



AEROSPACE STANDARD

AS8034™**REV. C**

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Superseding AS8034B

(R) Minimum Performance Standard for
Airborne Multipurpose Electronic Displays

RATIONALE

The current revision, AS8034C, now includes the minimum performance standards for touch screen enabled electronic displays. This document was developed by the SAE A-4 Electronic Display committee and supersedes AS8034, AS8034A and AS8034B.

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1. SCOPE

This SAE Aerospace Standard (AS) specifies minimum performance standards for all types of electronic displays and electronic display systems that are intended for use in the flight deck by the flight crew in all 14 CFR Part 23, 25, 27, and 29 aircraft. The requirements and recommendations in this document are intended to apply to all installed electronic displays and electronic display systems including those that have a touch screen interface within the flight deck, regardless of intended function, criticality, or location within the flight deck, but may also be used for non-installed electronic displays. This document provides baseline requirements and recommendations (see 2.3 for definitions of “shall” and “should”). This document primarily addresses hardware requirements, such as electrical, mechanical, optical, and environmental. It does not address system specific functions. It does not contain an exhaustive or comprehensive list of requirements for specific systems or functions, such as TCAS, ADS-B, GPS, weather, or shared display considerations (e.g., when should alerts be inhibited on a display system that simultaneously depicts navigation data integrated with terrain data or traffic alerting). This document is intended to be used in combination with other guidance material contained in current system specific, TSOs, Advisory Circulars (ACs), and other Federal Aviation Administration (FAA)-approved guidance material.

The requirements and recommendations in this document are intended to apply to, but are not limited to, the following types of display functions:

- Primary flight and primary navigation which include vertical situation, horizontal situation, and moving map displays.
- Systems display and displays that have alerting functions which may include engine instrument, aircraft systems information/control, pilot or flight crew alerting, and documentation displays.
- Control displays including communication, navigation, and system control displays.
- Information displays which may include navigation displays used for situation awareness only, supplemental data displays, and maintenance displays.

Electronic displays can include one or more of the following interconnected components. Other configurations are possible.

- Symbol Generator/Processor Unit (SG) containing display processing and symbol generation processing and symbol generation capability, power supplies, interface logic/buffer circuits and display unit interface capability. The SG receives data from external sources, produces symbols as electronic signals, and transmits the symbols to the display units(s).
- Control Panel (CP) is an optional component providing the means for manually selecting display symbology options/modes, selections, settings, brightness, etc.
- Touch Screen (TS) is an optional component providing the means for manually selecting display symbology options/modes, selections, settings, brightness, etc.
- Display Unit (DU) providing the visual display of SG symbology.

Head up displays are out of scope for this document. The minimum performance standards for head up displays are provided in AS8055A.

NOTE: This document is expected to be used by the FAA as the basic requirement for a Technical Standard Order (TSO) for multipurpose electronic displays. While not required, ARP1874 and ARP4067 give recommended means, but not the only means, of compliance to this standard for CRT based displays. In addition, while not required, ARP4256 gives recommended means, but not the only means, of compliance to this standard for Part 25 LCD displays. That document is subject to change to keep pace with experience and technical advances. A similar document for Part 23 aircraft does not exist at this time, however these documents may be used as the basis for electronic displays intended to be installed in Part 23, 27, and 29 aircraft, realizing that additional requirements may also apply.

2. REFERENCES

The documents listed in 2.1 are referenced in this document. The documents listed in 2.2 are provided for information purposes only and do not form a part of the requirements of this document.

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: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

ARP1782	Photometric and Colorimetric Measurement Procedures for Airborne Direct View CRT Displays
ARP1874	Design Objectives for CRT Displays for Part 25 (Transport) Aircraft
ARP4067	Design Objectives for CRT Displays for Part 23 Aircraft
ARP4102/7	Electronic Displays
ARP4256	Design Objectives for Liquid Crystal Displays for Part 25 (Transport) Aircraft
ARP4260	Photometric and Colorimetric Measurement Procedures for Airborne Electronic Flat Panel Displays
ARP5583	Guide to Certification of Aircraft in a High-Intensity Radiated Field (HIRF) Environment
AS8055	Minimum Performance Standard for Airborne Head Up Display (HUD)
ARP4761	Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment

2.1.2 CIE (Commissions Internationale de l'Eclairage) Publications

Available from CIE Central Bureau, Babenbergerstrasse 9/9A, 1010 Vienna, Austria, Tel: +43 1 714 31 87, www.cie.co.at.

Supplement No. 2 to CIE Publication No. 15 Recommendations on Uniform Color Spaces Color Difference Equations - Psychometric Color Terms

2.1.3 Code of Federal Regulations (CFR)

Available from the United States Government Printing Office, 732 North Capitol Street, NW, Washington, DC 20401, Tel: 202-512-0000, www.gpoaccess.gov.

14 CFR 23	Airworthiness Standards: Normal, Utility, Acrobatic, and Commuter Category Airplanes
14 CFR 25	Airworthiness Standards: Transport Category Airplanes
14 CFR 27	Airworthiness Standards: Normal Category Rotorcraft
14 CFR 29	Airworthiness Standards: Transport Category Rotorcraft

- Advisory Circular 20-136A Protection of Aircraft and Electrical/Electronic Systems against the Indirect Effects of Lightning
- Advisory Circular 20-155 SAE Documents to Support Aircraft Lightning Protection Certification
- Advisory Circular 20-158 The Certification of Aircraft Electrical and Electronic Systems for Operation in the High-Intensity Radiated Fields (HIRF) Environment.

The new Part 23 rule went into effect August 30, 2017. However, the former Part 23 regulations may still be used. In the NPRM, the FAA noted that “under the proposed rule, applicants may choose to use an industry consensus standard, the former Part 23 standards (available at no cost), or its own means of compliance accepted by the Administrator”.

2.1.4 EIA Publications

Available from Electronic Component Association (ECA), 2500 Wilson Boulevard, Arlington, VA 22201-3834, Tel: 703-907-7500, www.eia.org.

EIA RS-503a Recommended Practice for Measurement of X-Radiation from Direct View Display Cathode Ray Tubes

2.1.5 FAA Publications

FAA AC-() documents are available from the U.S. Department of Transportation, Subsequent Distribution Office M-30, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785, www.faa.gov/regulations_policies.

2.1.6 RTCA/EUROCAE Publications

Available from RTCA, Inc., 1150 18th Street, NW, Suite 910, Washington, DC 20036, Tel: 202-833-9339, www.rtca.org.

RTCA DO-160G/EUROCAE ED-14G Environmental Conditions and Test Procedures for Airborne Equipment

2.1.7 VESA Publications

Available from VESA, 1754 Technology Drive, Suite 238, San Jose, CA 95110, Tel: 408-982-3850, www.vesa.org.

Flat Panel Measurements Standard, Version 2.0, June 1, 2001

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Aerospace Technical Report.

2.2.1 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.

- AMS2521 Coating, Reflection-Reducing for Instrument Glasses
- AIR1093 Numeral, Letter and Symbol Dimensions for Aircraft Instrument Displays
- ARP4032 Human Engineering Considerations in the Application of Color to Electronic Aircraft Displays
- ARP4101 Flight Deck Layout and Facilities
- ARP4102 Flight Deck Panels, Controls, and Displays
- ARP4103 Flight Deck Lighting for Commercial Transport Aircraft
- ARP4105 Abbreviations, Acronyms, and Terms for Use on the Flight Deck

2.2.2 FAA Publications

FAA AC-() documents are available from the U.S. Department of Transportation, Subsequent Distribution Office M-30, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785, www.faa.gov/regulations_policies.

FAA AC 25-11B Electronic Flight Deck Displays

FAA AC 23-1311-1B Installation of Electronic Display Instrument Systems in Part 23 Airplanes

FAA AC 27-1 Certification of Normal Category Rotorcraft

FAA AC 29-2 Certification of Transport Category Rotorcraft

FAA AC 20-158 The Certification of aircraft Electrical and Electronic Systems for Operation in the High-Intensity Radiated Fields (HIRF) Environment

2.2.3 RTCA/EUROCAE Publications

Available from RTCA, Inc., 1150 18th Street, NW, Suite 910, Washington, DC 20036, Tel: 202-833-9339, www.rtca.org.

RTCA DO-178CB/EUROCAE ED-12B Software Considerations in Airborne Systems and Equipment Certification

2.2.4 U. S. Government Publications

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

MIL-HDBK-87213 Military Handbook: Electrically/Optically Generated Airborne Displays

2.3 Definitions

Definitions used in this document shall be as noted in the Glossary of Terms defined in Section 7.

The word “shall” is used to express an essential requirement where compliance is mandatory.

The word “should” is used to express a recommendation. Deviation from the specified recommendation shall require justification.

The word “must” is used to express an essential (mandatory) requirement that is required by a specific regulation.

3. GENERAL STANDARDS

3.1 Material

Material shall be of a quality which experience and/or tests have demonstrated to be suitable and dependable for use in aircraft instruments.

3.2 Workmanship

Workmanship shall be consistent with high quality aircraft electromechanical and electronic instrument manufacturing practices.

3.3 Compatibility of Components

If a display system component is individually acceptable but requires calibration adjustments or matching to other components in the aircraft for proper operation, it shall be identified in a manner that will insure performance to the requirements of this document.

3.4 Interchangeability

Display system components which are identified with the same manufactured part number shall be completely interchangeable.

3.5 Accessibility of Controls

Controls which are not normally adjustable in flight shall not be readily accessible to flight personnel when the instrument is installed in accordance with the instrument manufacturer's instructions.

3.6 Self-Test Capability

If the equipment contains integral arrangements to permit pre-flight and/or in-flight self-test checks on the operation of the equipment in combination with other aircraft sub-systems, such tests shall not adversely affect any associated subsystem.

In-flight, self-test activation features shall include a means to warn the pilot or appropriate flight crew member of this mode of operation.

3.7 Effect of Tests

Unless otherwise stated, the application of all prescribed in-service testing shall not produce a subsequent condition which would be detrimental to the continued performance of the instrument.

3.8 Malfunctions/Failure Indications

3.8.1 Malfunction Indication

Means shall be provided to indicate malfunctions or failures to the appropriate crew member. A blank display or a "X" across the display are examples of acceptable means of indicating failure.

3.8.2 Power Failure Indication

Means shall be provided to indicate when electrical power (voltage and/or current of all required phases), is not sufficient for proper operation of display and/or display system. A blank display is an example of acceptable means of indicating failure.

3.8.3 Fail Safe Provision

No single failure or malfunction of the display system shall introduce unsafe conditions to interconnected equipment.

- Unsafe conditions include the probability of failure of the article that could lead to an unsafe condition, based upon the design assurance level.
- A Failure Modes and Effects Analysis (FMEA) shall be performed to identify, isolate, and mitigate individual failures of the display. This is needed to be used in a System Safety Assessment (SSA) for aircraft airworthiness determination.
- ARP4761 Table 1 shows a means of evaluating the failure condition severity as related to probability objectives and assurance levels for components and systems in aircraft.

3.9 Multiple Mode Indications

When a display and/or display system has more than one mode each mode of operation shall be indicated on the display. One example of an acceptable exception is the depiction of the Horizontal Situation Indicator (HSI)-Full Compass versus Arc mode, which does not require a mode indication.

NOTE: Examples of modes on a moving map display include head-up versus track up. In contrast, a vertical profile display portion of the display screen would be considered a function, not a mode, and thus would not be required to be indicated (e.g., labeled).

3.10 Identification

The following information shall be legible and permanently marked on the equipment or nameplate attached thereto.

- a. Name of equipment
- b. Manufacturer's part number
- c. Manufacturer's serial number or date of manufacture
- d. AS8034 or equivalent approval identification
- e. Manufacturer's name or trademark
- f. Weight to the nearest 0.05 kg (tenth of a pound)
- g. Environmental categories per DO-160G/ED-14G

3.11 Display

The information being displayed should functionally conform to the applicable SAE Aerospace Recommended Practice.

3.11.1 Discernibility

Appropriate means shall be incorporated to prevent obscuration or confusion of task essential information. Task essential information shall be identified and defined by the applicant (e.g., typically the equipment manufacturer or OEM).

3.11.2 Critical Information

Means shall be provided to prevent the removal of information deemed critical to safe aircraft operation.

3.11.3 Information Limit Indication

A means shall be provided to identify when critical displayed information exceeds display format functional limits.

3.11.4 Scale Indications

The display scaling, graduations, and numeration shall be appropriate for the level of reading accuracy and dynamic range required (e.g., familiar units of measure are not as significant as the values and may be smaller font, but still must be discernible). The display should indicate if display items are not drawn to scale (e.g., TAWS displays).

3.11.5 Ambiguity

Appropriate means shall be provided to prevent ambiguous indications within the operating range of the display system.

3.11.6 Lighting

Per regulation 14 CFR 2X.1543, all instrument markings shall be clearly visible to the appropriate crewmember. All display, control labels, and markings shall be clearly visible and easily readable in all flight deck lighting conditions.

When integral lighting is provided, it shall, under normal flight deck ambient illumination conditions as defined in 4.3.1, make all indices within the required viewing envelope readily discernible.

3.12 Resistance to Dust and Moisture

Optics shall be designed to prevent contamination of surfaces by dust or moisture under all operating and test conditions of this standard.

When hermetically sealed, the case shall be filled with an inert gas, free of dust particles, and sufficiently dry so that fogging of the indicator glass does not occur during the low temperature and fogging tests of this document.

3.13 Mechanical Hazard System Protection

The display should be so designed that no hazard will result from implosion, or other mechanical failures.

3.14 Fire Resistance

Except for small parts (e.g., fasteners, grommets, knobs, seals, small electrical parts) that would not contribute significantly to the propagation of a fire, all materials used must be self-extinguishing when tested in accordance with the requirements of 14 Code of Federal Regulations (CFR).

3.15 Supplemental Heating/Cooling

Where supplemental heating or cooling is required by the equipment to ensure conformance with this standard, it shall be the responsibility of the equipment manufacturer to specify such requirements. If the loss of supplemental heating or cooling during normal system operation could lead to hazardously misleading information, the heating or cooling sources shall be monitored, and the flight crew alerted to the failure.

3.16 Touch Screen Displays

The information being displayed and the manipulation of the information on the display should consider the recommendations of the applicable SAE Aerospace Recommended Practice.

3.16.1 Touch Screen Disablement

If a touch screen is part of the electronic display unit and intentionally disabled via a user-controlled aircraft mechanism there shall be an indication to the user. One type of user-controlled aircraft mechanism might include the position or state of a switch, but this is not the only possible mechanism.

If a touch screen is part of the electronic display unit and can be disabled or limited via a non-user-controlled mechanism these limitations to operation shall be documented in the system safety analysis and in the installation or operating instructions. One type of non-user-controlled aircraft mechanism might be a HIRF event where the touch screen may temporarily lock out or limit (e.g., degraded mode) the touch screen usage until the event has passed. During this lock out or limitation time, an indication shall be made to the user.

The applicant can consider conditions before annunciating to the user (e.g., time duration, task performed) in such scenario the conditions shall be documented in the installation or operating instructions. After the event has cleared the system shall fully operate without intervention by the user and the annunciation removed unless this conflicts with other operational or functional requirements of the system.

3.17 Touch Screen Input

3.17.1 Touch Screen Interface

Document in the Installation or operating instructions the key operating characteristics and any known limitations. The following are a list of possible items but not necessarily the entire list.

Examples:

- Input Devices: Document if there are known limitations on type or size of input devices used to make touch screen inputs. Some examples could be limitations with the use of glove or stylus. If there are limitations with the size of the input device being too small to be recognized or too large such that it gets rejected these are also to be documented.