



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: Design and Installation Guidance for an Airborne System for Non-Required Telecommunication Service in Non-Aeronautical Frequency Bands

Date: 2/28/12

AC No: 20-177

Initiated by: AIR-130

1. Purpose.

a. In this advisory circular (AC), the Federal Aviation Administration (FAA) recommends one way to gain airworthiness approval for an Airborne System for Non-Required Telecommunication (ASNRT) service equipment in the cockpit. 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 ASNRT equipment. However, if you use the means described in this AC, you must follow it in its entirety.

b. ASNRT equipment is intended to provide flight crews with voice and data communication service over non aeronautical frequency bands. ASNRT consists of electronic onboard equipment which is not required for any phase of operation nor intended for Minimum Equipment List (MEL) dispatch relief.

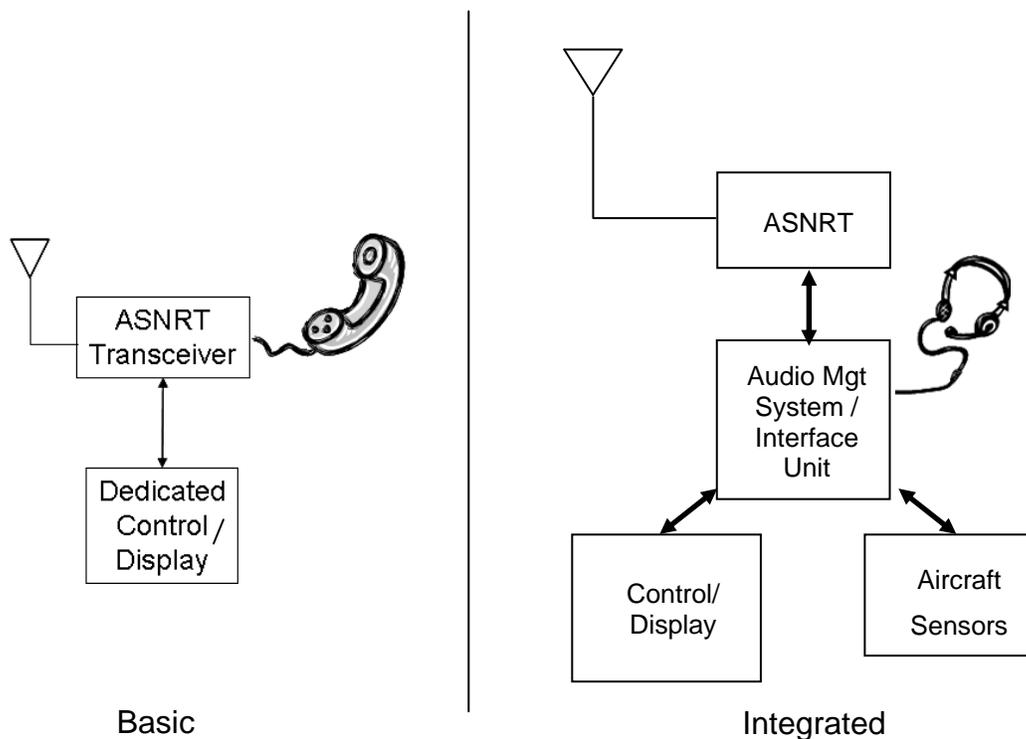
c. The guidelines contained in this AC are not intended to support airborne systems used for safety of flight communication such as Air Traffic Services (ATS), Airline Operational Control (AOC), or communication systems used to fulfill an operating requirement for a communication system. In addition, this AC provides guidance for aircraft equipment capable of subscribing to the FAA System Wide Information Management (SWIM) infrastructure.

2. Audience. This AC provides guidance for designers, manufacturers, and installers of ASNRT equipment.

3. Scope. The guidance in this AC applies to ASNRT installations under Title 14 of the Code of Federal Regulations (14 CFR) parts 23, 25, 27, and 29. Figure 1 provides two examples of notional ASNRT architecture. A basic ASNRT architecture may consist of a transceiver with a dedicated handset for voice communication and a dedicated control/display for data communication. An example would be a communication system for ground fire emergency coordination. A more complex ASNRT may partially or fully integrate with aircraft avionics with limitations identified in paragraph 4. Voice integration with the audio management system may afford the flight crew seamless voice communication management via existing interfaces. Integration with aircraft data communication capability might also allow for access to

maintenance information, airborne weather sensors, and FAA SWIM data for enhanced situational awareness.

Figure 1. Example of ASNRT Notional Architectures



4. Safety Assessment Considerations.

a. You 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 also evaluate failures or design errors of the ASNRT equipment which could cause or contribute to failure conditions of other systems. Reference AC 23.1309-1E, *System Safety Analysis and Assessment for Part 23 Aircraft*, AC 25.1309-1A, *System Design and Analysis*, AC 27.1309, *Equipment, Systems, and Installations*, or AC 29.1309, *Equipment, Systems, and Installations*, as applicable for conducting your safety assessment.

b. ASNRT equipment may be used in support of non-safety of flight communication during normal operating procedures. ASNRT equipment may not be used to satisfy any required communication system and therefore cannot be used for MEL dispatch credit. Functional loss or malfunction of the ASNRT equipment should not exceed a slight increase in pilot workload. Based upon the above assumptions, the likelihood of failure or malfunction of ASNRT equipment should be shown to be no more likely than probable (i.e., developed commensurate to a minor hazard classification).

c. If your safety assessment identifies hazards greater than minor, your equipment is outside the scope of this AC. You should contact your aircraft certification office (ACO) and consider application of AC 20-140A *Guidelines for Design Approval of Aircraft Data Link*

Communication Systems Supporting Air Traffic Services (ATS) or AC 20-150A Airworthiness Approval of Satellite Voice Equipment, as appropriate.

Note: In this AC, when another advisory circular is referenced and a later revision becomes available it is acceptable to utilize the latest revision.

5. Design Considerations.

a. Integration with Existing Aircraft Systems.

(1) ASNRT equipment should not adversely affect the safety of the aircraft or its occupants, or the proper functioning of required equipment or systems under any foreseeable operating conditions.

(2) Partition ASNRT equipment if it is integrated with other communication systems.

(3) A direct interface to the cockpit voice recorder (if applicable) is not required. However, if ASNRT equipment installations are integrated with the audio management system, we recommend ASNRT voice communication be directly recorded.

Note: For operations requiring a cockpit voice recorder, normal cockpit audio (including use of ASNRT for voice communication) will continue to be recorded via the cockpit voice recorder area microphone.

(4) Recording of ASNRT data communication in crash survivable memory is not required. ASNRT equipment cannot be used for messages which require recording in crash survivable memory (see AC 20-160, *Onboard Recording of Controller Pilot Data Link Communication in Crash Survivable Memory*, dated February 21, 2008).

b. Software. We recognize the vast majority of ASNRT equipment will likely be categorized as commercial-off-the-shelf (COTS) equipment and therefore not developed to any recognized aviation software standard. However, if the installation is relying upon ASNRT software to satisfy paragraph 5a(1) of this AC, the ASNRT software must be developed using AC 20-115B, *RTCA Inc. Document RTCA/DO-178B*, or AC 20-171, *Alternatives to RTCA/DO-178B for Software in Airborne Systems and Equipment*.

c. Electrical Power and Wiring.

(1) Perform an electrical load analysis on the electrical equipment to ensure the added electrical load does not exceed design capability. Utilize a non-essential electrical bus or load shedding capabilities if applicable.

(2) Provide circuit protective devices so a fault in the ASNRT equipment does not cascade to other airborne equipment.

d. Installation Manual. Provide installation instructions which include instructions for mounting, antenna installation, electrical connections, operational testing and recommended instructions for continued airworthiness (remove, install and test for each replaceable unit).

e. Control Capability.

- (1) Flight crew operation of the ASNRT equipment should not significantly affect crew workload.
- (2) Controls and indicators should be acceptable for the cockpit environment.

Note: For additional guidance, refer to AC 20-175, *Controls for Flight Deck Systems*.

f. Flammability. Flammability requirements should be met based upon the type certification basis of the aircraft per AC 23-2A, *Flammability Tests*, AC 25-16, *Electrical Fault and Fire Prevention and Protection*, AC 27.1351, *Electrical Equipment*, or AC 29.1351, *Electrical Equipment*.

6. Electromagnetic Compatibility. Electromagnetic compatibility tests should be performed to demonstrate that the ASNRT does not adversely affect other aircraft systems, including other required radio systems. The electromagnetic compatibility tests should be performed with the ASNRT antennas installed. If the ASNRT uses handsets with integrated portable antennas, the electromagnetic compatibility tests should be performed with the handsets and integrated portable antennas operated in all aircraft locations where the antenna is expected to be used. RF emissions tests on the ANSRT equipment using AC 21-16G, *RTCA Document DO-160 versions D, E, F and G, Environmental Conditions and Test Procedures for Airborne Equipment*, (RTCA/DO-160 section 21) is recommended.

7. Lightning Protection. For external antenna installations, determine lightning zones and account for system lightning protection. General guidance on lightning protection can be found in AC 20-136B, *Aircraft Electrical and Electronic Systems Lightning Protection*. Due to the minor failure effect of ASNRT equipment, the indirect effects of lightning do not need to be considered.

8. Additional Installation Considerations.

a. General guidance on installation can be found in AC 43.13-2B, *Acceptable Methods, Techniques, and Practices – Aircraft Alterations*.

b. Install the equipment in accordance with the manufacturer's installation instructions.

c. If your ASNRT equipment contains a memory retention device which is a rechargeable lithium battery, the flammability risk must be addressed. Installed ASNRT equipment employing a rechargeable lithium battery must ensure the lithium ion battery meet airworthiness standards appropriate for the battery size and intended function.

9. Ground and Flight Test. Ground and flight tests should consider the following guidance:

a. Ground Tests. The ground tests for certification should:

(1) Ensure the general arrangement and operation of controls, displays, circuit breakers, annunciators, alerts, and any placards for the non required communication system have an unobstructed view and are easily accessible.

(2) When active, ensure any self-test features, failure mode displays, and annunciators display clearly.

(3) Evaluate the system installation ensuring clear identification, accessibility, and visibility during both day and night conditions.

(4) If applicable, evaluate the integration of the system with other aircraft communication, navigation, and surveillance (CNS) systems ensuring proper operation of the integrated system.

(5) Perform aircraft electromagnetic compatibility ground tests to ensure the ANSRT is compatible with aircraft electrical and electronic systems, including required radio systems and Full Authority Digital Engine Control system. Aircraft electromagnetic compatibility ground tests should be performed in accordance with the following guidelines.

(a) Conduct tests with the ANSRT equipment powered by the aircraft electrical power system.

(b) All aircraft safety-related and required electrical and electronic systems should be on and operating during the electromagnetic compatibility tests.

(c) Results of emissions tests (reference paragraph 6) should be reviewed to identify ANSRT operating frequencies, spurious emissions, and harmonic emissions which may adversely affect required aircraft radio systems. Specifically, tune the required aircraft radio receivers to these frequencies that occur in their operating bands.

(d) Evaluate all reasonable combinations of control settings and operating modes for the ANSRT and aircraft safety-related and required electrical and electronic systems. With ANSRT equipment energized on the ground, individually operate other electrically operated equipment and systems on the aircraft to demonstrate electromagnetic compatibility.

b. Flight Tests. The flight tests for certification should:

(1) Demonstrate ANSRT electromagnetic compatibility with aircraft safety-related and required electrical and electronic systems. Aircraft safety-related and required electrical and electronic systems that could not be adequately operated during the aircraft electromagnetic ground test should be specifically monitored during the flight tests. Required aircraft radio receivers should be monitored with receivers tuned to frequencies where effects were observed during the aircraft electromagnetic compatibility ground tests, or where significant spurious emissions or harmonic emissions were recorded during emissions tests, reference paragraph 6.

(2) Insert (simulate) failure modes for conditions that could not be simulated on the ground, as necessary, to verify aural and visual annunciation and assess additional pilot workload.

10. Airplane/Rotorcraft Flight Manual (A/RFM) (Supplement).

a. AFM or RFM supplements should provide an operational system description of the ASNRT voice and/or data communication for all normal modes, sub-modes, and non-normal (if applicable) modes, including expected flight crew actions.

b. Document any flight crew procedural restrictions or operating limitations, including those imposed by the FCC if applicable, in the AFM/RFM (per current flight manual guidance).

11. Related Guidance Documents.

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

b. AC 20-136B, *Aircraft Electrical and Electronic System Lightning Protection*.

c. AC 20-140A, *Guidelines for Design Approval of Aircraft Data Link Communication Systems Supporting Air Traffic Services (ATS)*.

d. AC 20-150A, *Airworthiness Approval of Satellite Voice Equipment*.

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

f. AC 20-160, *Onboard Recording of Controller Pilot Data Link Communication in Crash Survivable Memory*.

g. AC 20-171, *Alternatives to RTCA/DO-178B for Software in Airborne Systems and Equipment*.

h. AC 20-175, *Controls for Flight Deck Systems*.

i. AC 21-16G, *RTCA Document DO-160 versions D, E, F and G, "Environmental Conditions and Test Procedures for Airborne Equipment."*

j. AC 23-2A, *Flammability Tests*.

k. AC 23.1309-1E, *System Safety Analysis and Assessment for Part 23 Aircraft*.

l. AC 25-16, *Electrical Fault and Fire Prevention and Protection*.

m. AC 25.1309-1A, *System Design and Analysis*.

n. AC 25.1581-1, *Airplane Flight Manual*.

o. AC 27.1309, *Equipment, Systems, and Installations (Found in AC 27-1B)*.

p. AC 27.1351, *Electrical Equipment (Found in AC 27-1B)*.

- q. AC 29.1309, *Equipment, Systems, and Installations (Found in AC 29-2C)*.
- r. AC 29.1351, *Electrical Equipment (Found in AC29-2C)*.
- s. AC 43.13-2B, *Acceptable Methods, Techniques, and Practices - Aircraft Alterations*.
- t. AC 120-76A, *Guidelines for the Certification, Airworthiness, and Operational Approval of Electronic Flight Bag Computing Devices*.

12. Where to Find Related Documents.

- a. You may access all ACs on the FAA website at www.faa.gov/regulations_policies/advisory_circulars/
- b. Order SAE documents from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001. Telephone (724) 776-4970, fax (724) 776-0790. You can also order copies online at www.sae.org



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