

AEROSPACE RECOMMENDED PRACTICE

SAE ARP991

REV.
B

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POSITION AND ANTICOLLISION LIGHTS - TURBINE POWERED FIXED-WING AIRCRAFT

RATIONALE

This document has been reaffirmed to comply with the SAE 5-year Review policy.

FOREWORD

This SAE Aerospace Recommended Practice (ARP) provides recommendations for a standard for airplane navigation position lights and anticollision lights which have intensities, redundancy, and are of a configuration commensurate with the vital role these lights play in collision avoidance during night-time and darkened sky conditions. Since, in some countries, the term "navigation" lights is used and in others, the term "position" lights is used, in this document, the term "navigation position" lights will be used to avoid confusion.

The two lighting systems serve a combined function. The higher intensity of the flashing anticollision lights serve to attract attention to the traffic. The steady-burning navigation position lights can better show position of the aircraft and direction of flight. While the color of the navigation position lights will indicate to the observer, the sector observed, the apparent motion of the light in the observing pilot's windshield is used as primary assessment of a collision threat. Therefore, the intensity of the steady-burning light should be such that it becomes visible almost as soon as the observer pilot's attention is attracted to the high intensity flashing light.

The intensities listed in this document are initial intensities for new light assemblies. These intensities are much higher than the intensities necessary for regulatory requirements and/or service performance requirements. One advantage gained by utilizing the intensities specified in this document are longer operating times at intensities above minimum service performance requirements. Increased intensity does marginally increase visibility distance under reduced visibility conditions, and under lower contrast conditions such as in metropolitan areas or in twilight or dawn conditions. These intensities are considerably higher than threshold levels for clear atmospheric conditions, are visible at very long distances, and include substantial allowances for atmospheric factors which may reduce the conspicuity of the lights. The electrical systems on the aircraft should be designed to produce the operating voltages required by the lights covered by this document to meet the design intensity requirements when new and under normal operating conditions.

Compensation for other factors which may cause the intensities of the lights to degrade in service are also included in the initial intensities. These include exterior dirt, interior contamination, lamp or flashtube degradation, and degradation of reflectors, capacitors and other components.

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FOREWORD (Continued)

The initial intensities recommended in this document are not intended to be utilized as regulatory requirements nor to imply any need for new regulatory requirements.

Acceptable service performance requirements need to be defined. It is recognized that the accurate measurement of the photometric quantities included in this document is extremely difficult and that large errors can occur. Test conditions such as test geometry, ambient temperature, lens temperature, ambient illumination, and reflections can be controlled in the laboratory but not in field tests. The result is that field measurements usually have much higher uncertainties than laboratory measurements.

1. SCOPE

This document covers the recommended lighting performance and design criteria for:

- a. Left Forward Navigation Position Lights (Red)
- b. Right Forward Navigation Position Lights (Green)
- c. Rear Navigation Position Lights (White)
- d. Anticollision Lights
 - (1) Red Flashing Lights Top and Bottom Fuselage
 - (2) White Flashing Lights Wing Tips and/or Tail

1.1 Purpose:

This document recommends design objectives for navigation, position, and anticollision light systems for visual detection and collision avoidance between airplanes in flight and on the ground. Customers for new airplanes or lighting components, and designers or manufacturers may take advantage of this document in specifying the initial requirements that, in most cases, significantly exceed the applicable minimum intensities as shown in the Federal Aviation Regulations as well provide better stability, longer life and lower operating costs.

2. REFERENCES:

The following publications form a part of this specification to the extent specified herein. In the event of conflict between the text of this specification and references cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

2.1.1 AIR1106A Some Factors Affecting Visibility of Aircraft Navigation Lights

2.1.2 AIR1276 Aircraft Anticollision Light Systems Using Flashtubes (Condenser Discharge Lamps)

2.1.3 AS8017 Minimum Performance Standards for Anticollision Light Systems

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2.1.4 AS8037 Minimum Performance Standard for Aircraft Position Lights

2.2 FAR Publications:

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591.

2.2.1 Federal Aviation Regulations, Part 25, Airworthiness Standards for Transport Category Airplanes

2.2.2 FAA Technical Standard Order C-30c

2.2.3 FAA Technical Standard Order C-96a

2.3 RTCA Publications:

Available from RTCA Inc., 1140 Connecticut Avenue, NW, Suite 1020, Washington, DC 20036.

2.3.1 RTCA Document No. DO-160, Environmental Conditions and Test Procedures for Airborne Electronics/Electrical Equipment and Instruments

2.3.2 Greenlee, P. H.; Hardware Design for Airplane Flashing Light Applications (1871)

2.4 Other References:

2.4.1 IES Guide for Calculating the Effective Intensity of Flashing Signal Lights; prepared by Aviation Lighting Committee of Illuminating Engineering Society: Illuminating Engineering, Volume 64, No. 11 November 1954, page 747-753

2.4.2 Projector, T. H., The Role of Exterior Lights in Mid-Air Collision Prevention, Applied Psychology Corporation, Final Report No. 4 (1962)

2.4.3 Crossley, J. K.; McClean, W. E.; Tobak, R. G.; Bailey, R. W.; the Use High Intensity Xenon Lighting to Enhance U. S. Army Aircraft Day/Night Conspicuity, USAARL Report No. 71-13 (1971)

3. DESIGN REQUIREMENTS

3.1 Navigation Position Lights:

It is recommended that the following minimum light intensities be provided in Table 1 and Table 2.

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TABLE 1 - Minimum Intensities in the Horizontal Plane For Navigation Position Lights

Navigation Position Light Type	Angle from Right or Left of Longitudinal Dead Ahead (Deg.)	Minimum Intensity (Candelas)
Fwd. - Red and/or Green	0 to 20	100
	20 to 50	60
	50 to 110	30
Rear - White	110 to 180	100

TABLE 2

Angles Above and Below the Horizontal Plane (Deg.)	Minimum Intensity (I)
0 to 5	1.00 I
5 to 10	0.90 I
10 to 20	0.80 I
20 to 30	0.60 I
30 to 50	0.40 I
50 to 75	0.20 I
75 to 90	0.10 I

- 3.1.1 The location on the airplane of the forward navigation position lights should be as near the wing tips as practicable.

Where availability of space and frontal area projection does not permit single fixtures of sufficient size and viewing angles to provide required candlepower distribution, consideration may be given to multiple fixtures. These fixtures may be installed in other wing locations or in the fuselage. In this case, each light individually must meet the distribution and intensity requirements through portions of the required sector angles, so that all lighting fixtures, including aerodynamic fairings, when taken together fully comply with the required distribution about the airplane. Lighting at any point must be supplied from a single fixture.

- 3.1.2 The location of the rear navigation position lights should be as near the extreme aft portion of the airplane as practicable with location on the trailing edge of the wing tips or horizontal stabilizer as an alternative.

When located on the wing tips, a supplemental light should be considered on the rear portion of the fuselage so that the region of the tail of the airplane can be identified during ground operation.

- 3.1.3 Redundancy: Consideration should be given to designing the system so that there are redundant lamps or light assemblies in each position so that one lamp failure will still permit the airplane to be dispatched.