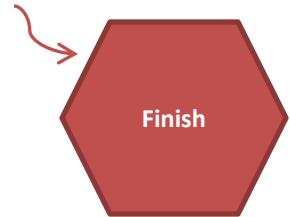
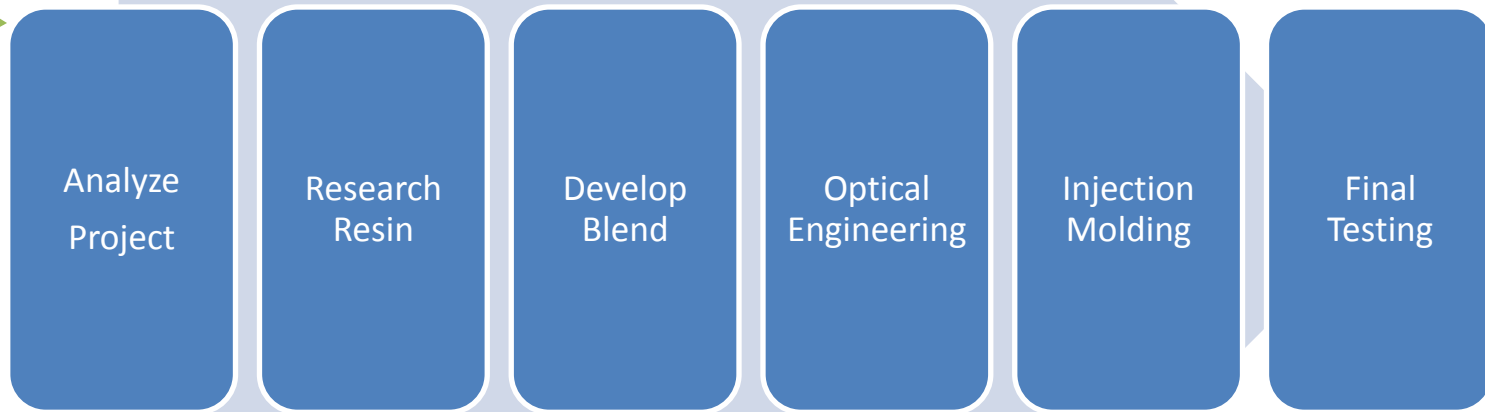


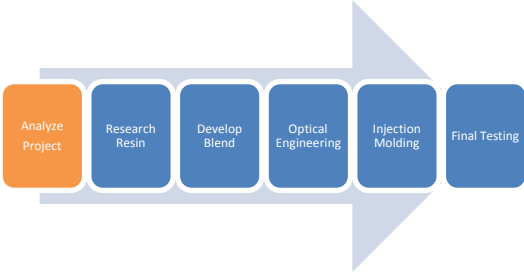
RemPhos

TECHNOLOGIES

Remote Phosphor Design Process

RemPhos Approach: “Total Project Management”

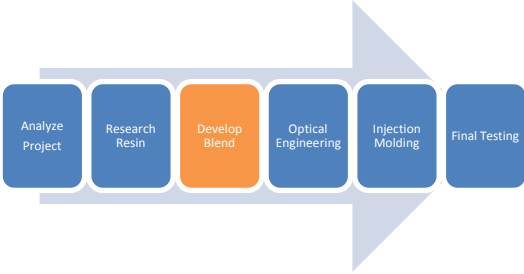




Analyze Project

- Each Remote Phosphor project is unique
- Questions:
 - Shape of light source?
 - Flux density?
 - Available cooling?
 - What is most important criteria?
 - Lumens
 - Cost
 - Life

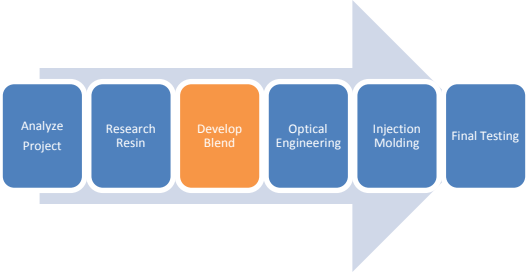




Develop Blend

- **RemPhos has designed process to combine phosphors with plastics**
- **This process differs for each resin (PP,PC etc)**
- **In house capabilities**
 - Class 10,000 clean room to control contamination
 - Custom designed extrusion/compounding machinery designed specifically to process the phosphor and embed it into the plastic resins
 - Testing: CCT meter, spectrophotometer





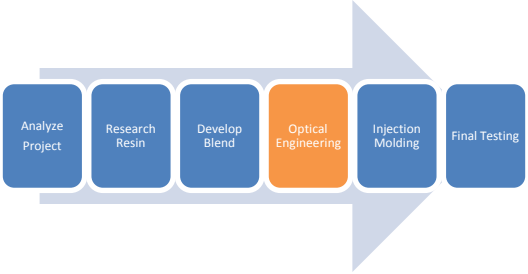
Develop Blend

Clean Room



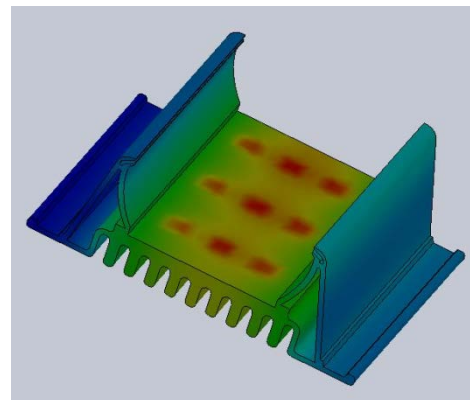
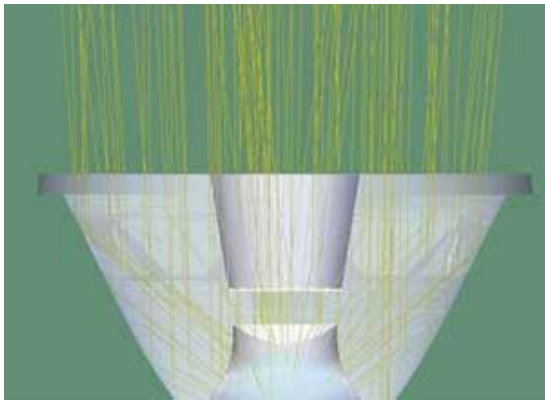
Extruder/Compounder

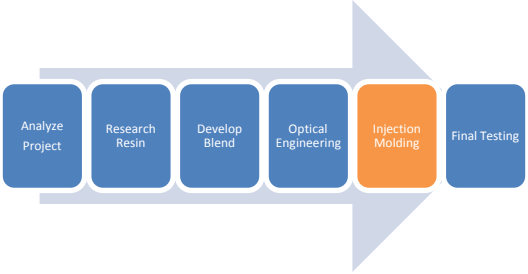




Optical Engineering

- **Optical Engineer and use of LightTools®**
 - Ray Tracing
 - Surface finish/reflector surface analysis
- **Study optical and thermal relationship**





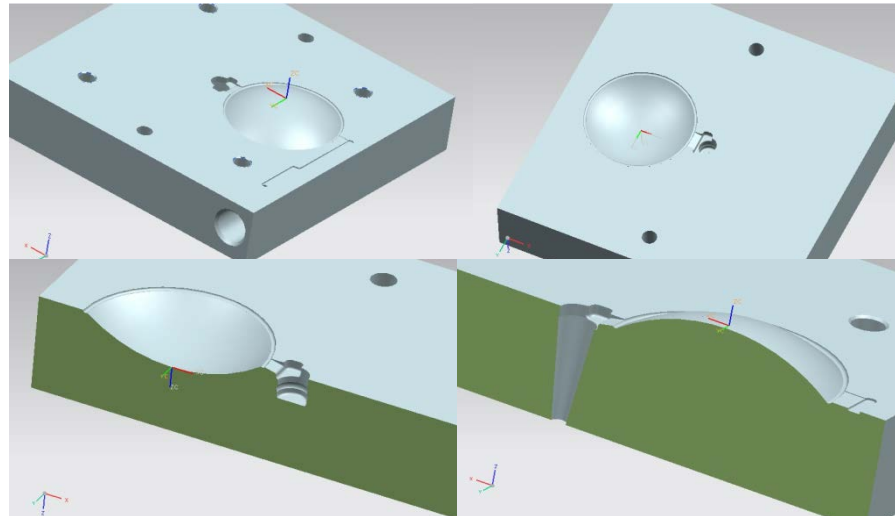
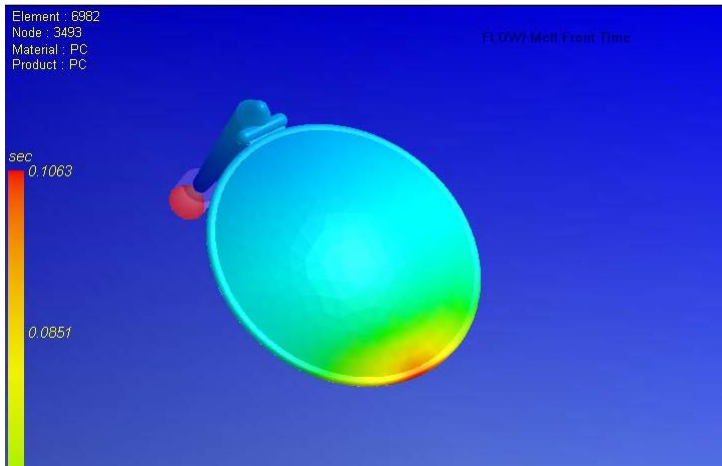
Injection Molding



- **In house capabilities:**

- **Mold design software**

- **Injection molding machine** (upgraded with electronics/hardware to allow for the processing of phosphor blends)



Final Testing

- Performance of total system in integrating sphere
- Thermal analysis



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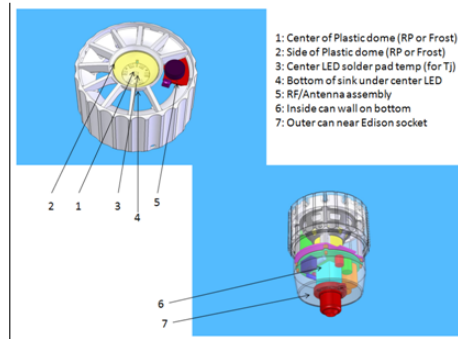


Figure 1: Location of thermocouples 1-7

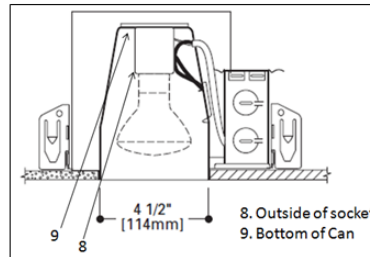


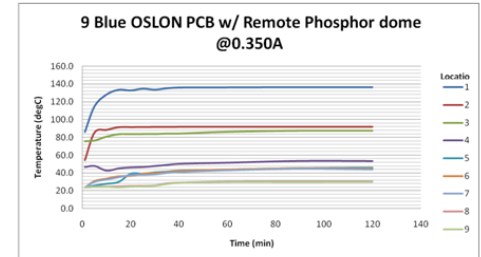
Figure 2: Location of thermocouples 8-9



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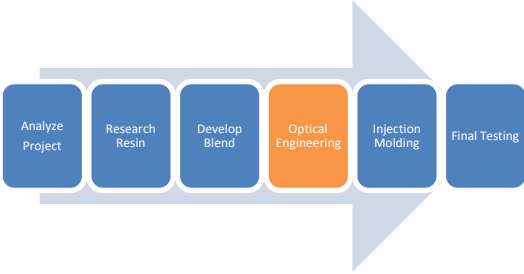
Data acquired:
9 Blue OSLOM PCB w/ Remote Phosphor dome
@0.350A
Ambient Temp: 23.8C

Time (min)	Location									Current	Voltage
	1	2	3	4	5	6	7	8	9		
1	86.3	54.3	75.5	46.8	23.9	23.9	23.8	23.8	23.9	0.35	27.8
5	115.0	85.3	76.2	48.0	26.1	31.1	30.2	24.5	24.6	0.35	27.9
10	128.1	88.2	80.8	42.8	28.1	33.8	32.8	24.8	24.8	0.35	27.8
15	133.3	91.2	83.5	45.3	30.2	36.4	35.4	25.0	24.1	0.35	27.8
20	132.6	91.3	83.6	46.4	39.4	36.9	37.7	25.5	24.9	0.35	27.8
25	134.5	91.4	83.7	46.8	39.4	39.3	38.0	25.6	25.2	0.35	27.8
30	133.4	91.5	83.7	48.0	40.9	40.0	38.6	26.1	25.9	0.35	27.8
35	135.0	91.5	84.2	49.2	41.7	41.0	40.2	28.5	27.9	0.35	27.8
40	135.8	91.6	84.2	50.4	42.8	42.4	41.1	29.2	29.1	0.35	27.7
60	136.0	91.7	86.2	51.7	43.9	43.9	43.1	30.5	30.1	0.35	27.7
90	136.2	91.6	87.5	53.7	45.6	45.3	44.8	30.6	30.1	0.35	27.7
120	136.2	91.7	87.5	53.6	46.1	44.8	44.0	30.6	30.2	0.35	27.7



- Comments:
- Phosphor temperature is high but not a concern since it is less than 150C
 - T_{solder} of center LED is around 10-18deg lower than 9 White OSLOM equivalent PCB
 - Temperature of electronics is well under 60C max
 - Steady state reached at around 90min

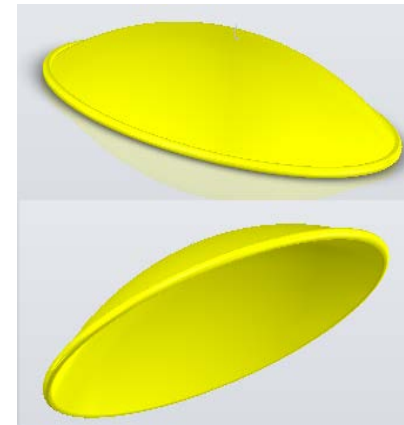
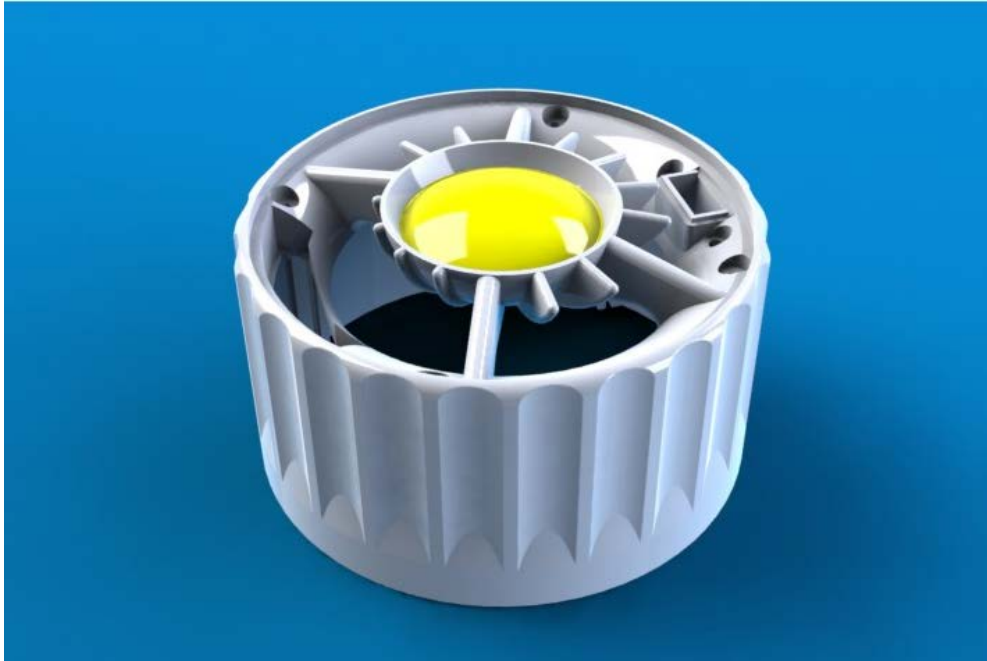


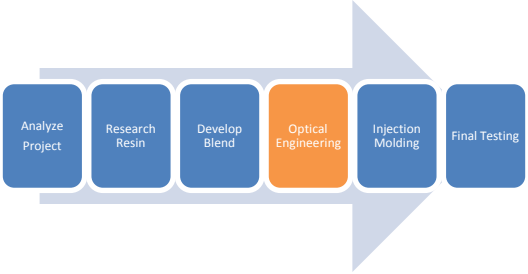


“Down Light”

- **Current Status:**

- Studied curvature of dome to determine optimal radius
- Analysis of shell thickness dependent on each resin
- Testing with top gated mould is complete, new side gated mould now in tooling





“Table Lamp”

- **Current study on shape of remote phosphor shell**
- **3 Main Criteria**
 - **Phosphor Cost**
 - **Light emission distribution**
 - **Maintain highest lumen efficacy possible**

