

## Flight Deck Head-Up Displays

### RATIONALE

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

#### 1. SCOPE:

This SAE Aerospace Recommended Practice (ARP) recommends criteria for the design and installation of Head-Up Display (HUD) systems. The recommendations are applicable to HUD systems for transport category aircraft, which display flight information (focused at infinity) in the forward field of view.

The HUD total system requirement recommendations shall primarily lead to certifiable fail-passive CAT III characteristics and performance. This document forms a part of these recommendations.

This document does not address devices for peripheral vision of displays worn by the pilot, nor the presentation of Enhanced Vision System (EVS) information.

#### 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 has been obtained.

This Annex should be used in conjunction with ARP4102 Core Document.

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## SAE ARP4102/8 Revision A

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

ARP4101	Flight Deck Layout and Facilities
ARP4102/4	Flight Deck Alerting System
ARP4102/7	Electronic Displays
ARP4105	Abbreviations, Acronyms and Terms for Use on the Flight Deck
AS8055	Minimum Performance Standard for Airborne Head Up Display (HUD)
AIR4654	Literature Review of HUD Symbology

2.1.2 FAA Publications: Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591.

AC120-29  
AC 120-28D

2.1.3 Other Publications:

ICAO Working Paper SP COM/OPS/95-WP/45 Economics of Introducing, Certificating and Using New All Weather Operations Systems

JAR-HUDS-901  
JAR-HUDS-902  
JAR-HUDS-903

2.2 Definitions:

2.2.1 HUD System Components:

2.2.1.1 PILOT'S DISPLAY UNIT (PDU): Component which consists of the image source, the collimating optics, and the combiner. It may include signal processing, symbol generation, drive electronics, power supplies, and controls.

2.2.1.2 IMAGE SOURCE: Component which provides the optical origin of the symbology, e.g., CRT screen, conventional projector, laser projector.

2.2.1.3 COLLIMATING OPTICS: Optical components used to collimate (project to infinity) the display image.

2.2.1.4 Types of Collimating Optics:

CONVENTIONAL (REFRACTIVE/REFLECTIVE): Using lenses and mirrors for collimation/superimposition.

HOLOGRAPHIC (DIFFRACTIVE): Using one or several holograms/diffracting elements for collimation/superimposition.

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- 2.2.1.5 COMBINER: Component located in the pilot's forward field of view which provides superimposition of the symbology on the external field of view.
- 2.2.1.6 Types of Combiner:
- DEDICATED: Dedicated to HUD role.
- WINDSHIELD: Utilizing an area of the windshield suitably treated, to enable it to function as a combiner.
- 2.2.1.7 SYMBOL GENERATOR UNIT (SGU): Component which provides symbology information to the image source.
- 2.2.2 HUD Terms, Features, and Optical Parameters:
- 2.2.2.1 CONFORMAL: A conformal HUD overlays display information intended to represent outside world objects, points or directions on top of the real objects, points or directions.
- 2.2.2.2 FIELD OF VIEW (FOV):
- TOTAL FOV: Spatial angle in which the symbology can be displayed, measured vertically and laterally from within the total viewing cone/wedge.
- INSTANTANEOUS FOV (IFOV):
- Monocular: Spatial angle in which the symbology can be viewed from any single eye position within total FOV.
  - Ambinocular: Envelope of both left and right eye monocular instantaneous FOV.
  - Binocular: Envelope within the ambinocular FOV which is common to both monocular FOV, and in which the symbology can be viewed by both eyes simultaneously.
- 2.2.2.3 TRANSMITTANCE OF COMBINER: Percentage of white light from an external source passing through the combiner, measured at or near the design eye position (DEP).
- 2.2.2.4 CONTRAST: Ratio of display symbology brightness to external visual background brightness, as viewed through the HUD.
- 2.2.2.5 EYE REFERENCE POINT: The spatial position of the observer's eye relative to the optical axis as designated by the manufacturer. The HUD Reference Point is contained within the specified HUD Eye Box.
- 2.2.2.6 EYE BOX: The HUD Eye Box is a three dimensional region in space, surrounding the HUD eye reference point, in which the HUD virtual display can be viewed with at least one eye.