumens (VEL)** is a key factor in vision.



SCOTOPIC/PHOTOPIC (S/P) RATIO

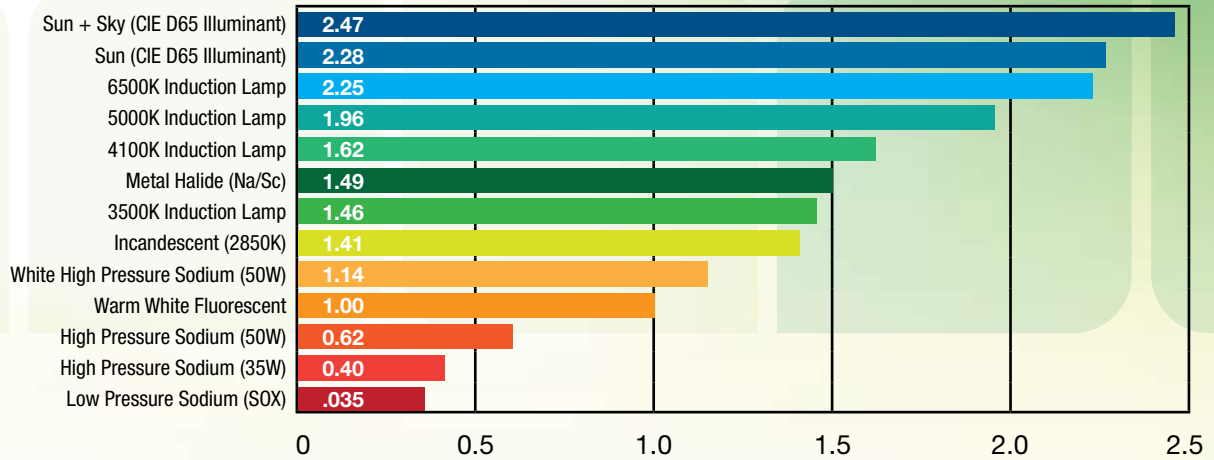


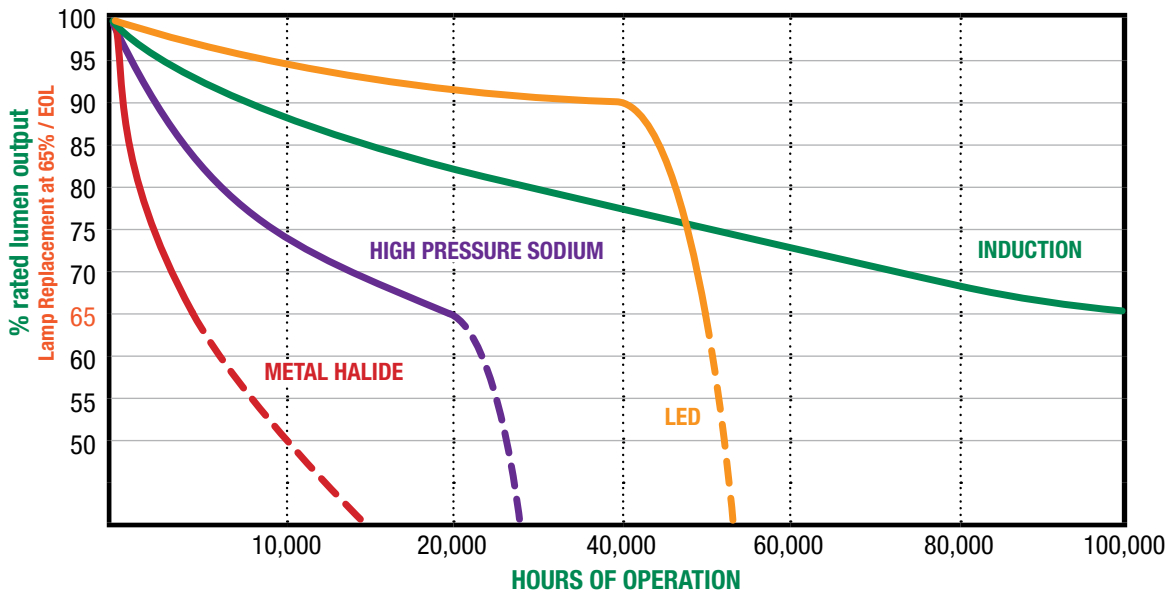
Chart calculations by Berkley Labs - actual selection of induction lamp wattage and type will vary with installation and user requirement.

HOW TO CALCULATE VISUAL EFFECTIVE LUMENS (VEL)

PARKING GARAGE APPLICATION 27,000 HRS = 3.0 YEARS

Type	Initial Lumens	S/P Ratio (from above)	VEL	10,000 hrs	20,000 hrs	27,000 hrs
150w HPS	15,000	0.62	9300	6789	6045	3720
85w Induction	6375	1.96	12,495	10,870	10,370	9,996

ESTIMATED LUMEN MAINTENANCE



Induction Rated Lumen Maintenance is largely determined by operating temperature of the lamp and quality of lamp design; Fulham HighHorse induction systems are designed and manufactured with high quality tri-phosphors and solid amalgam to optimize the performance and rated life of the lamp. The above chart is intended to represent an average rated lumen output stated as a percentage of the initial lumen output over the rated life of the lamp. Operating the lamp within the temperatures specification will typically result in an average estimated 70% lumen output at 60Khrs.

INDUCTION LIGHTING SYSTEMS

COMPARE THE LIGHT SOURCES

INDUCTION VS LED / METAL HALIDE / HIGH PRESSURE SODIUM

	INDUCTION	LED	MH	HPS
LAMP LIFE (Hours)	60k - 100k	30k - 50k	10k - 15k	15k - 24k
LIGHTING EFFICIENCY Lm/Wt	65 - 90	40 - 65	60 - 110	60 - 120
CRI	> 80	> 70	> 70	> 20
S/P RATIO	1.46 - 2.25	1.96	1.49	0.62
LUMEN MAINTENANCE	Reference Graph Below			
COLOR TEMPERATURE	Full Range	Limited Range	Limited Range	Limited Range
HOT RESTART	INSTANT	INSTANT	DELAY	DELAY
MERCURY	Low	N/A	Low - High	Low - Medium

RESOURCES MANAGEMENT

• ENERGY SAVINGS

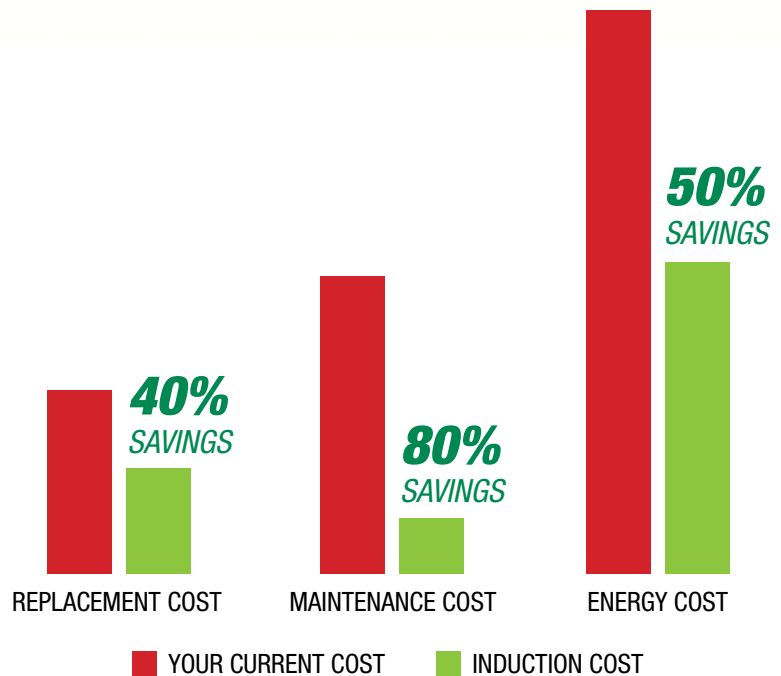
- Reduce Wattage
- High Efficiency Ballast Technology
- Dimming to 50%
- Motion Controls
- Photo-Cell Controls
- Control Management Systems

• MAINTENANCE SAVINGS

- Reduce Labor Cost for Re-Lamping
- Reduce Contract Service Cost
- Reduce Inventory Maintenance Cost

• REPLACEMENT SAVINGS

- Reduce Overall Replacement Cost



INDUCTION LIGHTING SYSTEMS COMPARE THE COST

5 YEAR COMPARISON	85W BULB INDUCTION	150W HPS
BURN HOURS	43,680	43,680
SYSTEM OPERATING WATTS	87	180
OPERATING COST (ENERGY)	\$289,459	\$583,783
RE-LAMPING CYCLE	0.7	2.18
RE-LAMPING COST	\$0	\$54,054
TOTAL ANNUALIZED COST	\$57,892	\$127,567

USING HIGHHORSE INDUCTION SYSTEM:	5 yr
TOTAL SAVINGS	\$439,290
TOTAL ANNUALIZED SAVINGS	\$91,477

OPERATING COST		85W INDUCTION	150W HPS
System Watts		89.25	180
Annual Burn Hours (÷1000)	X	8.736	8.736
# of Fixtures	X	550	550
Total Kilowatts		428828	864864
Kilowatt Rate†	X	0.135	0.135
Annual Cost		\$57,891	\$116,757
5 Year Cost		\$289,459	\$583,783
RE-LAMPING COST		85W INDUCTION	150W HPS
5 Year Actual Burn Hours		43680	43680
Avg. Re-lamping (Hrs)	÷	60,000	20,000
5 Year Re-lamping Cycles		0.7	2.18
Lamp Replacement Cost		\$0	\$15
Labor Replacement Cost		\$0	\$30
# of Fixtures		550	550
5 Year Re-lamping Cost		0	\$54,054

† Average Estimated Rate over 5 years.

Annualized Savings Calculation	
Power Savings (Kw)	436036
Kw Rebate	0.05
Annual Kw Rebate*	\$21,801
Annual Energy Savings	\$58,865
Re-Lamping Savings	\$54,054
Total Annualized Savings	\$91,477

*1-year rebate. Check with local utility for rebate program availability

CALCULATE THE PAYBACK

Example of an HPS System replaced with a HighHorse Induction Retro-fit System

$$\begin{array}{r}
 \text{Installed HighHorse Induction} \\
 \text{Retro-fit Kit System:} \\
 \text{\$285.00/per fixture}
 \end{array}
 \times
 \begin{array}{r}
 \text{\# of} \\
 \text{fixtures} \\
 550
 \end{array}
 =
 \begin{array}{r}
 \text{Total} \\
 \text{Installed cost} \\
 \text{\$156,750}
 \end{array}
 -
 \begin{array}{r}
 \text{Energy Rebate} \\
 \text{\$100/per fixture}
 \end{array}
 \div
 \begin{array}{r}
 \text{5-Year Annualized} \\
 \text{Savings} \\
 \text{\$74,035}
 \end{array}
 =
 \begin{array}{r}
 \text{Payback} \\
 \text{1.4 Years}
 \end{array}$$

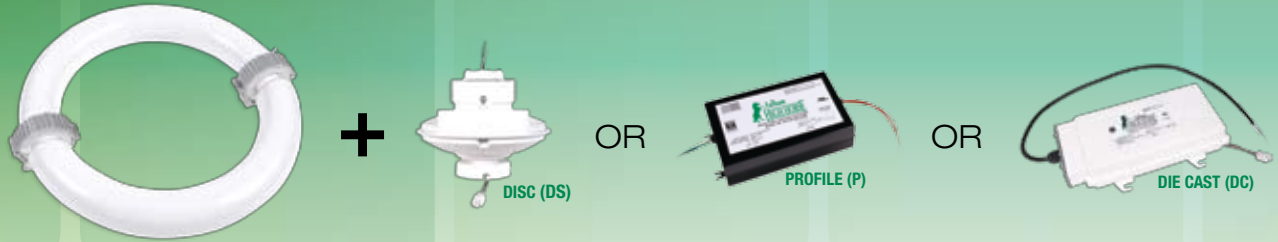
Actual cost of installed system and energy rebate may vary.

HIGHHORSE INDUCTION LIGHTING SYSTEMS

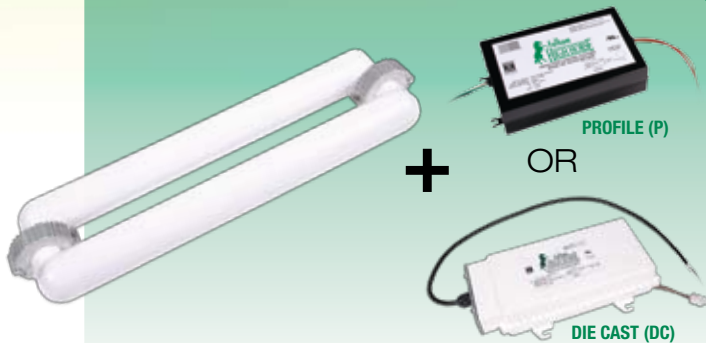
SYSTEM SPECIFICATIONS



CIRCULAR SYSTEM



TUBULAR SYSTEM



BULB SYSTEM



ADVANCED FEATURES

- ENERGY
 - Reduce Kw Operating Cost
 - Reduce Air Conditioning Cost
- OPERATIONS
 - Reduce Maintenance Cost
 - Improve Safety Conditions
 - Improve Security Conditions
 - Enhance Visual Performance
- SUSTAINABILITY
 - Social-Environmental
- Effective Use of Natural Resources
 - Environmental-Economic
- Energy Efficiency Technology
 - Economic-Social
- Improve Standard of Living

OPTIONS

- Full Range Color Temperatures
- 0-10V Control Dimming (select models) suffix (D)
- Auto-Transformer (480V)

COMMON BALLAST SPECIFICATIONS

Input Voltage:	120V-277V
Input Frequency	50/60 Hz
Output Frequency	250K Hz
THD	< 10%
Power Factor	> 0.95
Case Temp.	< 65°C
Operating Temp.	(0°C to 50°C)
Open Fixture	
Operating Temp.	(-20°C to 50°C)
Closed Fixture	

SYSTEM MODEL NUMBER EXAMPLE

HH ILS GP35 5K - A 35W HighHorse Induction System with a bulb lamp, profile ballast and 5K color temp

HH **ILS** **B** **P** **35** **5K** **D**

HH = HIGHHORSE **ILS** = INDUCTION LIGHTING SYSTEM **B** = BULB **T** = TUBULAR **C** = CIRCULAR **P** = PROFILE **DS** = DISC **DC** = DIE CAST **WATTS** **COLOR TEMP.** **DIMMING**
Dimming available on select models.

	System Model Number	Watts	Input Current (Amp) 120v - 277v	Input Power	Rated Initial Luminance (LM)	Efficacy (LM/W)	Luminance Maintenance (60K Hrs)	CRI	Color Temp. (Kelvin)	Average Lamp Life (Hours)					
BULB	HH-ILS-BP35-5K	35	0.32-0.35	37	2450	66	70%-75%	> 80	5000K*	100,000					
	HH-ILS-BP55-5K	55	0.505-0.21	58	3575	62									
	HH-ILS-BP85-5K HH-ILS-BDS85-5K	85	0.77-0.32	89	5950	67									
	HH-ILS-BP100-5K HH-ILS-BDS100-5K	100	0.91-0.38	105	7000	67									
	HH-ILS-BP120-5K HH-ILS-BDS120-5K	120	1.09-0.46	126	9000	71									
	HH-ILS-BP165-5K HH-ILS-BDS165-5K	165	1.495-0.63	173	11550	67									
	HH-ILS-BP200-5K HH-ILS-BDS200-5K	200	1.80-0.76	210	14000	67									
	HH-ILS-BP250-5K HH-ILS-BDS250-5K	250	2.25-0.95	263	18750	71									
	TUBULAR	HH-ILS-TP40-5K HH-ILS-TP40-5KD	40	0.363-0.153	42	2800					67	70%-75%	> 80	5000K*	100,000
		HH-ILS-TP70-5K HH-ILS-TP70-5KD HH-ILS-TDC70-5K	70	0.64-0.27	74	5250					71				
HH-ILS-TP80-5K HH-ILS-TDC80-5K		80	0.731-0.307	84	6000	71									
HH-ILS-TP100-5K HH-ILS-TP100-5KD HH-ILS-TDC100-5K		100	0.91-0.38	105	8000	76									
HH-ILS-TP120-5K HH-ILS-TDC120-5K		120	1.10-0.46	126	9600	76									
HH-ILS-TP150-5K HH-ILS-TDC150-5K		150	1.37-0.57	158	12000	76									
HH-ILS-TP200-5K HH-ILS-TDC200-5K		200	1.80-0.76	210	17000	81									
HH-ILS-TDC250-5K		250	2.25-0.95	263	21250	81									
HH-ILS-TDC300-5K		300	2.72-1.14	315	27000	86									
HH-ILS-TDC400-5K		400	3.63-1.52	420	36000	86									
CIRCULAR		HH-ILS-CP40-5K HH-ILS-CP40-5KD HH-ILS-CDS40-5K	40	0.365-0.153	42	2800	67	70%-75%	> 80	5000K*	100,000				
		HH-ILS-CP70-5K HH-ILS-CP70-5KD HH-ILS-CDS70-5K HH-ILS-CDC70-5K	70	0.64-0.27	74	5250	71								
		HH-ILS-CP80-5K HH-ILS-CDS80-5K HH-ILS-CDC80-5K	80	0.731-0.307	84	6000	71								
	HH-ILS-CP100-5K HH-ILS-CP100-5KD HH-ILS-CDS100-5K HH-ILS-CDC100-5K	100	0.91-0.38	105	8000	76									
	HH-ILS-CP120-5K HH-ILS-CDS120-5K HH-ILS-CDC120-5K	120	1.09-0.46	126	9600	76									
	HH-ILS-CP150-5K HH-ILS-CDS150-5K HH-ILS-CDC150-5K	150	1.37-0.57	158	12000	76									
	HH-ILS-CP200-5K HH-ILS-CDS200-5K HH-ILS-CDC200-5K	200	1.80-0.76	210	17000	81									
	HH-ILS-CDS250-5K HH-ILS-CDC250-5K	250	2.25-0.95	263	22500	86									
	HH-ILS-CDS300-5K HH-ILS-CDC300-5K	300	2.73-1.14	315	27000	86									

*5k standard stock color - Available temperatures: 2720k - 6500k

HIGHHORSE INDUCTION LIGHTING SYSTEMS **RETRO-FIT & OEM ENGINEERING SYSTEMS**

Fulham provides a complete range of supportive services that may enable the customer to retro-fit their existing fixtures with HighHorse Induction Lamps & Ballasts. This unique Fulham retro-fit system not only takes full advantage of Induction technology but provides a cost-effective solution with minimal investment.

HighHorse Induction Retro-Fit system's services make it easy to retro-fit existing fixtures, minimize labor cost of conversion, ensure reliability and maximize on components expected life.

The Fulham UL certified laboratory in Hawthorne, California is staffed with highly skilled engineering talent and the most state-of-the-art testing equipment in the world including lamp spheres for testing lumen output and efficiency.

BASIC 7 POINT ENGINEERED SYSTEM

- ✓ Generator Mounting and Thermal Management
- ✓ Lamp Mounting and Optical Enhancement
- ✓ Ease of Installation Components
- ✓ Thermal & Conductivity Test Report
- ✓ Component CAD Drawings*
- ✓ Installation Instructions
- ✓ Warranty Evaluation

Customer Option to Select Options

*Contact Factory for Applicable Charges



Complete Ballast & Lamp Mounting Assembly



Cobra head for street lighting. 100 watt HPS retro-fitted to a 55 watt Induction lighting system with Profile ballast



Highbay fixture for warehouse application. 400 watt MH retro-fitted to a 200 watt Induction lighting system with Disc ballast.

ENGINEERING SERVICES

SYSTEM EVALUATION

Fulham determines the best lamp and ballast combination for the existing fixture; this includes:

- Ballast mounting and thermal management
- Lamp mounting and optical enhancement
- Ease of installation component options
- Retro-fit Component CAD drawings
- Installation instructions
- Evaluation sample

CERTIFICATION SERVICES

UL CERTIFICATION

Fulham takes the responsibility to ensure that the retro-fit meets the UL Certification standard and provides the customer with a Multiple Listing for the retro-fit fixture. This ensures the fixtures operate safely and meet UL standards for this type of fixture conversion.

IES PHOTOMETRIC FILES

INDEPENDENT LAB TESTING

During the initial system evaluation Fulham evaluates basic performance; most often this performance level exceeds the existing levels of illumination. Fulham is contracted with an Independent Test Lab and can provide a new IES Photometric file for application specific purposes.

SAMPLE PROGRAM

BETA-SITE TESTING

Fulham provides flexible sample programs to ensure the HighHorse Retro-Fit System meets all the customer requirements.

To take full advantage of HighHorse Induction Lighting in various applications Fulham works with the customer to maximize the lighting effect and minimize the energy cost; this may require testing the retro-fit fixtures before wholesale conversion.



Highbay fixture for warehouse lighting. 400 watt MH retro-fitted to a 200 watt Induction lighting system with disc ballast.

WARRANTY PROGRAM

APPLICATION EVALUATION PROCESS

Fulham is known for high quality products and superior support services; HighHorse Induction Systems are designed for the Lamp and Ballast to operate as a system which provide long-life and consistent operation.

Before and during the process of retro-fit evaluation Fulham provides a Warranty Evaluation Summary; this identifies all the critical data necessary to determine life-expectancy.

HighHorse Induction Systems come with a Full Five-Year Warranty; but much longer life is possible with proper thermal management.

GREEN ENERGY SERVICES

REBATE PROGRAMS

Many programs have and are being offered for converting conventional lighting systems to Induction Lighting technology. Fulham is constantly reviewing these programs and providing our customers with links to these financial offers.

Where rebate programs do not exist we assist by providing cost and technical evaluation materials that can assist with implementation of a rebate program.



Decorative pole top fixture for pathway lighting. 70 watt MH retro-fitted to a 35 watt Induction lighting system with Profile ballast

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