



AEROSPACE RECOMMENDED PRACTICE

ARP4102™/8**REV. B**Issued 1988-07
Revised 2026-05

Superseding ARP4102/8A

(R) Permanent or Fixed Place Flight Deck Head-Up Displays

RATIONALE

This document is a pilot-centric update to previous head-up display (HUD) guidance, reflecting technology advancements (e.g., EFVS, SVS, CVS integration) and focusing on operational considerations from the pilot's perspective. It provides recommendations to Original Equipment Manufacturers (OEMs) and operators for designing and implementing head-up display systems that enhance safety and efficiency, while addressing human factors and training needs identified by the "voice of the pilot" in modern commercial operations. Redundant technical specifications already covered by standards like ARP5288 are minimized; instead, the emphasis is on how pilots use HUDs in day-to-day flying and the best practices to support those operations.

1. SCOPE

This SAE Aerospace Recommended Practice (ARP) provides criteria for the design, installation, operation, and training aspects of head-up display (HUD) systems in transport category aircraft, with emphasis on pilot interface and operational requirements. The recommendations apply to permanently installed (including stowable) HUDs that display primary flight information, including those integrating enhanced flight vision system (EFVS) imagery. The intent is to ensure HUDs are designed and used in a manner that improves pilot situational awareness and flight technical performance across all phases of flight, up to and including low-visibility operations. While technical design standards (optical performance, hardware specs, etc.) are defined in documents like ARP5288 and AS8055, this document focuses on pilot usage considerations and human factors. HUD systems addressed here are typically designed to support a fail-passive operational concept applicable to Category III instrument approach operations, where approved, though many recommendations also apply to HUD usage for Category I and II operations and other phases of flight. Devices such as head-worn displays are not specifically covered, though future provisions may consider "through-display" wearable systems as technology matures.

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.

2.1.1 SAE Publications

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

ARP5288 **Transport Category Airplane Head Up Display (HUD) Systems**

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Full document details: [SAE ARP4102_8B](http://www.sae.org/standards/content/ARP4102/8B/)

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Documents

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2.1.2 FAA Publications

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

AC 25.773-1	Pilot Compartment View Design Considerations
AC 25.1329-1C	Flight Guidance Systems
AC 90-106B	Enhanced Flight Vision System Operation
AC 120-28D	Criteria for Approval of Category III Weather Minima for Takeoff, Landing, and Rollout
AC 120-29A	Criteria for Approval of Category I/II Weather Minima for Takeoff, Landing, and Rollout

2.1.3 Code of Federal Regulations (CFR) Publications

Copies of these documents are available online at www.ecfr.gov.

14 CFR § 25.777	Cockpit Controls
14 CFR § 25.1302	Installed Systems and Equipment for Use by the Flightcrew
14 CFR § 91.176	Straight-in Landing Operations Below DA/DH or MDA Using an Enhanced Flight Vision System (EFVS) Under IFR

2.1.4 EASA Publications

Available from European Union Aviation Safety Agency, Konrad-Adenauer-Ufer 3, D-50668 Cologne, Germany, Tel: +49 221 89990 000, www.easa.europa.eu.

CS-25	Certification Specifications and Acceptable Means of Compliance for Large Aeroplanes
CS-AWO	Certification Specifications for All-Weather Operations

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Recommended Practice.

2.2.1 SAE Publications

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

ARP4101	Flight Deck Layout and Facilities
ARP4102/4	Flight Deck Alerting System (FAS)
ARP4102/7	Electronic Displays
ARP4105	Abbreviations, Acronyms, and Terms for Use on the Flight Deck
ARP5287	Optical Measurement Procedures for Airborne Head Up Display (HUD)
AS8055	Minimum Performance Standard for Airborne Head Up Display (HUD)

2.2.2 ICAO Publications

Available from International Civil Aviation Organization, 999 Robert-Bourassa Boulevard, Montréal Quebec H3C 5H7, Canada, Tel: +1 514-954-8219, www.icao.int.

ICAO Doc 9365 Manual of All-Weather Operations

2.2.3 Other Publications

IFALPA 17POS09 Head-Up Display and Vision Systems

2.3 Definitions

2.3.1 SHALL

Used to express an essential requirement where compliance is mandatory.

2.3.2 SHOULD

Used to express a recommendation. Deviation from the specified recommendation shall require justification.

2.3.3 MUST

Used to express an essential (mandatory) requirement that is required by a specific regulation.

2.3.4 HEAD-UP DISPLAY (HUD)

A display system that presents flight information in the pilot's forward field of view, typically by projecting symbols onto a transparent combiner between the pilot and the windshield. This allows the pilot to monitor critical flight data while looking out at the external scene.

2.3.5 HEAD-DOWN DISPLAY (HDD)

Conventional flight instrument display located on the instrument panel (e.g., primary flight display) that requires the pilot to look down or away from the external view.

2.3.6 DECLUTTER MODE

A selectable set of HUD modes that successively remove or prioritize information to support different phases of flight and mission requirements, reducing distraction while preserving essential cues.

2.3.7 CONFORMAL (CONFORMALITY)

A display characteristic in which symbology or imagery is aligned and moves in conjunction with the external scene as viewed by the pilot. A conformal symbol (e.g., flight path vector, runway outline) overlays its real-world reference when the pilot's eyes are within the design eyebox. Conformality depends on accurate boresighting, sensor alignment, and proper eye position.

2.3.8 ENHANCED FLIGHT VISION SYSTEM (EFVS)

An installed aircraft system that provides a real-time image of the forward external scene, either on an HDD or conformally projected on a Head-Up Display with required flight symbology, supporting identification of the runway environment in accordance with applicable EFVS operational approvals and regulations.

2.3.9 SYNTHETIC VISION SYSTEM (SVS)

A system that creates a computer-generated image representing the environment external to the airplane, derived from an onboard database of terrain, obstacles, and cultural features.