



U.S. Department  
of Transportation  
**Federal Aviation  
Administration**

# Advisory Circular

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**Subject:** Precision Approach Path Indicator  
(PAPI) Systems

**Date:** 7/29/2019

**AC No.:** 150/5345-28H

**Initiated by:** AAS-100

**Change:**

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1 **Purpose.**

This Advisory Circular (AC) contains the Federal Aviation Administration (FAA) standards for the Precision Approach Path Indicator (PAPI) systems, which provides pilots with visual glideslope guidance during approach for landing.

2 **Effective Date.**

Effective six months after the issue date of this AC, only that equipment qualified in accordance with the specifications herein will be listed in accordance with AC 150/5345-53, Airport Lighting Equipment Certification Program.

3 **Cancellation.**

AC 150/5345-28G, *Precision Approach Path Indicator (PAPI) Systems*, dated September 29, 2011, is cancelled.

4 **Application.**

The FAA recommends the guidance and specifications in this Advisory Circular for design of the Precision Approach Path Indicator System. This AC does not constitute a regulation and is not mandatory. It provides one, but not the only, acceptable means of meeting the requirements of 14 C.F.R. part 139, *Certification of Airports*.

The standards and guidelines contained in this AC are practices the FAA recommends to establish an acceptable level of safety, performance and operation for use in the National Airspace System (NAS) to provide visual descent guidance to a pilot on approach for landing.

The lighting configurations contained in this standard are a means acceptable to the Administrator to meet the lighting requirements of Title 14 CFR Part 139, Certification of Airports, Section 139.311, *Marking, Signs and Lighting*.

However, use of these guidelines 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. See Grant Assurance No. 34, *Policies, Standards, and Specifications*, or PFC Assurance No. 9, *Standards and Specifications*.

**5 Principal Changes.**

1. Added PAPI functional description to Chapter 1.
2. Deleted “Note” regarding “Siting and Installation Standards” removal for PAPI from Chapter 1.
3. Updated links to publications where appropriate.
4. Updated reference documents.
5. Figure 3-1 was redrawn for clarity.
6. Added reference for PAPI Maintenance AC to paragraph 3.9.
7. Updated requirement for prevention of dew or frost/ice from accumulating on PAPI lens surfaces in paragraph 3.2.2.
8. Updated Red Chromaticity requirement for incandescent lamps in paragraph 3.2.1, item 7.b.
9. Added requirement for PAPI to be capable of adjustment to horizontal light beam coverage to paragraph 3.2.4.1.3.
10. Humidity Test added to paragraph 4.14.
11. Added horizontal light beam coverage adjustment requirement to paragraph 4.9, item 8.

Hyperlinks (allowing the reader to access documents located on the internet and to maneuver within this document) are provided throughout this document and are identified with underlined text. When navigating within this document, return to the previously viewed page by pressing the “ALT” and “ ← ” keys simultaneously.

**6 Use of Metrics.**

Throughout this AC, U.S. customary units are used followed with “soft” (rounded) conversion to metric units. The U.S. customary units govern.

**7 Where to Find this AC.**

You can view a list of all ACs at [http://www.faa.gov/regulations\\_policies/advisory\\_circulars/](http://www.faa.gov/regulations_policies/advisory_circulars/). You can view the Federal Aviation Regulations at [http://www.faa.gov/regulations\\_policies/faa\\_regulations/](http://www.faa.gov/regulations_policies/faa_regulations/).

**8 Feedback on this AC.**

If you have suggestions for improving this AC, you may use the Advisory Circular Feedback form at the end of this AC.



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Director of Airport Safety and Standards

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## CHAPTER 1. SCOPE

This AC contains the design and equipment requirements for PAPI systems. This system enhances safety by providing visual approach slope guidance to assist the pilot of an aircraft in flying a stabilized approach.

### 1.1 PAPI Equipment Classifications.

#### 1.1.1 Type.

1. L-880 - System consisting of 4 light units.
2. L-881- System consisting of 2 light units.

#### 1.1.2 Style.

1. Style A - Voltage powered systems.
2. Style B - Current powered (series lighting circuit) systems.

#### 1.1.3 Class.

1. Class I - Systems that operate from -31 degrees Fahrenheit (F) (-35 degrees Celsius [C]) to 131 degrees F (55 degrees C).
2. Class II - Systems that operate from -67 degrees F (-55 degrees C) to 131 degrees F (55 degrees C).

#### 1.1.4 Options.

1. Lamp socket bypass device in paragraph 3.4.2.
2. An isolation transformer consolidating harness for Style B systems in paragraph 3.2.6.3.1.
3. PAPI horizontal light beam coverage adjustment capability in paragraph 3.2.3.1, item 1.
4. Lamp Monitoring option in paragraph 3.5.

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## CHAPTER 2. APPLICABLE DOCUMENTS

The following documents are referenced in, or applicable to, this AC.

### 2.1 FAA ACs.

<u>AC 150/5220-23</u>	<i>Frangible Connections</i>
<u>AC 150/5340-26</u>	<i>Maintenance of Airport Visual Aid Facilities</i>
<u>AC 150/5345-26</u>	<i>FAA Specification for L-823 Plug and Receptacle, Cable Connectors</i>
<u>AC 150/5345-47</u>	<i>Specification for Series to Series Isolation Transformers for Airport Lighting Systems</i>
<u>AC 150/5345-49</u>	<i>Specification L-854, Radio Control Equipment</i>
<u>AC 150/5345-53</u>	<i>Airport Lighting Equipment Certification Program</i>

Siting and installation standards for PAPI systems are in:

<u>AC 150/5340-30</u>	<i>Design and Installation Details for Airport Visual Aids</i>
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Electronic copies of FAA ACs may be obtained from:  
[www.faa.gov/airports/resources/advisory\\_circulars/](http://www.faa.gov/airports/resources/advisory_circulars/)

### 2.2 FAA Standards and Drawings.

FAA-STD-019	<i>Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment</i>
FAA Drawing C-6046	<i>Frangible Coupling, Type 1 and 1A, Details</i>

Electronic copies of FAA Standards may be obtained from:  
[https://www.faa.gov/air\\_traffic/publications/](https://www.faa.gov/air_traffic/publications/)

FAA drawings may be obtained from:

FAA William J. Hughes Technical Center  
 NAS Documentation Facility, ACK-1  
 Atlantic City International Airport  
 New Jersey, 08405

### 2.3 FAA Engineering Briefs.

<u>Engineering Brief #67</u>	<i>Light Sources Other Than Incandescent and Xenon for Airport and Obstruction Lighting Fixtures</i>
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Engineering Brief #95    *Additional Siting and Survey Considerations for Precision Approach Path Indicator (PAPI) and Other Visual Glide Slope Indicators (VGSI)*

Electronic copies of FAA Engineering Briefs may be obtained from:  
[www.faa.gov/airports/engineering/engineering\\_briefs/](http://www.faa.gov/airports/engineering/engineering_briefs/)

2.4    **FAA Orders.**

JO 6850.2B                      *Visual Guidance Lighting Systems*

Electronic copies of FAA Orders may be obtained from:  
[https://www.faa.gov/regulations\\_policies/orders\\_notices/](https://www.faa.gov/regulations_policies/orders_notices/)

2.5    **Military Specifications and Standards.**

MIL-C-7989                      *Covers, Light Transmitting, for Aeronautical Lights, General Specification for*

**Note:** MIL-C-7989 is withdrawn – AAS-100 maintains a copy on the website with this Advisory Circular.

MIL-STD-810F                      1 January 2000, *Environmental Test Methods and Engineering Guidelines*

Copies of Military Standards may be obtained from: <http://quicksearch.dla.mil/>  
Site use requires registration and user information.

2.6    **Illuminating Engineering Society (IES) Transaction.**

LM-46-04                      *Photometric Testing of Indoor Luminaires Using HID or Incandescent Filament Lamps*

Copies of IES standards may be obtained from: [www.ies.org/](http://www.ies.org/) (fees for documents)

2.7    **Society of Automotive Engineers (SAE).**

SAE-AS-25050                      *Colors, Aeronautical Lights and Lighting Equipment, General Requirements for*  
SAE-AMS-STD-595                      *Colors Used in Government Procurement*

Copies of SAE Standards are available from: [www.sae.org](http://www.sae.org)



2.8 **Institute of Electrical and Electronics Engineers (IEEE).**

C62.41-1991                      *IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits*

Copies of IEEE Standards are available from: <http://www.ieee.org>

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## CHAPTER 3. REQUIREMENTS

A PAPI system consists of:

- Four identical light units, Type L-880, or two identical light units, Type L-881.
- A power control unit (PCU) (for style A systems only).
- Aiming and calibration equipment (may be part of the light units).

### 3.1 **Environmental.**

The PAPI equipment must be designed for outdoor installation and continuous operation in the following environmental conditions:

#### 3.1.1 Temperature.

The PAPI equipment must operate in the following ambient temperatures:

- Class I systems - from -31 degrees F (-35 degrees C) to 131 degrees F (55 degrees C).
- Class II systems - from -67 degrees F (-55 degrees C) to 131 degrees F (55 degrees C).

#### 3.1.2 Humidity.

The PAPI equipment must operate in any relative humidity up to 100 percent.

#### 3.1.3 Sand and Dust.

The PAPI equipment must operate when exposed to windborne sand and dust particles.

#### 3.1.4 Wind-blown Rain.

The PAPI equipment must operate when exposed to wind-blown rain from any direction.

#### 3.1.5 Wind.

The PAPI equipment must operate when exposed to wind speeds up to 100 miles per hour (mph) (161 kilometers per hour [km/hr.]) from any direction.

#### 3.1.6 Salt Spray.

The PAPI equipment must operate when exposed to a salt laden atmosphere with relative humidity up to 100 percent.

#### 3.1.7 Sunshine.

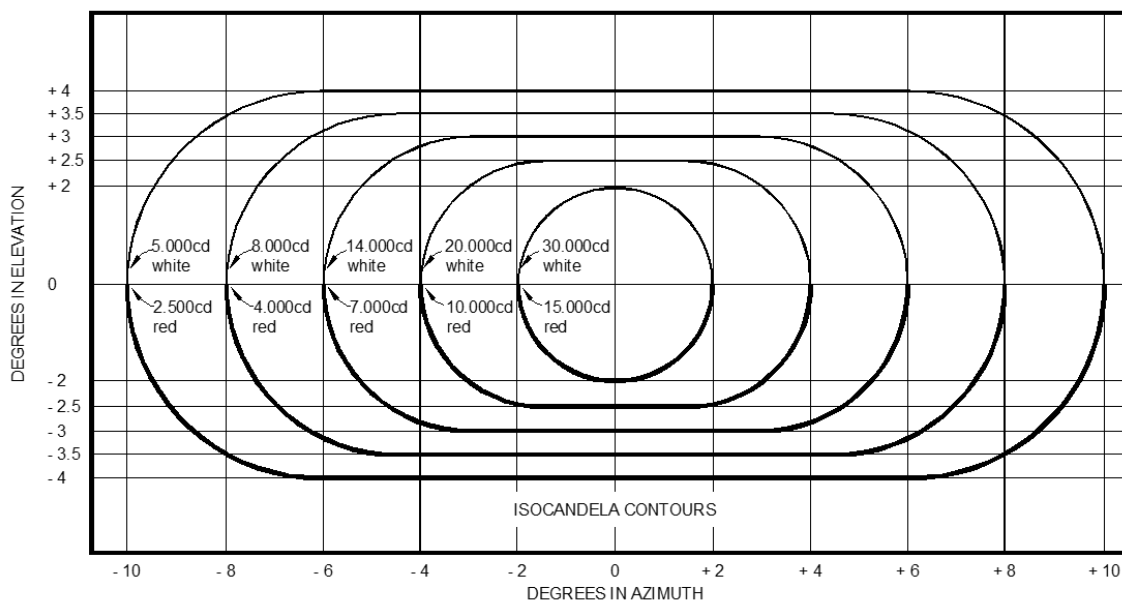
The PAPI equipment must operate when exposed to solar radiation with ambient temperatures stated in paragraph 3.1.1, Temperature.

## 3.2 Light Units.

### 3.2.1 Photometric Requirements.

1. When using LEDs, one or more individual LED lights may be used for each light source.
2. The light units must produce a beam of light split horizontally, with aviation white light in the top sector and aviation red light in the bottom sector.
3. When the PAPI is viewed at 1000 feet (300 meters), the transition from red light to white light must be within 3 minutes of arc at the beam center and within 5 minutes of arc at the beam edges.
4. A line drawn through center of the transition band at +10 degrees, 0 degrees, and -10 degrees must be straight within 3 minutes of arc.
5. The transition band must be flat within 3 minutes of arc.
6. The light distribution and intensity for each light unit must be per Figure 3-1.

**Figure 3-1. PAPI Light Distribution Requirements**



7. The PAPI light colors must be aviation white and red and meet the requirements of SAE-AS25050, *Colors, Aeronautical Lights and Lighting Equipment, General Requirements for*, paragraph 3.1, Aviation Colors.
  - a. For PAPI systems that use alternative lighting devices (LED), see FAA Engineering Brief #67, Light Sources Other Than Incandescent and Xenon for Airport and Obstruction Lighting Fixtures, for the aviation white and red chromaticity coordinate requirements.

- b. Alternatively, for PAPI systems that use incandescent light sources, the red color may also be per the aviation red chromaticity coordinate requirements found in FAA Engineering Brief #67. (This difference is to be identified on the device and noted in the manufacturer's operation manual.)
- 8. Light transmitting covers must conform to the requirements of MIL-C-7989, *Covers, Light Transmitting, for Aeronautical Lights, General Specification for*, paragraph 1.2, Classification, Class B.
- 9. Heat resistant glass per MIL-C-7989 is not required for PAPI systems that use alternative lighting devices.
- 10. Lamps with a minimum rated life of 1000 hours must be used in this application.
- 11. Light sources must be at their full intensity within 5 seconds after a cold start.
- 12. For non-incandescent lamps, refer to FAA Engineering Brief #67 for the performance criteria.

### 3.2.2 Light Unit Construction.

- 1. Light unit dynamic loading from wind, or static loading from snow or ice accumulation, must not cause the light pattern to shift.
- 2. The weight of each light unit must not exceed 100 pounds (45 kilograms).  
**Note:** If the PCU is part of the light unit, the combined unit weight must not exceed 150 pounds (68 kilograms).
- 3. A light unit may not be higher than 40 inches (1 meter) at its maximum height when installed at its minimum mounting height. See AC 150/5340-30, *Design and Installation Details for Airport Visual Aids*, for complete PAPI installation requirements.
- 4. The light unit must use a protective overhang or other method to prevent rain or snow from accumulating on its lens surfaces. The light unit must prevent dew or frost/ice from accumulating on its lens surfaces. This may be accomplished by thermostatically activated heating or intrinsic heat management (such as incandescent lamps).

### 3.2.3 Light Unit Mounting Provisions.

#### 3.2.3.1 **Mounting Legs.**

- 1. A minimum of three adjustable mounting legs must be used for leveling the light unit when one side of the unit is installed up to 1 inch (25 millimeters) higher or lower than the opposite side.  
**Note:** The manufacturer may use 2 mounting legs if equivalent rigidity and leveling capability to a 3-leg mounting system can be demonstrated.
- 2. At a minimum, the mounting legs must include:
  - a. a light housing mounting and level adjusting hardware;

b. frangible couplings per FAA Drawing C6046 (or an equivalent performing part that will pass the frangibility test in paragraph 4.7.) The FAA Drawing may be obtained from:  
[http://www.faa.gov/about/office\\_org/headquarters\\_offices/ato/service\\_units/techops/navservices/lsg/vgleap/specifications/index.cfm](http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/lsg/vgleap/specifications/index.cfm)

c. and flanges for mounting the light unit on a concrete pad.

**Note:** 2-inch electrical metallic tubing (EMT) must be furnished by the installer.

### 3.2.3.2 **Adjusting Hardware.**

Any adjusting hardware must be vibration resistant and prevent movement of the optical system.

## 3.2.4 Light Unit Adjustments.

### 3.2.4.1 **Vertical Adjustment.**

All light units must use built-in adjustments for accurate vertical positioning of the light beam center at any elevation between 2 and 8 degrees.

**Note:** The center of the light beam is the transition band between red and white light.

#### 3.2.4.1.1 Light Beam Aiming.

An aiming tool must be furnished with the PAPI system. The tool must measure the vertical angle of the light beam center from 2 to 8 degrees in graduated increments of 10 minutes of arc. The aiming tool must have a repeatable accuracy of  $\pm 3$  minutes of arc.

#### 3.2.4.1.2 Alternate Light Beam Aiming.

Light units may be factory calibrated to a fixed vertical angle specified by the purchaser. The manufacturer must provide a procedure to check the calibration of the aiming system in the field with an accuracy of  $\pm 3$  minutes of arc.

#### 3.2.4.1.3 Horizontal Light Beam Coverage.

Design the PAPI to be capable of modifying the horizontal light beam coverage of the PAPI for obstacle avoidance in the approach area and light signal obstruction clearance zone. This may be accomplished using baffles (also referred to as blanking devices).

## 3.2.5 Excessive Light Unit Tilt.

The unit design must ensure all lamps in the system are de-energized when one light unit is lowered more than  $\frac{1}{4}$  degree or raised greater than  $\frac{1}{2}$  degree.

1. The unit design must ensure all lamps in the system are de-energized when the optical pattern of one light unit is inadvertently lowered between  $\frac{1}{4}$  and  $\frac{1}{2}$  degree or raised between  $\frac{1}{2}$  degree and 1 degree with respect to the preset aiming angle.
2. A delay between 10-30 seconds before de-energizing the light units must be used to prevent intermittent activation caused by vibration or other movement.
3. The light unit tilt sensing must be fail-safe so any malfunction, including loss of input power, de-energizes the PAPI light units.

### 3.2.6 Light Unit Electrical Wiring.

Factory molded plugs must be on the exterior end of the wiring that penetrates the PAPI enclosure.

#### 3.2.6.1 **Lead Length.**

Power leads must be sufficiently long to extend from the light unit, through a flexible conduit, and to a breakaway connector at ground level.

#### 3.2.6.2 **Strain Relief.**

Strain relief must be used on any light unit power leads.

#### 3.2.6.3 **Plugs.**

Style B systems must use Class A, Style 1 or 6 plugs per AC 150/5345-26, FAA Specification for L-823, Plug and Receptacle, Cable Connectors, to mate with the output lead of the isolation transformer.

Style A systems may use any plug with a capacity and electrical performance equivalent to an L-823 plug.

#### 3.2.6.3.1 Style B Alternate Plug System.

The manufacturer may furnish an alternate harness that accepts the output of several transformers and combines them into a single receptacle for use in the transformer housing. The receptacle must be located just below the light unit's frangible coupling and mate with a compatible plug from the light unit.

### 3.3 **Style A Systems.**

#### 3.3.1 Power and Control.

The PAPI power supply and control functions may be enclosed in a separate PCU or inside a light box.

#### 3.3.2 PCU Cabinet.

1. The PCU cabinet must be an enclosure that meets the National Electrical Manufacturers Association (NEMA) Type 4 rating.

2. The PCU cabinet must contain all the power and control functions for a PAPI system.
3. The cabinet door must open to 110 degrees minimum and equipped with a locking device to ensure it remains open during field maintenance.
4. The cabinet must be furnished with a padlock hasp to secure the cabinet door when necessary.

### 3.3.3 Power.

1. The PAPI Style A system must operate from any standard utility single-phase alternating-current service voltage less than 600 volts.
2. A trip-free circuit breaker must be furnished to allow de-energizing the PAPI system power.

### 3.3.4 Style A Voltage Regulation.

If an incandescent lamp is used, the lamp socket voltage must be adjustable and regulated within 3 percent of its design value on the brightest step under the following conditions:

1. the input line voltage deviates up to 10 percent above or below its nominal value;
2. the individual light units are spaced between 20 feet (6 meters) and 30 feet (10 meters) apart measured center-to-center. See Figure A-81 of AC 150/5340-30J for details.
3. the Power Control Unit is located from 0 to 100 feet (30 meters) from the nearest light unit.

### 3.3.5 Style A Lamp Failure.

When one or more lamps fail, it may not cause damage to either the power supply or the remaining lamps.

### 3.3.6 Photoelectric Intensity Control.

The PAPI must be equipped with a photoelectric type control that automatically switches the lamps between two operating modes:

1. Day mode – full intensity complying with Figure 3-1.
2. When the system is first energized, and daylight is detected, the night mode must be selected between 2 to 3 seconds before switching to the day mode.
3. The photoelectric intensity control must have a delay between 45 to 75 seconds before switching lamp intensity to prevent unintentional switching caused by transient light, shadows, or transient voltages.

#### 3.3.6.1 **Day Mode Illumination Intensity.**

1. PAPI day mode must be selected when the illumination on a vertical surface facing north rises to a value between 50 to 60 foot-candles.



2. The PAPI must remain in the day mode until the illumination decreases to a value between 25 to 35 foot-candles.

#### 3.3.6.2 **Night Mode Illumination Intensity.**

1. The night mode must be selected when the illumination on a vertical surface facing north decreases to a value between 25 to 35 foot-candles.
2. When the PAPI has switched to night mode, it must remain in the night mode until the illumination rises to a value between 50 to 60 foot-candles.

#### 3.3.6.3 **Photoelectric Intensity Control Failure.**

The PAPI must automatically switch to night mode if the photoelectric control fails.

#### 3.3.6.4 **Transient Suppression.**

##### 3.3.6.4.1 Style A and B Surge and Transient Protection.

The PAPI equipment susceptibility to power line surges must be per the defined waveforms detailed in Table 4, Location Category C2, in ANSI/IEEE C62.41-1991, Recommended Practices on Surge Voltages in Low Voltage AC Power Circuits. Surge protection must be provided against a minimum of 3 applications at 15 second intervals of a 5-kilo amp 8/20 microsecond ( $\mu$ S) short circuit current pulse and 10 kilo volt 1.2/50  $\mu$ S open circuit pulse.

#### 3.3.7 PAPI Remote Control.

The PAPI must be provided by the manufacturer with the capability to be turned on and off from a remote location. The remote control may be a hardwired cable and/or a radio frequency controller (specified in AC 150/5345-49, Specification L854, Radio Control Equipment).

#### 3.3.8 Style A Night Mode Illumination Intensity.

There must be two selectable night mode intensity settings, approximately 5 and 20 percent of the day mode intensities shown in Figure 3-1, to adapt the PAPI to airport ambient light levels.

**Note:** PAPI remote control may be accomplished by sensing the current in the associated runway circuit during night operations.

#### 3.4 **Style B Systems.**

1. Style B systems must operate from a series lighting circuit with a current range of 2.8 to 6.6 amperes.

2. The lamps in Style B systems must be compatible with an isolation transformer size per AC 150/5345-47, Specification for Series to Series Isolation Transformers for Airport Lighting Systems.

**Note:** Components of the series lighting circuit (for example: L-828 regulator, isolation transformer) will not be supplied with the PAPI system.

#### 3.4.1 Failure of Style B Lamp.

Lamp failures must not cause damage to either the power supply or the remaining lamps.

#### 3.4.2 Style B Lamp Shorting Device.

A lamp bypass device to short circuit the socket of a burned-out lamp must be available upon request by the customer.

#### 3.5 **PAPI Lamp Monitor.**

The manufacturer may offer an optional go/no go type PAPI lamp monitoring output.

#### 3.6 **Equipment Grounding.**

Conductive materials enclosing electrical conductors, equipment, or housings within the equipment must be connected to a common lug that allows connection to the system ground conductor.

#### 3.7 **Equipment Finish.**

The exterior of all PAPI units must be painted International Orange, Federal Color Number 12197, per SAE-AMS-595.

#### 3.8 **PAPI Parts and Materials.**

1. All PAPI system parts and materials must meet the environmental requirements in this AC.
2. All parts and materials must be protected against corrosion.
3. All fasteners and other hardware must be compatible with the material joined and may not cause galvanic corrosion.
4. PAPI system components may not be operated in excess of the component manufacturers recommended rating.
5. Plastic components exposed to sunlight must be oxidation and ultraviolet resistant.

#### 3.9 **PAPI Maintenance.**

1. The PAPI system must be designed for ease of maintenance so field repairs and routine maintenance can be accomplished without special tools.

2. If lamp defocusing occurs after lamp replacement, the manufacturer must furnish any special tools and procedures required for refocusing.
3. If any special tools are required for other than routine maintenance and field repairs, the manufacturer must furnish them.
4. See AC 150/5340-26, *Maintenance of Airport Visual Aid Facilities*, for additional information for PAPI maintenance procedures.

### 3.10 **Workmanship.**

The equipment must be fabricated under the highest quality commercial standards of workmanship.

### 3.11 **PAPI Instruction Book.**

An instruction book containing the following information must be furnished with each system:

1. System schematic and wiring diagrams showing all components cross-indexed to the parts list;
2. Parts list with:
  - a. part name,
  - b. part rating,
  - c. physical characteristics of the part,
  - d. component manufacturer's name and part number.
3. Installation instructions, including procedures for aiming, calibration of the aiming system, focusing, and adjustment of the excessive tilt mechanism;
4. Maintenance instructions, including re-lamping procedure, theory of operation and trouble-shooting charts.
5. Operating instructions.

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## CHAPTER 4. PAPI QUALIFICATION REQUIREMENTS

Procedures for qualification approval are in AC 150/5345-53, *Airport Lighting Equipment Certification Program*.

The following tests are required to demonstrate compliance with this AC. All tests may be performed on the PAPI power supply and a single light unit; any other units may be simulated by a resistive load.

For PAPI equipment that uses alternative lighting devices, the requirements in Engineering Brief #67 must apply.

### 4.1 Visual Examination.

The equipment must be examined for compliance with the requirements in this AC for size, weight, materials, finish, and quality of workmanship.

### 4.2 High Temperature Test.

1. A high temperature test must be conducted per MIL-STD-810F, method 501.4, Procedure II.
2. The equipment must be exposed to 131 degrees F (+55 degrees C) for 4 hours after temperature stabilization.
3. The equipment must be operated during the temperature test.
4. Any deterioration in materials or system performance must be considered a test failure.

### 4.3 Low Temperature Test.

1. A low temperature test per MIL-STD-810F, Method 502.4, Procedure II must be conducted.
  - a. For Class I systems, the equipment must be exposed to -31 degrees F (-35 degrees C) for 24 hours.
  - b. For Class II systems, the equipment must be exposed to -67 degrees F (-55 degrees C) for 24 hours.
2. The equipment must be operated after temperature stabilization at the beginning and prior to the end of the test.
3. No accumulation of dew or frost must be evident on any portion of the PAPI front exterior light emitting surfaces.
4. Any deterioration in materials or performance must be considered a test failure.

#### 4.4 **Rain Test.**

1. A wind-blown rain test must be conducted per MIL-STD-810F, Method 506.4, Procedure I.
2. The rain must be at a rate of 5.2 inches/hour (130 millimeters/hour) with an exposure time of 30 minutes per side.
3. The equipment must be operated during the test.
4. Any deterioration of system performance or excessive accumulation of water in equipment cabinets must be considered a test failure.

#### 4.5 **Salt-Fog Test.**

1. A salt-fog test must be conducted per MIL-STD-810F, Method 509.4, Procedure 1.
2. The test duration must be 48 hours of exposure and 48 hours drying.
3. Any evidence of damage, rust, pitting, or corrosion (sacrificial coatings are excepted) must be considered a test failure.

#### 4.6 **Wind Loading.**

Using either wind tunnel tests or static loading, it must be demonstrated the system can withstand a 100 mph (161 km/hr.) wind load from any azimuth direction without displacing the optical pattern more than allowed in the rigidity test in paragraph 4.11. The light unit must be fully assembled at its maximum mounting height for the wind loading test.

#### 4.7 **Frangibility Test.**

The frangibility of the PAPI mounting legs must be demonstrated to be the same as the 2-inch frangible coupling depicted in FAA drawing C-6046 per AC 150/5220-23, *Frangible Connections*.

#### 4.8 **Transient Suppression Test.**

The test waveforms applied to the equipment must be per paragraph 1.1.

#### 4.9 **Photometric Tests.**

1. A photometric test for the color, intensity, and beam pattern requirements of paragraph 3.2.1 in this AC must be conducted.
2. All lamps used for photometric testing must be randomly selected from a production lot.
3. The photometric requirements in paragraph 3.2.1 must be tested for one set of lamps.

4. To demonstrate repeatability, the intensity along the horizontal and vertical axes for two additional sets of lamps must be checked. Measurements must be made outside of the transition zone, but no more than 0.5 degrees from the horizontal axis.
5. If any refocusing is required after lamp replacement, it must be accomplished using the manufacturer's FAA approved procedure to demonstrate that the required photometrics are reproduced.
6. Any test equipment must be calibrated before testing.
7. All measurements must be taken at a distance that allows full focusing of the beam.
8. Photometric tests must be conducted at full intensity without the horizontal light beam coverage adjustment features in use. The test must then be repeated with the full possible adjustment in place. The intensity of the reduced width light beam must comply with the intensity requirements where the light beam is unobstructed.

#### 4.9.1 Chromaticity Tests.

The PAPI must be tested at 100% intensity with the light sources, filters (if used), and optical system used to ensure that it meets chromaticity requirements.

1. Spectral transmittance measurements of the filter (if present) must be performed at the specified operating temperatures of the lamps.
2. The PAPI must meet the chromaticity requirements of SAE AS 25050 when tested at 100% intensity at the center of the main beam (center circle in Figure 3-1), and the horizontal and vertical extremes of the main beam. Chromaticity outside of distribution boundaries may be verified visually. Measurements must be made outside of the transition zone, but no more than 0.5 degrees from the horizontal axis.
3. For PAPI that use LEDs, see Engineering Brief #67 for additional information about chromaticity requirements aviation red. See also aviation white chromaticity limits for 1931 CIE color space. See paragraph 3.2.1, subparagraph 7.b for exceptions.

#### 4.10 **Lens Certification.**

A certificate of compliance must be furnished from the lens manufacturer stating that the light unit lenses meet:

1. The requirements in MIL-C-7989 for incandescent lamps (LED light sources are excepted).
2. The color requirements in SAE-AS-25050 for incandescent lamps. See Engineering Brief #67 for aviation red and white chromaticity limits.

#### 4.11 **Light Unit Rigidity Test.**

This test applies a static load equivalent to the maximum light unit design wind loading and determines if there is any movement of the light pattern.

1. Before applying the static load, the light unit must be set up and the light pattern displayed on a vertical surface 20 feet (6 meters) in front of the light unit.

2. The top, bottom, and the sides of the light unit beam pattern must be marked on the vertical surface in subparagraph 1 above.
3. A uniformly distributed sand load or other suitable material of 15 pounds per square foot (73 kilograms per square meter) must be applied over the entire top surface of the light unit.

**Note:** A framework or other method may be used to ensure the sand used to load the light unit does not spill over its sides.

4. The load must be applied by allowing the sand to pour down on the center top surface of the light unit.
5. The sand load must be left in place for 5 hours.
6. After 5 hours, the light housing beam pattern must be checked for any movement from the original marks drawn in subparagraph 2 above. The light unit beam pattern must be within +1/4 inch (6 millimeters) of the original markings.
7. Remove the sand load.
8. The beam pattern must be checked against the markings in subparagraph 2 above and mark any movement. The light unit beam pattern must be within +1/4 inch (6 millimeters) of the original markings.

#### 4.12 **Aiming Device Test.**

1. The PAPI aiming device must be checked, using the manufacturer's procedure (approved prior to testing by the FAA), to demonstrate that when the light unit is moved by the adjustment mechanism, the measuring device indicates the change with an accuracy of  $\pm 3$  minutes of arc.
2. The measuring device must be checked at one-degree intervals from 2 to 8 degrees.

#### 4.13 **Operational Test.**

1. A PAPI system operational test, using the manufacturer's test procedure (approved prior to testing by the FAA), must be conducted to demonstrate compliance with all operating requirements.
2. The manufacturer's procedure must test:
  - a. the excessive tilt mechanism;
  - b. the power supply performance (current, voltage while at 100% intensity);
  - c. the photoelectric controller;
  - d. operation with one light source out per light unit and verify proper voltage is still applied to the sockets of the operational lamps (if incandescent lamps are used);
  - e. if the failure of a light source produces transients or over-voltage conditions that damage the remaining light sources.



**4.14 Humidity Test.**

The test must be per MIL-STD-810F, Method 507.4. The equipment must be subjected to two complete cycles per Figure 507.4-1 (1 January 2000), except the maximum chamber temperature must be 55 degrees C. Failure of the equipment to operate as specified, or evidence of corrosion or excessive internal condensation is cause for rejection.

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## **CHAPTER 5. PRODUCTION TESTS**

A test procedure that verifies the light output and aiming device accuracy for each production unit must be submitted to the third-party certification body for approval.

After approval, the test procedure must be used for all production units.

The visual examination in paragraph 4.1 and the operational test in paragraph 4.13 must be performed for each production system.

## Advisory Circular Feedback

If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by (1) mailing this form to Manager, Airport Engineering Division, Federal Aviation Administration ATTN: AAS-100, 800 Independence Avenue SW, Washington DC 20591 or (2) faxing it to the attention of the Office of Airport Safety and Standards at (202) 267-5383.

Subject: AC 150/5345-28H

Date: \_\_\_\_\_

*Please check all appropriate line items:*

An error (procedural or typographical) has been noted in paragraph \_\_\_\_\_ on page \_\_\_\_\_.

Recommend paragraph \_\_\_\_\_ on page \_\_\_\_\_ be changed as follows:  
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In a future change to this AC, please cover the following subject:  
*(Briefly describe what you want added.)*  
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Other comments:  
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I would like to discuss the above. Please contact me at (phone number, email address).  
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Submitted by: \_\_\_\_\_

Date: \_\_\_\_\_