RemPhos TECHNOLOGIES

T8 Design Process Review

March 14, 2011

PRODUCT OVERVIEW:
T8 LED Lamps

RESARCH & DESIGN OF T8

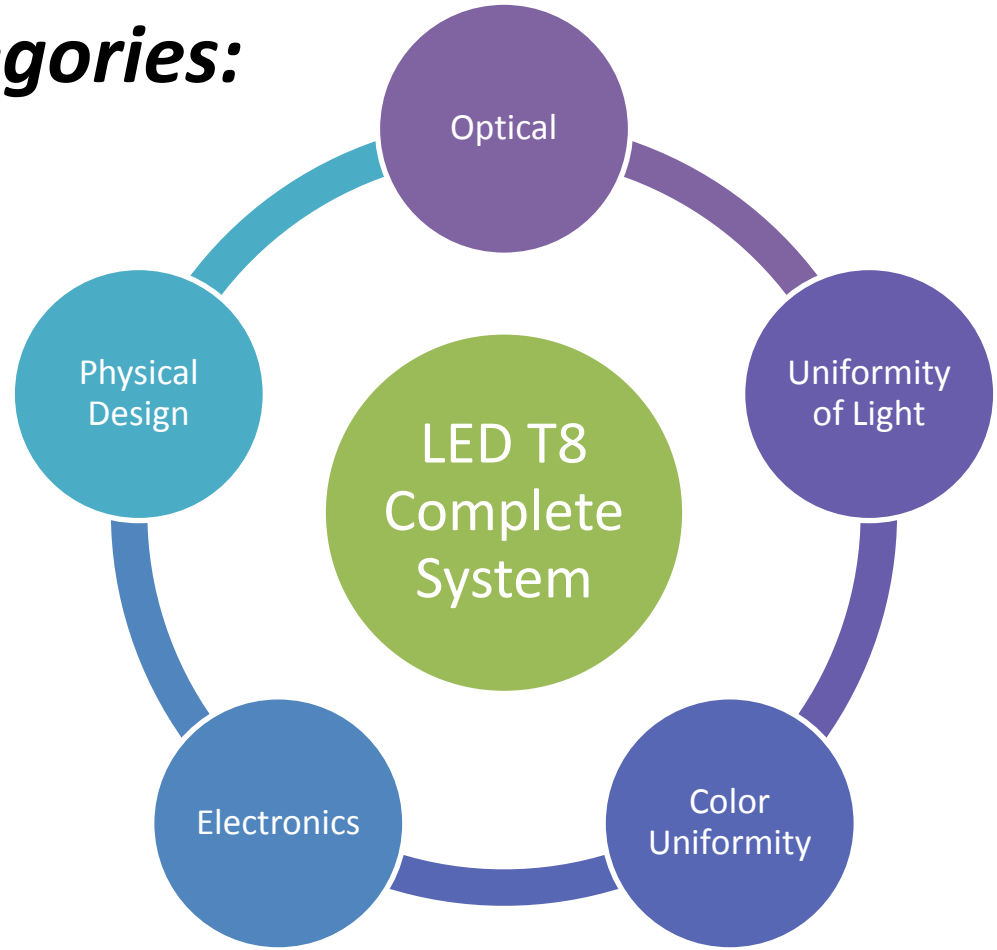
1.5+ years in R&D

- **GOAL #1:** Maximize optical efficiency
- **GOAL #2:** Maximize electrical efficiency
- **GOAL #3:** Lowest dollar/ft possible

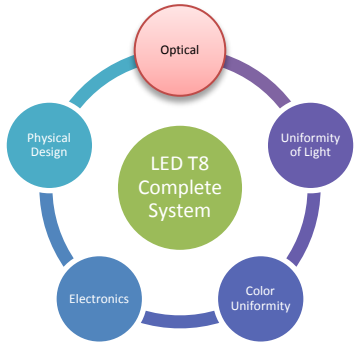
RESULT: Revolutionary innovative design which meets all goals and mimics the light distribution of traditional fluorescent

HOW IT WORKS

Innovation is separated into these following categories:



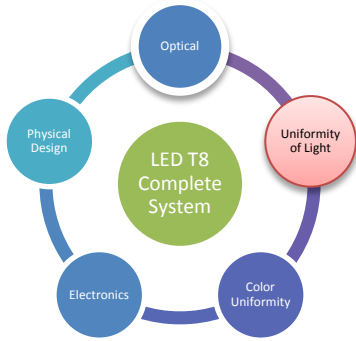
OPTICAL FEATURES



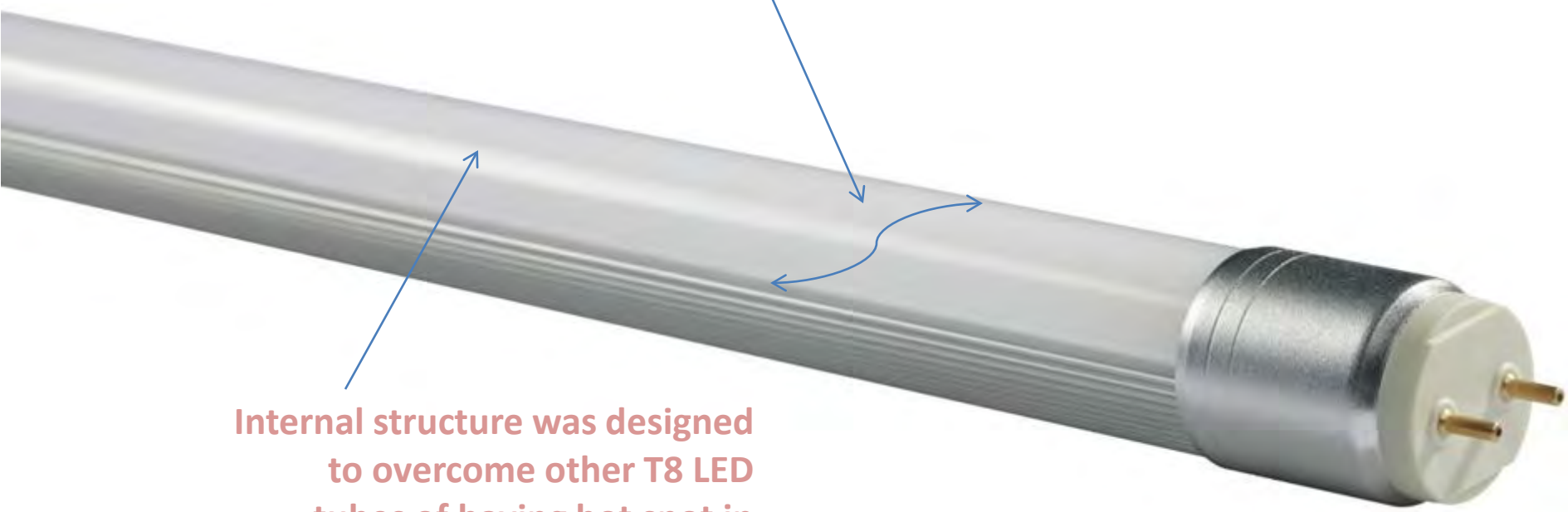
Internal optics were designed using ray tracing software to maximize lumen output

Reflectors were designed to allow internal scattering of light reduced to almost 0%

UNIFORMITY OF LIGHT

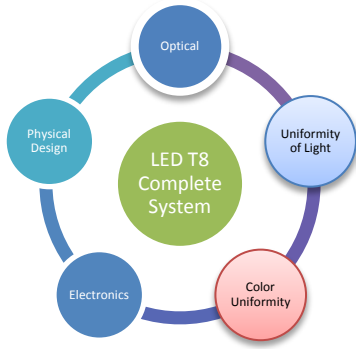


Light must be emitted equally around the hemisphere in order to mimic a fluorescent tube



Internal structure was designed to overcome other T8 LED tubes of having hot spot in center of distribution

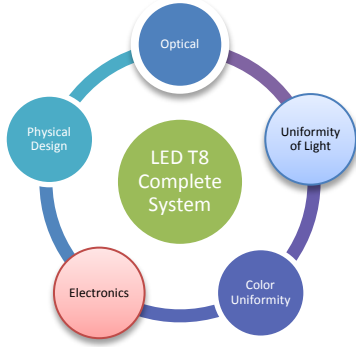
COLOR UNIFORMITY



Internal mixing allows CCT to be measured consistently within +-50K along the entire tube

We can control the color consistency from tube to tube, with using LED packages designed by us for this application only

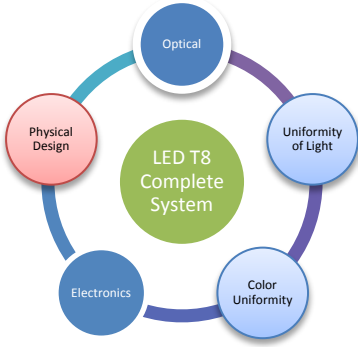
ELECTRONICS



High Efficiency, High PF Driver designed for this product must fit in small form factor

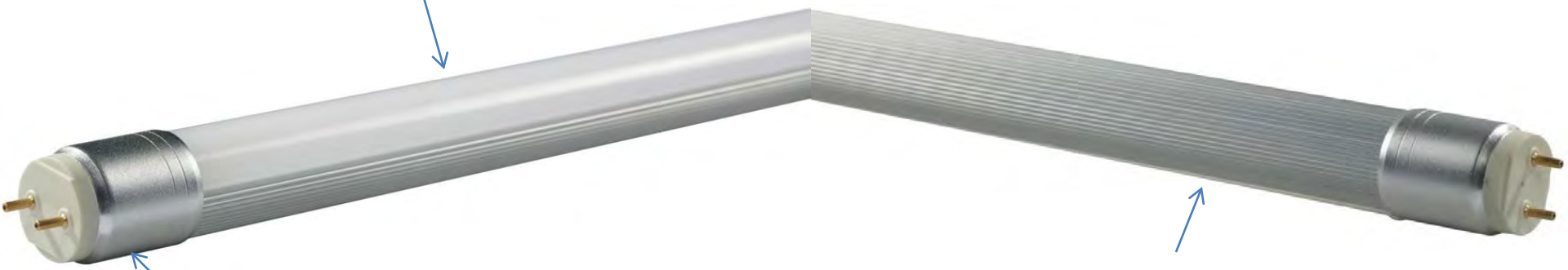
Electronic components were chosen for low cost, high reliability

PHYSICAL DESIGN



PC Cover

- High light transmittance
- High temperature resistance
- Extremely tough



End Cap Assembly

- Metal Outer for thermals
- High temperature plastic inner
- Holds pins secure
- Easy assembly process

Aluminum Extrusion

- Excellent thermal design
- Holds PCB secure
- VERY LOW material usage…low $!

RESULT: A strong and well built lamp that will stand up to the toughest of environments. Much more rigid compared to competition

MANUFACTURING OF T8

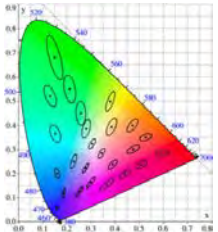
Manufacturing and assembly of lamp will be done here in our Shenzhen Plant!

- ISO 9001 Certified
- Complete OSRAM approved QC System
- Currently ~100 assembly technicians
- Current Capacity ~10000 lamps/day
- GOAL: Six Sigma Quality

MANUFACTURING OF T8

Close collaboration with LED package Manufacturer to develop LEDs specifically for the needs of this product

- Can achieve highest efficacy possible for CCT: 2700K,3500K,4100K
- Binning is controlled (to ~3 step MacAdam ellipse) using our proprietary process so that we can ensure consistency from tube to tube
- Traditionally means high cost…we keep cost low while ensuring highly consistent product



See our LED binning light up diagram!

REGULATORY TESTING OF T8

Product has TUV/CE/UL/FCC Certified

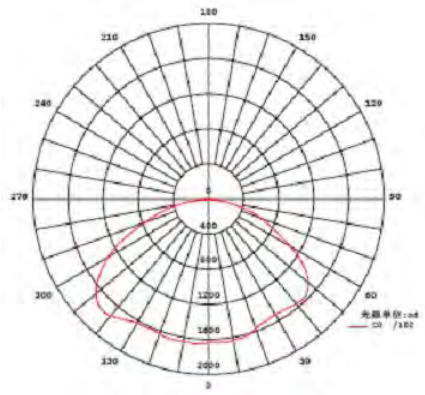
- Has already passed European TUV, CE
- UL Listed in 2011
- FCC Approved

TEST REPORT INFORMATION:
T8 LED Lamps

CANDLE POWER DISTRIBUTION

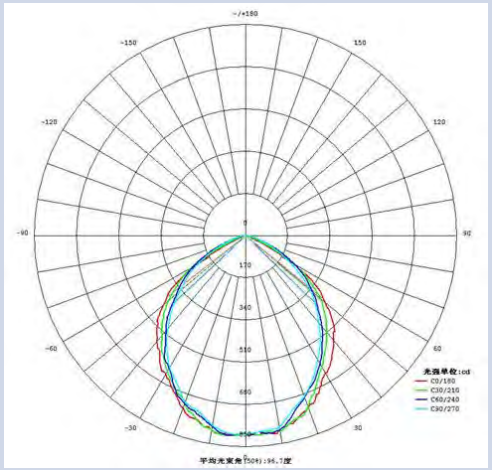
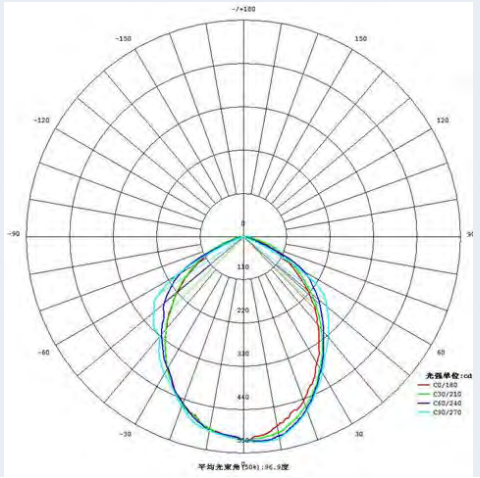
Test Setup:

- “Luminosity Distribution Meter”
- IES for OSRAM T8 fluorescent compared with LED T8



CANDLE POWER DISTRIBUTION

Result: Our T8 LED lamp has an almost identical distribution when compared to a fluorescent in a high efficiency fixture

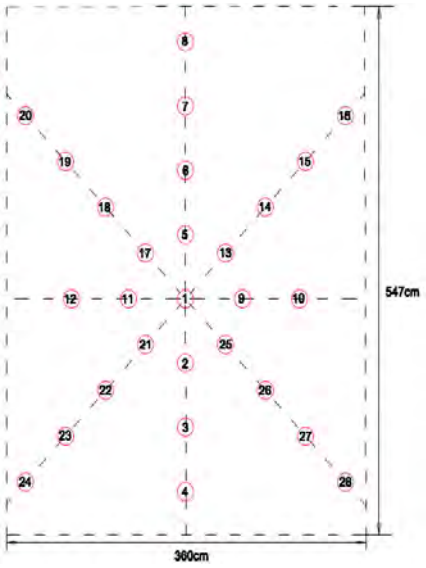
Bulb:	3: 2ft
LED T8	
OSRAM Fluorescent T8	

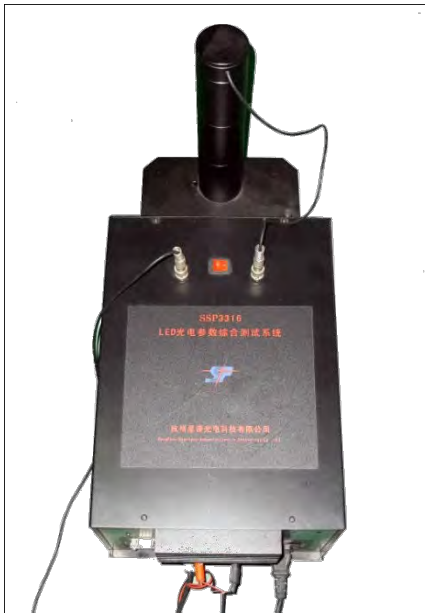
**Note: Candela are lower then reality, only to be used to study comparison*

ILLUMINANCE CHARACTERISTICS

Test Setup:

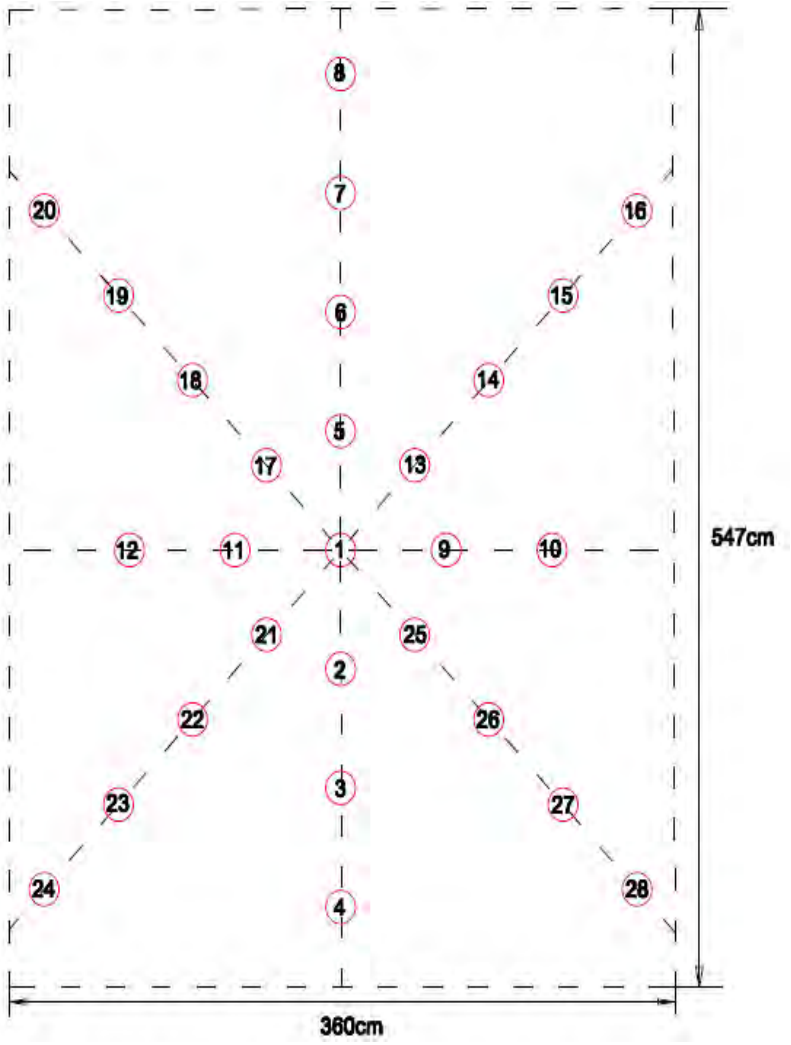
- "Intensity Distribution Meter"
- Using floor grid system to compare LED T8 in fixture to Fluorescent T8 in fixture





ILLUMINANCE CHARACTERISTICS

Result: Our T8 LED lamp has a 12% gain in illuminance over a fluorescent in a high efficiency fixture



LOCATION ON GRID	3: 2ft Lamps		LED T8 %
	LED T8	**OSRAM T8**	
Lumens	*630*	*1100*	*58*
1	151.8	233.5	65
2	101.3	142.8	71
3	55.6	73.1	76
4	35.4	45.4	78
5	88	125.1	70
6	51.5	69.8	74
7	32	43.2	74
8	20.4	26.7	76
9	124.9	197	63
10	80.4	125.1	64
11	124.2	189.5	66
12	78.9	120.2	66
13	93.3	134.9	69
14	49.3	66.8	74
15	29.2	39.8	73
16	18	24.4	74
17	92.4	132.9	70
18	47.6	66.3	72
19	29.2	39.2	74
20	17	22.5	76
21	103.5	151.3	68
22	51.4	68.4	75
23	29.8	39.0	76
24	17	22.9	74
25	102.1	147.8	69
26	52	69.2	75
27	30.7	40.6	76
28	18.8	25.0	75
Average	**61.63**	**88.66**	**70**

Note: Lumens are lower then reality, only to be used to study comparison

Which market are we targeting?

- **What is more important:**
  - **A completely uniform, "high light quality" source (similar to fluorescent) that has no "LED sparkle" (which draws your eyes to the light source and can be annoying to many)**
  - **Or, the highest EFFICACY and highest LUMEN system where light quality is of no or little concern**

T8 V1 (internal driver)

NON- COMMERCIAL USA + FOREIGN

- PF >0.50
- Input: 100V or 240V AC

OPTIONS	#1 (current)	#2 (non-uniform)	#3 (non-uniform + less diffuse lens)
Driver Location	Internal	Internal	Internal
Connection	One side live (UL)	One side live (UL)	One side live (UL)
PF	>0.50	>0.50	>0.80
Efficiency of Driver	>70%	>70%	>70%
Efficacy	55lm/watt	60lm/watt	70lm/watt
Dimmable	Step only	Step only	Step only

T8 V2 (external driver)

COMMERCIAL USA + FOREIGN

- E*: PF >0.90
- THD <20%
- Input: 100V or 240V AC

OPTIONS	#1 (current)	#2 (non-uniform)	#3 (non-uniform + less diffuse lens)
Driver Location	External	External	External
Connection	Any	Any	Any
PF	>0.90	>0.90	>0.90
Efficiency of Driver	>85%	>85%	>85%
Efficacy (w/driver)	75lm/watt	80lm/watt	86lm/watt
Dimmable	Triac	Triac	Triac

Factors for cost savings

- Class 2 External Driver will help make the lamp construction less expensive
- Our simple and elegant design lends itself very well to LOW assembly costs in mass production
- Our LED cost will be moving DOWN!
- OSRAM Approved LEDs are MORE expensive then non-approved!!
  - This can also have an affect on lumens and CRI

Thank you !