Appendix B

AIRWORTHINESS QUALIFICATION REQUIREMENTS

AVIONICS

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Changes and Revisions

Revision 1 Feb 01, 2019 General formatting. Added Alternate Means of Compliance for HF flight testing for Appendix C.
1. SCOPE

1.1 Scope. This Aeronautical Design Standard Handbook provides guidance for the airworthiness qualification of radio communication, Identification Friend or Foe (IFF)/surveillance, and datalink equipment integrated into Army aircraft, including rotorcraft, Unmanned Aerial Systems (UAS), and fixed wing aircraft.

The overall airworthiness guidance for a given user of this handbook is determined by the user’s required fielding types, the user’s required operational airspace types, and the expected flight operational requirements within the respective airspace. The appropriate fielding type is determined by the current level of the airworthiness certification of the airframe and the overall fielding requirements of the user. Operational airspace type and expected flight operational requirements within the respective airspace dictate the avionics communication equipment. Required avionics and their respective minimum performance level requirements vary by airspace type, airspace controlling authority, and type of operations.

Accordingly, the intended operational use of the aircraft and the corresponding military threshold levels and civil performance requirements shall be correctly identified to ensure that the final airworthiness products resulting from the qualification process provides the user with the equipment and qualifications necessary to conduct their respective flight operations. Civil equipage shall adhere to worldwide civil airspace regulations.

Radio communication, IFF/surveillance, and datalink equipment are referred to collectively in this handbook as Avionics Communications Equipment (ACE). This handbook provides guidance in verifying (IAW Appendix A) and qualifying an ACE system(s) that has been found to be satisfactory by the U.S. Army AR 70-62() delegated Qualification Authority.

1.2 Intended Use. This handbook is written in this arrangement so it could be used, in a liberal cut and paste fashion, for possible language used in an Airworthiness Qualification Plan (AQP), Airworthiness Qualification Specification (AQS), Statement of Work (SOW), and other relevant airworthiness documents. For example, specific GENERAL REQUIREMENTS (ACE SYSTEM PARAMETERS) and DETAILED GUIDANCE (ACE SYSTEM METHOD OF COMPLIANCE pairs (sections 4 and 5 respectively in this handbook, organized by correlating paragraph numbers) could be directly put into an airworthiness document.

AR 95-1() establishes policy and procedures for Army aircraft operations.

AR 95-2() prescribes policy, procedures, and responsibilities for Army Air Traffic Control Activity (USAATCA) including tactical and civil airspace entry equipage requirements.
AR 70-62() defines the airworthiness qualification process for Army aircraft and equipment for operations in tactical and civil airspace.
2. APPLICABLE DOCUMENTS

2.1 General. The documents listed below are not necessarily all of the documents referenced herein, but are those needed to understand the information provided.

2.2 Government Documents.

2.2.1 Specifications, Standards, and Handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein.

DEPARTMENT OF DEFENSE STANDARDS

| MIL-STD-188-110() | Interoperability and Performance Standards for Data Modems |
| MIL-STD-188-141() | Interoperability and Performance Standards for Medium and High Frequency Radio System |
| MIL-STD-188-182() | Interoperability Standard for 5-kHz UHF DAMA Terminal Waveform |
| MIL-STD-188-183() | Interoperability Standard for Multiple-Access 5-kHz and 25-kHz UHF Satellite Communications Channels |
| MIL-STD-188-184() | Interoperability and Performance Standard for the Data Control Waveform |
| MIL-STD-188-200() | Interface Standard for System Design and Engineering Standards for Tactical Communications |
| MIL-STD-188-220() | Interface Standard Digital Message Transfer Device Subsystems |
| MIL-STD-188-241() | Frequency Hopping Standard for Very High Frequency (VHF) Frequency Hopping Radios (U) (NOTE: SECRET) |

MIL-STD-188-243() Interface Standard for Tactical Single Channel Ultra High Frequency (UHF) Radio Communications

MIL-STD-882() System Safety

MIL-STD-1472() Design Criteria Standard, Human Engineering

MIL-STD-6016() Tactical Data Link (TDL) 16 Message Standard

Department of Defense (DoD) AIR TRAFFIC CONTROL RADAR SYSTEM (ATCRBS), IDENTIFICATION FRIEND OR FOE (IFF), MARK XII/XIIA, Systems (AIMS) PROGRAM OFFICE SPECIFICATIONS

DoD AIMS 03-1000() Technical Standard For The ATCRBS/IFF/Mark XIIA Electronic Identification System and Military Implementation of Mode S

DoD AIMS 03-1101() DoD International AIMS Program IFF Transponder Box Test Procedures

DoD AIMS 03-1102() DoD International AIMS Program IFF Platform Integration Test Procedures

DoD AIMS 03-1103() DoD International AIMS Program IFF Flight Test Procedures

DoD AIMS 04-900() Interface Control Standard For Mode 4/5 Cryptographic Computer

DoD AIMS 97-1000() Performance/Design and Qualifications Requirements Technical Standard for the ATCBRS/IFF/Mark XII Electronic Identification System and Military Mode S

DoD AIMS 97-1101() DoD International AIMS Program IFF Transponder Box Test Procedures
2.2.2 Other Government Documents, Drawings, and Publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein.

**ARMY REGULATIONS**

- **AR 70-62()** Airworthiness Qualification of Aircraft Systems
- **AR 95-1()** Flight Regulations
- **AR 95-2()** Airspace, Airfields/Heliports, Flight Activities, Air Traffic Control and Navigational Aids
- **AR 95-20()** Contractor’s Flight and Ground Operations
- **AR 380-5()** Department of the Army Information Security Program

**AIRWORTHINESS QUALIFICATION PLANS**

**ADS-B OUT AQP**

- **Automatic Dependent Surveillance-Broadcast (ADS-B) Out Performance Requirements**

**FEDERAL AVIATION ADMINISTRATION (FAA)**

**TECHNICAL STANDARD ORDER (TSO)**

- **TSO-c112()**
  - Air Traffic Control Radar Beacon System Mode Select (ATCRBS/Mode S) Airborne Equipment
- **TSO-c166()**
  - Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Service (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz).

**AERONAUTICAL DESIGN STANDARDS (ADS)**

- **ADS-37A-PRF()**
  - Aeronautical Design Standard, Electromagnetic Environmental Effects (E3) Performance Verifications Requirements
2.3 **Non-Government Publications.** The following documents form a part of this document to the extent specified herein.

**RADIO TECHNICAL COMMISSION FOR AERONAUTICS (RTCA)**

DO-181() Minimum Operational Performance Standard for Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment

DO-260() Minimum Operational Performance Standards for 1090 MHZ Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B)

**SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)**

**AEROSPACE RECOMMENDED PRACTICE (ARP)**

ARP-4761() Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment

ARP-4754() Guidelines for Development of Civil Aircraft and Systems

2.4 **Order of Precedence.**
In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.
3. DEFINITIONS

3.1 Method of Compliance. The verification method that substantiates a specific requirement has been successfully met.

3.2 Omnidirectional. An antenna pattern that is relatively equal in gain over 360° in azimuth, with limited directivity in elevation above and below 0° elevation.

3.3 Line of Sight Communication. Line of Sight (LOS) communication is the single unobstructed path between the location of a transmitter and location of the receiver.

3.4 Beyond Line of Sight Communication. Beyond Line of Sight (BLOS) communication is the communication required when line of sight communication is not possible due to obstruction such as the curvature of the earth.

3.5 Development Assurance. Development Assurance the level of effort or level of rigor (generally a specified set of objectives or activities) required to show compliance with certification/qualification requirements and demonstrate safe operation of the system.

3.6 Criticality. The ACE systems shall be verified to provide the level of criticality for its intended use. MIL-STD-882() defines the Army lifecycle system safety process. ARP-4761() and ARP-4754() are accepted methods for substantiating equipment design, and correlate criticality to a Design Assurance Level (DAL). The higher level of criticality takes precedence for systems with combined functions.

3.7 Acronyms.

AC Advisory Circular
ACE Avionics Communications Equipment
ADS Aeronautical Design Standard
SRD Systems Readiness Directorate, CCDC AvMC
AGL Above Ground Level
AIMS Air Traffic Control Radar Beacon System (ATCRBS) Identification
AM Amplitude Modulated
AQP Airworthiness Qualification Plan
<table>
<thead>
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<th>Abbreviation</th>
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<td>AQS</td>
<td>Airworthiness Qualification Specification</td>
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<td>AR</td>
<td>Army Regulations</td>
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<tr>
<td>ARP</td>
<td>Aerospace Recommended Practice</td>
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<td>ATC</td>
<td>Air Traffic Control</td>
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<td>Beyond Line Of Sight</td>
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<td>Design Assurance Level</td>
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<td>FAA</td>
<td>Federal Aviation Administration</td>
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<td>FM</td>
<td>Frequency Modulated</td>
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<td>Fixed Wing</td>
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<td>HF</td>
<td>High Frequency</td>
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<td>IAW</td>
<td>In Accordance With</td>
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<td>ICS</td>
<td>Integrated Communication System</td>
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<tr>
<td>IFF</td>
<td>Identification Friend or Foe</td>
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<tr>
<td>JITC</td>
<td>Joint Interoperability Test Command</td>
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<tr>
<td>KHz</td>
<td>Kilohertz</td>
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<td>LOS</td>
<td>Line Of Sight</td>
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<td>MHz</td>
<td>Megahertz</td>
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<td>Acronym</td>
<td>Description</td>
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<tr>
<td>NM</td>
<td>Nautical Mile</td>
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<tr>
<td>RTCA</td>
<td>Radio Technical Commission for Aeronautics</td>
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<td>SATCOM</td>
<td>Satellite Communications</td>
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<tr>
<td>SAE</td>
<td>Society of Automotive Engineers</td>
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<td>SOW</td>
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<td>TDL</td>
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<td>Very High Frequency</td>
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4. GENERAL REQUIREMENTS (ACE SYSTEM PARAMETERS)

4.1  ACE Parameters.

4.1.1  Antenna Coverage.  The system antenna(s) shall provide coverage to preclude loss of signal to support its specified mission.

    4.1.1.1  Antenna Cosite.  The system antenna(s) shall provide field of view that precludes loss of signal to support its specified mission.
    4.1.1.2  Spacing and Isolation.  The system antenna(s) should provide a minimum spacing of 3/8 wavelength separation at the lowest frequency between any two antennas.
    4.1.1.3  Interference.  The installed system shall meet EMI/EMC requirements IAW ADS-37().

4.1.2  Communications Security (COMSEC).  The installed COMSEC system shall meet COMSEC requirements IAW Army Regulation (AR) 380-5() and requirements of cognizant authorities.

4.1.3  Criticality of ACE Systems.  The ACE systems shall provide the level of criticality for its intended use as defined in paragraph 3.6.  The higher level of criticality takes precedence for systems with combined voice/data.

4.2  Voice Communications.  The voice communication system as installed on the platform shall provide, at a minimum, two qualified radios (civil and mission), one primary radio capable of VHF-AM voice communications and a secondary radio capable of VHF-AM or UHF-AM voice communications utilized via ICS.  Provide unique user requirements (example: secure voice, auto-position transmission, EMCON, etc.).

4.2.1  Primary VHF-AM.

    4.2.1.2  Voice Communication.  The Primary VHF-AM radio shall provide omnidirectional transmit and receive LOS voice communications over the 118-151.975 MHz frequency range (108-117.975 MHz receive only) for specified operations.  The preferred method is a communication range survey Test/Demonstration; the standard test shall be performed at 1,200’ AGL at 35 NM from the ground station at ground level.
4.2.1.3 **Monitoring the Guard Frequency.** The Primary VHF-AM radio shall provide simultaneous monitoring of the guard frequencies, 121.5 and 243 MHz, to the ICS system.

4.2.1.4 **Loss of Primary Power.** The Primary VHF-AM radio installation shall provide the flight crew with continued operation after loss of primary power.

4.2.1.5 **Guard Switch.** The Primary VHF-AM radio shall provide tuning to a guard frequency when the Guard Switch is suppressed.

4.2.1.6 **ICS Bypass.** The Primary VHF-AM radio shall provide the ability to bypass the ICS system.

4.2.1.7. **Emergency Control.** The Primary VHF-AM radio shall provide the capability for independent operation in emergency conditions.

4.2.2 **Secondary VHF-AM.**

4.2.2.1 **Secondary VHF-AM.** The requirement for a secondary VHF-AM radio is the same as the primary VHF-AM radio minus 4.2.1.4, 4.2.1.5, 4.2.1.7.

4.2.3 **UHF-AM/HAVEQUICK/HAVEQUICK II.**

4.2.3.1 **Component Functional Performance.** The UHF-AM radio (225-400 MHz) shall meet MIL-STD-188-243(), Interoperability & Performance Standards for Tactical Single Channel Ultra High Frequency (UHF-AM) Radio Equipment and implement HAVEQUICK/HAVEQUICK II waveform.

4.2.3.2 **Voice Communication.** The UHF-AM radio shall provide omnidirectional transmit and receive LOS voice communication over the 225 to 400 MHz frequency range for specified tactical operations. The preferred method is a communication range survey Test/Demonstration; the standard test shall be performed at 1,200' AGL at 35 NM from the ground station at ground level.

4.2.4 **HF.**

4.2.4.1 **Component Functional Performance.** The HF radio (2-30 MHz) shall meet MIL-STD-188-141(), Interoperability and Performance Standards for Medium and High Frequency Radio System.

4.2.4.2 **Voice Communication.** The HF radio shall provide omnidirectional transmit and receive BLOS voice communications over the 2 to 30 MHz frequency range for specified operations. The preferred method is a communication range survey Test/Demonstration; the standard test shall be performed at an altitude less than 4,000' AGL at BLOS range (threshold 162 NM (300 km))
4.2.5 **VHF-FM SINCGARS.**

4.2.5.1 **Component Functional Performance.** The VHF-FM SINCGARS radio (30-88 MHz) shall meet:

4.2.5.1.1 MIL-STD-188-241(S), Frequency Hopping Standard for VHF Frequency Hopping Radios

4.2.5.1.2 MIL-STD-188-242(U), Interoperability & Performance Standards for Tactical Single Channel Very High Frequency (VHF) Radio Equipment

4.2.5.2 **Voice Communication.** The VHF-FM SINCGARS radio shall provide omnidirectional transmit and receive LOS voice communications over the 30-88 MHz frequency range for specified tactical operations. The preferred method is a communication range survey Test/Demonstration; the standard test shall be performed at 1,200’ AGL at 35 NM from the ground station at ground level.

4.2.6 **SATCOM.**

4.2.6.1 **Component Functional Performance.** The SATCOM radio shall meet:

4.2.6.1.1 MIL-STD-188-181(), Interoperability Standard for Single-Access 5-kHz and 25-kHz UHF Satellite Communications Channels

4.2.6.1.2 MIL-STD-188-182(), Interoperability Standard for UHF SATCOM Demand Assigned Multiple Access (DAMA) Orderwire Messages and Protocols

4.2.6.1.3 MIL-STD-188-183(), Interoperability Standard for Multiple-Access 5-kHz and 25-kHz UHF Satellite Communications Channels

4.2.6.1.4 MIL-STD-188-185(), Interoperability UHF MIL SATCOM DAMA Control System.

4.2.6.2 **Voice Communication.** The SATCOM radio shall provide omnidirectional voice communications at specified bandwidths in dedicated satellite and Demand-Assigned-Multiple Access (DAMA) modes.

4.2.7 **ICS.**

4.2.7.1 **ICS Integration.** The ICS shall provide integration of the audio signals from all platform specified radio communication systems, associated Warning Caution Advisory (WCAs), and COMSEC equipment.

4.2.7.2 **Controls.** The ICS shall provide platform specified communications controls for the integrated communication systems.
4.2.7.3 **Primary Communications Isolation from Passenger Station.** The ICS shall provide the means to prevent a passenger ICS station from overriding flight crew control of the primary communication radios.

4.2.7.4 **Loss of Primary Power.** The ICS installation shall provide the flight crew with continued operation after loss of primary power.

4.2.8. **Other Voice Communications.** Other voice communications shall meet platform defined specification requirements.

4.3 **IFF/Surveillance.** The IFF/surveillance system as installed on the platform shall consist of a transponder, antenna(s), and a user interface. Provide any unique user requirements.

4.3.1 **IFF/Surveillance.**

4.3.1.1 **IFF Component Functional Performance.** The IFF/Surveillance (1030/1090 MHz) shall meet DoD AIMS 03-1000(), Air Traffic Control Radar Beacon System (ATCRBS) IFF Mark XII/XIIA Systems (AIMS). The IFF shall also have component-level certification by DoD AIMS IAW Appendix D.

4.3.1.2 **Aircraft Identification.** The IFF/Surveillance installation shall meet the combined airworthiness and AIMS certification aircraft level IAW DoD AIMS 03-1000(). Aircraft-level certification by DoD AIMS IAW Appendix D.

4.3.2 **Other IFF/Surveillance.** Other IFF/surveillance shall meet platform defined specification requirements.

4.4 **Datalink Communications.** There are multiple types of datalinks for Flight Control, Payload, sensor, telemetry, etc. These datalinks utilize different waveforms and frequencies for their application. Appendix E provides datalink metrics. Provide unique user requirements (example: secure data or auto-position transmission).

4.4.1 **Availability.** The datalink communications system shall provide sufficient connectivity per the criticality of the system to preclude degradation and/or loss of signal.

4.4.2 **Error Rate.** Datalink error rate shall be IAW system specified data rate limits in all modes of operation.

4.4.3 **Latency.**

4.4.3.1 **LOS Systems.** Datalink latency shall provide system specified limits.

4.4.3.2 **BLOS Systems.** Datalink latency shall provide system specified limits.
4.4.4 Reliability.

4.4.4.1 Monitoring/Display Datalink Parameters. All datalink parameters should provide monitoring/display in real time.

4.4.5 Primary VHF-AM.

4.4.5.1 Component Functional Performance. The Primary VHF-AM radio (118-137 MHz) shall meet:


4.4.5.1.2 MIL-STD-188-220() Interface Standard Digital Message Transfer Device Subsystems.

4.4.5.2 Datalink Communication. The Primary VHF-AM radio system shall provide omnidirectional data communication in all modes of operation. The preferred method is a communication range survey Test/Demonstration; the standard test shall be performed at 1,200’ AGL at 35 NM from the ground station at ground level.

4.4.6 Secondary VHF-AM. The requirement for a Secondary VHF-AM radio is the same as the Primary VHF-AM radio, section 4.4.5.

4.4.7 UHF-AM/HAVEQUICK/HAVEQUICK II.

4.4.7.1 Component Functional Performance. The UHF-AM radio (225-400 MHz) shall meet:


4.4.7.2 Datalink Communication. The UHF-AM radio system shall provide omnidirectional data communications in all modes of operation. The preferred method is a communication range survey Test/Demonstration; the standard test shall be performed at 1,200’ AGL at 35 NM from the ground station at ground level.

4.4.8 HF.

4.4.8.1 Component Functional Performance. The HF radio (2-30 MHz) shall meet:
4.4.8.1.1 MIL-STD-188-141(), Interoperability and Performance Standards for Medium and High Frequency Radio System.


4.4.8.2 Datalink Communication. The HF radio system shall provide omnidirectional data communications in all modes of operation. The preferred method is a communication range survey Test/Demonstration; the standard test shall be performed at an altitude less than 4,000’ AGL at BLOS range (threshold 162 NM (300 km)).

4.4.9 VHF-FM SINCGARS.

4.4.9.1 Component Functional Performance. The VHF-FM SINCGARS radio (30-88 MHz) shall meet:

4.4.9.1.1 MIL-STD-188-241(S), Frequency Hopping Standard for VHF Frequency Hopping Radios


4.4.9.2 Datalink Communications. The VHF-FM SINCGARS radio system shall provide omnidirectional data communications in all modes of operation. The preferred method is a communication range survey Test/Demonstration; the standard test shall be performed at 1,200’ AGL at 35 NM from the ground station at ground level.

4.4.10 SATCOM.

4.4.10.1 Component Functional Performance. The SATCOM radio shall meet:

4.4.10.1.1 MIL-STD-188-181(), Interoperability Standard for Access To 5-kHz and 25-kHz UHF Satellite Communications Channels

4.4.10.1.2 MIL-STD-188-182(), Interoperability Standard for UHF SATCOM Demand Assigned Multiple Access (DAMA) Orderwire Messages and Protocols

4.4.10.1.3 MIL-STD-188-183(), Interoperability Standard for Multiple-Access 5-kHz and 25-kHz UHF Satellite Communications Channels
4.4.10.1.4 MIL-STD-188-184(), Interoperability and Performance Standard for the Data Control Waveform

4.4.10.1.5 MIL-STD-188-185(), Interoperability UHF MIL SATCOM DAMA Control System

4.4.10.2 Datalink Communications. The SATCOM radio shall provide omnidirectional data communication in all modes of operation at specified bandwidths in dedicated satellite and Demand-Assigned-Multiple Access (DAMA) modes.

4.4.11 TDL Link 16.

4.4.11.1 Component Functional Performance. The Link 16 radio shall meet MIL-STD-6016(), Tactical Data Link (TDL) Link 16 Message Standard. The Link 16 radio shall also have JITC certification.

4.4.11.2 Datalink Communications. The Link 16 radio shall meet MIL-STD-6016(), Tactical Data Link (TDL) Link 16 Message Standard. The aircraft’s Link 16 installation shall also have JITC certification.

4.4.12 Other Datalink Communications. Datalink communications shall meet platform defined specification requirements.
5. DETAILED GUIDANCE (ACE SYSTEM METHOD OF COMPLIANCE)

Note: DiDs of plans/procedures/reports/analysis' IAW Appendix F.

5.1 ACE Parameters.

5.1.1 Antenna Coverage. The system antenna(s) coverage shall be verified to provide coverage to preclude loss of signal to support its specified mission.

5.1.1.1 Antenna Cosite. The system antenna(s) cosite shall be verified to provide antenna RF performance to include effects of rotor shading, carriage stores, etc., for all user defined configurations. This shall ensure the system antenna(s) has field of view to preclude loss of signal to support its specified mission.

5.1.1.2 Spacing and Isolation. The system antenna(s) should be verified to provide minimum spacing of 3/8 wavelength separation at the lowest frequency of platform specified operation between any two antennas.

5.1.1.3 Interference. The installed system shall be verified to meet the EMI/EMC requirements IAW ADS-37().

5.1.2 COMSEC. The installed COMSEC system shall be verified to meet COMSEC requirements IAW AR 380-5() and requirements of cognizant authorities.

5.1.3 Criticality of ACE Systems. The ACE systems shall be verified to provide the level of criticality for its intended use as defined in paragraph 3.6. The higher level of criticality takes precedence for systems with combined voice/data.

5.2 Voice Communications. The voice communication system as installed on the platform shall be verified to provide installation of, at a minimum, two qualified radios (civil and mission), one primary radio capable of VHF-AM voice communications and a secondary radio capable of VHF-AM or UHF-AM voice communications employed via ICS. Voice communication shall be verified IAW Appendix A. Verification shall be provided for unique user requirements (example: secure voice or auto-position transmission, EMCON, etc.).

5.2.1 Primary VHF-AM.


5.2.1.2 Voice Communication. The Primary VHF-AM radio system shall be verified to provide omnidirectional transmit and receive LOS voice communications over
the 118-151.975 MHz frequency range (108-117.975 MHz receive only). The preferred method of verification is a communication range survey Test/Demonstration; the standard test shall be performed at 1,200' AGL at 35 NM from the ground station at ground level IAW Appendix B. Alternate means of compliance for the communication range survey are specified in Appendix B.

5.2.1.3 Monitoring the Guard Frequency. The Primary VHF-AM radio shall be verified to provide simultaneous monitoring of guard frequencies, 121.5 and 243 MHz, to the ICS system.

5.2.1.4 Loss of Primary Power. The Primary VHF-AM radio installation shall be verified to provide the flight crew with continued operation after loss of primary power.

5.2.1.5 Guard Switch. The Primary VHF-AM radio shall be verified to provide tuning to a guard frequency when the guard switch is suppressed.

5.2.1.6 ICS Bypass. The Primary VHF-AM shall be verified to provide the ability to bypass the ICS system and utilize a backup control panel for emergency use.

5.2.1.7 Federated Control. The Primary VHF-AM radio shall be verified to provide a federated means of control.

5.2.2 Secondary VHF-AM.

5.2.2.1 Secondary VHF-AM. The verification for a Secondary VHF-AM radio is the same as the Primary VHF-AM radio minus 5.2.1.4, 5.2.1.5, 5.2.1.7.

5.2.3 UHF-AM/HAVEQUICK/HAVEQUICK II.


5.2.3.2 Voice Communication. The UHF-AM radio system shall be verified to provide omnidirectional transmit and receive LOS voice communications over the 225 to 400 MHz frequency range to support platform specified tactical operations. The preferred method of verification is a communication range survey Test/Demonstration; the standard test shall be performed at 1,200' AGL at 35 NM from the ground station at ground level IAW Appendix B. Alternate means of compliance for the communication range survey are specified in Appendix B.

5.2.4 HF.
5.2.4.1 **Component Functional Performance.** The HF radio shall be verified to meet MIL-STD-188-141(), Interoperability and Performance Standards for Medium and High Frequency Radio System.

5.2.4.2 **Voice Communication.** The HF radio system shall be verified to provide omnidirectional transmit and receive BLOS voice communications over the 2-30 MHz frequency range to support the platform specified operations. The preferred method of verification is a communication range survey Test/Demonstration; the standard test shall be performed at an altitude less than 4,000’ AGL at BLOS range (threshold 162 NM (300 km)) IAW Appendix C.

5.2.5 **VHF-FM SINCGARS.**

5.2.5.1 **Component Functional Performance.** The VHF-FM SINCGARS radio shall be verified to meet:

5.2.5.1.1 MIL-STD-188-241(S), Frequency Hopping Standard for VHF Frequency Hopping Radios

5.2.5.1.2 MIL-STD-188-242(), Interoperability and Performance Standards for Tactical Single Channel Very High Frequency (VHF) Radio Equipment.

5.2.5.2 **Voice Communication.** The VHF-FM SINCGARS radio system shall be verified to provide omnidirectional transmit and receive LOS voice communications over the 30-88 MHz frequency range to support the platform specified tactical operations. The preferred method of verification is a communication range survey Test/Demonstration; the standard test shall be performed at 1,200’ AGL at 35 NM from the ground station at ground level IAW Appendix B. Alternate means of compliance for the communication range survey are specified in Appendix B.

5.2.6 **SATCOM.**

5.2.6.1 **Component Functional Performance.** The SATCOM radio shall be verified to meet:

5.2.6.1.1 MIL-STD-188-181(), Interoperability Standard for Single-Access 5-kHz and 25-kHz UHF Satellite Communications Channels

5.2.6.1.2 MIL-STD-188-182(), Interoperability Standard for UHF SATCOM Demand Assigned Multiple Access (DAMA) Orderwire Messages and Protocols

5.2.6.1.3 MIL-STD-188-183(), Interoperability Standard for Multiple-Access 5-kHz and 25-kHz UHF Satellite Communications Channels
5.2.6.1.4 MIL-STD-188-185(), Interoperability UHF MIL SATCOM DAMA Control System

5.2.6.2 Voice Communication. The SATCOM radio shall be verified to provide omnidirectional transmit and receive BLOS voice communication in the platform specified bandwidths in dedicated satellite and DAMA modes.

5.2.7 ICS.

5.2.7.1 ICS Integration. The ICS shall be verified to provide audio signals from all platform specified radio communication systems, associated WCAs, and COMSEC equipment without interference or degradation.

5.2.7.2 Controls. The ICS shall be verified to provide platform specified communications controls for the integrated communication systems.

5.2.7.3 Primary Communications Isolation from Passenger Station. The ICS shall be verified to prevent a passenger ICS station from overriding flight crew control of the primary communication radios.

5.2.7.4 Loss of primary power. The ICS installation shall be verified to provide the flight crew with continued operation after loss of primary power.

5.2.8 Other Voice Communications. Other voice communications shall be verified to meet platform defined specification requirements.

5.3 IFF/Surveillance. Verification shall be provided for unique user systems and/or requirements (example: secure identification or auto-position transmission).

5.3.1 IFF/Surveillance.

5.3.1.1 Component Functional Performance. The IFF/Surveillance shall be verified to meet AIMS certification component level IAW DoD AIMS 03-1000() IAW Appendix D.

5.3.1.2 Aircraft Identification. The IFF/Surveillance installation shall be verified to meet AIMS certification aircraft level IAW DoD AIMS 03-1000() IAW Appendix D.

5.3.2 Other IFF/Surveillance. Other IFF/surveillance shall be verified to meet platform defined specification requirements.

5.4 Datalink Communications. Verification shall be provided for unique user requirements (example: secure data or auto-position transmission). See Appendix E for datalink metrics.
5.4.1 **Availability.** The datalink communications system shall be verified to provide sufficient connectivity per the criticality of the system to preclude degradation and/or loss of signal.

5.4.2 **Error Rate.** Datalink error rate shall be verified IAW system specified data rate limits in all modes of operation.

5.4.3 **Latency.**

5.4.3.1 **LOS Systems.** Datalink latency shall be verified to provide system specified limits.

5.4.3.2 **BLOS Systems.** Datalink latency shall be verified to provide system specified limits.

5.4.4 **Reliability.**

5.4.4.1 **Monitoring/Displaying of Data Link Parameters.** All data link parameters should be verified to provide monitoring/displaying in real time.

5.4.5 **Primary VHF-AM.**

5.4.5.1 **Component Functional Performance.** The VHF-AM radio that is primary shall be verified to meet:

5.4.5.1.1 MIL-STD-188-242(), Interoperability & Performance Standards For Tactical Single Channel Very High Frequency (VHF-AM) Radio Equipment

5.4.5.1.2 MIL-STD-188-220() Interface Standard Digital Message Transfer Device Subsystems.

5.4.5.2 **Datalink Communication.** The VHF-AM radio shall be verified to provide omnidirectional data communication over the 118-151.975 MHz frequency range (108-117.975 MHz receive only) in all modes of operation. The preferred method of verification is a communication range survey Test/Demonstration; the standard test shall be performed at 1,200’ AGL at 35 NM from the ground station at ground level IAW Appendix B. Alternate means of compliance for the communication range survey are specified in Appendix B.

5.4.6 **Secondary VHF-AM.** The verification for a secondary VHF-AM radio is the same as the Primary VHF-AM radio, section 5.4.5.

5.4.7 **UHF-AM/HAVEQUICK/HAVEQUICK II.**
5.4.7.1 **Component Functional Performance.** The UHF-AM radio shall be verified to meet:

5.4.7.1.1 MIL-STD-188-243(), Interoperability & Performance Standards For Tactical Single Channel Ultra High Frequency (UHF-AM) Radio Equipment

5.4.7.1.2 MIL-STD-188-220() Interface Standard Digital Message Transfer Device Subsystems.

5.4.7.2 **Datalink Communication.** The UHF-AM radio system installation shall be verified to provide omnidirectional data communication over the 225 to 400 MHz frequency range in all modes of operation. The preferred method of verification is a communication range survey Test/Demonstration; the standard test shall be performed at 1,200' AGL at 35 NM from the ground station at ground level IAW Appendix B. Alternate means of compliance for the communication range survey are specified in Appendix B.

5.4.8 **HF.**

5.4.8.1 **Component Functional Performance.** The HF radio shall be verified to meet:

5.4.8.1.1 MIL-STD-188-141(), Interoperability and Performance Standards for Medium and High Frequency Radio System

5.4.8.1.2 MIL-STD-188-220() Interface Standard Digital Message Transfer Device Subsystems

5.4.8.2 **Datalink Communication.** The HF radio installation shall be verified to provide omnidirectional data communications over the 2-30 MHz frequency range in all modes of operation. The preferred method of verification is a communication range survey Test/Demonstration; the standard test shall be performed at an altitude less than 4,000’ AGL at BLOS range (threshold 162 NM (300 km)) IAW Appendix C.

5.4.9 **VHF-FM SINCGARS.**

5.4.9.1 **Component Functional Performance.** The VHF-FM SINCGARS radio shall be verified to meet:

5.4.9.1.1 MIL-STD-188-241(S), Frequency Hopping Standard for VHF Frequency Hopping Radios

5.4.9.1.2 MIL-STD-188-242(U), Interoperability and Performance Standards For Tactical Single Channel Very High Frequency (VHF) Radio Equipment
5.4.9.1.3 MIL-STD-188-220(), Interface Standard Digital Message Transfer Device Subsystems

5.4.9.2 Datalink Communication. The VHF-FM/SINCGARS radio shall be verified to provide omnidirectional data communications over the 30-88 MHz frequency range in all modes of operation. The preferred method of verification is a communication range survey Test/Demonstration; the standard test shall be performed at 1,200' AGL at 35 NM from the ground station at ground level IAW Appendix B. Alternate means of compliance for the communication range survey are specified in Appendix B.

5.4.10 SATCOM.

5.4.10.1 Component Functional Performance. The SATCOM radio shall be verified to meet:

5.4.10.1.1 MIL-STD-188-181(), Interoperability Standard for Single-Access 5-kHz and 25-kHz UHF Satellite Communications Channels

5.4.10.1.2 MIL-STD-188-182(), Interoperability Standard for UHF SATCOM Demand Assigned Multiple Access (DAMA) Orderwire Messages and Protocols

5.4.10.1.3 MIL-STD-188-183(), Interoperability Standard for Multiple-Access 5-kHz and 25-kHz UHF Satellite Communications Channels

5.4.10.1.4 MIL-STD-188-184(), Interoperability and Performance Standard for the Data Control Waveform

5.4.9.1.5 MIL-STD-188-185(), Interoperability UHF MIL SATCOM DAMA Control System

5.4.10.2 Datalink Communication. The SATCOM radio shall be verified to provide omnidirectional data communication in all modes of operation in the platform specified bandwidths in dedicated satellite and DAMA modes.

5.4.11 TDL Link 16.

5.4.11.1 Component Functional Performance. The Link 16 radio shall be verified to meet MIL-STD-6016(), Tactical Data Link (TDL) 16 Message Standard are met. The Link 16 radio shall provide JITC certification.

5.4.11.2 Datalink Communication. The Link 16 radio installation shall provide JITC certification.
5.4.12 Other Datalink Communications. Other datalink communications shall be verified to meet platform defined specification requirements.

CONCLUDING MATERIAL

Custodians:
Army -
Matthew J. Benzek
Avionics Team
Avionics Architecture Branch
U.S. Army Combat Capabilities
Development Command
Aviation & Missile Center

Preparing activity:
Army -
APPENDIX A

VERIFICATION GUIDANCE

Scope.

This appendix outlines verification guidance for the ACE system parameters stated in section 5. The methods of verification are designated below. Because this document contains parameters that are applicable across all aviation platforms, the verification methods employed for individual parameters may be different, depending upon the platform. Therefore, the individual parameters in this section may state from one to all five possible verification methods (inspection, demonstration, analysis, test, and simulation) as part of the verification requirement. The verification method identified within section 5 is the preferred method. Substantiation shall be provided for other proposed methods.

Verification methods are as follows:

**Inspection.** Inspection shall consist of visual examination, physical manipulation, or measurement (as applicable) of documentation, hardware, or software to verify that parameters have been satisfied.

**Analysis.** Analysis shall consist of the examination of applicable attributes of the existing documentation, hardware, software, and recorded data to verify that parameters have been satisfied. Analysis includes verification by investigation, mathematical analysis, and sampling the collection of measured data and observing test results with calculated, expected values.

**Demonstration.** Demonstration shall consist of a functional verification in which the observation of events is the predominant vehicle. Measurements are not usually necessary. When appropriate, it includes the actual exercise of software along with appropriate drivers, simulators, or integrated hardware to verify that parameters have been satisfied.

**Test.** Test shall consist of the collection of analysis of data obtained from the actual exercise of hardware or software or combination thereof in either a controlled or an operational environment as appropriate. Actual input stimuli or stimuli or combination thereof obtained from drivers or simulators may be employed as deemed appropriate. Comparison of the tested requirements with performance and operational parameters is the usual means employed to verify compliance. Tailoring of test parameters may be acceptable depending on configuration and equipment. This includes, but is not limited
to, test frequencies, headings, aircraft flight characteristics, and range/operational altitude.

See Appendix B, C, D, and E for specific test guidance.

**Simulation.** Simulation shall include verification through the use of mathematical models incorporated into a simulation which replicates the following: the operation or performance of the equipment being evaluated; the threat which the equipment shall operate against; the environment in which the equipment shall operate; and combinations of the equipment, threat, and environmental simulators.
APPENDIX B

LOS VOICE/DATA COMMUNICATION SYSTEMS LEVEL PERFORMANCE TESTING

Scope.

This appendix provides guidance for ground and flight tests that verify omnidirectional transmit and/or receive LOS performance for voice and/or data communication systems.

Systems Level Testing.

Communications range verification for full qualification shall consist of a system level test. The test shall characterize the functionality and performance of the LOS communication system as installed on the target platform for communications range and antenna pattern coverage. The communication system consists of all radios, power amplifiers, logic switches, antennas, and all necessary cable harnesses on a production-representative aircraft. The testing consists of a ground test followed by a flight test.

System Ground Testing.

The ground test shall verify that communication can be established with a ground station at ground level. Antenna null frequencies shall be determined prior to test, and worst case null frequencies shall be tested if warranted.

System Flight Testing.

For LOS communication systems, the flight test shall be performed at 1200’ AGL at 35 NM from the ground station at ground level. The ground station shall be representative of a tactical system with 10 watts (nominal) transmit power. Antenna height shall be approximately 25’ AGL. A minimum of 10 frequencies across the band shall be tested. Additional frequencies may be required from the noise floor test results, or if antenna patterns vary substantially as a function of frequency. Worst case noise/null frequencies from the ground test shall be tested, if warranted. Readings shall be taken for headings at every 30° (12 points) through a cloverleaf pattern (Appendix B, Figure 1). If LOS communication cannot be established at 35 NM for a given frequency and heading in the test matrix, then the distance to the ground antenna shall be reduced in 5 NM increments, and the characterized range distance and relative azimuth recorded for each frequency.
Intelligible voice communication at a data point shall be considered acceptable if a subjectively determined 3X3 (out of 5X5) intelligibility transmission/reception score is achieved with the understanding that the MIL-STD-1472 reading-rhyme methods have been used to subjectively calibrate the scale by the tester(s). See Appendix B, Table A: Intelligibility Transmission/Reception Scoring.
### Table A. Intelligibility Transmission/Reception Scoring

<table>
<thead>
<tr>
<th>Rating Criteria (Clarity)</th>
<th>Signal Strength (Loudness)</th>
<th>Audio Quality (Voice)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Faint to very weak</td>
<td>Unreadable</td>
</tr>
<tr>
<td>2</td>
<td>Weak to fair</td>
<td>Barely readable (occasional breaks)</td>
</tr>
<tr>
<td>3</td>
<td>Fair to good</td>
<td>Readable (occasional difficulty)</td>
</tr>
<tr>
<td>4</td>
<td>Good to strong</td>
<td>Readable (no difficulty)</td>
</tr>
<tr>
<td>5</td>
<td>Very Strong</td>
<td>Readable (no difficulty)</td>
</tr>
</tbody>
</table>

NOTE: For voice communication with civil ATC, testing under these tactical requirements meets civil requirements.

**Datalink.**

Datalink metrics at a data point shall be considered acceptable when the quantifiable datalink metrics are determined to meet the user requirements IAW Appendix E.

NOTE: If the LOS voice testing is applicable to the data communication system and the receiver sensitivity for voice is equal to or less than the data sensitivity, then a duplicate LOS data test is not required (e.g. Link-16 J-Voice).

**Alternate Means of Compliance.**

System Flight Testing tailoring by platform type:

a) **Rotary Wing**

A pedal turn can be done in place of flying the cloverleaf pattern. Readings shall be taken for headings at every 30° (12 points) through a pedal turn. The angle of attack during a pedal turn shall be the same as the platform’s cruising speed.

b) **Fixed Wing**

As an alternate to the cloverleaf pattern a circle pattern may be used. The circle pattern shall consist of orbits at a minimal cruise speed and a maximum bank of 10°. Readings shall be taken for headings at every 10° through the orbit as per
AC 23-8() or AC 25-7(); however, these 36 readings are not required per orbit and may be captured over multiple orbits and frequencies of the same band (36 readings spaced every 10° per frequency band).

The range and altitude of testing may deviate from the 1200’ AGL at 35 NM, depending upon the flight characteristics of the aircraft and its operational altitude. The flight test shall be performed at an CCDC AvMC approved range and altitude from the ground station at ground level.

The specified testing range shall be dependent on the system’s operating power, frequency band, typical mission altitude, and curvature of the earth equations.

The viability of this method is dependent on the flight characteristics of the aircraft, and may not be suitable for all fixed-wing aircraft.

c) UAS/ Non-Traditional Airframes

Readings shall be taken for headings at every 30° (12 points) through a cloverleaf pattern (Appendix B, Figure 1).

The range and altitude of testing may deviate from the 1200’ AGL at 35 NM, depending upon the flight characteristics of the aircraft and its operational altitude. The flight test shall be performed at an CCDC AvMC approved range and altitude from the ground station at ground level.

The specified testing range shall be dependent on the system’s operating power, frequency band, typical mission altitude, and curvature of the earth equations.
APPENDIX C

HF BLOS VOICE/DATA COMMUNICATION SYSTEMS LEVEL PERFORMANCE TESTING

Scope.

This appendix provides guidance for ground and flight tests that verifies omnidirectional transmit and/or receive BLOS performance for voice and/or data communication systems.

NOTE: Received signals at frequencies below 30 MHz may be a combination of space waves, surface/ground waves, and ionospherically reflected waves, so flight range test shall be carefully planned to minimize the uncertainty resulting from multimode propagation. With this in mind, consider distance, altitude, terrain, weather, and time of day for both the receiving and transmitting stations. These effects may be minimized if Automatic Link Establishment (ALE) function is implemented. ALE automatically selects the best available frequency from a preprogrammed almanac list of frequencies to establish the link.

Systems Level Testing.

Communications range verification for full qualification shall consists of a system level test. The test shall characterize the functionality and performance of the BLOS communication system as installed on the target platform for communications range and antenna pattern coverage. The communication system consists of all radios, power amplifiers, logic switches, antennas, and all necessary cable harnesses on a production-representative aircraft. The testing consists of a ground test followed by a flight test.

System Ground Testing.

The ground test shall:

(1) Verify that communication can be established with a ground station at a minimum distance of 15 NM on at least three frequencies spread across the band (Lo, Med, Hi).

(2) Verify via demonstration the functional and performance requirements of ALE operations IAW MIL-STD-188-141() protocols.
System Flight Testing.

Verify via flight test that communications can be established between a ground station at ground level and the aircraft at an altitude less than 4,000’ AGL at BLOS range (threshold 162 NM (300 km)) on at least three (3) frequencies spread across the band (Lo, Med, Hi) at four (4) cardinal headings.

Voice.

Intelligible voice communication at a data point shall be considered acceptable if a subjectively determined 3X3 (out of 5X5) intelligibility transmission/reception score is achieved with the understanding that the MIL-STD-1472() reading-rhyme methods have been used to subjectively calibrate the scale by the tester(s). See Appendix B, Table A: Intelligibility Transmission/Reception Scoring.

NOTE: For voice communication with civil ATC, testing under these tactical requirements meets civil requirements.

Alternate Means of Compliance.

System Flight Testing tailoring by platform type:

a) Rotary Wing
   A pedal turn can be done in place of flying the cloverleaf pattern. Readings shall be taken for headings at all four (4) cardinal points through a pedal turn. The angle of attack during a pedal turn shall be the same as the platform’s cruising speed.

b) Fixed Wing
   As an alternate to the cloverleaf pattern a circle pattern may be used. The circle pattern shall consist of orbits at a minimal cruise speed and a maximum bank of 10°. Readings shall be taken for headings at every 90° through the orbit as per AC 23-8() or AC 25-7().

The altitude of testing may deviate from the 4000’ AGL, depending upon the flight characteristics of the aircraft and its operational altitude. The flight test shall be performed at an CCDC AvMC approved range and altitude from the ground station at ground level.

The viability of this method is dependent on the flight characteristics of the aircraft, and may not be suitable for all fixed-wing aircraft.
Datalink.

Datalink metrics at a data point shall be considered acceptable when the quantifiable datalink metrics are determined to meet the user requirements IAW Appendix E.

NOTE: If the BLOS voice testing is applicable to the data communication system and the receiver sensitivity for voice is equal to or less than the data sensitivity, then a duplicate BLOS data test is not required.
APPENDIX D

IFF QUALIFICATION REQUIREMENTS

1. United States Government (USG) military aircraft are required to comply with the DoD AIMS process for IFF certification. The DoD AIMS controls the DoD's Mode S addresses, which are required for civil airspace. The DoD AIMS certification process requires three levels of testing; the DoD AIMS 03-1101 is the transponder box level test which culminates into a box-level certification. The DoD AIMS 03-1102/1103 are aircraft integration ground and flight tests respectively. Successful integration testing culminates into an aircraft-level certification for all aircraft of that configuration. Successful completion of the DoD AIMS certification process also certifies civil surveillance modes in addition to IFF modes.

2. For IFF transponders that do not carry a DoD AIMS 03-1000B certification (example; DoD AIMS 03-1000A certified), and have ADS-B Out capability, refer to ADS-B Out AQP (referenced in 2.2.2 of this document) for method of compliance.

3. For IFF transponder installations not in USG military aircraft (Example; Foreign Military Sales (FMS), Department of Homeland Security (DHS), Custom Border Patrol (CBP), National Guard) the DoD AIMS test plans (1101/1102/1103) still need to be utilized for compliance criteria (DoD AIMS certification not required). All test plans and results shall be submitted, reviewed and approved by CCDC AvMC (not by DoD AIMS).

4. For non-IFF transponder installations (civil only), compliance to the following civil requirements is mandatory:

   a) Applicable component level requirements:

   DO-181() & TSO-c112() for civil modes

   DO-260() & TSO-c166() for ADS-B

   b) Applicable integration level documents:

   AC 27-1() or AC 29-2() for rotorcraft civil modes

   AC-23-8() or AC-25-7() for FW civil modes

   AC 20-165() for ADS-B
APPENDIX E

DATALINK METRICS

There are multiple types of datalinks for flight control, payload, sensor, telemetry, etc. These datalinks utilize different waveforms and frequencies for their application. To characterize the airworthiness of these datalinks, CCDC AvMC uses the following metrics for both LOS and BLOS:

Note: The following are provided as metrics for an acceptable datalink for the function required, however, other quantifiable metrics may be used to meet the performance requirements.

Availability- The geographic range of the RF signal that provides the datalink capability.

Error Rate- The number of erroneous data elements relative to the total number of elements. The error rate is calculated after all error corrections have been performed. Examples include bit error rate, message error rate, block error rate, etc.

Latency- The time interval from transmission of the signal to the reception of actionable data elements. This metric encompasses error correction, encryption, computations, etc.

Reliability- The probability of which the system provides datalink capability based upon the criticality of the function, quantified as Mean Time Between Failure (MTBF).

The minimum performance requirements for the datalink performance metrics shall be derived from the System Safety Analysis. The System Safety Analysis shall cover all datalink modes and waveforms applicable for airworthiness.
APPENDIX F

DELIVERABLES

The following DiDs shall be utilized to define deliverables to the USG:

Test Plans shall be provided IAW DI-NDTI-80566.
Test Procedures shall be provided IAW DI-NDTI-80603.
Test Reports shall be provided IAW DI-NDTI-80809.
Analyses shall be provided IAW DI-MISC-80711.