GETTING THE MOST OUT OF LED AIRFIELD LIGHTING

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Agenda

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- Introduction
  - Airfield lighting overview
- LED Lighting Management
  - Warranty
  - Fixture obsolescence and spare parts
- Physical Impacts on Lighting Systems
  - Moisture
  - Vibration
- Preventative Maintenance and Refurbishment
- Return on Investment
  - ROI Factors
  - Mean Time to Failure
  - ROI Assessment
- Heaters
  - Factors and Considerations
- Photometrics and Chromaticity
  - Photometric Output
  - Intensity Dimming
  - Chromaticity
  - Color Location
  - Evaluation
- Takeaways

Converting to LED Airfield Lighting

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LED Lighting Management

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- Identifying LED lighting as an asset
- Change in maintenance philosophy
- Establish repeatable and recordable maintenance procedures

Warranty

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- Engineering Brief 67D

  4.0 Minimum Warranties

  4.1 – All LED light fixtures with the exception of obstruction lighting (AC 150/5345-43) must be warranted by the manufacturer for a minimum of 4 years after date of installation inclusive of all electronics.

- Fixtures under warranty sent to manufacturer for repair
- Post warranty options:
  - Extended warranty
  - Service contract
  - In-house repair
- Maintenance needs to budget and plan for post warranty option

Fixture Obsolescence and Spare Parts

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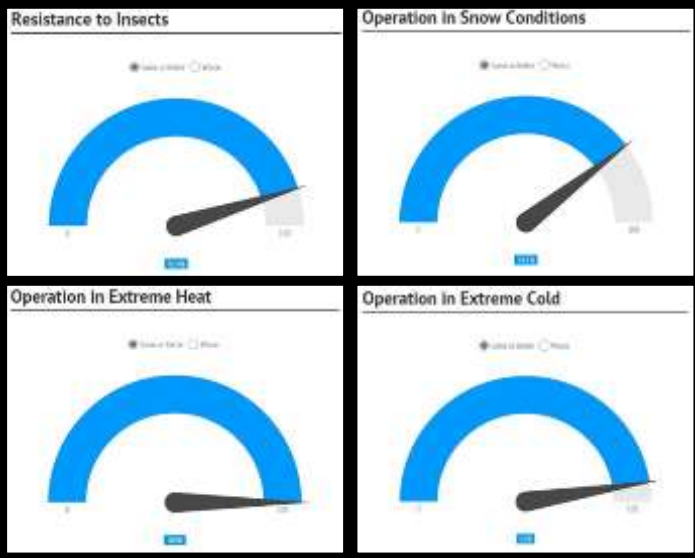
- LED fixtures and components continue to evolve
- Vendors try to standardize but some components eventually are no longer supported
- Recommendation on spare parts (whole fixtures vs. individual components)
- Develop strategy for replacement or upkeep of unsupported fixtures

Physical Impacts on Lighting Systems

- Moisture
- Vibration
- Heat
- Cold
- Insects
- Deicing Fluid



Moisture

- Most common issue airports have reported with LED lights
- Constant presence of water in lighting infrastructure
- Early generations of fixtures were not encapsulated
- Longer lamp life equates to less frequent inspection

Vibration

- Higher incident of failure of T/W CL fixtures at high speed exits
- Complex forces placed on in-pavement fixtures
- May have an affect on bolts
- Infrequent maintenance can make matters worse

Boeing 747-400
Empty operating weight: 406,000 lbs.
Max landing weight: 652,000 lbs.
Max takeoff weight: 910,000 lbs.

Vibration

Preventative Maintenance and Refurbishment

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- Preventative maintenance is NOT system repairs
- Proper training of maintenance personal is key
- Asset management programs can track installed date, spare stock and warranty expiration
- Refurbishment is important with longer life LEDs – prism, gaskets, housing
- Consult and work closely with vendors
- FAA AC 150/5340-26C – Maintenance of Airport Visual Aid Facilities

FAA Advisory Circular 150/5340-26C

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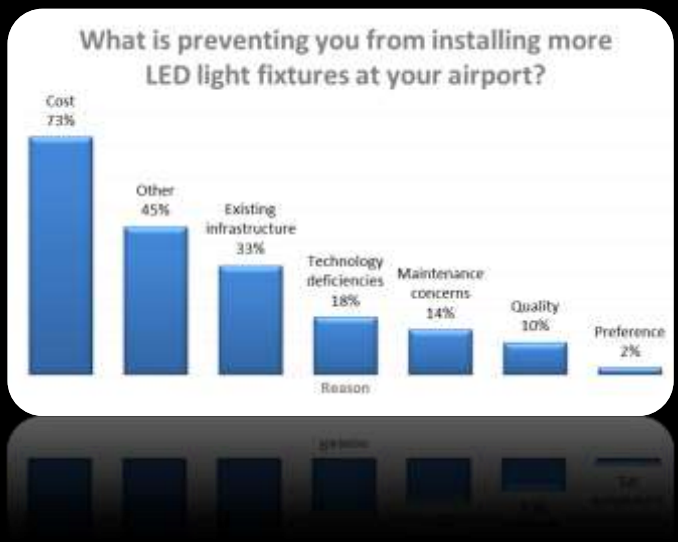
Table 5-5. Preventive Maintenance Inspection Schedule for Runway and Taxiway Elevated Edge Lights

MAINTENANCE REQUIREMENT	DAILY	WKLY	MTHLY	SMANY	ANNLY	UNSCH
1. Inspect for outages; repair as necessary	X					
2. Check cleanliness of lenses	X					
3. Perform photometric testing (HIRL) and check light alignment and orientation			X			X
4. Re-align lights as needed			X			X
5. Clean fixtures and sockets						X
6. Check light elevation				X		
7. Check for moisture in lights				X		
8. Inspect fixture for rust, deterioration					X	
9. Check lamp fitting and clean contacts					X	
10. Check gaskets					X	
11. Remove snow and/or vegetation from around lights						X

Return on Investment

- Cost greatest concern
- LED lighting comprises between 20% - 50%
- Understanding ROI of LED vs. non-LED
  - LED higher initial investment
  - Non-LED has back end costs



ROI Factors

- Energy cost
  - Varies from Region to Region
- Maintenance cost
  - Significant Issue Impacting ROI
- Material Cost
  - Consumable Items

Category of Cost	Percent Savings	Costs
Energy Cost	4.2%	$3,521.52
Lamp Replacement Labor Cost	71.0%	$60,000.00
Material Cost	24.8%	$21,000.00

Cost difference between Incandescent and LED technology for a 100 light, IRGL circuit and a 15 year life expectancy

Mean Time to Failure (MTTF)

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- Shift to fixture performance

Factors	LED	Incandescent
Lamp Life	Average LED life of 56,000 hours under high-intensity conditions and more than 150,000 hours under typical operating conditions.	Low-energy/long-life halogen lamps are 48W with a rated life of 1,500 hours at 6.6A and in excess of 6,000 hours in practical use.
Photometric Output dips below 70%.	Approximately the life of the fixture.	Photometric Intensity of the Quartz lamp may drop below 70% at 50% of the life of the lamp.
Deterioration of Optical Lens and Environmental Factors	Subject to deterioration is the same for either type of fixture.	Subject to deterioration is the same for either type of fixture.

ROI Assessments

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- Not Simple Energy Consumption
- Track fixture maintenance and replacement to determine costs
- Initiate programs to evaluate MTTF

Heaters

- EB 67D
- Artic kit or appropriate addressing of potential icing conditions
- Optional to customer

Heaters

- Arctic Kit Test Requirements
  - "…at the highest intensity setting, the main beam light emitting surface temperature must rise a minimum of 15°C after 30 minutes operation."
- No test requirements on lower steps

Heaters – Factors and Considerations

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- Precipitation Type
- Snow Removal Procedures
- Light System Operation

Heaters

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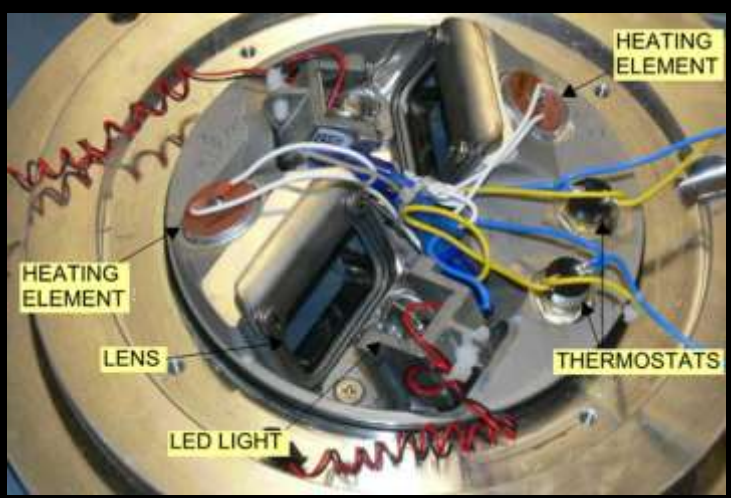
- Provides predictable and efficient heating operation
- Energy savings
- Verify mean time to failure includes heaters



Photometric/Chromaticity

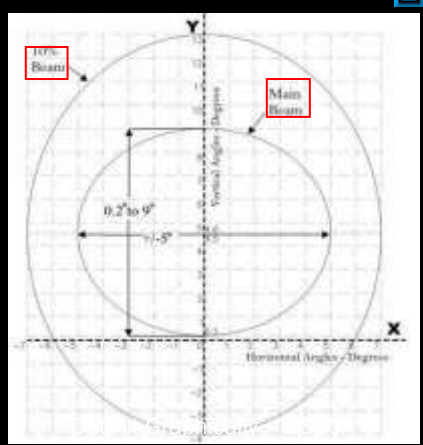
- Photometrics
  - Light output
  - Light intensity dimming curves
- Chromaticity
  - Coloration

Photometric Output

Table 1. Photometric Requirements for In-pavement Lights.

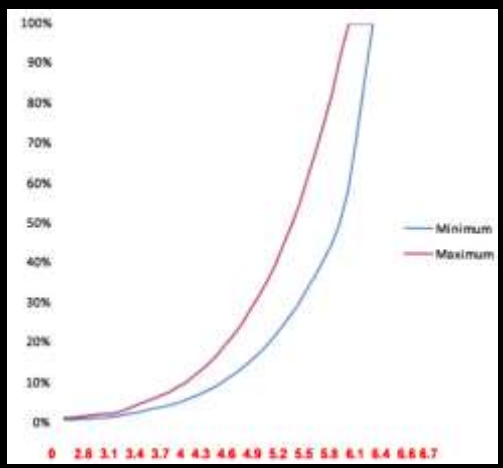
Type	Minimum beam coverage (degrees) (a)				Intensity (candelas) (b)				
	Main beam (c)		10 percent (d)						
	H	V	H	V	White	Yellow	Green	Red	Blue
L-850A	±5	0.2 to 9	±7	-4 to 13	5,000			750	
L-850T (g)	±5	0.2 to 9	±7	-4 to 13				1200	
L-850B (j)	-1 to 9	2 to 9	-3 to 11	-0.5 to 11.5	5,000				
L-850C	-2 to 9	0.2 to 7	-4 to 11	-2.5 to 9.5	10,000	5,000	5,500	1,500	
L-850D	-2 to 9	1 to 10					5,500		
	±6	0.2 to 4.7	±7.5	-2.5 to 7.5				2,500	

FAA AC 150/5345-46D



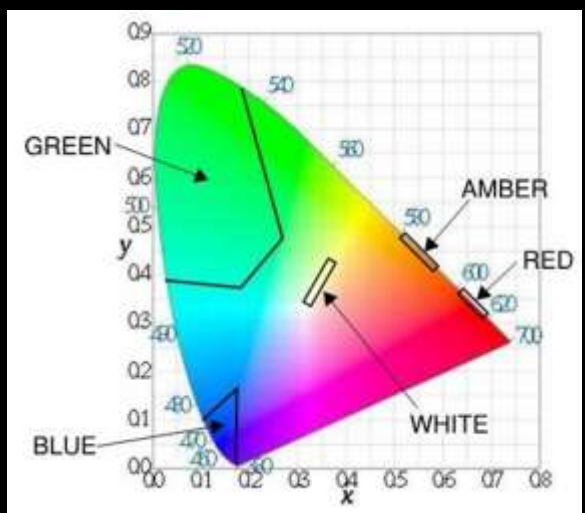
Intensity Dimming

- Mismatched light intensity output (Dimming curve)
- Uneven light output in intermediate operational intensity settings
- FAA EB #67
  - Light Sources Other Than Incandescent and Xenon for Airport and Obstruction Lighting Fixtures



Chromaticity

- Aerospace Standard
  - AS25005 – General Requirements for Colors, Aeronautical Lights and Lighting Equipment
- International Commission on Illumination (CIE) Mixture Diagram



Color Location

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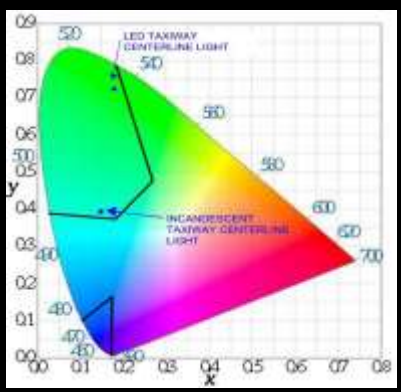
LED TW Centerline Light Color Location

Position Degrees	X	Y
(-3.5,1)	0.177	0.730
(-3.5,8)	0.178	0.730
(3.5,1)	0.174	0.732
(3.5,8)	0.174	0.737
(0,4.5)	0.176	0.733

Incandescent TW Centerline Light Color Location

Position Degrees	x	y
(3.5L, 4.5U)	0.1622	0.3960
(0H, 4.5U)	0.1620	0.3929
(3.5R, 4.5U)	0.1626	0.3970
(0H, 1U)	0.1641	0.3940
(0H,8U)	0.1614	0.3988



Evaluation

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- Verify color coordinates & color spectrum
- Test & verify system photometric output

Takeaways

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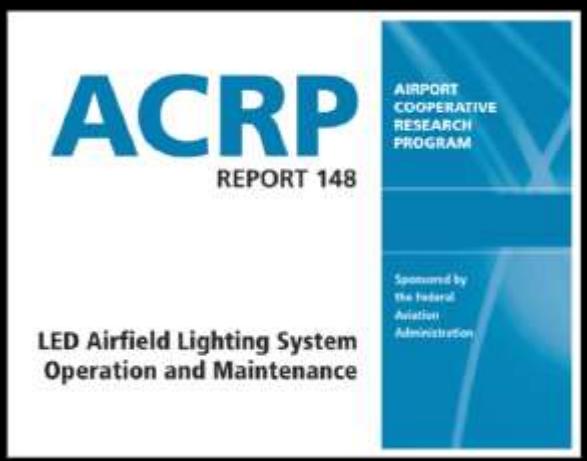
- Get the Guidebook:
  - http://onlinepubs.trb.org/onlinepubs/acrp/acrp_rpt_148.pdf



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