



AEROSPACE RECOMMENDED PRACTICE

ARP694™**REV. D**Issued 1963-01
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Superseding ARP694C

Aerial Refueling Lights - Design Criteria

RATIONALE

This SAE Aerospace Recommended Practice (ARP) is revised to include more document references, and to include more illuminance and radiant intensity recommendations.

1. SCOPE

This SAE Aerospace Recommended Practice (ARP) is intended to cover all external lights on the tanker and fixed wing receiver airplanes used to accomplish aerial refueling.

This ARP describes lights used for two basic types of aerial refueling: the probe and drogue, and the boom/receptacle method.

1.1 Purpose

The purpose of this ARP is to set forth the basic considerations and criteria which the design engineer should observe when designing an aerial refueling lighting system. In case of conflict between this ARP and existing military specifications, the military specification will take precedence, unless a waiver is obtained.

2. 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 has been obtained.

2.1 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.

ARP4087	Wing Inspection Lights - Design Criteria
ARP5825	Design Requirements and Test Procedures for Dual Mode Exterior Lights
AS25050	Colors, Aeronautical Lights and Lighting Equipment, General Requirements for

SAE Executive Standards Committee Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

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SAE WEB ADDRESS:

Full document details: SAE ARP694D

For more information on this standard, visit
<https://www.sae.org/standards/content/ARP694D>

Documents

Document Sharing Hub

2.2 FAA Publications

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

Code of Federal Regulations Title 14, Part 23

2.3 Military Publications

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

MIL-A-19736A	Air Refueling systems, General Specification for
MIL-L-6503	Lighting Equipment, Aircraft, General Specification for Installation of
MIL-L-006730	Lighting Equipment; Exterior, Installation of Aircraft (General Specification)
MIL-STD-3009	Lighting, Aircraft, Night Vision Imaging System (NVIS) Compatible
STANAG ATP-56(B)	Air-to-Air Refuelling General Requirements

3. TYPES OF LIGHTS FOR AERIAL REFUELING

The type of lights required by the airplanes depends on the method of aerial refueling as indicated in Table 1. The “type of light” should not be confused with the “number of light fixtures.” A light fixture may be designed to perform the function of two or more types of lights or several fixtures may be required to perform the functions of one type of light. The designer should evaluate the aerial refueling lighting system in a manner that ensures that all required functions are performed.

Table 1 - Types of lights for aerial refueling

Light Type		Use with Probe and Drogue		Use with Boom/Receptacle		Document References
		Receiver	Tanker	Receiver	Tanker	
Rendezvous lighting (4.1)			X		X	MIL-L-6503 Sec. 3.3.8.3 ARP5825 Sec. 3.3.2.1
Tanker illumination (4.2)			X		X	MIL-L-6503 Sec. 3.3.8.1 ARP5825 Sec. 3.3.6.1
Receiver illumination (4.3)		X		X		
Tanker mounted receiver illumination (4.4)					X	
Probe lighting (4.5)		X				MIL-L-6503 Sec. 3.3.8.4 MIL-L-006730 Sec. 3.2.9.1 MIL-A-19736 Sec. 3.15.6
Boom nozzle lighting (4.6)					X	MIL-STD-3009 Secs. 4.5.3 & 5.8.3
Slipway/receptacle and area lighting (4.7)				X		ARP5825 Secs. 3.2.5.1 & 3.3.6.1
Drogue lighting (4.8)		X	X			ARP5825 Secs. 3.2.5.2 & 3.3.6.1
Hose illumination lighting (4.9)			X			
Boom illumination lighting (4.10)					X	MIL-STD-3009 Secs. 4.5.3 & 5.8.3
Pilot director light (4.11)					X	
Signal lights (4.12)	Equipment malfunction		X			MIL-L-6503 Sec. 3.3.8.2 MIL-L-006730 Sec. 3.2.9.3 MIL-A-19736 Sec. 3.7.5.1
	Breakaway		X		X	
	Equipment is ready		X			
	Receiver too close to tanker		X			
	Fuel is flowing		X			

3.1 Light Locations

The light fixtures should be designed and located properly so they can perform their functions. Due to the various airplane designs it is not practical to specify the exact location and design of each type of light. However, there are a number of factors which must be considered and methods of evaluation which should be used to determine if the location and design are satisfactory. Suggested design information is given in Section 4.

3.1.1 Field of Vision

The field of vision of the receiver pilot and boom operator is limited. The lights must be visible when the crew members are in design eye position and the airplanes are at or near the expected relative positions. Drawings, computer simulations, and mockups showing the airplanes in various relative positions and attitudes should be used. Consideration should be given to visual obstructions such as canopy bows, heads-up displays, gun sights, etc.

3.1.2 Glare

Lights should not cause hot spots or glare either for the receiver pilot or the boom operator. Light sources used to illuminate the airplane should not be visible to the crew.

3.1.3 Reliability

When a light is operating, the crew that controls the light should be provided with an indication that the light is operating satisfactorily. Redundancy of critical lighting/light bulbs should be considered.

3.1.4 Contrast

Lights should be designed to have sufficient color and intensity contrast when necessary. All colored lights that can be dimmed should be operated both at full brightness and dimness to determine that the color is satisfactory. A signal light used in daytime operations should be tested to determine if the observer can positively identify that the light is "on" or "off" and specific consideration should be given to flying over undercast skies where high ambient light conditions exist. The reflected illuminance from such an undercast can easily be 107600 lx (10000 foot-candles).

3.1.5 Ambiguity

The signal lights should be designed to give an unambiguous signal. It should not be possible for the signal lights to direct the pilot to perform multiple operations which are in contradiction to one another.

The floodlights should outline the airplane clearly and sufficiently.

3.2 Requirements as defined herein are intended for normal operation for both day and night. Certain operations involving combat tasked tankers and receivers may require the use of night vision goggles. In this case, lighting should be provided which would be compatible with night vision goggles.

3.3 Color

The red, green, white, and yellow colors shall be within the boundaries listed below on the CIE 1931 chromaticity diagram. The corner points define the intersections of the lines defined by the equations below with each other or with the spectrum locus.

Red light signals

Purple boundary	$y = 0.980 - x$
Yellow boundary	$y = 0.335$

Red corner points

0.720, 0.260
0.645, 0.335
0.665, 0.335

Green light signals

Yellow boundary $x = 0.360 - 0.080y$ White boundary $x = 0.650y$ Blue boundary $y = 0.390 - 0.171x$

Green corner points

0.0280, 0.385

0.2281, 0.3509

0.3205, 0.4932

0.305, 0.6875

White light signals (alternatively, aviation white per SAE AS25050 may be specified.)

Yellow boundary $x = 0.500$ Red boundary $y = 0.382$ Purple boundary $y = 0.047 + 0.762x$ Blue boundary $x = 0.285$ Green boundary $y = 0.150 + 0.640x$ $y = 0.440$

White corner points

0.500, 0.382

0.500, 0.440

0.4531, 0.440

0.285, 0.3324

0.285, 0.263

0.4396, 0.382

Yellow light signals (amber)

Red boundary $y = 0.382$ White boundary $y = 0.790 - 0.677x$ Green boundary $y = x - 0.120$

Yellow corner points

0.6175, 0.382

0.6027, 0.382

0.5426, 0.4226

0.560, 0.440

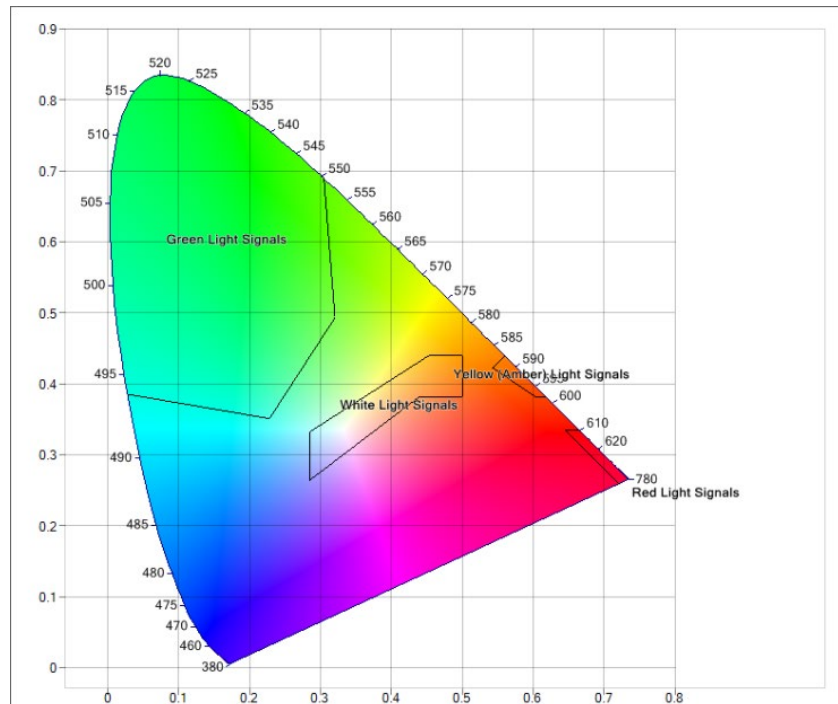


Figure 1 - CIE 1931 chromaticity chart with ARP694 colors

