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AC 20-177 ASNRT

#	Commenter	Page & Paragraph No.	Comment	Reason for Comment	Suggested Change	Comment Resolution
1.	Cirrus Aircraft	Page 3, Par 5.d.(1)	For small part 23 aircraft, it is not reasonable to require separate switches for non-essential equipment. Pilots in our products don't receive the same level of training as professional pilots in larger aircraft. Each additional switch in a cockpit adds more complexity that can become overwhelming to a non-professional pilot.	If each piece of non-essential equipment were to require a switch, the cockpit would be consumed by switches. To keep our cockpit simple, we try to minimize the quantity of switches, only using them to disconnect entire systems of components. A switch adds one more element of complexity that can succumb to mechanical or operator failure. A CB should be sufficient for emergency situations to disconnect power from an individual device.	Allow for an easily accessible CB to disconnect power in case of an emergency.	Partially Accepted – Agree with the intent. Deleted the paragraph. See also comments 7, 27 & 28
2.	American Eurocopter	Page 2, Par 4	<p>Safety Assessment Considerations</p> <p>VFR vs. IFR limitations of aircraft - Is there a differentiation based on type of operation?</p> <p>Would the FAA consider in an FHA/SSA that an identified "intermittent" harmonic interference (ex; VOR navigation</p>			Acknowledged – The FAA takes into consideration operational context in establishing hazard classification. This AC provides "a means, but not the only means, of

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			frequency) produced by a non-aviation radio transmitter to be minor hazard in VFR vs. IFR aircraft?			compliance”, thus an applicant may propose an alternative means. This proposed VFR only operation, may be found acceptable, but would likely include technical, procedural and/or operational limitations.
3.	American Eurocopter	Page 3, Par 5.a	Software The expectation that non-aviation radios have or “should comply” with AC20-115B is a delusion.			Accepted – We have modified Paragraph 5.a. to address commercial-off-the-shelf radio equipment and moved it to 5.b. Also, see comment 17
4.	American Eurocopter	Page 3, Par 5.b	FCC Requirements 90% or more of the non-aeronautical frequency radios presently installed in aircraft do not comply with Part 87. The “shall” meet FCC requirements eliminates a large percentage of potential installations.			Accepted – Deleted the paragraph requiring compliance to FCC Part 87

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5.	American Eurocopter	Page 3, Par 5.b	<p>FCC Requirements</p> <p>There is no FAA Orders or Regulations (non TSO equipment) requirement for an “Installation Manual” therefore limitations and system constraints should be addressed in some other manner or an Installation Manual should become a requirement.</p>			<p>Accepted – Added a new paragraph 5.d requiring both an installation manual and instructions for continued airworthiness</p>
6.	American Eurocopter	Page 3, Par 5.c	<p>Integration with Existing Systems</p> <p>Based on experience there is almost always some level of interference with lower frequency broad band equipment therefore “must not interfere with other on-board systems in any manner” is a project killer from the start. There needs to be established an acceptable level or mitigation means for identified interference.</p>			<p>Partially Accepted – Deleted paragraph 5.c. (2). Electromagnetic compatibility is covered in section 6 and specifically states “does not adversely affect other aircraft systems”. Reference XX.1431</p>
7.	American Eurocopter	Page 4, Par 5.e	<p>Control Capability</p> <p>Majority of this type equipment installation will have controls located in the back end of the aircraft and therefore not always be accessible to the flight crew. We would propose in these type installations the pilot have an auxiliary control lock-out or some means to disable transmit capability</p>			<p>Partially Accepted – Agree with the intent. Deleted the paragraph. See also comments 1, 27 & 28. Note - This AC does not apply for communication equipment in the cabin, reference 1.a & 1.b.</p>

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			when objectionable interference is identified.			
8.	American Eurocopter	Page 4, Par 6.	Electromagnetic Compatibility No mention of compatibility with or effects on FADEC systems. (Seems to always be an oversight on Field Approvals)			Accepted – Revised paragraph 9.a.(5) to include Full Authority Digital Engine Control.
9.	American Eurocopter		Memory Retention Batteries No mention of memory retention batteries which most of the newer computer based communication equipment have. Majority of the time these batteries are lithium type batteries of various varieties. This should be researched and evaluated with each piece of equipment installation.			Accepted – Added new paragraph 8.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.
10.	American		Instructions for Continued			Accepted –

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	Eurocopter		<p>Airworthiness</p> <p>No mention of ICA requirements for these type installations. Due to the COTS nature of these type radio equipment, special procedures should be included in the ICA that require compatibility retest and evaluation of the installation after repair or replacement of the equipment.</p>			Added new paragraph 5.d 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).
11.	American Eurocopter	Page 6, Par 10	<p>AFM or RFM</p> <p>Are operational limitations placed in the FMS acceptable to mitigate inter-system interference and claim “minor hazard”?</p>			Acknowledged – Without knowing the specifics an operational limitation as a means of mitigation would need to be evaluated on a case by case basis
12.	Garmin	Page 1, Paragraph 1.a	<p>Includes the following:</p> <p>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</p>	The guidance in the AC body includes the terms “must”, “shall”, “should”, “recommend” and “highly encouraged”; consequently it is	This AC should provide guidance regarding the terms “must”, “shall”, “should”, “recommend” and “highly	Partially Accepted – For clarity the use of the word shall was changed to must. Highly encouraged was changed to recommended. The

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			<p>for your ASNRT equipment. However, if you use the means described in this AC, you must follow it in its entirety.</p>	<p>unclear exactly what portion of the “means described in this AC” must be followed “entirely”.</p>	<p>encouraged” to make it clear what guidance must be followed entirely and what guidance is optional.</p> <p>For example, AC 20-172 paragraph 1-1.c includes the following:</p> <p>The term “must” is used to indicate mandatory requirements when following the guidance in this AC. The terms “should” and “recommend” are used when following the guidance is recommended but not required to comply with this AC.</p>	<p>additional language in AC 20-172 regarding the use of the terms is unique to ADS-B where both required and non required functions reside. We do not concur that the additional language applies with this AC. The terms should and recommended remain.</p>

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					Additionally recommend reducing the number of terms; e.g., change all instances of “shall” to “must”; change “highly encouraged” to “recommended”.	
13.	Garmin	Page 2, Paragraph 3	<p>Includes the following:</p> <p>Integration with aircraft data communication capability might also allow for access to maintenance information, airborne weather sensors, and FAA SWIM data.</p> <p>The wording of this item seems inconsistent with paragraph 5.c.(5) (recording to crash survivable memory).</p> <p>AC 20-160 references EUROCAE ED-93 Sections 2.3.2.1 and 2.3.2.2, and Appendix D.2 to describe what data should be recorded in crash-survivable memory. If any SWIM data would meet these requirements, it is likely not suitable for an ASNRT link and should be recorded.</p>	Clarify the types of data permitted over an ASNRT link	Suggest revising to “...and advisory-only FAA SWIM data.”	Partially Accepted – Concur with the intent but prefer using situational awareness instead of advisory only

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			Advisory-only data, such as XM weather, is not recorded to crash-survivable memory. If the intent of paragraph 3 is to permit access to SWIM data that is advisory only, this should be stated explicitly.			
14.	Garmin	Page 2, Paragraph 4.a	The reference to ARP4761 should be removed.	Other recent FAA publications regarding specific functionality, such as AC 20-172, only mention ARP4761 in an appendix of related material. Additionally, AC 20-174, which recognizes ARP4754A, only mentions ARP4761 as related material.	Remove the reference to ARP4761. If a direct reference to system safety material is desired, consider referencing AC 20-174, <i>Development of Civil Aircraft and Systems</i> .	Partially Accepted – We agree with the intent and have changed the paragraph referencing each category aircraft with the applicable corresponding AC guidance
15.	Garmin	Page 2, Paragraph 4.c, Page 3, Paragraph 5.a, Page 3, Paragraph 5.c.(5), Page 4, Paragraph 5.e.(2) Note, Page 4, Paragraph 5.f	All of these paragraphs refer to other ACs by specific revisions.	This AC should refer to the current or later revisions of referenced ACs as ACs can change independently of each other.	Suggest changing each of the AC references to include “(or later revision)” as is done in paragraph 11 of this AC.	Partially Accepted – Concur with the intent. For clarity added a one time note after the first AC reference - Note: In this AC when another advisory circular is referenced and a later revision becomes available it is acceptable to utilize the latest revision.

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		Note, Page 4, Paragraph 6, Page 4, Paragraph 7, Page 4, Paragraph 8.a				
16.	Garmin	Page 2, Paragraph 4.c	The references to AC 20-140A and AC 20-150A do not include the AC title.	Most, if not all, other AC references include the AC title in italics.	Include the AC title for both of these references.	Accepted – Revised as suggested
17.	Garmin	Page 3, Paragraph 5.a	Includes the following: The ASNRT equipment should comply with AC 20-115B, <i>RTCA, Inc., Document RTCA/DO-178B</i> , dated January 11, 1993.	This should be consistent with other ACs in recognizing AC 20-171, which allows for software to be developed to other than DO-178B. An example of this recognition is in AC 20-173. Additionally, suggest removing the AC 20-115B date since other AC references do not include it.	Suggest revising the text to: Ensure the design assurance level of the ASNRT equipment software is consistent with the failure condition for the intended function. Software should be developed using AC 20-115B, <i>RTCA, Inc.</i> ,	Partially Accepted – Agree with the intent. Revised and included the additional AC 20-171 reference. Moved to paragraph 5.b. Also see comment 3

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					<p><i>Document RTCA/DO-178 B or AC 20-171, Alternatives to RTCA/DO-178B for Software in Airborne Systems and Equipment.</i></p>	
18.	Garmin	Page 3, Paragraph 5	While paragraph 11 of this AC references AC 20-152, there is no reference to it within paragraph 5.	Suggest referencing AC 20-152 in the equipment design considerations to be consistent with other ACs such as AC 20-173.	<p>Suggest adding a new paragraph 5.b with the following text:</p> <p>Airborne Electronic Hardware (AEH). For ASNRT equipment complex including complex custom AEH, if the failure condition classification is major or greater, complex custom AEH should be</p>	Partially Accepted – Reference paragraph 4.c which states that if your safety assessment is greater than minor your equipment is outside the scope of this AC. DO-254 for complex airborne electronic hardware is optional for hazard classification minor or below and this AC does not prevent the use of it.

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					<p>developed using AC 20-152, <i>RTCA, Inc., Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware</i>, to the design assurance level consistent with the failure classification. If the failure condition classification is minor or no effect, an existing design assurance practice may be used to develop the complex custom AEH.</p>	
19.	Garmin	Page 4, Paragraph 6	The paragraph discusses “Electromagnetic Compatibility” and recommends use of AC 21-16G and RTCA/DO-160. But AC 21-	Suggest referencing AC 20-16G in the broader context of environmental testing	Suggest adding a new paragraph with the following text:	Not Accepted – We acknowledge that the electromagnetic compatibility

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			16G and RTCA/DO-160 address many other areas of environmental testing in addition to electromagnetic compatibility.	to be consistent with other ACs such as AC 20-173.	<p>Environmental Qualification. Ensure the environmental qualification of ASNRT equipment is appropriate for the installation. We recommend utilizing AC 21-16G, <i>RTCA Document DO-160 Versions D, E, F, and G, "Environmental Conditions and Test Procedures for Airborne Equipment,"</i> to demonstrate equipment performance in environmental conditions encountered during</p>	requirement in this AC only addresses a portion of AC 21-16G for environmental conditions. We non concur that a stand alone COTS communication system installed should meet all the requirements of AC 21-16G. We limit the testing to electromagnetic compatibility, include a circuit protective devise and ensure that the equipment does not interfere with existing equipment.

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					operation of the ASNRT equipment in aircraft.	
20.	Garmin	Page 4, Paragraph 6	Includes the following statement: RF emissions tests on the ANSRT equipment using AC 21-16G <i>RTCA Document DO-160 versions D, E, F and G, "Environmental Conditions and Test Procedures for Airborne Equipment."</i> (RTCA/DO-160 section 21) or equivalent standards are highly encouraged.	Some editorial issues: 1) "AC 21-16G" should be followed by a comma and 2) the title of AC 21-16G should end as "... <i>Equipment,</i> " (change period to a comma). Additionally, while AC 21-16G defines a means but not the only means to show electromagnetic compatibility, it is not clear what "equivalent standards" FAA considers acceptable (i.e., we don't know of an AC that defines an alternative method of compliance such as AC 20-171 does for software). It seems sufficient to end the sentence with "recommended".	Suggest revising the text to: RF emissions tests on the ANSRT equipment using AC 21-16G, <i>RTCA Document DO-160 versions D, E, F and G, "Environmental Conditions and Test Procedures for Airborne Equipment,"</i> (RTCA/DO-160 section 21) or equivalent standards are highly encouraged is recommended.	Accepted – Revised as suggested.
21.	Garmin	Page 4, Paragraph 6	If the handsets discussed in this paragraph could be considered PEDs, suggest include a reference	Ensure ASNRT installations are as tolerant of EM	Update paragraph 6 to include a reference to AC	Not Accepted – The handset in paragraph 6 is

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			to AC 20-164.	compatibility issues as possible.	20-164, <i>Designing and Demonstrating Aircraft Tolerance to Portable Electronic Devices</i> , as a recommended testing method.	considered integrated with the radio regardless if it is wired or wireless. It would not be considered a PED for this installation.
22.	Garmin	Page 4, Paragraph 7	This paragraph appears to limit lightning protection requirements to only those installations that have external antennas.	Lightning protection is for more than just external antennas. Suggest modifying this paragraph to be consistent with other ACs such as AC 20-173, while also recognizing AC 20-155 for external lightning protection guidance.	Suggest revising the text as follows: Lightning Protection. Ensure installed ASNRT equipment meets the lightning requirements of 14 CFR 23.1306, 25.1316, 27.1316, and 29.1316, as appropriate. We recommend using AC 20-136B, <i>Aircraft Electrical and</i>	Not Accepted – 2. We acknowledge that the lightning protection requirements for this AC are limited to externally mounted antennas only. We did add some additional language. “Due to the minor failure effect of ASNRT equipment, the indirect effects of lightning do not need to be considered.” ASNRT equipment is limited in scope and can not be used to support required operations or functions for continued safe operations and

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					<p><i>Electronic System Lightning Protection</i>, to demonstrate appropriate lightning protection. Ensure external ASNRT equipment components meet the lightning requirements of 14 CFR 23.867, 25.581, 27.610, and 29.610. We recommend AC 20-155, <i>SAE Documents to Support Aircraft Lightning Protection Certification</i>, to demonstrate appropriate external lightning</p>	<p>therefore the requirements recommended are out of scope for this AC.</p>

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23.	Garmin	Page 4, Paragraph 7	While paragraph 7 of this AC references AC 20-136B with regard to lightning, there is similar acknowledgment of AC 20-158 for HIRF.	Suggest referencing AC 20-158 to be consistent with other ACs such as AC 20-173.	<p align="center">protection.</p> <p>Suggest adding a new paragraph with the following text:</p> <p>High Intensity Radiated Fields (HIRF). Ensure installed ASNRT equipment meets the HIRF requirements of 14 CFR 23.1308, 25.1317, 27.1317, and 29.1317, as appropriate. We recommend using AC 20-158, <i>The Certification of Aircraft Electrical and Electronic Systems for Operation In</i></p>	Not Accepted – The HIRF requirements listed are for equipment whose function or loss could prevent the continued safe flight of the aircraft. ASNRT equipment can not be used for any required function or operation and therefore the HIRF requirements are not applicable for this AC.

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					<p><i>The High-Intensity Radiated Fields (HIRF) Environment, to demonstrate the equipment is protected when operating on an aircraft when the aircraft is exposed to an external HIRF environment.</i></p>	
24.	Garmin	Page 5, Paragraph 9.a.(5)(e)	ASNRT systems should be evaluated with any other installed satellite systems that may be used for ATS/AOC. The installer must ensure that ATS communications are not affected when the ASNRT system is in use.	There are often specific installation considerations for installing multiple SATCOM radios on an aircraft, whether those radios use the same satellite network or different satellite networks.	<p>Suggest adding a new item 9.a.(5)(f) that states:</p> <p>If the ASNRT uses a SATCOM system, and the aircraft uses a SATCOM system for ATS, AOC, or other safety-related services, evaluate the</p>	<p>Not Accepted – We agree with the intent, however this is not limited to just SATCOM and we believe paragraphs 9.a.(4) & (5) already address all installed communication, navigation and surveillance systems without having to single out a particular installation such as SATCOM</p>

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					ASNRT SATCOM operation to ensure compatibility with any SATCOM system providing safety-related services.	
25.	Embraer	Paragraph 5.c	The intended meaning of the phrase "impair airworthiness" is unclear and may not be congruent with the common use of the word "airworthiness."	Embraer believes the presumed intent of subparagraphs (1) and (2) could better expressed using wording similar to that in AC 20-168 to say <i>"ASNRT equipment should not adversely affect the safety of the aircraft or its occupants, or the proper functioning of required equipment and systems impair the airworthiness of the aircraft under any foreseeable operating conditions."</i>		Partially Accepted – Concur with the intent and revised as follows: 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.
26.	Embraer	Paragraph 5.c	Subparagraph (3), the need for partitioning should be limited to ASNRT systems integrated with			Partially Accepted – Concur with the intent and revised as follows: Partition

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			other required communications systems.			ASNRT equipment if it is integrated with other communication systems
27.	Bombardier Aerospace	Page 3 Para. 5.d.1: “Provide a means to disconnect or reset ASNRT equipment from electrical power for the case of unexpected malfunction, interference, fire, smoke or other hazards. You must not use a circuit breaker as the primary means of satisfying this objective.”	This line item is concerning because it states a circuit breaker is not an adequate means to remove electrical power from an ASNRT device in the event of malfunction, interference, fire, smoke, or other hazards. Required aircraft systems use circuit breakers for this purpose and are considered acceptable, typically for higher development assurance levels than those needed for non-required systems.	Paragraph requires additional components to be installed, contrary to common practice and increasing complexity and cost, while reducing the reliability of the system.	Delete final sentence. This will allow pilot-accessible circuit breakers to be used as a primary means of disconnecting power to ASNRT.	Partially Accepted – Agree with the intent. Deleted the paragraph. See also comments 1, 7, & 28
28.	Boeing Commercial Airplanes	Page 3 Para 5.d.(1) The proposed text states: (1) Provide a means to disconnect or reset ASNRT equipment from electrical power for the case of	The requirement seems to imply the use of a switch in the flight deck to power off the communication system.	Communications systems used exclusively in the flight deck (such as VHF, HF, and Inmarsat SATCOM systems dedicated to the flight deck) do not have dedicated power switches in the flight deck. Safety threats	We request that this paragraph be deleted.	Partially Accepted – Agree with the intent. Deleted the paragraph. See also comments 1, 7 & 27

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		unexpected malfunction, interference, fire, smoke or other hazards. You must not use a circuit breaker as the primary means of satisfying this objective.		<p>due to malfunction, interference, fire, smoke, and other hazards are addressed using the assumption that the flight crew will not have access to a means to power off a single communication system.</p> <p>Further, communications systems shared between flight deck and cabin [such as Inmarsat SATCOM systems connected to both flight deck and in-flight entertainment (IFE)] also do not have power switches in the flight deck.</p> <p>It is only when a communication system is used exclusively in the cabin that it is designed to be powered off by an IFE power switch in the flight deck.</p> <p>The flight crew would not expect to lose a</p>		

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				<p>flight deck communication system when powering off the existing IFE power switch in the flight deck. The addition of a specialized power switch in the flight deck for a single communication function would not be desirable due to additional crew training requirements associated with the switch and the difficulty in finding space to mount the switch in the flight deck.</p> <p>In addition, if a means to remove power is deemed a requirement, there is other guidance material available to preclude the use of a traditional circuit breaker as a switch in the flight deck to satisfy the requirement.</p>		