U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Airworthiness Approval of Satellite Voice Equipment Supporting Air Traffic Service (ATS) Communication

Date: 8/22/11

AC No: 20-150A

Initiated by: AIR-130

1. Purpose. This advisory circular (AC) provides guidance on airworthiness approval for designers, manufacturers, and installers of satellite voice equipment supporting air traffic service (ATS). In this AC, the Federal Aviation Administration (FAA) recommends one way to gain airworthiness approval for satellite voice equipment. This AC is not mandatory and does not constitute a regulation. This AC describes an acceptable means, but not the only means, to gain airworthiness approval for your satellite voice equipment. However, if you use the means described in this AC, you must follow it in its entirety.

2. Applicability. This AC affects new applications submitted after its effective date.

3. Cancellation. This AC cancels AC 20-150, Airworthiness Approval of Satellite Voice Equipment Supporting Air Traffic Service (ATS) Communication, dated 2/10/06.

4. Background. Due to frequency congestion and ionospheric/solar conditions in oceanic and remote flight operations, aircraft operators requested the use of satellite voice equipment as one of their two long range communication systems (LRCS). Appendix A contains a list of acronyms. Appendix B provides guidance for obtaining related documents.

5. Design Considerations. The following guidance applies to the design approval of satellite voice equipment, including performance standards of the intended function, software, hardware, recording, and audio guidance. You should use the following documents and guidance during the design stage:

a. Minimum Performance Standards. The satellite voice equipment should comply with TSO-C159a, *Next Generation Satellite Systems (NGSS) Equipment***,** dated June 30, 2010 or TSO-C132, *Geosynchronous Orbit Aeronautical Mobile Satellite Services Aircraft Earth Station Equipment*, dated March 25, 2004.

b. Software Qualification. The equipment should comply with AC 20-115B, *Radio Technical Commission for Aeronautics, Inc. Document RTCA/DO-178B*, dated January, 11, 1993.

c. Hardware Qualification. The equipment should comply with AC 20-152, *RTCA, Inc., Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware,* dated June 30, 2005.

d. Cockpit Voice Recorder (CVR). Satellite voice is considered voice communication for the purpose of the operating rules pertaining to CVR. Means must be provided to record all flight crew satellite voice communications in crash survivable memory, if a cockpit voice recorder is required.

e. Audio Management System. Means should be provided to interface with the existing audio management system. This interface should afford the flight crew the ability to promote crew awareness, coordination, and verbal error detection equivalent with current HF communication systems. Push-to-talk (PTT) operation should be maintained in all aircraft operations, but only to the extent that the flight crew must actuate a PTT key in order to be heard by the ground user.

> **Note:** We recommend the audio management system provide full-duplex voice capability via hand, boom, and oxygen mask microphones for both pilots and any additional cockpit member.

6. Safety Assessment Considerations. The applicant should conduct a safety assessment which considers the effects of failures on the aircraft. The safety assessment should determine, classify, and evaluate failure conditions resulting from malfunction, loss of function, or design errors. The safety assessment should evaluate failures or design errors of the satellite voice system, which could cause or contribute to failure conditions of other systems.

a. Likelihood of failure or malfunction of the satellite voice communication system intended for LRCS use in the oceanic/remote area environment supporting ATS communication is shown to be no more likely than probable (i.e., developed commensurate to a minor hazard classification). Deviation from the requirements of this AC, modification to the operational environment, or use of satellite voice as a sole means of routine ATS communications may increase the criticality and assessment of the hazard classification.

b. Some of the safety assessment considerations include:

(1) Derived Safety Requirements. If the satellite voice system is intended to be utilized for one of the two LRCS transceivers, evaluate the operation of the satellite voice system under a potential load-shed environment.

(2) User-Modifiable and Option-Selectable Software. If the system contains software-enabled options that the user can select or is designed for the user to modify without re-evaluation for airworthiness, then define the means of compliance (e.g., processes, design features, environment, tools, certification data) per AC 20-115B.

7. Priority, Preemption, Precedence (PPP). The priority level column of figure 1 shows the order of precedence in setting up and receiving a satellite voice call. We define preemption as the immediate and automatic seizure of resources allocated to a lower-priority call. The satellite voice equipment reallocates the resources to a higher-priority call. Trade-offs of flight safety requirements versus passenger satisfaction should not be a consideration, except for camp-on calls described below. Treat PPP as follows:

a. Satellite voice calls should be prioritized consistent with figure 1.

b. If a satellite voice channel is in use and the ground station wants to send a higher-priority call, the satellite voice equipment should clear the lower-priority channel. If all available channels are in use, the equipment should preempt the channel supporting the lowest priority channel in favor of the higher-priority call.

c. The satellite voice equipment must provide the flight crew the means to preempt any call at any time. The equipment may provide the means for automatic preemption of cabin communications.

d. The satellite voice equipment may also allow flight crew members to place their call request at the top of a queue – that is, to camp-on while awaiting free resources. Flight crew procedures should include explicit instructions defining how the flight crew can use camp-on capability.

e. The satellite voice equipment should configure the cockpit default priority to level 2. The flight crew must have the capability to set the priority level for an individual call.

Figure 1. Priorities for Satellite Voice Calls

Priority Level	Application Category	Satellite Voice Call Examples
1 *Emergency* (highest) Safety of Flight	Distress and Urgency	Rapid Descent, Urgent Sidestep for Weather
2 *Operational High* (second highest) Safety of Flight	Flight Safety	Altitude Request
3 *Operational Low* (third highest) Safety of Flight	Regularity of Flight, Meteorological, Administrative	Air Traffic Information Service, Redispatch, Maintenance
4 *Nonoperational* (lowest) Nonsafety	Public Correspondence	Public Phone Calls

8. Flight Deck Annunciation. Alerting associated with non-normal conditions (e.g., failures) of the airborne satellite voice system must comply with the appropriate part of Title 14 of the Code of Federal Regulations 14 (CFR) section XX.1322. For additional guidance, you may review AC 25.1322-1, *Flightcrew Alerting*, and AC 25-11A, *Electronic Flight Deck Displays*. The annunciation for the airborne satellite voice system should comply with the following criteria and should be integrated into the aircraft's existing alerting scheme:

a. An aural and visual alert should be provided for each ground-to-air ATS call consistent with 14 CFR section XX.1322. Visual alerts alone may be used for annunciation of non-ATS communications.

b. A means should be provided to alert the flight crew of detected airborne system failures that render the satellite voice system inoperative.

c. There should be a continuous visual annunciation to the crew indicating a call in progress for each satellite voice channel available via the flight deck audio panel by means of a readily available indication of call status. The indication should permit the crew to determine when a call is active on a given channel.

Note: For air-to-ground calls, the call status indication may indicate an active call at call initiation (rather than connection). This provides feedback to the flight crew that the satellite voice system is responding to their input.

d. For each air-to-ground call which cannot be completed, the satellite voice system should provide for an appropriate annunciation.

e. In cases where the satellite voice system utilizes flight deck call camp-on capability, the system should visually indicate to the flight crew that the requested air-to-ground call has been designated as camp-on until terminated or further acted upon.

f. Any destination address remaining in the satellite voice display (e.g., Multi-purpose Control and Display Unit (MCDU, or display controller)) from a previous air-to-ground call should clear or be removed while a ground-to-air call is in progress to avoid flight crew confusion.

g. In the event of the loss of the satellite signal, the satellite voice system should alert the flight crew.

h. The system should annunciate to the flight crew if a current call is preempted by a higher priority, ground-to-air call.

i. The system should provide a continuous visual indication that a SATCOM call is connected, even if the flight crew member is talking on another radio system.

j. The system should display the priority for ground-to-air calls. In addition, the system may display caller identification (ID) information to the flight crew for incoming calls, if caller ID is supported by the satellite network.

k. The system should provide an aural indication of satellite voice connection.

l. The system should provide an indication to the flight crew in the event of detectable abnormal call terminations or link failures.

9. Control Capability. Control capability for the satellite voice system should meet the following criteria:

a. Each flight crew member should have adequate accessibility to satellite voice controls.

b. A means should be provided for the flight crew to terminate a connected call (i.e., by manual action).

c. The use of speed dialing (i.e., satellite voice address database), in lieu of the full international number, should be utilized wherever possible. The option to manually dial a full international number should be available to the crew.

d. After satellite voice system initialization, the flight crew should not have to unlock, or re-activate by other means (e.g., insert a credit card, reenter a security code), the satellite voice resources for the duration of the flight.

e. A means should be provided to allow the flight crew to place an individual call on hold such that communication on other radio channels is possible without terminating the satellite voice call. A means to allow call hold function capability should be provided via the audio control panel, use of a MCDU or display controller. When the crew places a satellite voice call on hold, the risk of inadvertently clearing the call should be minimized.

f. A means for the flight crew to display the satellite voice system configuration (i.e., operational software version/part number, database version/part number) should be provided.

10. Voice Call Routing. The satellite voice equipment should verify the priority level when a ground-to-air voice call is received. The following priority levels are routed:

a. To the flight deck, if they are satellite voice calls of priority levels 1 through 3.

b. To the passenger cabin, if they are satellite voice calls of priority level 4.

11. Test and Evaluation.

a. Evaluate the general arrangement and operation of controls, displays, circuit breakers, annunciators, alerts, and any placards of the satellite voice system. Evaluation should verify that operational procedures minimize the requirement for the flight crew to back-out of multiple branches of the menu structure in order to initiate/answer a call.

> **Note:** For example, if the pilot were editing the flight plan on the MCDU, it is not acceptable to have to back out to the main MENU page to select the SATCOM pages in order to answer a satellite voice call.

b. Evaluate any self-test features and failure mode displays and annunciators. The criteria that define flight crew alerting should be consistent with the particular flight deck philosophy associated with the aircraft in question.

c. Evaluate the satellite voice system installation for satisfactory identification, accessibility, and visibility. Credit may be allowed from previous installation verification.

d. Purposely insert input errors to verify the system is robust.

e. Evaluate the satellite voice and other aircraft systems for mutual non-interference, which may be associated with radio frequency emissions. Determine the digital computer clock frequencies associated with the aircraft earth station (AES) design. If applicable, evaluate existing navigation and communications receivers at these discrete frequencies and their associated harmonics to confirm non-interference. Intermodulation products have also caused interference and may need to be evaluated.

f. Evaluate the integration of the satellite voice system with other systems. Evaluate other systems as necessary to show the satellite voice system does not interfere with their operation.

> **Note:** Attention should be given to other "L" band equipment, particularly the global positioning system (GPS) equipment. Intermodulation effects are possible between multiple channel SATCOM installations and GPS.

g. Determine whether the satcom voice system can be used within acceptable workload and with a minimal reliance upon flight crew memory.

12. Airplane Flight Manual (Supplement) Wording. The airplane flight manual (AFM) supplement should provide a description of normal and non-normal procedures for the use of the system operation, including what actions are expected by the flight crew for each case.

a. Operating Limitations. Systems installed in accordance with this AC should not warrant any new operating limitations.

b. Operating Procedures. The normal operating procedures of the AFM supplement should identify the criteria used in the airworthiness assessment. For example, "The Federal Aviation Administration has evaluated the SATCOM voice equipment in accordance with AC 20-150A as a supplement to other means of LRCS. Compliance with AC 20-150A does not constitute operational approval."

Susan J. M. Cabler
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Appendix A. Acronyms

Acronym	Definition
AC	Advisory Circular
AES	Aircraft Earth Station (Airborne Satellite Voice Equipment)
AFM	Airplane Flight Manual
AMS(R)S	Aeronautical Mobile Satellite (Route) Service
AMSS	Aeronautical Mobile Satellite Service
ATC	Air Traffic Control
ATS	Air Traffic Services
CNS	Communication, Navigation, Surveillance
FAA	Federal Aviation Administration
FMC	Flight Management Computer
FMS	Flight Management System
GPS	Global Positioning System
HF	High Frequency
HPA	High Powered Amplifier
ID	Identification
LRCS	Long Range Communication Service
MCDU	Multi-purpose Control and Display Unit
MEL	Minimum Equipment List
NGSS	Next Generation Satellite System
PPP	Priority, Precedence & Preemption
PSTN	Public Switched Telephone Network

Appendix A. Acronyms

Acronym	Definition
PTT	Push-to-Talk
RFM	Rotorcraft Flight Manual
SATCOM	Satellite Communication
TSO	Technical Standard Order
VHF	Very High Frequency

Appendix B. Related Documents

The following information may help you determine the airworthiness of your satellite equipment:

1. Title 14 of the Code of Federal Regulations (14 CFR). You can get copies of 14 CFR parts 21, 23, 25, 27, 29, 43, 91, 121, and 135 from the Superintendent of Documents, Government Printing Office, P.O. Box 371954, Pittsburgh PA 15250-7954. Telephone 202-512-1800, fax 202-512-2250. You can also get copies from the Government Printing Office website at www.access.gpo.gov. Select "Access," then "Online Bookstore." Select "Aviation," then "Code of Federal Regulations."

2. FAA Advisory Circulars (AC).

Although we do not refer to all of the following ACs, they all relate to this AC (for example, both AC 20-140 and AC 120-70 provide guidance for data communication). You may access all ACs on the FAA website at www.faa.gov/regulations_policies/advisory_circulars/.

a. AC 20-115B, *RTCA, Inc., Document (RTCA/DO)-178B*

b. AC 20-152, *RTCA, Inc., Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware uidance for Airborne Electronic Hardware*

c. AC 21-16F, *RTCA/DO-160E, Environmental Conditions and Test Procedures for Airborne Equipment*

d. AC 23.1309-1, *System Safety Analysis and Assessment For Part 23 Airplanes*

e. AC 23.1311-1, *Installation of Electronic Displays in Part 23 Airplanes*

f. AC 25-11A, *Transport Category Airplane Electronic Display Systems*

g. AC 25.1309-1, *System Design and Analysis*

h. AC 25.1322-1, *Flightcrew Alerting*

3. FAA Technical Standard Order (TSO). You can get copies of TSO-C159a, *Next Generation Satellite Systems (NGSS) Equipment***,** dated June 30, 2010, from the RGL website at www.airweb.faa.gov/rgl. On the website, select "Technical Standard Orders (TSO) and Index," then select "Current."

4. RTCA Documents. You can get copies of the following documents from RTCA, Inc., 1828 L Street, NW, Suite 805, Washington, D.C. 20036-4008. Telephone (202) 833-9339, fax (202) 833-9434, website www.rtca.org.

a. RTCA/DO-160E, *Environmental Conditions and Test Procedures for Airborne Equipment*, dated December 9, 2004.

b. RTCA/DO-178B, *Software Considerations in Airborne Systems and Equipment Certification*, dated December 1, 1992.

c. RTCA/DO-210D, (Change 1 and 2), *Minimum Operational Performance Standards (MOPS) for Geosynchronous Orbit Aeronautical Mobile Satellite Services (AMSS) Avionics*, dated April 19, 2000.

d. RTCA/DO-262A, *Minimum Operational Performance Standards for Avionics Supporting Next Generation Satellite Systems (NGSS),* dated December 16, 2008.

e. RTCA/DO-270 CH 1, *Minimum Aviation System Performance Standards for the Aeronautical Mobile Satellite (Route) Service (AMS(R)S) as Used in Aeronautical Data Links System Specific Attachment for Iridium Satellite,* dated April 14, 2009.

5. International Civil Aviation Organization (ICAO). You can get copies of Annex 10, Aeronautical Telecommunication, from ICAO External Relations and Public Information Office, 999 University Street, Montreal, Quebec H3C 5H7, Canada. Telephone (514) 954-8022, fax (514) 954-6769, website www.icao.int.