heard by the flight crew if the level of flight deck noise subsequently increases.

(b) We recommend automatic volume control to maintain an acceptable signal-to-noise ratio.

g. Onset and Duration

(1) The onset of Voice information should occur:

(a) In a timeframe appropriate for the alerting condition and the desired response.

(b) Simultaneously with the onset of its related Visual alert information. Any delays between the onset of the Voice information and its related visual alert should not cause flight crew distraction or confusion.

(c) Simultaneously at each pilot's station, if more than one source of the Voice information is provided for the same condition, so that intelligibility is not affected.

(2) The duration of Voice information associated with Time-critical warnings should continue until the alerting condition no longer exists (for example, terrain warning). The Voice information should be repeated and non-cancelable during this time.

(3) Voice information associated with Time-critical warnings and Cautions shouldnot be repeated if it interferes with the flight crew's ability to respond to the alerting condition (for example, windshear warning, or ACAS II resolution advisory).

(4) To support the flight crew in taking corrective action Voice information associated with Warnings should be repeated and non-cancelable if the flight crew needs continuous awareness that the condition still exists.

(5) Voice information associated with Warnings should be repeated and cancelable if the flight crew does not need continuous aural indication that the condition still exists (for example, Cabin Altitude Warning or Autopilot Disconnect).

(6) Reset the alerting mechanisms after cancelling them so they will annunciate any subsequent fault condition.

(7) For voice alerts associated with a Caution alert, the corresponding Voice information should either:

(a) Be limited in duration (for example, ACAS II Traffic Advisory or Windshear Caution), or

(b) Be continuous until the flight crew manually cancels it or the Caution condition no longer exists.

h. Voice Information Content

(1) The content should take into account the flight crew's ability to understand the English language.

(2) When practical, Voice information should be identical to the alphanumeric text message presented on the visual information display. If that is not possible, the Voice information and alphanumeric messages should at least convey the same information, so it is readily understandable and initiates the proper pilot response.

(3) For Time-critical warnings, the content and vocabulary of Voice information must elicit immediate (instinctive) directive corrective action (CS 25.1322(a)(2)). In order to do this, it should identify the condition triggering the alert. In some cases, it may also be necessary to provide guidance or instruction information.

(4) For Warning and Caution alerts, the content of Voice information must provide an indication of the nature of the condition triggering the alert (CS 25.1322(a)(2)). The Voice information should be descriptive and concise.

(5) The content should be consistent with any related visual information display (for example, Aural: “Pull up”; Visual: “Pull up” on the PFD.)

(6) Structure Voice information that uses more than one word so if one or more words are missed the information will not be misinterpreted (for example, avoid the word “don’t” at the beginning of a voice message).

(7) Design Voice information so the flight crew can easily distinguish one spoken word message from another to minimise confusion.

[Amdt 25/11]

Appendix 3 – Regulations

ED Decision 2016/010/R

The following related documents are provided for information purposes and are not necessarily directly referenced in this AMC. The full text of CS-25 can be downloaded from the Internet at http://easa.europa.eu/agency-measures/certification-specifications.php.

CS-25 Paragraph	Subject
CS 25.207	Stall warning
CS 25.253(a)(2)	High-speed characteristics
CS 25.672(a)	Stability-augmentation and automatic and power-operated systems
CS 25.679(a)	Control system gust locks
CS 25.699	Lift and drag device indicator
CS 25.703	Take-off warning system
CS 25.729(e)	Extending and retracting mechanisms
CS 25.783(e)	Fuselage Doors
CS 25.812(f)(2)	Emergency lighting
CS 25.819(c)	Lower deck service compartments
CS 25.841(b)(6)	Pressurised cabins
CS 25.854(a)	Lavatory fire protection
CS 25.857(b)(3), (c)(1), (e)(2)	Cargo compartment classification
CS 25.859(e)(3)	Combustion heater fire protection
CS 25.863(c)	Flammable fluid fire protection
CS 25.1019(a)(5)	Oil strainer or filter
CS 25.1165(g)	Engine ignition systems
CS 25.1203(b)(2), (b)(3), (f)(1)	Fire-detector system
CS 25.1302	Installed systems and equipment for use by the flight crew
CS 25.1303(c)(1)	Flight and navigation instruments
CS 25.1305(a)(1), (a)(5), (c)(7)	Powerplant instruments
CS 25.1309(a), (b), (c), (d)(4)	Equipment, systems, and installations
CS 25.1322	Flight crew Alerting
CS 25.1326	Pitot heat indication systems
CS 25.1329	Flight guidance system
CS 25.1331(a)(3)	Instruments using a power supply
CS 25.1353(c)(6)(ii)	Electrical equipment and installations
CS 25.1419(c)	Ice protection
CS 25.1517	Rough air speed, V_{RA}
CS 25.1549	Powerplant and auxiliary power unit instruments
CS 25J1305	APU Instruments
CS-25 Appendix I, I 25.6	Automatic Take-off Thrust Control System (ATTCS) Powerplant controls
CS-AWO 153	Audible warning of automatic pilot disengagement
CS-AWO 253	Audible warning of automatic pilot disengagement
CS-AWO 352	Indications and warnings

[Amdt 25/11]
[Amdt 25/12]
[Amdt 25/18]

Appendix 4 – Related Documents

ED Decision 2016/010/R

1. FAA Reports. A paper copy of the following reports may be ordered from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

   a. Report DOT/FAA/RD-81/38, II, "Aircraft Alerting Systems Standardisation Study, Volume II, Aircraft Alerting Systems Design Guidelines."

   b. 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.

2. ACs. An electronic copy of the following ACs can be downloaded from the Internet at http://rgl.faa.gov. A paper copy may be ordered from the U.S. Department of Transportation, Subsequent Distribution Office, M-30, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20795..

Number	Title
AC 20-69	Conspicuity of Aircraft Malfunction Indicators
AC 20-88A	Guidelines on the Marking of Aircraft Powerplant Instruments (Displays)
AC 25-7C	Flight Test Guide for Certification of Transport Category Airplanes
AC 25-11A	Electronic Flight Deck Displays
AC 25-23	Airworthiness Criteria for the Installation Approval of a Terrain Awareness and Warning System (TAWS) for Part 25 Airplanes
AC 25.703-1	Takeoff Configuration Warning Systems
AC 25.783-1A	Fuselage Doors and Hatches
AC 25.1309-1A	System Design and Analysis
AC 25.1329-1B	Approval of Flight Guidance Systems
AC 25.1523-1	Minimum Flightcrew

3. Technical Standard Order (TSO). TSO C-151b, "Terrain Awareness and Warning Systems," can be downloaded from the Internet at http://rgl.faa.gov.

4. European Aviation Safety Agency (EASA) Documents. Copies of the following documents can be found on the EASA website at http://www.easa.eu.int/agency-measures/certification-specifications.php.

Number	Title
AMC 25-11	Electronic Display Systems
AMC 25.1302	Installed Systems and Equipment for Use by the Flightcrew
AMC 25.1309	System Design and Analysis
AMC 25.1322	Alerting Systems

5. Civil Aviation Authority Document. Patterson, R.D. "Guidelines for Auditory Warning Systems on Civil Aircraft." Civil Aviation Authority paper 82017. London: Civil Aviation Authority, 1982.

6. Other Related Documents

   a. Abbott, K.; Slotte, S.M.; and Stimson, D.K. Federal Aviation Administration Human Factors Team Report: The Interfaces Between Flightcrews and Modern Flight Deck Systems. June 18, 1996. Federal Aviation Administration, Aircraft Certification Service, Transport Airplane Directorate, 1601 Lind Avenue, SW, Renton, WA 98057-3356. http://www.faa.gov/education_research/training/aqp/library/media/interfac.pdf.

b. DOD-CM-400-18-05, Department of Defense User Interface Specifications for the Defense Information Infrastructure, Defense Information Systems Agency, February 1998. E-mail: cio-pubs@disa.mil. The Defense Information Systems Agency website is restricted to visitors from .gov and .mil domains.

c. Edworthy, J. and Adams. A. Warning Design: A Research Perspective. : Taylor and Francis, 1996. Mortimer House, 37-41 Mortimer Street, London, W1T 3JH. http://www.taylorandfrancis.com.

d. Kuchar, J.K. "Methodology for alerting-system performance evaluation." Journal of Guidance, Control, and Dynamics, 19, pp. 438-444 (1996). AIAA, 1801 Alexander Bell Drive, Suite 500, Reston, VA 20191. http://www.aiaa.org/content.

e. Parasuraman, R. and Riley, V. "Human and Automation: use, misuse, disuse, abuse." Human Factors: The Journal of the Human Factors and Ergonomics Society, Volume 39, Number 2, June 1997, pp. 230-253. Human Factors and Ergonomics Society, , PO Box 1369, Santa Monica, CA 90406-1369. http://hfes.publisher.ingentaconnect.com/.

f. SAE ARP 4033. Pilot-System Integration, August 1, 1995. SAE International, 400 Commonwealth Drive, Warrendale, PA 15096 http://www.sae.org.

g. Satchell, P. Cockpit Monitoring and Alerting System. Aldershot, England: Ashgate, 1993. Summ House, 170 Finchley Road, , . http://www.ashgate.com.

[Amdt 25/11]
[Amdt 25/18]

Appendix 5 – Definitions

ED Decision 2011/004/R

Definitions are written to support the content of this AMC and its associated certification specification. Elsewhere, terms such as "warning" may be used in a manner that is not consistent with the definitions below. However, the intent of this section is to facilitate standardisation of these terms.

Term	Definition
Advisory	The level or category 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 aeroplane system condition. Alerts are classified at levels or categories corresponding to Warning, Caution, and Advisory. Alert indications also include non-normal range markings (for example, exceedances on instruments and gauges.)
Alert inhibit	Application of specific logic to prevent the presentation of an alert. Alerts can be inhibited automatically by the alerting system or manually by the flight crew.
Alert message	A visual alert comprised of text, usually presented on a flight deck display. Note: Aural Alert messages are referred to as "Voice Information."
Alerting function	The aeroplane function that provides alerts to the flight crew for non-normal operational or aeroplane 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: 1. The reason for implementing an alert. 2. The level of alert required for a given condition. 3. The characteristics of each specific alert. 4. 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 or category of alert for conditions that require immediate flight crew awareness and a less urgent subsequent flight crew response than a warning alert.
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. Traditionally, this type of message is not a flight crew alert and does not indicate a non-normal system or operational condition.
(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 that 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	An occurrence that affects the operation of a component, part, or element such that it can no longer function as intended. This includes both loss of function and malfunction.
Failure flag	One local visual means of indicating the failure of a displayed parameter.
Flashing	Short term flashing symbols (approximately 10 seconds) or flash until acknowledged.
Flight crew response	The activity accomplished due to the presentation of an alert such as an action, decision, prioritisation, or search for additional information.
Master aural alert	An overall aural indication used to attract the flight crew's attention that is specific to an alert urgency level (for example, Warning or Caution).
Master visual alert	An overall visual indication used to attract the flight crew's attention that is specific to an alert urgency level (for example, Warning or Caution).
Normal condition	Any fault-free condition typically experienced in normal flight operations. Operations are typically well within the aeroplane flight envelope and with routine atmospheric and environmental conditions.
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 and Figure A5-1 provide 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.

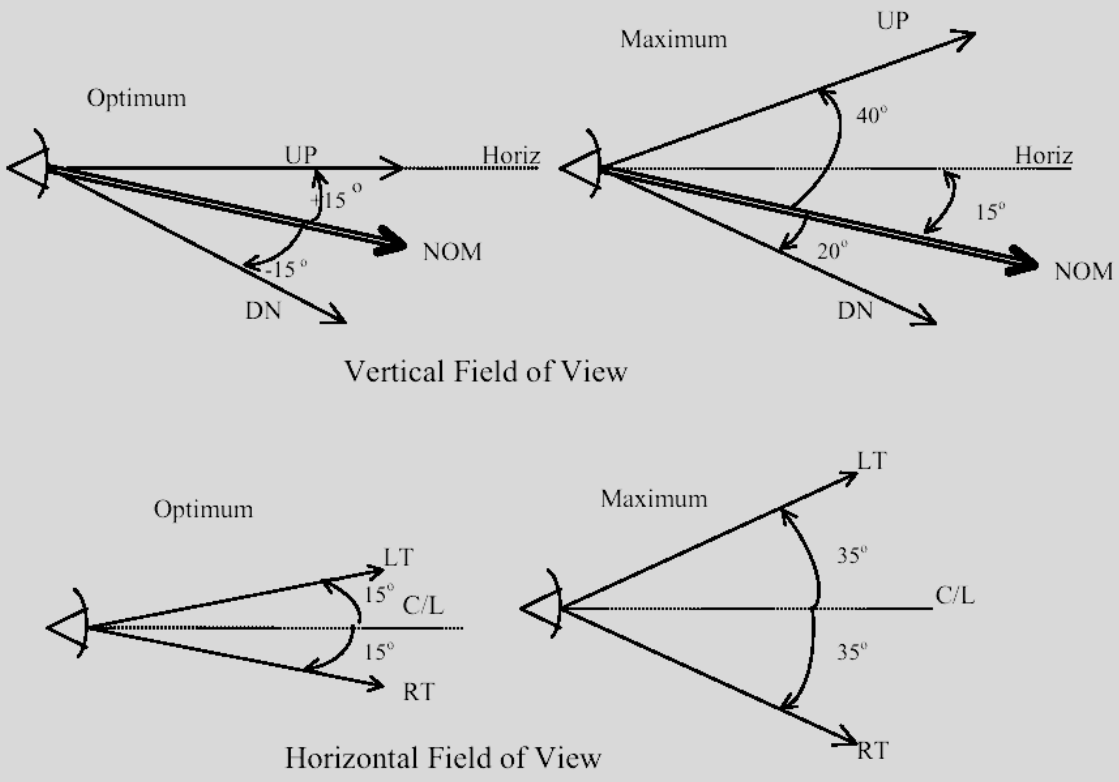

Figure A5-1. Primary Field of View

Status	A specific aircraft system condition that is recognised 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 aeroplane dispatch capability for subsequent flights.
Tactile/haptic information	An indication means where the stimulus is via physical touch, force feedback, or vibration (for example, a stick shaker).
Time-critical warning	A subset of warning. The most urgent warning level to maintain the immediate safe operation of the aeroplane. Examples of Time-critical warnings are: Predictive and Reactive Windshear Warnings, Terrain Awareness Warnings (TAWS), Airborne Collision Avoidance System (ACAS) II Resolution Advisories, Overspeed Warnings, and 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. This is different than a Collector message. A Collector message replaces two or more related Alert messages that do "not share" a common cause or effect.
Unique tone (unique sound)	An aural indication that is dedicated to specific alerts (for example, fire bell and 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 awareness.
Voice information	A means for informing the flight crew of the nature of a specific condition by using spoken words.
Warning	The level or category of alert for conditions that require immediate flight crew awareness and immediate flight crew response.

[Amdt 25/11]

CS 25.1323 Airspeed indicating system

ED Decision 2016/010/R

(See AMC 25.1323)

For each airspeed indicating system, the following apply:

(a) Each airspeed indicating instrument must be approved and must be calibrated to indicate true airspeed (at sea-level with a standard atmosphere) with a minimum practicable instrument calibration error when the corresponding pitot and static pressures are applied.

(b) Each system must be calibrated to determine the system error (that is, the relation between IAS and CAS) in flight and during the accelerated takeoff ground run. The ground run calibration must be determined –

(1) From 0·8 of the minimum value of V_1, to the maximum value of V_2, considering the approved ranges of altitude and weight; and

(2) With the wing-flaps and power settings corresponding to the values determined in the establishment of the take-off path under CS 25.111 assuming that the critical engine fails at the minimum value of V_1.

(c) The airspeed error of the installation, excluding the airspeed indicator instrument calibration error, may not exceed 3% or five knots, whichever is greater, throughout the speed range, from –

(1) V_{MO} to 1·23 V_{SR1} with wing-flaps retracted; and

(2) 1·23 VS_{R0} to V_{FE} with wing-flaps in the landing position.

(d) From 1·23 V_{SR} to the speed at which stall warning begins, the IAS must change perceptibly with CAS and in the same sense, and at speeds below stall warning speed the IAS must not change in an incorrect sense. (See AMC 25.1323(d).)

(e) From V_{MO} to V_{MO} + ⅔ (V_{DF} – V_{MO}) the IAS must change perceptibly with CAS and in the same sense, and at higher speeds up to VDF the IAS must not change in an incorrect sense. (See AMC 25.1323(e))

(f) There must be no indication of air-speed that would cause undue difficulty to the pilot during the take-off between the initiation of rotation and the achievement of a steady climbing condition.

(g) The effects of airspeed indicating system lag may not introduce significant takeoff indicated airspeed bias, or significant errors in takeoff or accelerate-stop distances.

(h) Each system must be arranged, so far as practicable, to prevent malfunction or serious error due to the entry of moisture, dirt, or other substances. (See AMC 25.1323(h).)

(i) Reserved

(j) Where duplicate airspeed indicators are required, their respective pitot tubes must be far enough apart to avoid damage to both tubes in a collision with a bird.

[Amdt 25/16]
[Amdt 25/18]

AMC 25.1323(d) Airspeed indicating system

ED Decision 2003/2/RM

An acceptable means of compliance when demonstrating a perceptible speed change between 1.23 V_{SR} to stall warning speed is for the rate of change of IAS with CAS to be not less than 0.75."

AMC 25.1323(e) Airspeed indicating system

ED Decision 2003/2/RM

An acceptable means of compliance when demonstrating a perceptible speed change between V_{MO} to V_{MO} + 2/3 (V_{DF} - V_{MO}) is for the rate of change of IAS with CAS to be not less than 0.50."

AMC 25.1323(h) Airspeed indicating system

ED Decision 2003/2/RM

The design and installation of the pitot system should be such that positive drainage of moisture is provided, chafing of the tubing and excessive distortion at bends is avoided, and the lag and the possibility of moisture blockage in the tubing should be kept to an acceptable minimum.

CS 25.1324 Flight instrument external probes

ED Decision 2015/008/R

(See AMC 25.1324)

Each flight instrument external probes systems, including, but not necessarily limited to, pitot tubes, pitot-static tubes, static probes, angle of attack sensors, side slip vanes, and temperature probes, must

be heated or have an equivalent means of preventing malfunction in the heavy rain conditions defined in Table 1 of this paragraph, in the icing conditions as defined in Appendices C and P, and the following icing conditions specified in Appendix O:

(a) For aeroplanes certificated in accordance with CS 25.1420(a)(1), the icing conditions that the aeroplane is certified to safely exit following detection;

(b) For aeroplanes certificated in accordance with CS 25.1420(a)(2), the icing conditions that the aeroplane is certified to safely operate in and the icing conditions that the aeroplane is certified to safely exit following detection;

(c) For aeroplanes certificated in accordance with CS 25.1420(a)(3), all icing conditions.

Table 1 – Rain test conditions

Altitude Range		Liquid Water Content	Horizontal Extent		Droplet MVD
(ft)	(m)	(g/m3)	(km)	(NM)	(µm)
0 to 10 000	0 to 3 000	1	100	50	500 to 2 000
		6	5	3	
		15	1	0.5	

[Amdt 25/16]

AMC 25.1324 Flight instrument external probes

ED Decision 2018/005/R

CS 25.1324 requires each flight instrument external probes systems, including, but not necessarily limited to Pitot tubes, Pitot-static tubes, static probes, angle of attack sensors, side slip vanes and temperature probes, to be heated or have an equivalent means of preventing malfunction in the heavy rain conditions of table 1 of CS 25.1324 and in the icing conditions as defined in the Appendices C and P, and in Appendix O (or a portion of Appendix O) of CS-25.

It is unlikely that the icing conditions critical to the equipment will be encountered during flight tests. Consequently, it is anticipated that tests should be conducted in wind tunnel simulated icing environment to supplement the icing flight test data (natural or tanker) as necessary.

The following AMC provides some guidance related to the test setup and the conditions to be tested.

Note: Engine sensors such as pressure/temperature probes must meet CS-E certification specifications. However, when the signals from these sensors are used by the aeroplane system(s), the aeroplane manufacturer must ensure that the involved engine sensor meets CS 25.1324 specifications. Coordination of this activity should be ensured with the engine manufacturer.

1. Acronyms

SAT: Static Air Temperature

LWC: Liquid Water Content

MVD: Median Volume Diameter

IWC: Ice Water Content

MMD: Median Mass Dimension

L(i): “Liquid” supercooled water conditions