SAE INTERNATIONAL

AEROSPACE RECOMMENDED PRACTICE

ARP1088™ REV. C

Issued 1970-12
Reaffirmed 2015-08
Revised 2021-06

Superseding ARP1088B

(R) Aircraft Indicating Systems Optical Performance

RATIONALE

One of the referenced documents CFR 25.1322 has dramatically changed and we need to provide guidance on the revision.

1. SCOPE

1.1 This ARP is intended to cover the warning, caution, and advisory indicating system required for commercial and military aerospace vehicles.

1.2 The purpose of this ARP is to recommend certain basic optical and lighting considerations which the design engineer should observe when designing a visual warning indicating system. It is recognized that many types of warning indicators and systems are available for the designer to use. This ARP does not recommend any specific system but outlines design and installation requirements.

2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of 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.

AS425C	Nomenclature and Abbreviations for Use on the Flight Deck
AS18012	Markings for Aircrew Station Displays, Design and Configuration of
AS25050	Colors, Aeronautical Lights and Lighting Equipment, General Requirements for
ARP4103	Flight Deck Lighting for Commercial Transport Aircraft
APR4102/4	Flight Deck Alerting System (FAS)
ARP4105	Abbreviations, Acronyms, and Terms for Use on the Flight Deck

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For more information on this standard, visit
https://www.sae.org/standards/content/ARP1088C/

2.2 U.S. Government Documents

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

HANDBOOKS

JSSG documents can be obtained from ASC/ENOI, Bldg 560, 2530 Loop Road West, Wright-Patterson AFB, OH 45433-7101.

JSSG-2010-5	Joint Service Specification Guide – Crew Systems – Aircraft Lighting Handbook

SPECIFICATIONS

CFR 25.1301	Function and installation
CFR 25.1302	Installed systems and equipment for use by the flightcrew
CFR 25.1309	Equipment, systems, and installations.
CFR 23.1322	Airworthiness Standards: Normal, Utility, Acrobatic, and Commuter Category Airplanes, Warning, Caution and Advisory Lights
CFR 25.1322	Airworthiness Standards: Transport Category Airplanes, Warning, Caution and Advisory Lights
CFR 27.1322	Airworthiness Standards: Normal Category Rotorcraft, Warning, Caution and Advisory Lights
CFR 29.1322	Airworthiness Standards: Transport Category Rotorcraft, Warning, Caution and Advisory Lights
MIL-PRF-22885	Switches, Push Button, Illuminated, General Specification For
MIL-PRF-38039	Systems, Illuminated, Warning, Caution, and Advisory, General Specification For

STANDARDS

MIL-STD-411	Aircrew Station Alerting Systems
MIL-STD-1472	Human Engineering
MIL-STD-3009	Lighting, Aircraft, Night Vision Imaging System (NVIS) Compatible

3. CATEGORIES OF INDICATING SYSTEMS

3.1 Warning Indicating Systems

A Warning Indicating System is one which indicates to the pilot, or crew member, that a hazardous condition exists requiring immediate action to prevent loss of life, equipment damage, or abortion of the mission. Example: FIRE WARNING.

3.2 Caution Indicating Systems

A Caution Indicating System is one which indicates to the pilot, or crew member, that an impending dangerous condition exists. The condition will require attention but not necessarily immediate action. Example: FUEL PRESSURE LOW.

3.3 Advisory Indicating Systems

An Advisory Indicating System is one which indicates to the pilot, or crew member, a safe or normal configuration, operation of essential equipment, or otherwise attracts attention for routine awareness. Example: NAV READY.

4. RECOMMENDATIONS

4.1 Design Criteria

4.1.1 Warning, Caution, and Advisory System Indicators should be of the legend type i.e., containing alphanumeric characters or symbols. For military aircraft, actuation of the indicator should display the warning legend.

4.1.2 For commercial aircraft, Advisory System Indicators may be either the legend type or bulls-eye type (non-legend indicator), with the legend type preferred. In the event a legend type indicator is not employed, an illuminated legend should be provided adjacent to the indicator. The bulls-eye indicator, if used, should not have the movable shield or shutter for dimming, but should be tied into the regular dimming system.

4.1.3 Indicators may be either Light Indicators or Mechanical Indicators. A lighted type indicator is defined as one employing lamps or LEDs as the primary method of indication. A mechanical type indicator is defined as one employing motion as the primary method of indication, such as rotating a drum or electrically opening or closing a shutter.

4.2 Legend Color

4.2.1 Warning Indicator Lights should be Aviation Red in accordance with AS25050, except where NVIS compatibility is required. Where NVIS compatibility is required, the color and NVIS Radiance of the warning indicators should be in accordance with MIL-STD-3009. The legends should be translucent on an opaque background.

4.2.2 Caution Lighted Indicators should be Aviation Yellow/Amber in accordance with AS25050, except where NVIS compatibility is required. Where NVIS compatibility is required, the color and NVIS Radiance of the caution indicators should be in accordance with MIL-STD-3009. The legends should be translucent on an opaque background.

4.2.3 Caution Mechanical Indicators should be Aviation Yellow/Amber in accordance with AS25050, except where NVIS compatibility is required. Where NVIS compatibility is required, the color and NVIS Radiance of the caution indicators should be in accordance with MIL-STD-3009. The legends should be translucent on an opaque background.

4.2.4 For military aircraft, Advisory Lighted Indicators should be Aviation Green in accordance with AS25050, except where NVIS compatibility is required. Where NVIS compatibility is required, the color and NVIS Radiance of the advisory indicators should be in accordance with MIL-STD-3009. The legends should be translucent on an opaque background.

4.2.5 For military aircraft, Advisory Mechanical Indicators should be Aviation Green in accordance with AS25050, except where NVIS compatibility is required. Where NVIS compatibility is required, the color and NVIS Radiance of the advisory indicators should be in accordance with MIL-STD-3009. The legends should be translucent on an opaque background.

NOTE: FAR 25.1322 and FAR 27.1322 permit the use of any other color, including white for lights not described in 4.2.1 through 4.2.5 of this section, provided the color sufficiently differs from the colors prescribed in 4.2.1 through 4.2.5 of this section to avoid possible confusion.

NOTE: On large systems on military aircraft, consideration could be given to using other colors at the flight engineer's panel. Green, blue, or white may be used at other crew stations.

4.2.6 The use of Aviation Blue is not recommended for indicators. There are also readability and human factors issues due to focusing on those wavelengths.

4.3 Luminance

4.3.1 Warning Lighted Indicators should have a minimum luminance of 150 foot lamberts (514 candelas per square meter) at normal operating voltage. At least two lamps/LEDs operated in parallel should be employed. When required the lights should be dimmed to approximately 15 foot lamberts (51 candela per square meter) for night operation in military aircraft and approximately 10 foot lamberts (34 candela per square meter) in commercial aircraft.

This dimming may be automatically incorporated when the pilot's primary light control is energized. A failure of an automatic dimming circuit should default to a bright condition. This will prevent inadvertent daylight operation of the warning lights in the dim mode. In the event this is not used a bright dim switch should be located in a conspicuous location. This would give the pilot a visual indication plus control in the event he wants dim panel lights and bright warnings.

4.3.2 Caution and Advisory Lighted Indicators should have a minimum luminance of 150 foot lamberts (514 candelas per square meter) at rated voltage. At least two lamps/LEDs operated in parallel should be employed. When required, indicators should be dimmed to approximately 10 foot lamberts (34 candelas per square meter) for night operation. This dimming may be automatically incorporated when the pilot's primary light control is energized. The lights should return to the bright condition with removal of power from the dimming control. This will prevent inadvertent daylight operation of the warning lights in the dim mode. In the event this is not used, a bright dim switch should be located in a conspicuous location. This would give the pilot a visual indication plus control in the event he wants dim panel lights and bright warnings.

4.3.3 Mechanical Indicators (Including Legend Type) should require no internal lighting under daylight conditions, and should be illuminated to a level of approximately 10 foot lamberts (34 candelas per square meter) for night operation. The mechanical indicators should be lighted internally for night operation.

4.4 Master Indicators

4.4.1 A Master Indicator is one which indicates to the pilot or crew member, that one or more indicators have been energized. All aircraft equipped with multiple Warning and Caution Indicators should be equipped with a Master Warning and/or Caution Indicator. The only exception would be a small system where all indications could be grouped on the panel within the pilot's 30 degree forward field of vision. If this method is used flashing of the incoming fault may be considered. The fault could then be acknowledged by resetting to steady. If flashing is used, the flash rate should be three to five flashes per second with approximately equal on-off time.

4.4.2 The Master Warning Indicator and/or Master Caution Indicator may be similar to the legend type indicators in presentation. A verbal or non-verbal audio signal should be used to complement the Master Warning and/or Master Caution indication. The indicators may be a steady light or a flashing light with provisions for mechanical resetting. Provided the master lights are located so sufficient attention getting is obtained, they should also be dimmed for night operation. The luminance should be a minimum of 150 foot lamberts (514 candelas per square meter) during day operation and approximately 10 foot lamberts (34 candelas per square meter) during night operation. If flashing is used, the flash rate should be three to five flashes per second with approximately equal on-off time.

4.4.3 The Mechanical Master Warning and/or Master Caution Indicator brightness should be approximately 10 foot lamberts (34 candelas per square meter) during night operation. The color should be the same as specified for the individual mechanical indicators.

4.4.4 Advisory Indicators normally do not require a Master Indicator.

4.5 Test System

The Warning and/or Caution Indicating Systems should be provided with a Master Test Switch. This should test each individual indicator simultaneously as a complete system. The test function should check the complete system operation, not just the lamps/LEDs in the indicators. The system is defined as the indicators, master lights and associated electronics.