



AEROSPACE RECOMMENDED PRACTICE

ARP8467™

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Aircraft Exterior Camera Video System Lighting

RATIONALE

Video camera systems have become common as a visual aid to commercial transportation aircraft pilots by providing images of areas that cannot be directly seen from their seated positions in the flight deck and to enhance their view and situational awareness. A video system consists of camera(s), lighting for the camera in dark ambients, video interface electronics to convert the camera image to be displayed, display of the video information in the flight deck (or in other locations) on displays, and flight deck controls. This document provides recommendations for lighting the task surfaces of the video imaging systems to help ensure good image quality.

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1. SCOPE

The video systems include a camera, display, and lights. Video is the recording, reproducing, or broadcasting of moving visual images as illustrated in Figure 1.

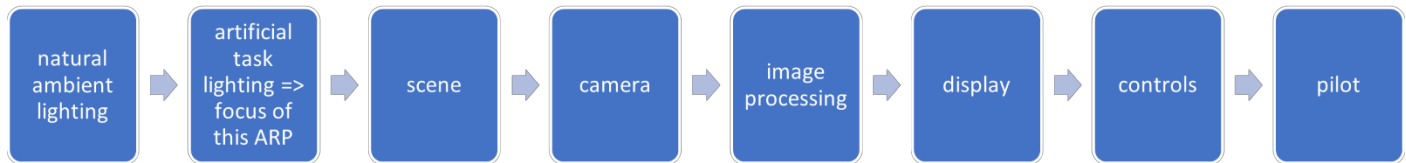


Figure 1 - General depiction of a camera video system

A camera video imaging system is a system composed of a camera and a monitor, as well as other components, in which the monitor provides a real-time or near real-time visual image of the scene captured by the camera. Such systems are capable of providing remote views to the pilot and can therefore be used to provide improved visibility (for example, coverage of blind spots). In general, camera video systems may be used in the pilot's work position for purposes of improving airplane and corresponding environmental visibility.

Examples of aircraft video system applications include:

- Ground maneuver or taxi camera system
- Flight deck entry video surveillance system
- Cargo loading and unloading
- Cargo compartment livestock monitoring
- Monitoring systems that are used to track the external, internal, and security functions of an aircraft
- Environmental camera system
- Cabin surveillance system

In 2012, the National Transportation Safety Board suggested that large aircraft be equipped with external cameras to give pilots a better view of a plane's wingtips as they travel along the taxiway and possibly cut down on ground crashes (refer to NTSB Safety Recommendations A-12-48 and -49).

Airplane camera system applications have experienced new usage scenarios and image quality issues (washout, color shift, bright spots, flickering, color rendering) due to:

- Uncontrolled environment
- Wide range of ambient lighting environment
- Wide temperature range

- Harsh weather
- Complex hardware
- High aircraft speed

The scope of this SAE Aerospace Recommended Practice (ARP) is recommendations about the lighting for the airplane exterior camera video system with a pilot in the loop.

This ARP does not address enhanced or synthetic vision systems that help pilot visibility during flight. This ARP does not cover so-called enhanced flight vision systems (EFVS). Refer to FAA AC 90-106. Enhanced vision is a technology that incorporates information from aircraft-based sensors (e.g., near-infrared [IR] cameras, millimeter wave radar) to provide vision in limited visibility environments. Enhanced vision systems (EVS) allow for increased pilot visibility and flight safety during flight operations in darkness, smoke, haze, rain, fog, and other low visibility conditions. EVS enhances a pilot's ability to safely fly an aircraft by providing increased flight visibility for improved situation awareness.

The initial scope of this recommended practice is lighting for airplane exterior lighting for ground maneuver camera systems. Section 3 gives general guidance for camera video systems, and Section 4 provides specific design recommendations for airplane exterior ground camera video system lighting. The camera and display parts of the video system are not the focus of this ARP, but pertinent characteristics need to be described, understood, and defined for the lighting guidelines to be useful for the video system designer.

For flight deck display requirements, utilize:

- FAA Advisory Circular (AC) 25-11A
- FAA Technical Standard Order (TSO) C113
- AS8034
- ARP4256

SAE J3155 is an SAE camera recommended practice for automotive rear-view mirror cameras. In addition to SAE J3155, for camera recommendations, refer to:

- IEC 62676
- IEEE 1858
- IEEE P2020
- ISO 12232
- ISO 12233
- ISO 14524
- ISO 15739
- ISO 16505
- ISO 17850
- ISO 17957
- ISO 18844

- ISO 18844-2
- ISO 19084
- ISO 19093
- ISO 19567
- ISO/TC 22

1.1 Purpose

The purpose of this ARP is to provide considerations and recommendations for lighting design of airplane cameras used for ground and taxi operation.

1.2 Mandating and Recommending Phrases

“Shall” - The word “shall” indicates a mandatory criterion for compliance to this ARP.

“Should” - The word “should” indicates a criterion for which an alternative, including noncompliance, may be applied if it is documented and justified.

1.3 Application

Application of this recommended practice is aircraft exterior lighting for ground maneuver camera systems. Ground maneuvering camera systems are designed to assist the pilot in ground maneuvering of an airplane by providing camera views of the airplane, runway, and nearby obstacles such as other aircraft, ground support personnel and equipment, vehicles, and airport infrastructure.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption, special condition, or Equivalent Level of Safety (ELOS) is obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AIR5689	Light Transmitting Glass Covers for Exterior Aircraft Lighting
ARP4256	Design Objectives for Liquid Crystal Displays for Part 25 (Transport) Aircraft
ARP5637	Design and Maintenance Considerations for Aircraft Exterior Lighting Plastic Lenses
ARP6253	LEDs and Aircraft Applications
ARP6402	LED Landing, Taxiing, Runway Turnoff, and Recognition Lights
AS8034	Minimum Performance Standard for Airborne Multipurpose Electronic Displays
SAE J3155	Camera Monitor Systems, Test Protocols and Performance Requirements

2.1.2 FAA and Government Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

Copies of these documents are available online at <https://quicksearch.dla.mil>.

Regulations that affect displays, systems, and pilot-system interface are in 14 CFR Parts 23, 25, 27, and 29. Many of the rules are similar across the CFR Parts, but there are also distinct differences that reflect the differences in use of the aircraft identified in each part. The list of applicable regulations is long and comprises substantial sections of the regulations. The list of regulations is too long to be reproduced here, and the user of this document is encouraged to seek further expert advice on the existing regulations surrounding the installation of avionics to cover items as diverse as structural loads, emergency conditions, cockpit controls, flight and navigation systems, control markings, and others.

14 CFR Part 25 Airworthiness Standards: Transport Category Airplanes

FAA AC 25-11A Electronic Flight Deck Displays

FAA AC 90-106 Enhanced Flight Vision Systems

FAA TSO C113 Airborne Multipurpose Electronic Displays

MIL-DTL-7989 Detail Specification: Cover, Light Transmitting, for Aeronautical Lights, General Specification for

MIL-STD-810 Department of Defense Test Method Standard: Environmental Engineering Considerations and Laboratory Tests

NTSB Safety Recommendations A-12-48 and -49

2.1.3 IEC Publications

Available from IEC Central Office, 3, rue de Varembe, P.O. Box 131, CH-1211 Geneva 20, Switzerland, Tel: +41 22 919 02 11, www.iec.ch.

IEC 62676 Video Surveillance Systems for Use in Security Applications

2.1.4 IEEE Publications

Available from IEEE Operations Center, 445 and 501 Hoes Lane, Piscataway, NJ 08854-4141, Tel: 732-981-0060, www.ieee.org.

IEEE 1858 CPIQ: Camera Phone Image Quality

IEEE P2020 Standard for Automotive System Image Quality

2.1.5 IES Publications

Available from Illuminating Engineering Society, 85 Broad Street, Floor 17, New York, NY 10004, Tel: 212-248-5000, www.ies.org.

IES RP-37 Recommended Practice: Lighting Airport Outdoor Environments

2.1.6 ISO Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

ISO 12232 ISO, speed rating, standard output sensitivity, and recommended exposure index

ISO 12233 Photography and electronic still picture imaging, resolution and spatial frequency



Documents

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