Will publish in the Federal Register On April 26, 2004.

[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Aviation Rulemaking Advisory Committee Meeting on

Transport Airplane and Engine Issues

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of public meeting.

SUMMARY: This notice announces a public meeting of the FAA's Aviation Rulemaking Advisory Committee (ARAC) to discuss transport airplane and engine (TAE) issues.

DATES: The meeting is scheduled for May 14, 2004, from 11:00 am to 1:30 pm.

ADDRESS: Federal Aviation Administration, 800 Independence Ave, SW., Room 810, Washington, DC 20591.

FOR FURTHER INFORMATION CONTACT: Alicia K. Douglas, Office of Rulemaking, ARM-204, FAA, 800 Independence Avenue, SW., Washington, DC 20591; telephone (202) 267-9681; facsimile (202) 267-5075; or e-mail at alicia.k.douglas@faa.gov.

SUPPLEMENTARY INFORMATION: Pursuant to section 10(a)(2) of the Federal Advisory Committee Act (Pub. L. 92-463; 5 U.S.C. app. III), notice is given of an ad hoc ARAC meeting to be held May 14, 2004, at the Federal Aviation Administration, 800 Independence Ave., Room 810, Washington, DC. The meeting/teleconference is being held to approve the Avionics Systems Harmonization Working Group (AVSHWG) report and draft associated advisory circular that addresses section 25.1322 pertaining to flight deck alerting systems. The TAE expected to vote on the AVSHWG report and associated draft advisory circular, but did not because of concerns associated with the lack of display color guidance contained in the draft advisory circular, at the February 2004 TAE meeting. At that time, however, TAE members agreed to accept the report and draft advisory circular but to hold the vote at a future date, after the AVSHWG

Aviation Rulemaking Advisory Committee (ARAC)
Transport Airplane and Engine Issues Group (TAEIG)
Meeting Minutes

DATE: May 14, 2004
TIME: 11:00 a.m.-1:30 p.m.
LOCATION: Federal Aviation Administration
800 Independence Ave., SW
Room 810
Washington, DC 20591

Call to Order/Administrative Reporting

Craig Bolt, Assistant Chair, called the ad hoc meeting to order. Mike Kaszycki, Assistant Executive Director, read the required statement for conducting the meeting, and attendees introduced themselves. Most attendees joined the meeting by phone. In attendance were:

Members				NonMembers	
Keith Barnett	AIAC-Bombardier	Maher Khouzam	Transport Canada	Kirk Baker	FAA
Craig Bolt*	Pratt & Whitney	Doug Lane	Boeing	Steve Boyd	FAA
Curt Graeber	Boeing	Mike Romanowski	AIA	Paul Faducia	SAMA
Jens Hennig	GAMA	Jim Wallace	ALPA	Dionne Krebs	FAA
Mike Kaszycki**	FAA			Bob Myers	Boeing
Rolf Greiner	Airbus			Alicia K. Douglas	FAA

* Assistant Chair
** Assistant Executive Director

The Agenda

Mr. Bolt reviewed the agenda, with the only agenda item being a vote on the Avionics Systems Harmonization Working Group (AVSHWG) report and associated draft advisory circular on section 25.1322 pertaining to flight deck alerting systems. This ad hoc TAEIG meeting was necessary because the AVSHWG report is directly linked to a safety enhancement recommended by the Commercial Aviation Safety Team (CAST).

Handout#

Avionics Systems Harmonization Working Group (AVSHWG)

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At the February 2004 TAEIG meeting, the AVSHWG provided a summary of the WG's latest updates to the draft rule § 25.1322 and draft AC/ACJ 25.1322, and submitted their report and draft documents (handouts 1 and 2). Because there were concerns associated with the proposed display color guidance contained in the draft advisory circular, the TAEIG accepted the report and draft AC, but decided to hold the vote at a future date, after the WG addressed the concerns.

Bob Myers stated that following the February 2004 TAEIG meeting, the WG reviewed and discussed the FAA's proposed language. The WG revised the language for clarity and incorporated it into their document. Some of the
discussion highlights:

1) Craig shared that one group questioned why the FAA's proposed language wasn't incorporated without change, suggesting the WG's language was more restrictive.

2) The draft rule and AC could cause previously accepted designs (relative to instrumentation) to be questioned in future applications. The rule and AC will apply to future application: TC, STC, and TSO. However, it should not affect TCs, STCs, and TSOs retroactively.

3) Mike Romanowski recommended the statement, "...this condition requires...immediate flight crew response." be deleted. Mr. Kaszycki, Mr. Hennig, and Mr. Lane agreed the sentence should be deleted, as the issue is being worked elsewhere.

4) GAMA expressed two concerns:
   a. These documents lack information on graphical weather depiction.
   b. There is ambiguity in the text. The documents should include examples, e.g.,"...acceptable uses are ..."

   Kirk Baker stated that he understands these concerns, but suggested that they might be more appropriately addressed in the changes considered for AC 25-11.

The issue regarding sub paragraph (e) in the draft rule caused some controversy. The issue was satisfactorily resolved by revising both the draft regulation and advisory material, based on comments received from the RTCA SC-195 committee and from within group membership.

Finally, Mr. Kaszycki stated the document is a good compromise between the FAA and the WG wording. GAMA agreed and stated there should be no delay in accepting the documents and transmitting them to the FAA in order to meet the CAST deadline.

The TAEIG unanimously accepted the ASHWG report with minor changes. It was agreed the report would be submitted to the FAA with a cover letter stating, "when considering the acceptability of these colors for graphical weather depiction, the potential safety benefits should be considered during the certification process."

- **Wrap-Up**

Action Items
Mr. Bolt to draft letter to the FAA, with agreed upon language, and transmit the AVSHWG report, draft rule and associated AC to the FAA.

Next Meeting: June 15-16, 2004 in Seattle, Washington.

Public Notification **3**
The *Federal Register* published an announcement notice of this meeting on April 26, 2004.

Approval
I certify the minutes are accurate.

ARAC WG Report
FAR/JAR 25.1322 & AC/ACJ 25.1322

1. What is underlying safety issue addressed by the FAR/JAR?
   The rule provides color requirements for warning, caution and advisory lights associated with alerting functions. However, the current rule only addresses "lights" and does not take into consideration the implementations, technology, and associated safety issues with the latest flight deck alerting systems.

   FAR/JAR 25.1322 describes standards for the color of warning, caution, advisory, and other message lights that are installed as annunciation displays in the flight deck. It addresses visual alerting cues only in the form of colored lights installed in the flight deck. The regulation became effective February 1, 1977 (Amendment No. 25-38, 41 FR 44567, December 20, 1976) and has never been amended. It does not consider the use of corresponding aural tones/voice and prioritization of multiple alerts that may occur at the same time. Nor does it consider new technologies, other than colored lights, that may be more effective in aiding the flight crew in decision making. Further, FAR/JAR 25.1322 is outdated, does not address safety concerns associated with today's display systems, and has resulted in additional work for applicants when showing compliance, and for the FAA when addressing new flight deck designs and the latest display technologies via special conditions and issue papers.

2. What are the current FAR and JAR standards?

   Current FAR text:
   If warning, caution, or advisory lights are installed in the cockpit, they must, unless otherwise approved by the Administrator, be--
   (a) Red, for warning lights (lights indicating a hazard which may require immediate corrective action);
   (b) Amber, for caution lights (lights indicating the possible need for future corrective action);
   (c) Green for safe operation lights; and
   (d) Any other color, including white, for lights not described in paragraphs (a) through (c) of this section, provided the color differs sufficiently from the colors prescribed in paragraphs (a) through (c) of this section to avoid possible confusion.

   Current JAR text:
   If warning, caution, or advisory lights are installed in the cockpit, they must, unless otherwise approved by the Authority, be -
   (a) Red, for warning lights (lights indicating a hazard which may require immediate corrective action);
   (b) Amber, for caution lights (lights indicating the possible need for future corrective action);
   (c) Green, for safe operation lights; and
   (d) Any other colour, including white, for lights not described in sub-paragraphs (a) to (c) of this paragraph, provided the colour differs sufficiently from the colours prescribed in sub-paragraphs (a) to (c) of this paragraph to avoid possible confusion.

3. What are the differences in the standards and what do these differences result in?:
   There are no differences in the standards. There is a related AMJ, but no AC.

4. What, if any, are the differences in the means of compliance?
   Specific means of compliance to JAR 25.1322 are provided in the associated AMJ.
   No specific means of compliance exists for FAR 25.1322.

5. What is the proposed action?
   The FAR 25 and JAR 25 and their associated guidance material have been identified as lacking content and guidance commensurate with the state-of-the-art. Therefore, a new FAR/JAR 25.1322 will be written to address current or future flight deck design and the technologies associated with flight crew alerting. The existing AMJ will be reviewed and harmonized advisory material will be generated.

6. What should the harmonized standard be?
   A new FAR/JAR 25.1322 and associated AC/AMJ 25.1322. (See Attachment and file Draft AC25.1322 DC Meeting 1003_rev a)

7. How does this proposed standard address the underlying safety issue (identified under #1)?
   The new standard will address the requirements for crew alerting systems and provide content and guidance that is commensurate with the state-of-the-art flight deck alerting systems.

8. Relative to the current FAR, does the proposed standard increase, decrease, or maintain the same level of safety?
   The level of safety will be increased by providing new standards and guidance material that is commensurate with the state-of-the-art and crew alerting, and by providing guidance for other Part 25 regulations that require the use of alerting.

9. Relative to current industry practice, does the proposed standard increase, decrease, or maintain the same level of safety?
   The new standards and guidance material supports current industry practice and will increase the level of safety.

10. What other options have been considered and why were they not selected?:
    The group initially thought of adopting the JAR and associated AMJ. However, this was still deemed insufficient for today's flight deck alerting systems. The level of effort to rewrite the rule was significant, and each sub-paragraph was reviewed and many options were considered. In addition, the Human Factors Harmonization Working Group provided additional options for consideration. The group has modified wording in the draft AC/ACJ to address the means of compliance to sub paragraph e) in the rule.

11. Who would be affected by the proposed change? The (Part 25) aviation industry in general including aircraft manufacturers, aircraft operators, avionics manufacturers, and regulators, if they are not already practicing the essence of these standards. There may be indirect effect to manufacturers that wish to develop products and systems that are intended to cross part 23/25/27/29 applications.

12. To ensure harmonization, what current advisory material (e.g., ACJ, AMJ, AC, policy letters) needs to be included in the rule text or preamble?
    AC/AMJ 25-11, and parts of the draft AC/AMJ 25-1322.

13. Is existing FAA advisory material adequate? No. There is no existing FAA advisory material. However, there is an existing AMJ 25.1322 and that document has been revised to incorporate this latest information.

14. How does the proposed standard compare to the current ICAO standard?
    There are no applicable ICAO standards.

15. Does the proposed standard affect other HWGs? Yes. We have coordinated with the working groups responsible for Human Factors (25.1301(e)), Propulsion and Safety (25.1309). We have also coordinated with other industry groups such as the RTCA SC-195 committee.

16. What is the cost impact of complying with the proposed standard?

    For those manufacturers that are already in compliance / already practicing. Harmonization of 25.1322 and the associated guidance material will significantly reduce certification costs, thereby improving the allocation of limited resources.

    For those manufacturers that are not in compliance/not already practicing, there may be additional costs to comply with the new rule.

    There is a general potential problem with the change process, if this revised rule is used for new applications of existing products and systems, or if this revised rule is applied to any modifications to existing products and systems.

17. Does the HWG want to review the draft NPRM at "Phase 4" prior to publication in the Federal Register?

    Yes

18. In light of the information provided in this report, does the HWG consider that the "Fast Track" process is appropriate for this rulemaking project, or is the project too complex or controversial for the Fast Track Process?

    Yes, it is appropriate for the "Fast Track" process. The group identified an issue regarding sub paragraph (e) in the draft rule that caused controversy. The group resolved this to our satisfaction by revising both the regulation and advisory material, based on comments received from the RTCA SC-195 committee and from within group membership.

    The AVHWG will also update AC/AMJ 25-11 to cover the broad scope of the use of colors in the flight deck.

FAR/JAR 25.1322 Flight Crew Alerting

(a) When flight crew alerts are provided they must:

1) Provide timely attention-getting cues through at least two different senses by combination of aural, visual, or tactile indications, for crew alerts requiring immediate flight crew awareness.
2) Provide the flight crew with the information needed to identify the alert and determine correct action, if any.
3) Be readily and easily detectable and intelligible by the flight crew under all foreseeable operating conditions including conditions where multiple alerts are provided.

(b) Alerts must conform to the following prioritization hierarchy based upon urgency of flight crew awareness and urgency of flight crew response.

1) Warning: For conditions that require immediate flight crew awareness and immediate flight crew response. If warnings are time critical to maintain the immediate safe operation of the airplane, they must be prioritized higher than other warnings.
2) Caution: For conditions that require immediate flight crew awareness and subsequent flight crew response.
3) Advisory: For conditions that require flight crew awareness and may require subsequent flight crew response.

(c) Alert presentation means must be designed to minimize nuisance effects. In particular a crew alerting system must:

1) Permit each occurrence of attention getting cues, if provided, to be acknowledged and suppressed unless they are otherwise required to be continuous.
2) Prevent the presentation of an alert that is inappropriate or unnecessary for the particular phase of operation.
3) Remove the presentation of the alert when the condition no longer exists
4) Provide a means to suppress an attention getting component of an alert caused by a failure of the alerting system, and/or the sensors, which interfere with the flight crew's ability to safely operate the aircraft. This means must not be readily available to the flight crew such that it could be operated inadvertently, or by habitual reflexive action. In this case, there must be a clear and unmistakable annunciation to the flight crew that the alert has been suppressed.

(d) Alerts must conform to the following color convention for visual alert indications:

1) Red for Warning alert indications.
2) Amber/yellow for Caution alert indications.
3) Any color except red or green for Advisory alert indications.

(e) The colors red and amber/yellow are normally reserved for alerting functions. The use of these colors for functions other than crew alerting must be limited and must not adversely affect crew alerting.

this notice is to improve the public's awareness of, and participation in, this aspect of FAA's regulatory activities. Neither publication of this notice nor the inclusion or omission of information in the summary is intended to affect the legal status of any petition or its final disposition.

DATES: Comments on petitions received must identify the petition docket number involved and must be received on or before May 17, 2004.

ADDRESSES: You may submit comments identified by DOT DMS Docket Number FAA–2004–17317–1 by any of the following methods:

- *Web site: http://dms.dot.gov.*

Follow the instructions for submitting comments on the DOT electronic docket site.

- *Fax:* 1–202–493–2251.
- *Mail:* Docket Management Facility; U.S. Department of Transportation, 400 Seventh Street, SW., Nassif Building, Room PL–401, Washington, DC 20590–0001.
- *Hand Delivery:* Room PL–401 on the plaza level of the Nassif Building, 400 Seventh Street, SW., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.
- *Federal eRulemaking Portal:* Go to *http://www.regulations.gov.* Follow the online instructions for submitting comments.

Docket: For access to the docket to read background documents or comments received, go to *http://dms.dot.gov* at any time or to Room PL–401 on the plaza level of the Nassif Building, 400 Seventh Street, SW., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

FOR FURTHER INFORMATION CONTACT: Mr. Wes Ryan (816–329–4127), Small Airplane Directorate (ACE–111), Federal Aviation Administration, 901 Locust, Kansas City, MO 64106; or John Linsenmeyer (202–267–5174), Office of Rulemaking (ARM–1), Federal Aviation Administration, 800 Independence Avenue, SW., Washington, DC 20591.

This notice is published pursuant to 14 CFR 11.85 and 11.91.

Issued in Washington, DC, on April 20, 2004.

Donald P. Byrne,

Assistant Chief Counsel for Regulations.

Petitions for Exemption

Docket No.: FAA–2004–17317–1.

Petitioner: Cessna Aircraft Company.

Sections of 14 CFR Affected: 14 CFR 23.181(b).

Description of Relief Sought: To allow the Cessna Model 525B to be certificated with relief from the requirements of § 23.181(b), as outlined in Exemption 5759, which was issued for the original 525. However, the exemption for the 525B would contain the additional restriction to require the 525B to operate below 30,000 feet in the event of a yaw damper failure.

[FR Doc. 04–9392 Filed 4–23–04; 8:45 am]

BILLING CODE 4910–13–P

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Aviation Rulemaking Advisory Committee Meeting on Transport Airplane and Engine Issues

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of public meeting.

SUMMARY: This notice announces a public meeting of the FAA's Aviation Rulemaking Advisory Committee (ARAC) to discuss transport airplane and engine (TAE) issues.

DATES: The meeting is scheduled for May 14, 2004, from 11 a.m. to 1:30 p.m.

ADDRESSES: Federal Aviation Administration, 800 Independence Ave, SW., Room 810, Washington, DC 20591.

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The agenda will include:

- Opening remarks.
- Avionics HWG Report and Draft Advisory Circular, AC 25.1322, and Approval.

Attendance is open to the public, but will be limited to the availability of meeting room space and telephone lines. The public may participate by teleconference by contacting the person listed under the heading **FOR FURTHER INFORMATION CONTACT** after May 4. The public must make arrangements by May 7 to present oral statements at the meeting. Written statements may be presented to the committee at any time by providing 25 copies to the Assistant Executive Director for Transport Airplane and Engine issues or by providing copies at the meeting. Copies of the documents to be voted upon may be made available by contacting the person listed under the heading **FOR FURTHER INFORMATION CONTACT.**

If you are in need of assistance or require a reasonable accommodation for the meeting or meeting documents, please contact the person listed under the heading **FOR FURTHER INFORMATION CONTACT.** Sign and oral interpretation, as well as a listening device, can be made available if requested 10 calendar days before the meeting.

Issued in Washington, DC, on April 20, 2004.

Ida M. Klepper,

Acting Executive Director, Aviation Rulemaking Advisory Committee.

[FR Doc. 04–9390 Filed 4–23–04; 8:45 am]

BILLING CODE 4910–13–P

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Notice of Intent to Rule on Application to Impose and Use the Revenue From a Passenger Facility Charge (PFC) at Honolulu International, Kahului, Kona International, and Lihue Airports, HI

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of intent to rule on application.

SUMMARY: The FAA proposes to rule and invites public comment on the application to impose and use the revenue from a PFC at Honolulu International (HNL), Kahului (OGG), Kona International (KOA), and Lihue (LIH) Airports under the provisions of the 49 United States Code (U.S.C.) section 40117 and part 158 of the

Final Version AC/ACJ 25.1322 – ~~Updated October 2003 in Washington, D.C.~~**Updated April 2004 in London.**
Flight Crew Alerting

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1. PURPOSE

This advisory circular (AC) provides guidance for the design and approval of flight crew Alerting Functions installed in transport category airplanes.

2. SCOPE

This advisory circular applies to the installation, integration, and certification of flight deck alerting systems, whether they are integrated or not. That is, it applies to individual aircraft systems that provide alerts that may or may not be integrated with a central alerting system, as well as systems whose primary function is alerting, such as a central alerting system. The alerting system may be approved as part of a TC/STC/ATC/ASTC.

This AC provides guidance as to what is considered an alert. However, what should be alerted to the flight crew is dependent on the specific design and overall flight deck philosophy. For example, the failure of a single sensor in a multi-sensor system in some cases may not necessarily result in an alert condition that the pilot needs to be aware of. However, for a single sensor system such a failure would certainly result in alert. Thus, the applicant should discuss the overall flight deck design and alerting philosophy with the Authority when determining what should be alerted to the flight crew. Any system that provides an alert should follow the guidance in this AC.

Like all AC material, this AC is not mandatory and does not constitute a regulation. It is issued to provide guidance and to outline a method of compliance with rules and in particular 25.1322.

3. RELATED REGULATIONS

The following list of regulations describe requirements for flight crew alerting for which this advisory circular provides guidance.

CFR/JAR 25.207	Stall warning
CFR/JAR 25.253(a)(2)	High-speed characteristics
CFR/JAR 25.672(a)	Stability Augmentation...
CFR/JAR 25.679(a)	Control system gust locks
CFR/JAR 25.703	Takeoff warning system
CFR/JAR 25.729(e)	Retracting mechanism
CFR/JAR 25.783(e)	Doors
CFR/JAR 25.812(f)(2)	Emergency lighting
CFR/JAR 25.819(c)	Lower deck service compartments
CFR/JAR 25.841(b)(6)	Pressurized cabins
CFR/JAR 25.854(a)	Lavatory fire protection
CFR/JAR 25.857(b)(3)	Cargo compartment classification
CFR/JAR 25.857(c)(1)	Cargo compartment classification
CFR/JAR 25.857(e)(2)	Cargo compartment classification
CFR/JAR 25.859(e)(3)	Combustion heater fire protection
CFR/JAR 25.863(c)	Flammable fluid fire protection
CFR/JAR 25.1019(a)(5)	Oil strainer or filter
CFR/JAR 25.1165(g)	Engine ignition systems
CFR/JAR 25.1203(b)(2)	
CFR/JAR 25.1203(b)(3)	Fire-detector system
CFR/JAR 25.1203(f)(1)	Fire-detector system
CFR/JAR 25.1303(c)(1)	Flight and navigation instruments
CFR/JAR 25.1305(a)(1)	
CFR/JAR 25.1305(a)(5)	Powerplant instruments
CFR/JAR 25.1305(c)(7)	Powerplant instruments
CFR/JAR 25.1309(c)	Equipment, systems, and installations
CFR/JAR 25.1309(d)(4)	Equipment, systems, and installations
CFR/JAR 25.1322	Warning, caution, and advisory lights
CFR/JAR 25.1326	Pitot heat indication systems
CFR/JAR 25.1331(a)(3)	Instruments using a power supply
CFR/JAR 25.1353(c)(6)(ii)	Electrical equipment and installations
CFR/JAR 25.1419(c)	Ice protection
CFR/JAR 25.1517(3)	Rough air speed, V_{RA}
CFR/JAR 25, Appendix I Section 25.6	Installation of an Automatic Takeoff Thrust Control System (ATTCS) Powerplant Instruments
CFR/JAR 33.71(b)(6)	Lubrication system.
CFR/JAR 91.219	Altitude alerting system or device: Turbojet powered civil airplanes
CFR/JAR 91.221	Traffic alert and collision avoidance system equipment and use
CFR/JAR 91.223	Terrain awareness and warning system
CFR/JAR 91.603	Aural speed warning device
CFR/JAR 91, Appendix A Section 91.2(b)(1)	Required instruments and equipment
CFR/JAR, Appendix G Section 91.2(c)(3) Minimum (RVSM) Airspace - Aircraft approval	Operations in Reduced Vertical Separation
CFR/JAR 91, Appendix G Section 91.3(c)(6)	Instruments and Equipment Approval
CFR/JAR 121.221(c)(1)	Fire precautions
CFR/JAR 121.221(d)(1)	Fire precautions

14 CFR 121.221(f)(2)	Fire precautions
14 CFR 121.289	Landing gear: Aural warning device.
14 CFR 121.307(k)	Engine instruments
14 CFR 121.308(a)	Lavatory fire protection.
14 CFR 121.319(b)	Crewmember interphone system
14 CFR 121.354	Terrain awareness and warning system
14 CFR 121.356(b)	Traffic alert and collision avoidance system
CFR/JAR 121.358	Low-altitude windshear system equipment requirements
CFR/JAR 121.360(a)	
CFR/JAR 121.360(e)	
CFR/JAR 121.360(f)	Ground proximity warning-glide slope deviation alerting system
CFR/JAR 125.187	Landing gear: Aural warning device.
CFR/JAR 125.205(d)	Equipment requirements: Airplanes under IFR.
CFR/JAR 125.221(a)	Traffic alert and collision avoidance system
CFR/JAR 135.150(b)(7)	Public address and crewmember interphone system
14 CFR 135.153(a)	Ground proximity warning system.
14 CFR 135.154	Terrain awareness and warning system
14 CFR 135.163(d)	Equipment requirements: Aircraft carrying passengers under IFR.
14 CFR 135.180(a)	Traffic alert and collision avoidance system
14 CFR 135, Appendix A Section A135.1	Additional Airworthiness Standards for 10 or More Passenger Airplanes

4. RELATED DOCUMENTS

Only those sets of materials that were used as reference for this AC/AMJ are listed.

4.a Federal Aviation Administration Documents.

(1) Report DOT/FAA/RD-81/38, II, Aircraft Alerting Systems Standardization Study, Volume II, Aircraft Alerting Systems Design Guidelines. This document can be obtained from the National Technical Information Service, Springfield, Virginia 22166

(2) AC 25-11, Transport Category Airplane Electronic Display Systems 7/16/87

(3) Report DOT/FAA/CT-96/1 - GAMA Report No 10, "Recommended Guidelines for Part 23 Cockpit/Flight Deck Design" (September 2000), Section 4, Definitions, Primary Field of View.

(4) AC 25-23 TAWS Terrain Awareness and Warning Systems
(5) AC 25-1309-1A System Design and Analysis
(6) TSO C-151a, Terrain Awareness and Warning Systems
(7) AC 25.1523-1, Minimum Flight Crew & Workload

4.b JAA Documents.

(1) AMJ 25.1322, Alerting Systems, dated 12 April, 1991
(2) AMJ 25.1309 System Design and Analysis
(3) AMJ 25-11, Electronic Display Systems

(4) Patterson, R.D. (1982). *Guidelines for Auditory Warning Systems on Civil Aircraft.* Cheltenham, England: Civil Aviation Authority paper 82017.

4.c Industry Documents.

1. Edworthy, J. and Adams, A. (1996). Warning Design: A Research Perspective. Bristol, PA: Taylor & Francis.

2. Kuchar, J.K. (1996). Methodology for alerting-system performance evaluation. *Journal of Guidance, Control, and Dynamics. 19, 438-444.*

3. Parasuraman, R., & Riley, V. (1997). Human and Automation: use, misuse, disuse, abuse. *Human Factors, 39,* 216-229.

4. Satchell, P. (1993). *Cockpit monitoring and alerting systems.* Aldershot, England: Ashgate.

5. SAE ARP 4033 (Pilot-System Integration), August 1995

5. BACKGROUND

In the past airplanes have been designed with discrete lights for the alerting function. Now the alerting functions can be integrated with other systems, including electronic display systems, and aural warning or tone generation systems. This AC addresses the aspects of integration including prioritization, commonality between types of alerts, competing simultaneous aural and visual alerts, correlation of aural and visual alerts, potential inhibiting of alerts, and the increased possibility of false or nuisance alerts.

FAR/JAR Part 25 Regulations and advisory material often provide references to an alert, such as a warning, to provide awareness of a certain condition that is relevant to the applied rule. Many of these rules were written without recognition of a consistent flight deck alerting philosophy, and may use the term "warning" in a generic sense. This AC/ACJ does not intend to conflict with or replace the intent of those rules, but it is meant to provide standardization of crew alerting terminology that may be used in the development of consistent regulations and advisory material, and consistency to show compliance to existing rules.

6. DEFINITIONS

Definitions are written to support the content of this AC and its associated rule. Other regulations may use terms such as "warning" in a manner that is not necessarily consistent with the definitions below. However, the intent of this section is to facilitate standardization of these terms.

Advisory
The level of alert for conditions that require flight crew awareness and may require subsequent flight crew response

Alert
A generic term used to describe a flight deck indication meant to attract the attention of and identify to the flight crew a non-normal operational or airplane system condition. Warnings, Cautions, and Advisories are considered to be alerts.

Alert Inhibit
Application of specific logic to prevent the presentation of the alert.

Alert Message
A visual alert comprised of text, usually presented on a flight deck display.

Alerting Function
The aircraft function that provides alerts to the flight crew for non-normal operational or airplane system conditions. This includes Warning, Caution and Advisory information.

Alerting Philosophy
The principles, guidance and rules for implementing alerting functions within a flight deck. These typically consider:

- The reason for implementing an alert
- The level of alert required for a given condition
- The characteristics of each specific alert
- Integration of multiple alerts

Attention Getting Cues
Perceptual signals (visual, auditory or tactile/haptic) designed to attract the flight crew's attention in order to obtain the immediate awareness that an alert condition exists.

Caution
The level of alert for conditions that require immediate flight crew awareness and subsequent flight crew response.

Collector Message
An alert message that replaces two or more related alert messages that do not share a common cause or effect. Example: A Doors alert collector message is displayed when more than one entry, cargo, or service access door is open at the same time.

Communication message
A type of message whose initiating conditions are caused by incoming communications, primarily data link conditions. This type of message is not a crew alert.

(1) **Comm High**: A communication message which requires immediate flight crew awareness and immediate flight crew response. (Note: At this time there are no communication messages defined that require immediate flight crew response.)

(2) **Comm Medium**: An incoming communication message which requires immediate flight crew awareness and subsequent flight crew response.

(3) **Comm Low**: An incoming communication message which requires flight crew awareness and future flight crew response.

False Alert
An incorrect or spurious alert caused by a failure of the alerting system including the sensor.

Failure Flag
One local means of indicating the failure of a displayed parameter.

Flashing
Short term flashing symbols approximately 10 seconds or flash until acknowledge.

Flight Crew Response
The activity accomplished due to the presentation of an alert such as an action, decision, prioritization, search for additional information.

Master Aural Alert
An aural indication used to attract the flight crew's attention that is specific to an alert urgency level (e.g. Warning, Caution)

Master Visual Alert
A visual indication used to attract the flight crew's attention that is specific to an alert urgency level (e.g. Warning, Caution).

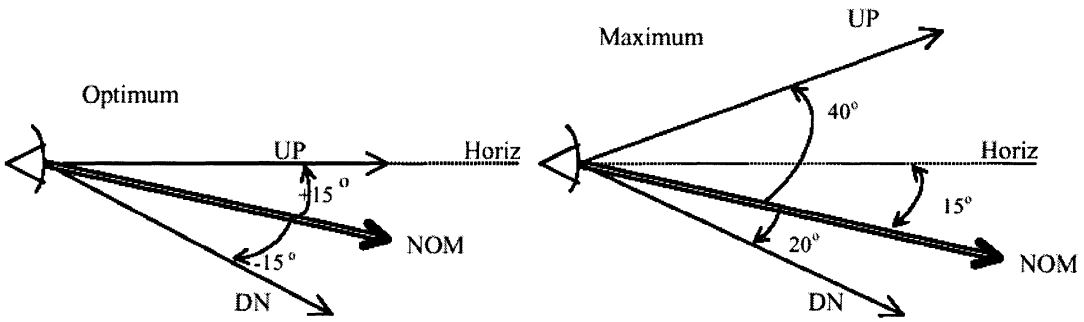
Normal Condition
Any fault-free condition typically experienced in normal flight operations. Operations typically well within the aircraft flight envelope and with routine atmospheric and environmental condition.

Nuisance Alert
An alert generated by a system that is functioning as designed but which is inappropriate or unnecessary for the particular condition.

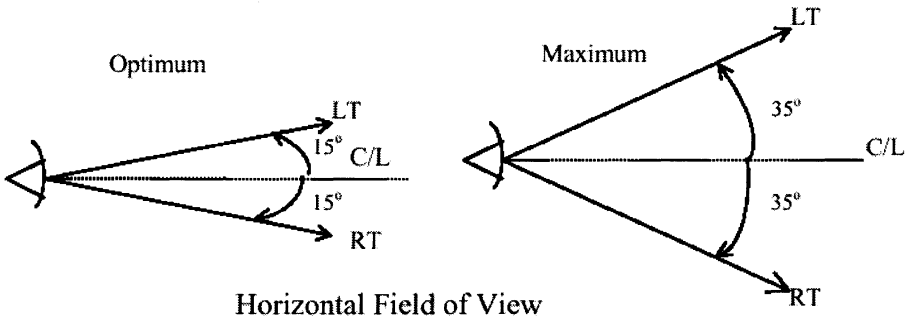
Primary field of view
Primary Field-of-View is based upon the optimum vertical and horizontal visual fields from the design eye reference point that can be accommodated with eye rotation only. The description below provides an example of how this may apply to head-down displays.

With the normal line-of-sight established at 15 degrees below the horizontal plane, the values for the vertical (relative to normal line-of-sight forward of the aircraft) are +/-15 degrees optimum, with +40 degrees up and -20 degrees down maximum.

For the horizontal visual field (relative to normal line-of-sight forward of the aircraft), the values are +/-15 degrees optimum, and +/-35 degrees maximum. .



Vertical Field of View



Horizontal Field of View

Status
A specific aircraft system condition that is recognized using a visual indication, but does not require an alert and does not require flight crew response. These types of messages are sometimes used to determine airplane dispatch capability for subsequent flights.

Tactile/haptic Information
Indication means where the stimulus is via physical touch, force feedback or vibration (e.g. stick shaker).

Time-Critical Warning
A subset of warning. The highest level of warning for conditions that require immediate flight crew response, to maintain the immediate safe operation of the airplane.Examples of Time-Critical warnings are:

- Predictive and Reactive Windshear Warnings
- Terrain Awareness Warnings (TAWS)
- TCAS Resolution Advisory
- Overspeed Warnings
- Low Energy Warnings

Umbrella Message
An alert message that is presented in lieu of two or more alert messages that share a common cause. Example: A single Engine Shutdown message in lieu of the multiple messages for electrical generator, generator drive, hydraulic pump and bleed air messages which would otherwise have been displayed.

Unique Tones (Unique Sounds)
An aural indication that is dedicated to specific alerts. (e.g. fire bell, overspeed)

Visual Alert Information
A visual indication that presents the flight crew with data on the exact nature of the alerting situation. For advisory level alerts, it also provides the awareness.

Voice Information
Means for informing the flight crew of the nature of a specific condition.

Warning
The level of alert for conditions that require immediate flight crew awareness and immediate flight crew response.

7. GENERAL

The purpose for alerting functions on airplanes is to get the attention of the flight crew, and inform the flight crew of specific airplane system conditions and certain operational events that require their awareness. The ability of the alerting function to accomplish its purpose is effected not only by the alert presentation itself, but also by the sensed condition and information processing for which the alert presentation was initiated. The alert presentation, condition sensing and information processing for the alert should all be designed to support the purpose of the alerting function.

Only airplane system conditions and operational events that require flight crew awareness to support a flight crew response should cause an alert. Conditions and events that do not require flight crew awareness should not cause an alert.

For all alerts which are presented to the flight crew, the action or accommodation for that alert must be either intuitive or a specific procedure must be provided to assist the flight crew in accomplishing corrective or compensatory action. Appropriate flight crew action for flight crew alerts are normally defined by airplane procedures (ex: in checklists), and are trained as part of a flight crew training curriculum or considered basic airmanship.

The presentation of all alerting signals should be accomplished using a consistent alerting philosophy.

7.a Alerting Presentation Elements

Alerting system presentation elements typically include:

- Master Visual Alerts
- Visual Alert Information
- Master Aural Alerts
- Voice Information
- Unique Tones (Unique Sounds)
- Tactile/haptic Information
- Failure Flag

Logic should be incorporated to ensure that the alerting system components are coordinated and provide the proper alert presentation format for each urgency level. For example, the onset of the master visual alert should occur simultaneously with the onset of the master aural alert.

When practical, the voice information message should be identical to the alphanumeric message presented on the visual information display, but at a minimum the voice and alphanumeric messages should be compatible and readily understandable.

Colors used for master caution and master warning should match colors for their respective caution and warning visual alerts.

To maintain the effectiveness of voice alerting, the use of voice should be minimized. To maintain the effectiveness of the visual alerting, consistent use of the colors red and amber/yellow must be implemented throughout the flight deck.

Failure flags and exceedances do not necessarily need to meet the requirements 25.1322(a)(1). For example, failure flags on primary flight displays have been shown to have sufficient attention getting characteristics and thus do not necessarily satisfy all of the requirements for crew alerts, such as providing attention-getting cues through at least two different senses.

7.b Functional Components for each type of Alert

(1) Warning:

The alerting system functional components used to accomplish the alerting and informing functions for warnings should include:

- Master Visual Alert, AND
- Visual Information, AND
- Master Aural Alert, or
  Voice Information or unique tone
  Note: Voice information may be preceded by a master aural alert

It is recognized that in a limited number of cases a master visual and master aural alert may not be required. For example, visual information presented in the pilot's primary forward field of view may be acceptable in place of a master visual alert if it provides sufficient attention-getting characteristics. Exceptions must be evaluated on a case by case basis.

The immediacy of pilot response required for some warning conditions may not be supported by use of the alerting system components described above. Examples of such warning conditions are reactive windshear warning and ground proximity warning. These are typically called "time-critical warnings."

The alerting system components used for indicating these kinds of conditions must support immediate pilot awareness of the specific condition without further reference to other indications in the flight deck.

The alerting system functional components used to accomplish the alerting and informing functions for time-critical warnings should include:

- Unique voice information and/or unique tone for each condition, AND
- Unique visual alert information in both pilots primary forward field of view for each condition.

Since, for time-critical warnings, it is expected that the unique visual alert information and the unique voice information or unique tone meets the attention-getting requirements for the condition, then the use of a master visual alert is not required. However, if the master visual alert is used, it should be used to aid in the overall attention-getting characteristics and to obtain the desired flight crew response and should not distract the flight crew from the time-critical condition.

2) Caution

The alerting system functional components used to accomplish the alerting and informing functions for cautions should include:

- Master Visual Alert, AND
- Visual Information, AND
- Master Aural Alert, or
  Voice Information or unique tone
  Note: Voice information may be preceded by a master aural alert

It is recognized that in a limited number of cases a master visual and master aural alert may not be required. For example, visual information presented in the pilot's primary forward field of view may be acceptable in place of a master visual alert if it

provides sufficient attention-getting characteristics. Exceptions must be evaluated on a case by case basis.

Some caution alerts are related to conditions that are precursors to potential time-critical warning conditions. In these cases, the alerting system components associated with the caution should be consistent with the components for related time-critical warning.

For example, a TCAS II Traffic condition, which can be a precursor to a TCAS II Resolution Advisory condition, may not have an associated Master Caution and is acceptable because the TCAS Traffic voice information alone provides the characteristic of a caution.

3) Advisory

The alerting system functional components used to accomplish the alerting and informing functions for advisories should include:

- Visual Information - Advisory information may be located in an area where the flight crew is expected to periodically scan for information

  Note: Advisory information does not require immediate flight crew awareness and therefore does not require an attention getting (master) visual or aural feature

Aural or visual information such as maintenance messages, information messages, and other status messages associated with conditions that do not require an alert may be presented to the flight crew, but the presentation of this information should not interfere with the alerting function or its use.

7.c Alerting System Reliability and Integrity

The alerting system should be designed to avoid false and nuisance alerts while providing reliable alerts to the flight crew when needed.

For establishing compliance of the alerting system with 25.1309, both the failure to operate when required and false operation should be considered.

When applying the 25.1309 process to a particular system or function that has an associated flight crew alert, both the failure of the system/function and a failure of its associated alert should be assessed. This should include assessing the effect of a single (common mode) failure that could cause the loss or failure of a system function and the loss of any associated alerting function.

When assessing crew alerting system compliance to 25.1309, particular attention should be paid to the following:

- Availability of the crew alerting function as a common point to several systems: although the individual assessment of not presenting an alert for a given system when required may lead to a specific consequence, the impact of a larger or a complete failure of the crew alerting function may lead to a more severe consequence, and should be assessed.
- Integrity of the alerting system driving the crew's confidence: since the individual assessment of a false or nuisance alert for a given system may lead to a specific consequence, the impact of frequent false or nuisance alerts increases the flight

crew's workload, reduces the flight crew's confidence in the alerting system, and affects their reaction in case of a real alert.

Existing implementations have shown that design of crew alerting systems as an essential system satisfy the two points above, but do not replace the need to show compliance with 25.1309.

8. MANAGEMENT OF ALERTS

8.a Prioritization

The objective of prioritization is to provide the most urgent alert to the flight crew.

(1) General Guidelines

A prioritization scheme should be established for all alerts presented throughout the flight deck. Prioritization within each category (Warning, Caution, Advisory) may also be necessary. For example, AC 25-23 (TAWS) identifies situations where prioritization within alert categories is necessary. The prioritization scheme, as well as the rationale for prioritization should be documented and evaluated.

Documentation should include the results of analysis that shows that any alerts that are delayed or inhibited as the result of the prioritization scheme do not adversely impact safety.

(2) Multiple Aural Alerts

Aural alerts should be prioritized so that only one aural alert is presented at a time. If more than one aural alert is presented at a time, each should be clearly distinguishable and intelligible to the flight crew.

Aural alerts must be prioritized based upon urgency of flight crew awareness and urgency of flight crew response. Normally this means Warnings are prioritized first, followed by Cautions and then Advisories. However, there may be a need to prioritize certain alerts of a lower urgency level over alerts of a higher urgency level depending on phase of flight.

When aural alerts are provided, an active alert should be completed before initiating another aural alert. However, active aural alerts may be interrupted by alerts from higher urgency levels if the delay to annunciate the higher priority alert would impact the timely response of the flight crew. If the interrupted alert condition is still active, it may be repeated once the higher urgency alert is completed.

(3) Multiple Visual Alerts

Since two or more visual alerts can occur at the same time, it should be shown that each alert is clearly recognizable to the flight crew.

Visual alert information should be prioritized between levels - Warnings have the highest priority, followed by Cautions and Advisories. When multiple alerts exist in a specific level (ie. multiple Warnings, multiple Cautions), a means for the flight crew to determine the most recent or most urgent alert should be provided. For example, the most recent or highest priority alert may be listed at the top of its own category. This also applies to time-critical alerts that share a dedicated display region.

8.b Alert Inhibits

Alert inhibits are used to prevent the presentation of an alert which is inappropriate or unnecessary for the particular phase of operation.

Alert inhibits are techniques that can be used to resolve prioritization of multiple alert conditions, alert information overload and display clutter. In many

circumstances, alert inhibits should be used to prevent additional hazard due to unnecessary flight crew distraction or response (i.e. during takeoff). Alerts may be inhibited automatically by the alerting system, or manually by the flight crew.

The presentation of alert indications should be inhibited under certain conditions where:

- The alert could cause a hazard if the flight crew was distracted by or responded to the alert.
- The alert contributes to display clutter
- The alert provides unnecessary information or awareness of airplane conditions

A number of consequential alerts may be combined into a single higher-level alert

For certain operational conditions not recognized by the alerting system, a means may be provided for the flight crew to inhibit a potential alert that would be expected to occur as the result of the specific operation (e.g. preventing a landing configuration alert for a different landing flap setting). There should be a clear and unmistakable indication that an alert has been manually inhibited by the flight crew, for as long as the inhibit exists.

8.c Clear/Recall of visual alert messages

Clearing visual alert messages from the current display allows the flight crew to remove a potential source of distraction. If a message can be cleared, the system should provide the ability to recall any cleared visual alert message that has been acknowledged where the condition still exists.

There should be a means to identify if alerts are stored (or otherwise not in view), either through a positive indication on the display or through normal flight crew procedures.

8.d Considerations for interface or integration with other systems (ex. Checklist, synoptics, switches, discrete lamps)

All annunciations and indications used to present an alert should be consistent with wording, color, position, or other attributes they may share. Other information displayed in the flight deck associated with the alert condition should facilitate the flight crew's ability to identify the alert condition and determine any correct action.

Information conveyed by the alerting system should lead the flight crew to the correct checklist procedure to facilitate the correct flight crew action. Some alerts may not have an associated checklist procedure because the correct flight crew action is covered by training or basic airmanship (e.g. autopilot disconnect, time critical warnings).

8.e Color standardization

The regulation 25.1322(e) requires that "The colors red and amber/yellow are normally reserved for alerting functions. The use of these colors for functions other than crew alerting must be limited and must not adversely affect crew alerting."

For discrete lights and indicators, the use of red and amber/yellow should be limited exclusively to flight crew alerting functions. The regulation applies to the use of these colors on both alerting systems and non-alerting systems including displays

and other indications. Note that a display is not necessarily a single piece of hardware but may include an appropriately partitioned and segregated section/function of a display used exclusively for non-alerting functions. The objective is to limit the use of red and amber/yellow within the flight deck so that these colors always provide an indication of immediacy of response commensurate with the associated hazard.

The use of red and amber/yellow for non-alerting functions may also be appropriate in the flight deck. Authorization can be expected if any of the following guidelines are met:

A. Red may be used ~~(on both alerting and non-alerting systems)~~ for conditions that require immediate flight crew awareness and immediate flight crew response.

B. Amber/yellow may be used ~~(on both alerting and non-alerting systems)~~ for conditions that require immediate flight crew awareness and subsequent flight crew response.

C. If the colors red or amber/yellow are proposed to be used in any other way, the applicant should submit rationale to the authorities for their review and approval including the benefits and the following:

1. The use of red and amber/yellow is appropriate to the task and context of use;
2. The proposed use does not affect the attention getting qualities and does not adversely affect~~of~~ the alerting functions across the flight deck.

NOTE: Graphical depictions of a single weather phenomenon that use color to represent varying intensity or severity may be used only if the use of red and amber/yellow are consistent with paragraphs A, B, or C above.

Examples of already accepted~~able~~ uses of red and amber/yellow related to the paragraphs above ~~typically~~ include:

- Engine and airframe limit indications;
- Failure flags;
- Electronic checklist elements that correlate to an alert;
- Indications that correlate to an associated alert;
- Weather radar;
- Proximate terrain that correlates to an onboard terrain alerting function.

It is appropriate to use red or amber/yellow failure flags and system indicators for failures/exceedances associated with hazard conditions requiring immediate flight crew awareness. In these cases, the color should be selected based on the immediacy of the flight crew response. ~~For example, it is appropriate to have the EGT engine limit be red because in the event of an exceedance, this condition requires immediate flight crew awareness and immediate flight crew response.~~ In other cases, the use of red and amber/yellow is not appropriate. However, it would not be appropriate to use red flag to indicate the loss of weather radar data, because immediate flight crew response is not required.

8.f Suppression of False Alerts

Pulling circuit breakers should not be the means for the flight crew to suppress an alert.

9. CERTIFICATION TEST AND EVALUATION CONSIDERATIONS

Because alerting systems or systems with alerting functions vary in complexity, level of integration, number of alerts, and types of alerts, these systems may raise unique certification issues. Thus it is recommended that applicants develop a plan to establish and document how issues will be identified, tracked, and resolved throughout the life cycle of the program. Applicants typically use the Certification Plan for this purpose. For addressing human factors/pilot interface issues applicants may use FAA Policy Memo ANM-99-2, *Guidance for Reviewing Certification Plans to Address Human Factors for Certification of Transport Airplane Flight Decks.* Additionally, the JAA *INT/POL*/25/14 "human factors aspects of flight deck design" provides guidance to evaluate this type of issues, particularly with new or novel systems or functions. A new harmonized AC/ACJ is also being developed.

It is recommended that the applicant document means of compliance with the appropriate regulations, as well as document compliance to and/or divergence from the recommendations in this AC/ACJ. Additionally, rationale should be provided for decisions regarding new or novel features in the design of the alerting system. This will facilitate the certification evaluation in that it enables the Authorities to focus on evaluating areas where the proposed system diverges from the recommended guidance and new or novel features. Thus, areas where the applicant has demonstrated compliance with this AC would typically receive less scrutiny.

The type of certification evaluation will vary depending upon the complexity, degree of integration, and specifics of the alerting system or function proposed. The evaluation should include evaluations of acceptable performance of the intended functions, including the human-machine interface, and acceptability of failure scenarios of the alerting system. The scenarios should reflect the expected operational use of the system. The validation of the performance and integrity aspects will typically be accomplished by a combination of the following methods:

- Analysis
- Laboratory Test
- Simulation
- Flight Test

The certification program should include evaluations of the alerts in isolation and combination throughout appropriate phases of flight and maneuvers, as well as representative environmental and operational conditions. The alerting function as a whole needs to be evaluated in a representative flight deck environment. Representative simulators can be used to accomplish the evaluation of some human factors and workload studies. The level and fidelity of the simulator used should be commensurate with the certification credit being sought and its use should be agreed with the regulatory authority. The assessment of the alerts may be conducted in a lab, simulator or in the actual aircraft. Certain elements of the alerting system may have to be validated in the actual aircraft. The evaluation should be conducted by a representative population of pilots of various background and expertise.

Some specific aspects that should be considered during the evaluation(s):

- Visual, aural, and tactile/haptic aspects of the alert(s)
- Effectiveness of meeting intended function from the human/machine integration, including workload, the potential for flight crew errors and confusion
- Normal and emergency cancellation logic and accessibility of related controls
- Proper integration with other systems, including labelling

- Acceptability of operation during failure modes
- Compatibility with other displays and controls
- Ensure that the alerting system by itself does not issue excessive nuisance alerts nor interfere with other systems
- Inhibition of alerts for specific phases of flight (e.g., takeoff and landing) and for specific airplane configurations (e.g., abnormal flaps and gear)

Evaluations may also be useful to verify the chromaticity (e.g., red looks red, amber looks amber) and discriminability (i.e., colors can be distinguished reliably from each other) of the colors being used, under the expected lighting levels. These evaluations can be affected by the specific display technology being used, so final evaluation with flight quality hardware is sometimes needed

10. RETROFIT APPLICABILITY

10.a Purpose

This provides recommendations for the integration of flight crew alerting associated with new aircraft systems into aircraft that currently have a FAR/JAR Part 25 type certificate (legacy aircraft). Many of these systems provide flight deck alerting functionality – This material is provided to give the applicant a means to comply with FAR/JAR 25.1322 without major modification to the existing aircraft flight deck alerting system.

Systems upgrades for legacy aircraft should be compatible with the aircraft flight deck alerting philosophy.

10.b Visual Alerts

(1) Master Warning System. A determination should be made per section 6.3 of this AC/ACJ if the added system warnings will require activation of an aircraft master warning system.
(2) Master Caution System. A determination should be made per section 6.3 of this AC/ACJ if the added system caution will require activation of an aircraft master caution system.
(3) The existing aircraft alerting system may not be able to facilitate the integration of additional aircraft systems and associated alerts due to limitations in the system inputs, incompatible technologies between the aircraft and the system being added, or economic considerations.
    i. The incorporation of an additional master visual function is discouraged. If it is not feasible to interface to the existing master visual function, an additional master visual function may be installed, provided that it does not delay the flight crew's response time for recognizing and responding to the alert.
    ii. New alerts should be integrated into the existing aircraft crew alerting system where possible. If these alerts cannot be integrated, individual annunciators or an additional alerting display system may be added.
    iii. It is permissible for some failure flags not to be integrated in the central alerting system. Thus, a master visual or master aural may not be initiated. The need to
    iv. Conditions that generate failure flags are not necessarily generating an alert.

10.c Aural Alerts

(1) A determination should be made per the guidance of this AC/ACJ, if the added system will require activation of an aural alert.
(2) If possible this new aural alert should be incorporated into the existing aural alerting system, if this is not possible, a separate aural alerting system may be introduced provided that all of the following have been considered
    i. A means is provided to set a prioritization scheme in place between existing aural alerts and the new aural alerts such that each alert is recognized and can be acted upon in the time frame appropriate for the alerting situation.
    ii. Each individual alert can be understood and acted upon. This may require a demonstration of any likely combination of simultaneous alerts.
    iii. The material provided in this AC/ACJ should be utilized in determining the prioritization for the integration of new aural alerts with existing aural alerts

10.d Special Considerations for Head-Up Displays (HUDs)

Although HUDs , when used as Primary Flight Displays (PFDs), are not intended to be classified as integrated caution and warning systems, they may display alerts such as time-critical warnings.

HUDs, when used as PFDs, should provide the equivalent alerting functionality as current head down display (HDD) PFDs. Time critical warnings that require continued flight crew awareness on the PFD should be presented on the HUD (e.g., TCAS, Windshear, and Ground Proximity Warning annunciations). In addition if master alerting indications do not provide sufficient attention to the pilot while using the HUD, the HUD should provide annunciations that inform the pilot of caution and/or warning conditions.

Time-critical warning information that is presented on a Head Up Display may include attributes which are different than those presented on a Head Down Display. For example the use of red on a HUD may not be technically feasible and under certain conditions may detract from the attention-getting characteristics of the associated time-critical warning.

To the extent that current HUDs are single color devices, cautions and warnings should be emphasized with the appropriate use of attention-getting properties such as flashing, outline boxes, brightness, size, and/or location. Report No. DOT/FAA/RD-81/38, II stresses the importance of preserving the distinguishing characteristics of caution and warning cues. . Where multi-color HUD symbols are used for alerts, consideration should be given to ensure consistency between the HUD and the head down flight displays.

Single HUD installations can take credit for the copilot monitoring of head down instruments and alerting systems, for failures of systems, modes, and functions not associated with primary flight displays.

Dual HUD installations require special consideration for alerting systems, since it must be assumed that both pilots will be head up simultaneously. If master alerting indications do not provide sufficient attention to each pilot while using the HUD, then each HUD should provide annunciations that direct the pilot's attention to head down alerting displays. The types of information that should trigger the HUD master alerting display are any cautions or warnings not already duplicated on the HUD from head down primary displays.

Appendices

APPENDIX A EXAMPLES FOR THE INCLUSION OF VISUAL SYSTEM ELEMENTS IN AN ALERTING SYSTEM

Examples are included in this AC/ACJ to help the reader through the detailed design of an alerting system. They are based on experience of existing and recommended alerting systems that comply with the rule. The extent to which these examples are applied to a specific certification program will vary, depending on the types of alerts that are presented, and the level of integration associated with an alerting system.

The visual elements of an alerting system include:

- Master Visual
- Visual Information
- Time-Critical Warning Visual Information

A.1 Master Visual

(1) Number & Location
A warning master visual alert and caution master visual alert should be provided at each pilot's station. Master visual alerts for warnings (Master Warning) and for cautions (Master Caution) should be located directly in front of each pilot in their primary field of view.

(2) Onset/Duration/Cancellation

The onset of a master visual alert should occur in a timeframe appropriate for the alerting condition and the desired response.

The onset of a master visual alert should occur simultaneously with the onset of its related master aural alert or unique tone, and its related visual alert information. Any delays between the onset of the master visual alert and its related master aural alert or unique tone, and its visual alert information should not cause flight crew distraction or confusion.

The onset of master visual alerts for the same condition (warnings, cautions) should occur simultaneously at each pilot's station.

The master visual alert should remain on until it is cancelled either manually by the flight crew, or automatically when the alerting situation no longer exists.

Upon cancellation the alerting mechanisms should be reset to annunciate any subsequent fault condition.

(3) Attention-getting visual characteristics

In addition to color, steady state or flashing master visual alerts may be used, as long as the method employed provides positive attention-getting characteristics. If flashing is used, all master visual alerts should be synchronous to avoid any unnecessary distraction.

(4) Brightness

Master visual alerts should be bright enough to attract the attention of the flight crew in all ambient light conditions.

Manual dimming should not be provided unless the minimum setting retains adequate attention-getting qualities when flying under all ambient light conditions.

(5) Display/Indicator Size and Character Dimensions

Any character types, sizes and fonts should be designed so that the master visual alerts are legible and understandable at the pilot's station where they are installed and should provide suitable attention-getting characteristics.

Master visual alerts that subtend at least 1 degree of visual angle have been shown to be acceptable.

(6) Color

Standard color conventions should be followed for the master visual alerts:

- Red for warning
- Amber/yellow for caution

Master visual alerts for conditions other than warnings or cautions (for example, ATC Datalink alerts) must be in a color other than red or amber/yellow.

(7) Test function

To comply with the safety requirements of FAR/JAR 25.1309, provisions may need to be included to test/verify the operability of the master visual alerts.

A.2 Visual Information

(1) Number & Location

The number of displays that provide warning, caution, and advisory alerts should be determined by a combination of ergonomic, operational and reliability criteria, as well as any flight deck physical space constraints.

The visual information should be located so that both pilots are able to readily identify the alert condition.

All warning and caution visual information linked to a master visual should be grouped together on a single dedicated display area. There may be a separate area for each pilot. Advisory alerts may also be presented on the same display area. The intent is to provide an intuitive and consistent location for the display of information.

(2) Format

A consistent philosophy should be provided for the format of visual information to unambiguously indicate the alert condition. The objectives of the corresponding text message format are to direct the flight crew to the correct checklist procedure, and to minimize the risk of flight crew error.

The alerting philosophy should describe the format for visual information. A consistent format should be used.
A format philosophy should include the following three elements:

- The general heading of the alert, (e.g. HYD, FUEL)
- the specific subsystem or location (e.g. L-R, 1-2), and,
- the nature of the condition (e.g. FAIL, HOT, LOW)

For any given message, the available space on a single page should be able to present the entire text on a single defined area to encourage short and concise messages. Additional lines may be used provided the alert message is clear and unambiguous.

If alerts are presented on a limited display area, an overflow indication should be used to inform the flight crew that additional alerts may be called up for review. A memory indication should be used to indicate the number and urgency level of the alerts that have been stored.

A "collector message" is a technique that can be used to resolve problems of insufficient display space, prioritization of multiple alert conditions, alert information overload and display clutter.

Collector messages should be used where the procedure or action is different for the multiple fault condition than the procedure or action for the individual messages being collected. Example: Non-normal procedures for loss of a single hydraulic system on it's own is different than non-normal procedures for loss of two hydraulic systems. The messages that are "collected" should be inhibited.

An alphanumeric font should be of a sufficient thickness and size to be readable when users are seated at the normal viewing distance from the screen.

NOTE: Minimum character height of 1/200 of viewing distance has been shown to be acceptable (e.g a viewing distance of 36 inches requires a 0.18 inch character height on the screen)(DOD-CM-400-18-05, p 12-1)

NOTE: Arial and Sans serif fonts have been shown to be acceptable for visual alert text. The size of numbers and letters required to achieve acceptable readability may depend on the display technology used. Stroke width between 10 and 15% of character height appears to be best for word recognition on text displays and extensions of descending letters and ascending letters should be about 40% of letter height.

(3) Color

Standard color conventions should be followed for the visual information:

- Red for warning
- Amber/yellow for caution

Red should be used for indicating a non-normal operational or non-normal aircraft system condition that requires immediate flight crew awareness and immediate action or immediate flight crew decision.

Amber/yellow should be used for indicating a non-normal operational or non-normal aircraft system condition that requires immediate flight crew awareness and future action or future flight crew decision.

In addition to red (for warning) and amber/yellow (for caution), a third color may be used to indicate advisory level alerts, to provide a unique and easily distinguishable coding method for all alerting categories.

Advisories may be any color except red or green, and preferably not amber/yellow. If amber/yellow is used for both caution and advisory messages, the alerting system should provide a distinguishable coding method.

NOTE: Use of red, amber, or yellow not related to caution and warning functions must be minimized to prevent diminishing the attention-getting characteristics of true warnings and cautions
Consistent color conventions for alerts within the cockpit should be provided.

(4) Luminance

The visual alert information should be bright enough so that both pilots are able to readily identify the alert condition in all ambient light conditions.

The luminance of the visual alert information display may be adjusted automatically as ambient lighting conditions inside the flight station change. A manual override control may be provided to enable the pilots to adjust display luminance.

A.3 Time Critical Warning Visual Information

(1) Number & Location

Time-critical warning visual information should be provided directly in front of each pilot within their primary field of view.

Note: The Primary Flight Display (PFD) is used as a practical and preferred display to use as the time critical warning display. Integration of time critical information into the PFD may vary depending on the exact nature of the warning. For example, a dedicated location on the PFD may be used both as an attention-getting function and a Visual Information Display by displaying alerts such as "WINDSHEAR", "SINK RATE", "PULL UP", "TERRAIN AHEAD", "CLIMB, CLIMB" etc. In addition, graphic displays of target pitch attitudes for TCAS RAs and Terrain may also be included.

(2) Format

Time critical warning visual information must be consistent with the corresponding time critical warning aural information.

Time critical warning visual information may be presented as a text message (for example, "WINDSHEAR"). Certain time critical warning visual information, including guidance, may be presented graphically (for example, TCAS Resolution Advisory)

Text messages that are used for time-critical warning visual information should be red.

The time-critical warning visual information should be erased when corrective actions have been taken, or when the alerting situation no longer exists

(3) Size

An acceptable means of a time-critical display is to subtend at least two square degrees of visual angle, to immediately attract the attention of the flight crews and to modify their habit pattern for responding to non-time-critical alerts.

A.4 Failure Flags

The use of failure flags on flight deck instruments is a means of indicating failures of displayed parameters or it's data source. In the sense that these flags indicate failures of airplane systems they have been displayed using colors that are the same as for crew

alerts. Failure flags are typically associated with only single instrument displays and as such don't necessarily satisfy all of the guidance material for flight crew alerts in general. However, in the integrated environment of the flight deck it is appropriate to display instrument failure flags in a color consistent with the alerting system, as part of the alerting function(see paragraph 8d) Conditions that set failure flags may also generate flight crew alerts and the subsequent flight deck indications should be consistent.

APPENDIX B EXAMPLES FOR INCLUSION OF AURAL SYSTEM ELEMENTS IN AN ALERTING SYSTEM

Examples are included in this AC/ACJ to help the reader through the detailed design of an alerting system. They are based on experience of existing and recommended alerting systems that should comply with the rule. The extent to which these examples are applied to a specific certification program will vary, depending on the types of alerts that are presented, and the level of integration associated with an alerting system.

The aural elements of an alerting system include:

- Unique tones, including master aural alerts
- voice information

Each sound should differ from other sounds in more than one dimension (e.g. frequency, sequence, intensity) so that each one is easily distinguishable from the others.

B.1 Master Aural Alert and Unique Tones

(1) Frequency

Aural signals using frequencies between 200 and 4500 Hz have been found to be acceptable.

Aural signals composed of at least two different frequencies or aural signals composed of only one frequency that contain different characteristics (e.g. spacing) have been found to be acceptable.

To minimize masking, frequencies different from those that dominate background noise should be used

(2) Intensity

The aural alerting must be audible to the flight crew in the worst-case (ambient noise) flight conditions whether or not the flight crew is wearing headsets (taking into account their noise attenuation characteristics). The aural alerting should not be so loud and intrusive as to interfere with the flight crew taking the required action.

The minimum volume achievable by any adjustment (manual or automatic) (if provided) of aural alerts should be adequate to ensure it can be heard by the flight crew if the level of flight deck noise subsequently increases.

Automatic volume control is recommended to maintain an acceptable signal-to-noise ratio

(3) Number of Sounds

The number of different master aural alerts and unique tones should be limited, based on the ability of the flight crew to readily obtain information from each alert and tone. While different studies have resulted in different answers, in general these studies conclude that the number of unique tones should be less than 10.

One unique tone for master warning and one unique tone for master caution should be provided. A master aural tone for advisories is not recommended.

(4) Onset/Duration

It is recommended that an onset and offset of any aural alert or unique tone be ramped to avoid startling the flight crew.

- A duration for onsets and offsets of 20-30 ms in the region above threshold has been shown to be acceptable.

- An onset level of 20-30 dB above the flight deck ambient threshold has been shown to be acceptable.

The onset of the master aural alert or unique tone should occur in a timeframe appropriate for the alerting condition and the desired response. Any delays between the onset of the master aural alert or unique tone and its related visual alert should not cause flight crew distraction or confusion.
If more than one source of the master aural alert or unique tone is provided, the master aural alert or unique tone for the same condition should occur simultaneously and synchronously at each pilot's station. Any timing differences should not be distracting nor should they interfere with identification of the aural alert or unique tone.

Signal duration of the master aural alert and unique tones should vary, depending on the alert urgency level and the type of response desired.

Unique tones associated with time-critical warnings should be repeated and non-cancellable until the alerting condition no longer exists (e.g. stall warning), unless it interferes with the flight crew's ability to respond to the alerting condition.

Unique tones associated with warnings should be repeated and non-cancellable if the flight crew needs continuous awareness that the condition still exists, to support the flight crew in taking corrective action (ref. 1303.c.(1), Flight and Navigation Instruments, and 25.729.e, Retracting Mechanism)

Unique tones associated with warnings should be repeated and cancellable if the flight crew does not need continuous aural indication that the condition still exists (e.g. Fire Bell, Abnormal Autopilot Disconnect).

Unique tones associated with warnings should be non-repeatable if the flight crew does not need continuous aural indication that the condition still exists.
Master warnings should be repeated and non-cancellable if the flight crew needs continuous awareness that the condition still exists, to support the flight crew in taking corrective action (e.g. FAR/JAR 25.729(e) 2).

Master aural warnings should be repeatable until the flight crew acknowledges the warning condition or when the warning condition no longer exists.

For master aural cautions and unique tones associated with a caution, the sound should be limited in duration or can be continuous until the flight crew manually cancels it, or when the caution condition no longer exists.

Unique tones that are neither associated with a warning nor a caution (e.g. certain advisories, altitude alert, SELCAL), should be limited in duration.

(5) Cancellation

For caution level alerts, the master aural and unique tone should continue through one presentation and cancel automatically.

addressed the concerns. This ad hoc TAE meeting is necessary because the AVSHWG report is directly linked to a safety enhancement recommended by the Commercial Aviation Safety Team (CAST).

The agenda will include:

- Opening remarks
- Avionics HWG Report and Draft Advisory Circular, AC 25.1322, and Approval

Attendance is open to the public, but will be limited to the availability of meeting room space and telephone lines. The public may participate by teleconference by contacting the person listed under the heading FOR FURTHER INFORMATION CONTACT after May 4. The public must make arrangements by May 7 to present oral statements at the meeting. Written statements may be presented to the committee at any time by providing 25 copies to the Assistant Executive Director for Transport Airplane and Engine issues or by providing copies at the meeting. Copies of the documents to be voted upon may be made available by contacting the person listed under the heading FOR FURTHER INFORMATION CONTACT.

If you are in need of assistance or require a reasonable accommodation for the meeting or meeting documents, please contact the person listed under the heading FOR FURTHER INFORMATION CONTACT. Sign and oral interpretation, as well as a listening device, can be made available if requested 10 calendar days before the meeting.

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Ida M. Klepper
Acting Executive Director,
Aviation Rulemaking Advisory Committee