The Good, The Bad & The Ugly of Airport Lighting Maintenance

IESALC
ILLUMINATING ENGINEERING SOCIETY
AVIATION LIGHTING COMMITTEE

YOU CANNOT MANAGE WHAT YOU DO NOT MEASURE

THE GOOD THE BAD AND THE UGLY

Performed by:

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Who are we?

1. Airport Electricians
2. Consultants & Consultants
3. Contractors and Installers
4. Equipment Manufacturers
5. Government
6. Pilots & Passengers

Safety & Compliance

- When you get on a plane do you expect it to be properly maintained at all times?
- Do you expect the Crew to be Competent and Trained?
- Do you expect ATC to be Competent and Trained?
- Do you expect the ILS to be properly maintained?
- Do you expect the visual aids (lights, signs and PAPI's) to be compliant

There are no barriers to success

- Maintenance requirements are clearly documented in AC 150-5340/26c
- Processes and procedures exist to support their implementation (SMS)
- Tools and Equipment have been developed to support installation and maintenance in compliance with these standards
- Competent Electricians have been trained to execute their tasks necessary to maintain compliant lighting

But are there?

- Recently I was asked, on the topic of serviceability of lighting systems:

  - What are the levels below where operations should not continue and;
  - What are the considerations to take in to account when setting this levels and;
  - What should we do when the levels are reached?
  - Is it left to the Pilots discretion to decide whether to take-off or land?

And the answer is:

1. All national and International Standards specify airfield lighting serviceability levels for CAT I/II/III
2. Since the light levels are mandatory, a failure to meet the Standard is a regulatory breach and a NOTAM should be published
3. If points 1 and 2 are implemented then the pilot will be constrained to take the appropriate decision by the licensing regulations. This will vary by aircraft, airport and qualifications of the pilot. This decision is not discretionary.

Is your airfield lighting compliant?

- Ask the Airport Manager

  - I would expect the answer to be yes
  - The next question is “how do you know”
  - The answer will be along the lines “I have a SMS in place with people who take care of it for me.” But how do they know?

- Ask a FAA inspectors
  - They never ask for photometric measurements
  - They tell me they can only measure what they can e.g. Signs and markings for physical compliance
  - They have no means of measuring an airports safety critical visual aids AND VERY FEW AIRPORTS HAVE MEASUREMENT TOOLS

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So what?
Does anybody care?
Why should they care?

- The aviation industry prides itself on their being no single point of failure in the system that could, on its own, cause a fatal accident. Runway lighting is an important part of this system, especially in low visibility conditions
- A Boeing study into aviation fatal accidents found that the final approach and landing stages of flights accounted for 60%
- More than 90% of these accidents occurred in low visibility
- What is the difference between good visibility and bad visibility?
- You can’t see the lights!

Airport Lighting Maintenance - Airport 4.0

and migration towards Performance based and Predictive Maintenance techniques, tools and processes :

Installation & Material

- ❑ Correctly selected equipment
- ❑ Equipment correctly installed
- ❑ Correct acceptance criteria

Tools, Test Equipment and Product Support

- ❑ Correct tools & calibrated test equipment
- ❑ Adequate working space & storage
- ❑ Product Training and After Sales Support

Maintenance Processes & Procedures

- ❑ Scheduled inspections & Tests
- ❑ Equipment kept in good condition
- ❑ Correctly adjusted equipment

Electricians

- ❑ Competence
- ❑ Training
- ❑ Access to runways & taxiways

Measure – Maintain – Monitor - Manage

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Installation & Material

- Correctly selected equipment
  - Involve the Airfield Electricians
  - Ensure that the equipment is compatible with other systems or equipment
  - Define equipment requirements
- Equipment correctly installed
  - Process
  - Tools
  - Training
  - Competence
  - Management
- Correct acceptance criteria
  - Define appropriate acceptance criteria

Maintenance Processes & Procedures

- AC No: 150/5340-26C

This advisory circular (AC) provides recommended guidelines for maintenance of airport visual aid facilities.

Use of this AC is mandatory for all projects funded with federal grant monies through the Airport Improvement Program (AIP) and with revenue from the Passenger Facility Charges (PFC) Program.

Tools, Test Equipment & Product Support

- Adequate working space & storage
  - availability of appropriate and sufficient physical room and organizational capacity within a workspace to facilitate efficient and safe operations
- Correct tools & calibrated test equipment
  - using the correct tools and calibrated test equipment is essential for ensuring precision, safety, and reliability
  - calibrating test equipment contributes significantly to the accuracy and effectiveness of work processes.
- Product Training and After Sales Support
  - product training and after-sales support are integral parts of customer service. They ensure that customers not only understand how to use the product effectively but also receive assistance and support whenever they encounter issues

Electricians

- Competence
  - the necessary knowledge, skills, training, and attitude to perform specific tasks or make decisions safely and effectively.
- Training
  - the process of teaching, developing skills, and imparting knowledge to individuals or groups to improve their performance, competence, and abilities in a specific area
- Access to runways and taxiways
  - airports must establish procedures whereby electricians can routinely access runways and taxiways to perform scheduled maintenance tasks

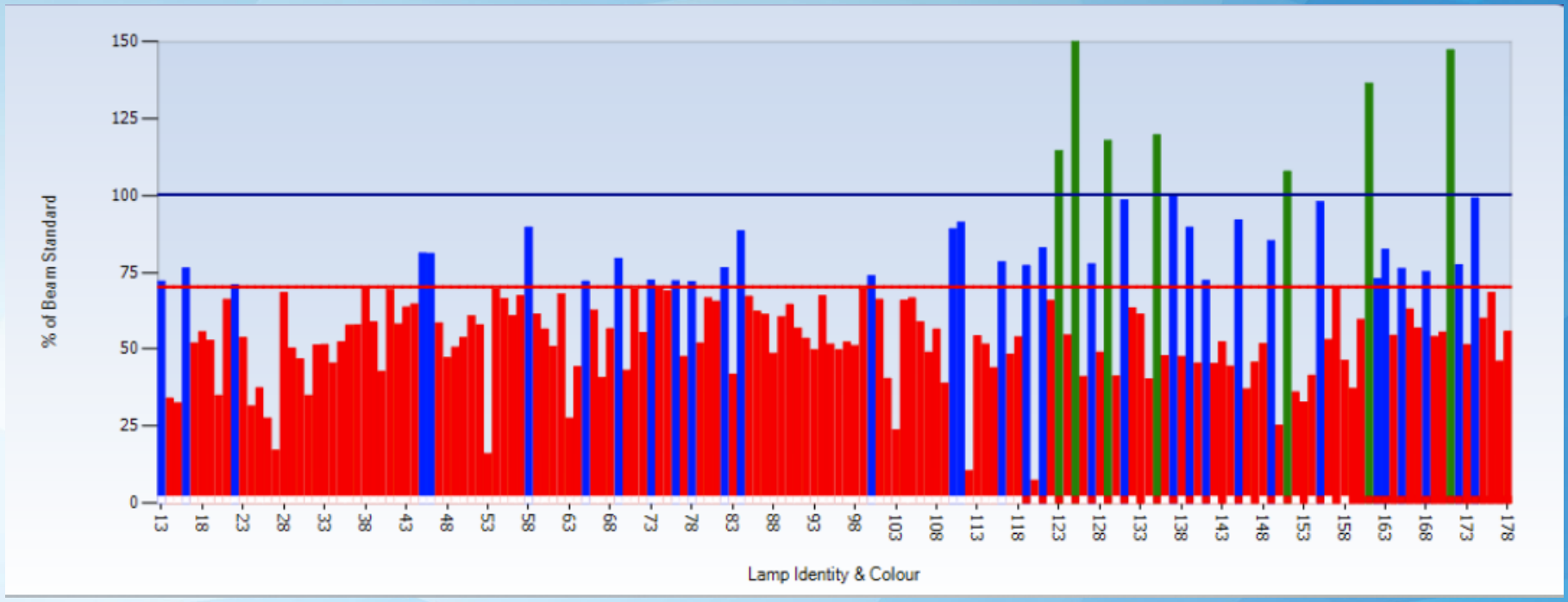
Light Fixture Maintenance Maintaining Proper Light Output per FAA AC 150/5340-26C

Intensity Checks/Photometric Testing

Regular photometric measurements are the only practical way of determining if the lights are emitting the specified amount of light and for determining misalignment errors.

Any runway light fixture exhibiting a light output of less than 70% of the minimum output required when operated at maximum intensity per AC 150/5345-46, Specification for Runway and Taxiway Light Fixtures, is ineffective for high background brightness, low visibility conditions and should be targeted for cleaning or maintenance.

Light Fixture Maintenance Maintaining Proper Light Output per FAA AC 150/5340-26C



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What Affects Photometric Results?

- Dirt & Contamination
- Lying Water
- Warm-up period
- Variation of lumen output
- Current
- Fixture alignment
- Ambient Light
- Color
- Condition of Lens
- Level of seating / plough ring
- Fixture Design / manufacturing issues

Sign Measurement

Sign Test Report

The Lethbridge Airport
Signs / Signs / < - A
From: 9/18/2023 To: 9/25/2023
Report Prepared: 9/25/2023 2:17:41 PM (Week 39)

Test Details

Light Test ID:	1_2
Date/Time:	9/23/2023 9:42:59 AM
Area:	Signs
Zone:	Signs
Location:	< - A
System:	YB
Sign No.:	1/2
Sign Type:	<- A
Colour:	Yellow
Width/Height:	1.8/0.6 m
Latitude:	49.630883
Longitude:	-112.790902
Operator Name:	

Parameter	Measured	Reference	Result
Sign Face			
Mean L (cd/m^2)	192.3	>= 150.0	OK
Max L (cd/m^2)	250.8		
Min L (cd/m^2)	98.6		
CIE x, CIE y	0.486, 0.508		
Colour	Yellow	Yellow	OK
L Ratio Adjacent	2.14	<= 1.5	Warning
L Ratio Global	2.54	<= 5.0	OK
L Ratio Red/White	0.00	>= 0.1 & <= 0.2	
Face Characters			
Mean L (cd/m^2)			
Max L (cd/m^2)			
Min L (cd/m^2)			
CIE x, CIE y			
Colour			
Side Characters			
Mean L (cd/m^2)			
Max L (cd/m^2)			
Min L (cd/m^2)			
CIE x, CIE y			
Colour			

Test Result

Warning

1

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Mandatory Sign

Sign Test Report

Lethbridge Airport

The Lethbridge Airport
Signs / Signs / 13-31
From: 9/18/2023 To: 9/25/2023
Report Prepared: 9/25/2023 2:22:17 PM (Week 39)

MALMS Engineer

Test Details	
Light Test ID:	3_4
Date/Time:	9/23/2023 9:53:01 AM
Area:	Signs
Zone:	Signs
Location:	13-31
System:	RW
Sign No.:	1/2
Sign Type:	13-31
Colour:	Red
Width/Height:	1.8/0.6 m
Latitude:	49.629806
Longitude:	-112.791845
Operator Name:	Richard Gore

Parameter	Measured	Reference	Result
Sign Face			
Mean L (cd/m^2)	37.0	>= 30.0	OK
Max L (cd/m^2)	47.1		
Min L (cd/m^2)	19.8		
CIE x, CIE y	0.663, 0.316		
Colour	Red	Red	OK
L Ratio Adjacent	1.95	<= 1.5	Warning
L Ratio Global	2.38	<= 5.0	OK
L Ratio Red/White	0.13	>= 0.1 & <= 0.2	OK
Face Characters			
Mean L (cd/m^2)	280.5	>=300.0	Fail
Max L (cd/m^2)	340.2		
Min L (cd/m^2)	195.0		
CIE x, CIE y	0.393, 0.414		
Colour	White	White	OK
Side Characters			
Mean L (cd/m^2)			
Max L (cd/m^2)			
Min L (cd/m^2)			
CIE x, CIE y			
Colour			

Test Result
Fail

1

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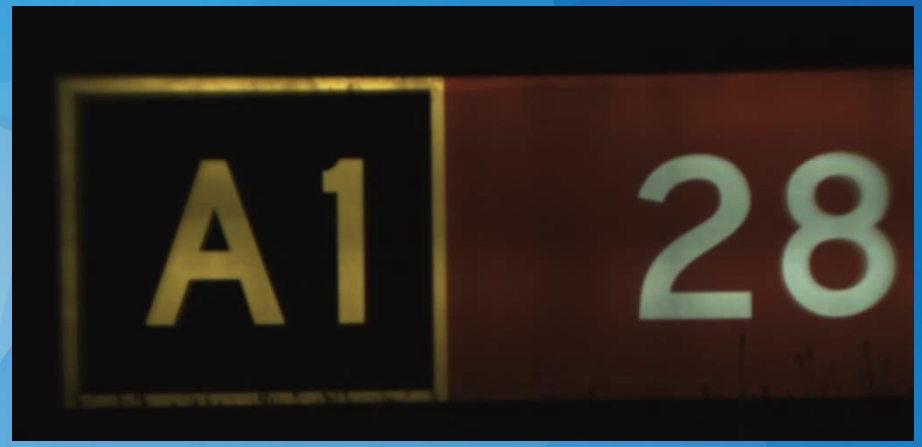
What affects the sign results?

- Age of the sign board
- Cleanness of the sign board inside and outside
- Age of the bulbs/LED strips/fluorescent tube
- Damage to the sign face (environmental and physical)
- Obstacles, such as growing vegetation
- Sign design issues including retrofit



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PAPI Measurement

PAPI Status (180 Days)

Zone	% OK	Reports	Last Inspection
PAPI06	50%		9/23/2023
PAPI13	0%		9/22/2023
PAPI24	75%		9/23/2023
PAPI31	50%		9/23/2023
All	44%		9/23/2023

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PAPI 24-C

Test Details	
Light Test ID:	11_14
Date/Time:	9/23/2023 7:38:36 AM
Area:	PAPI
Zone:	PAPI24
Location:	PAPI24-C
System:	PAPI24
Light No.:	3/4
Light Type:	PAPI (Precision Approach Path Indicator)
Manufacturer:	
Fitting Type:	
Colour:	White/Red
Latitude:	49.628565
Longitude:	-112.793129
Operator Name:	Richard Gore

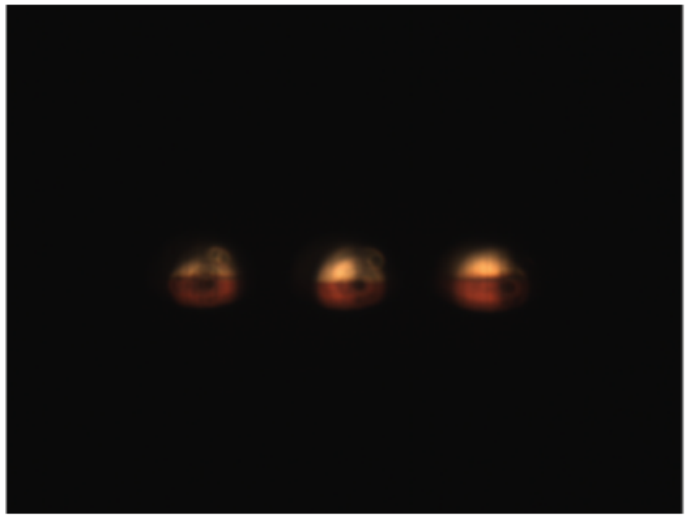
Optics Quality: Medium

All colour transitions could be estimated.

Test Result

Pass

Parameter	Measured	Reference	Result
Minimum Intensity White (cd)	75621.1	> 30000.0	OK
Minimum Intensity Red (cd)	16609.8	> 15000.0	OK
Ratio Min White/Red	4.55	>= 2.0 & <= 6.5	OK
Vertical Angle (deg)	3°08'32''	3°10'00'' ± 3'	OK
White Colour CIEx, CIEy	0.435, 0.399	White	OK
Red Colour CIEx, CIEy	0.670, 0.322	Red	OK
Mean Intensity White (cd)	78624.2		
Mean Intensity Red (cd)	17991.6		
Maximum Intensity (cd)	87079.9		
Horizontal Angle (deg)	0°24'00''	0°00'00'' ± 12'	OK
Filter Alignment	Well Aligned		OK



PAPI 13-C

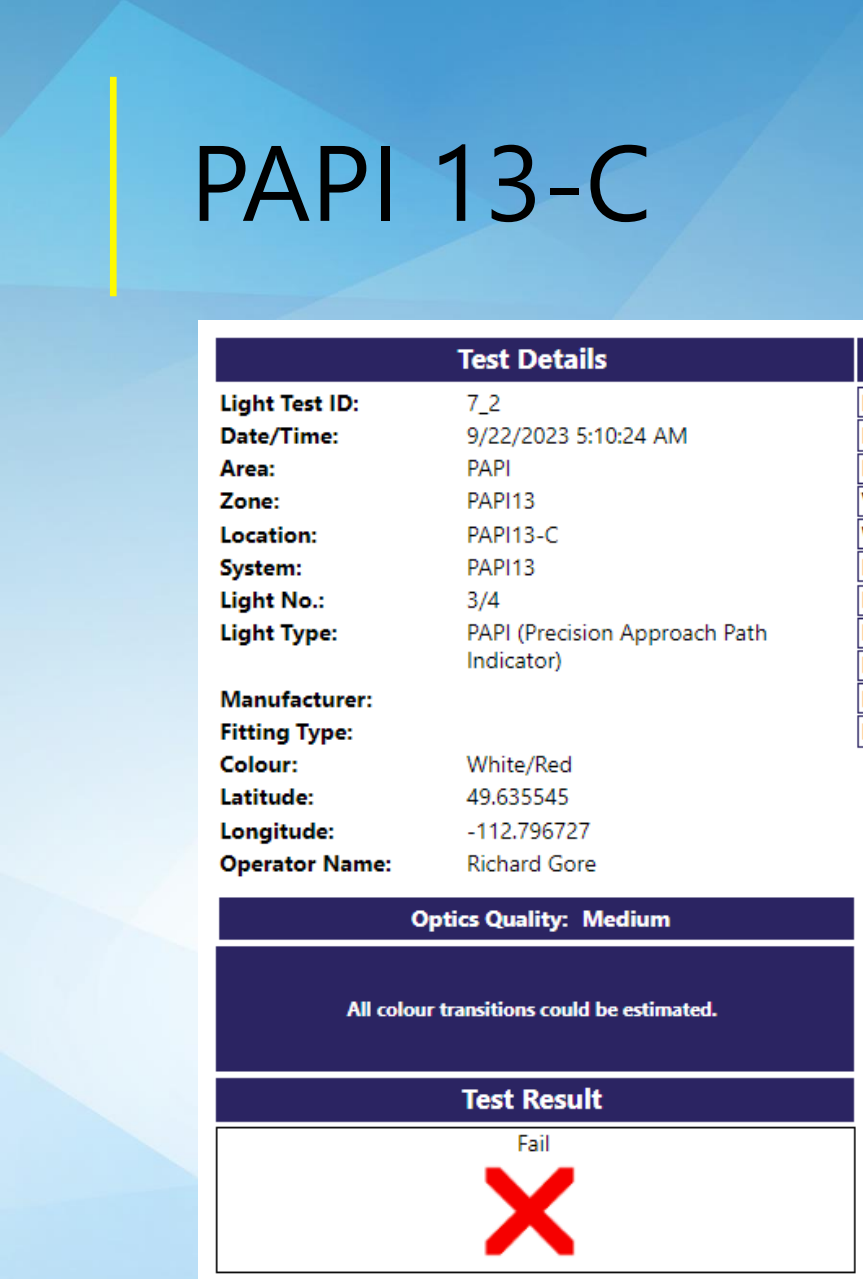
Test Details	
Light Test ID:	7_2
Date/Time:	9/22/2023 5:10:24 AM
Area:	PAPI
Zone:	PAPI13
Location:	PAPI13-C
System:	PAPI13
Light No.:	3/4
Light Type:	PAPI (Precision Approach Path Indicator)
Manufacturer:	
Fitting Type:	
Colour:	White/Red
Latitude:	49.635545
Longitude:	-112.796727
Operator Name:	Richard Gore

Optics Quality: Medium

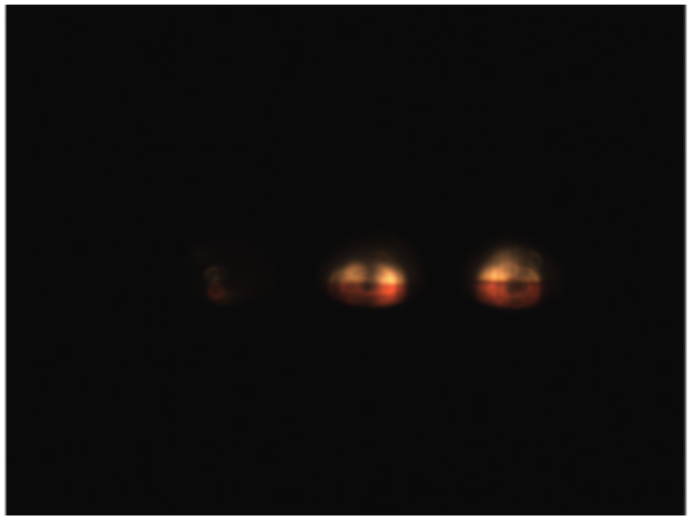
All colour transitions could be estimated.

Test Result

Fail

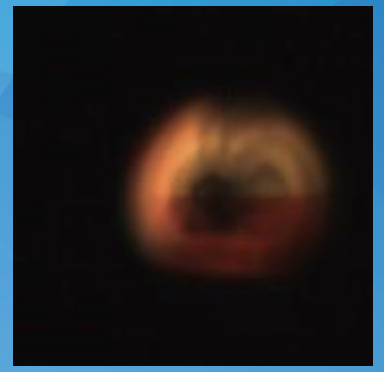


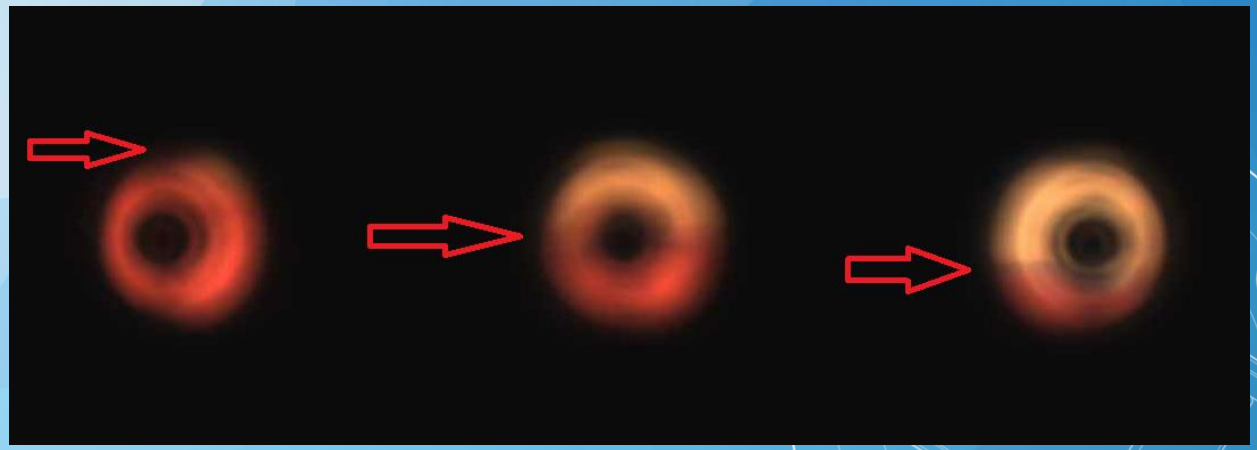
Parameter	Measured	Reference	Result
Minimum Intensity White (cd)	26440.2	> 30000.0	Fail
Minimum Intensity Red (cd)	6691.8	> 15000.0	Fail
Ratio Min White/Red	3.95	>= 2.0 & <= 6.5	OK
Vertical Angle (deg)	3°07'48"	3°10'00" ± 3'	OK
White Colour CIEx, CIEy	0.443, 0.400	White	OK
Red Colour CIEx, CIEy	0.662, 0.328	Red	OK
Mean Intensity White (cd)	26992.7		
Mean Intensity Red (cd)	7472.0		
Maximum Intensity (cd)	28920.1		
Horizontal Angle (deg)	0°00'00"	0°00'00" ± 12'	OK
Filter Alignment	Well Aligned		OK



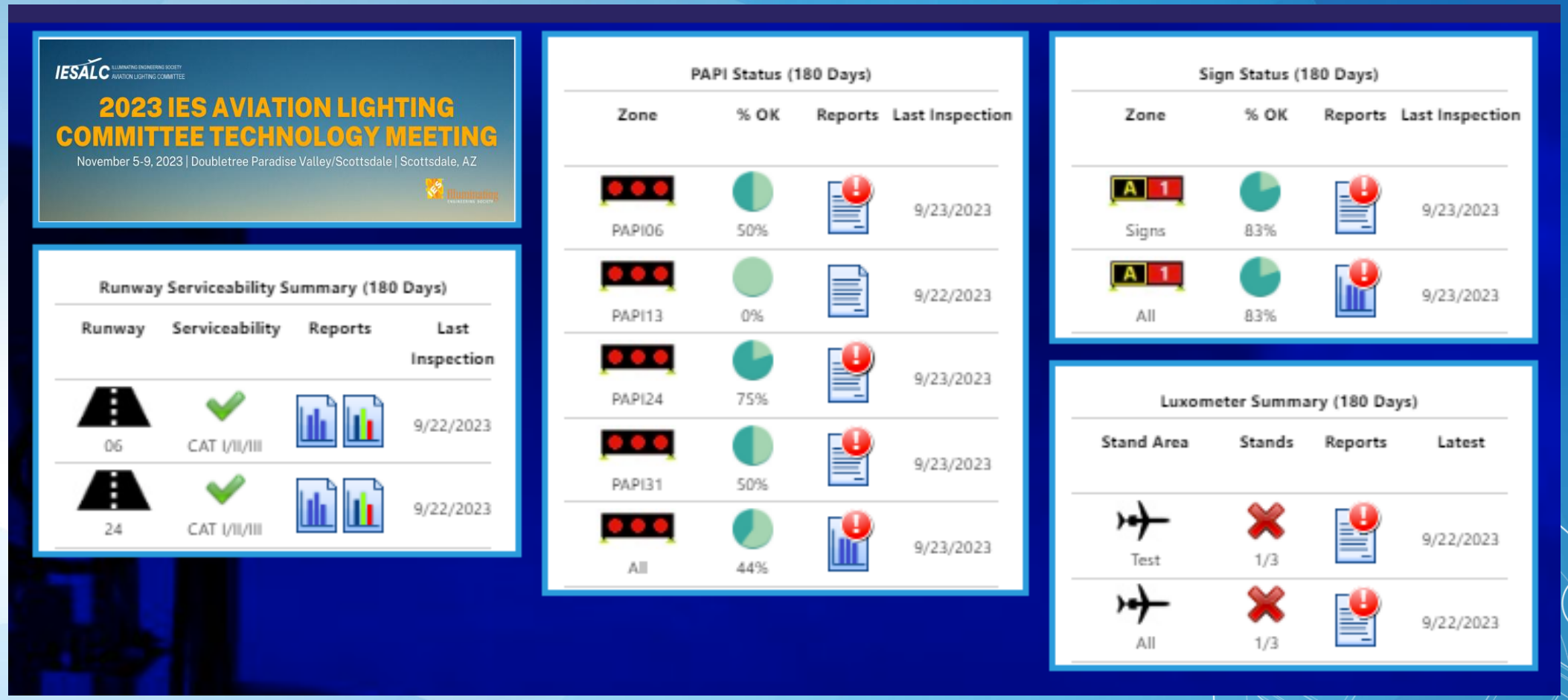
What affects the PAPI lamp unit results?

- Vertical and horizontal alignment of the PAPI unit (requires accurate clinometer)
- Age and condition of the bulbs/reflectors/lenses/filters
- Internal and external cleanness
- Misaligned filters
- Vegetation
- Physical damage





Airport CMMS Dashboard



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