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ADS-45-HDBK
19 DECEMBER 2005

SUPERSEDING
ADS-45
JUNE 1993

AERONAUTICAL DESIGN STANDARD HANDBOOK

DATA AND TEST PROCEDURES FOR AIRWORTHINESS RELEASE

FOR

U.S. ARMY HELICOPTER ARMAMENT TESTING (GUNS, ROCKETS, MISSILES)

This handbook is for guidance only.
Do not cite this document as a requirement.

AMSC N/A FSC 10GP

FOREWORD

1. This handbook is approved for use by the U.S. Army Research, Development and Engineering Command and is available for use by all departments and agencies of the Department of Defense.

2. This handbook covers the data and test procedures that must be met to obtain an Airworthiness Release to flight test armament on Army aircraft. Major additions to this revision include Safety-of-Flight analyses and ground tests, airworthiness reviews and software procedures. It also includes format changes to comply with MIL-STD-967, Department of Defense Standard Practice for Defense Handbooks Format and Content.

3. Comments, suggestions, or questions on this document should be addressed to Commander, U. S. Army Research, Development and Engineering Command, Aviation and Missile Research, Development and Engineering Center, ATTN: AMSRD-AMR-SE-TD-ST, 5400 Fowler Road, Huntsville, AL 35898-5000 or emailed to WilliamSmith@rdec.redstone.army.mil. Since contact information can change, verify the currency of this address information using the ASSIST Online database at http://assist.daps.dla.mil/online/start/.

4. Technical questions may be addressed to the following office:

U.S. Army Aviation and Missile Research, Development and Engineering Center
Redstone Arsenal
ATTN: AMSRD-AMR-AE-S-W
Building 4488, Room C-316
Huntsville, AL 35898-5000
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DATA AND TEST PROCEDURES FOR AIRWORTHINESS RELEASE
FOR U.S. ARMY HELICOPTER ARMAMENT TESTING (GUNS, ROCKETS, MISSILES)

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DATE: 12/19/05

Certification Record

Board date: _____

Document Identifier and Title:

ADS-45-HDBK, Aeronautical Design Standard Handbook, Data and Test Procedures for Airworthiness Release for U.S. Army Helicopter Armament Testing (Guns, Rockets, Missiles)

Rationale for Certification:

Decision:

General Type	**Decision (√)**	**Certification**
Specification		Performance
		Detail
Standard		Interface Standard
		Standard Practice
		Design Standard
		Test Method Standard
		Process Standard
Handbook	√	Handbook (non-mandatory use)
Alternative Action		

	Concur	Nonconcur	Date
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DATA AND TEST PROCEDURES FOR AIRWORTHINESS RELEASE FOR U.S. ARMY HELICOPTER ARMAMENT TESTING (GUNS, ROCKETS, MISSILES)

1.0 SCOPE. This handbook establishes guidelines for data and test procedures, that should be completed prior to the issuance of a Contractor Flight Release (CFR) or Airworthiness Release (AWR) to conduct flight testing of armament on U.S. Army aircraft. A CFR/AWR is required for aircraft ground firing tests with the rotors turning, and for aircraft flight tests, both non-firing (captive carriage) and firing. The guidelines include documentation on armament configuration/design, analyses, component tests and aircraft ground tests. The documentation is required so the Government can conduct an airworthiness assessment in order to ensure that U.S. Army aircraft are safe to flight test. The requirements should be tailored based on the nature, magnitude, complexity and integration risk associated with the new or modified armament system. The difference between an "airworthy" system and a "qualified" system is the degree to which the system meets specification requirements and provides the system "performance" expected by the user. For a tutorial on the overall helicopter airworthiness qualification process, including flight releases, see ADS-51-HDBK. For purposes of this handbook, the terms "armament" and "weapon" are interchangeable.

2.0 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 by this handbook.

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.

JSSG-2001B	Air Vehicle
JSSG-2010-7	Crew Systems, Crash Protection Handbook
MIL-A-8591	Airborne Stores, Suspension Equipment and Aircraft-Store Interface (Carriage Phase); General Design Criteria
MIL-E-7016	Electrical Load and Power Source Capacity, Aircraft, Analysis of
MIL-STD-461	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-704	Aircraft Electric Power Characteristics
MIL-STD-810	Test Method Standard for Environmental Engineering Considerations and Laboratory Tests
MIL-STD-882	Standard Practice for System Safety
MIL-STD-1289	Airborne Stores, Ground Fit and Compatibility Requirements
MIL-STD-1425	Safety Design Requirements for Military Lasers and Associated Support Equipment
MIL-STD-1472	Human Engineering
MIL-STD-7080	Electric Equipment, Aircraft, Selection and Installation
MIL-HDBK-1763	Aircraft/Stores Compatibility: Systems Engineering Data Requirements and Test Procedures

Copies of the above specification, standards, and handbooks are available from the Standardization Document Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094 or online at the following web site: http://assist.daps.dla.mil/online/start/.

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.

ADS-37A-PRF	Electromagnetic Environmental Effects (E3) Performance and Verification Requirements
ADS-51-HDBK	Rotorcraft & Aircraft Qualification Handbook
ADS-20-HDBK	Armament and Fire Control System Survey for U.S. Army Aircraft
ADS-62-SP	Data and Test Requirements for Airworthiness Release for Helicopter Sensor Data and Testing Requirements in Development Phase
FMASAP: 1-1	AMRDEC Software Engineering Directorate (SED), Software Engineering Evaluation System (SEES), Volume 5, Special Assessment Procedure for Software Failure modes, Effects and Criticality Analysis
Aviation Policy Memorandum 03-02	Program Executive Officer (PEO), mail symbol SFAE-AV PI, Risk Management Process
TR-RD-TE-97-01	Electromagnetic Environmental Effects Criteria and Guidelines for EMRH, EMRO, Lightning Effects, ESD, EMP, and EMI Testing of US Army Missile Systems.

Copies of the above other government documents, drawings, and publications are available from the U.S. Army Research, Development and Engineering Command (RDECOM), Aviation and Missile Research, Development and Engineering Center (AMRDEC), Aviation Engineering Directorate, Redstone Arsenal, Alabama 35898.

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein.

Institute of Electrical and Electronics Engineers (IEEE)

IEEE J-STD-016	Standard for Information Technology Software Life Cycle Processes Software Development

Copies of this document may be obtained from the Institute of Electrical and Electronics Engineers Operations Center, 445 Hoes Lane, Piscataway, NJ 08854-1331 or online at the following web site: http://www.ieee.org

Society of Automotive Engineers (SAE)

SAE AS50881	Wiring, Aerospace Vehicle

Copies of this document may be obtained from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096 or online at the following web site: http://www.sae.org

International Soeiety of Allied Weight Engineers

SAWE RP7	Weight and Balance Control Data (for Airplanes and Helicopters) Society of Allied Weight Engineers Recommended Practice 7

Copies of this document may bc obtained from the Society of Allied Weight Engineers (SAWE), 5530 Aztec Drive, La Mesa, CA 91942-2110 or online at the following web site: http://www.sawe.org

3.0 DEFINITIONS.

3.1 Acronyms and abbreviations.

ADS	Aeronautical Design Standard
AIL	Avionics Integration Lab
AFCSS	Armament and Fire Control System Survey
AMCOM	Aviation and Missile Command
AMRDEC	Aviation and Missile RDEC
AMSC	Acquisition Management Systems Control
AUR	All-Up-Round
AWR	Airworthiness Release
CAD	Computer Aided Design
CE	Conducted Emissions
CFE	Contractor Furnished Equipment
CFR	Contractor Flight Release
c.g.	center of gravity
CS	Conducted Susceptibility
CSCI	Computer Software Configuration Item
DID	Data Item Description
DoD	Department of Defense
DoDISS	Department of Defense Index of Specifications and Standards
E3	Electromagnetic Environmental Effects
EED	Electro-Explosive Device
EID	Electrically Initiated Device
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EMP	Electromagnetic Pulse
EMRH	Electromagnetic Radiation Hazard
EMRO	Electromagnetic Radiation Operational
EMV	Electromagnetic Vulnerability
ESD	Electrostatic Discharge
ETV	Eject Test Vehicle
FFDR	First Flight Design Review
FMASAP	Failure Modes Analysis Special Assessment Procedure
FOD	Foreign Objeet Damage
FRR	Firing Readiness Review
GFE	Government Furnished Equipment
HDBK	Handbook
HERO	Hazards of Electromagnetic Radiation to Ordnance
IEEE	Institute of Electrical and Electronics Engineers
IS	Interface Standard
JSSG	Joint Serviee Specification Guide
MMI	Man-Machine Interface
PEO	Program Executive Office

PRF	Performance
RDEC	Research, Development and Engineering Center
RDECOM	Research, Development and Engineering Command
RE	Radiated Emissions
RS	Radiated Susceptibility
SAE	Society of Automotive Engineers
SAR	Safety Assessment Report
SAWE	Society of Allied Weight Engineers
SDZ	Surface Danger Zone
SIL	Software Integration Lab
SOF	Safety of Flight
SP	Standard Practice
SVD	Software Version Description
UAV	Unmanned Aerial Vehicle
USARDECOM	United States Army Research, Development and Engineering Command
WCA	Warnings, Cautions and Advisories
WILI	Weapon Inhibits, Limits and Interrupts

4.0 GENERAL REQUIREMENTS. Drawings, data, Computer Aided Design (CAD) models, software documents or other documentation should be provided according to the following:

4.1 Armament description and installation. Submit functional diagrams that show and describe all components of the entire armament system/subsystem. These records should identify each item of the system/subsystem and should include the functional relationship and purpose of the items. The interconnections to systems, such as hydraulic, pneumatic, and electrical, should be shown. Structural attachment details must be provided and all loaded joints clearly shown. Mounting details depicting the equipment to bracket, pallet, or rack attachments and bracket, pallet, and rack attachments to the aircraft structure are needed. Electrical schematics and wire diagrams should be provided, using SAE AS50881 and MIL-STD-7080 as guides.

4.2 Location of armament. Submit equipment installation and arrangement drawings that show the location of all major items of armament equipment for which provisions have been made and that show the location of exterior equipment.

4.3 Electrical installation. Drawings, sketches and block diagrams are required which describe the locations and interconnections of the armament system components and flight test instrumentation throughout the helicopter, as well as the routing, support and protection of associated wires, wire harnesses and cables. Schematics and wire diagrams are also required which should include interconnections among the newly added equipment, as well as with existing aircraft equipment including electrical power sources. Failure analyses should be provided for the interfaces with existing aircraft circuits. Detailed requirements are the identification of shielded wires, overbraids, shield and overbraid terminations, points of electrical bonding, wire types used, wire gauges, wire temperature ratings, details regarding harnesses and bundles of wires and cables, circuit breakers (including their ratings and locations), and power bus identification. This data will be used to evaluate electromagnetic environmental effects (E3) integrity as well as evaluate adequacy of circuit protection against electrical faults in the newly added/modified equipment.

4.4 Software description. Software documents or updates to the existing documents must be submitted that are necessary for the armament operation and safety, and its effective safe aireraft integration. If other aireraft subsystems are affected by the integration, the relevant interfacing system documents should be updated. The documentation should describe the architectural design and detailed design necessary to implement the software. The Software Version Description (SVD) should identify and describe the software version for each Computer Software Configuration Item (CSCI). Problem Change Reports (PCR) should log each software, hardware and documentation problem found during system integration testing. The proposed solution and corrective action taken should also be logged. See IEEE J-STD-016 for guidance.

4.5 Equipment furnished by contractor. Contractor-Furnished-Equipment (CFE) armament design data are required when CFE armament equipment or systems, or modification of Government-Furnished-Equipment (GFE) is used in the eonfiguration to be tested.

5.0 DETAILED REQUIREMENTS. In addition to the data described in section 4.0, this section includes the performance of analyses and tests prior to issuance of the AWR. If any required analysis or test is found unaceeptable by the Government, the Government may require additional information, re-test, limit thc planned scope of flight tests, or place restrictions or limitations in the AWR, or disapprove the AWR.

5.1 Analyses. The scope of analyses required prior to an AWR for ground test with the rotors turning or flight test depends on the nature, magnitude, complexity and risk associated with the new or modified armament system. The scope also depends on the nature and extent of the tests that require the AWR. For example, a major event such as an Armament and Fire Control System Survey (AFCSS) of a new aircraft/armament suite would require most or all the analyses specified herein. See ADS-20-HDBK for guidance on an AFCSS. On the other hand, a modification of an existing armament on an existing aircraft would require far less analyses.

5.1.I Safety Assessment Report (SAR)/hazard analysis. A SAR, which includes hazard analysis for both hardware and software, is required to show that there is no residual hazard and that the aircraft integrated weapon system is certified safe to flight test. The environment induced by the armament on the aircraft, and by the aircraft on the armament, must not adversely affect Safety-of-Flight (SOF) of the aircraft and safety of the crew, troops and maintenance personnel. Armament systems/subsystems may use the safety criteria of ADS-51-HDBK for guidance.

All known hazards and their ratings should be identified using MIL-STD-882 and the Program Executive Office (PEO) Aviation Policy Memorandum Number 03-02 (Risk Management Process) or applicable PM safety management process or plan. Safety precautions and hazard mitigation techniques should be provided. The analyses should include but should not be limited to the following:

a. All possible causes of premature or inadvertent armament firing and stores jettisoning, including electrically initiated devices (EID) and electro-explosive devices (EED).
b. Hangfire of guns, rockets, missiles, and mines.
c. Potential effects on the crew from munitions exhaust gas and noise levels.
d. Aircraft effects of munition propellant combustion products, blast effects and potential foreign object damage (FOD) caused by debris generated by weapon firing. The engine and drive system performance transients generated by these conditions should be estimated, including temperature and pressure distortion effects of gas ingestion through engine inlets. Any engine surges and resulting torque spikes must be safe.
e. Jettison of rocket pods, missiles, launchers, and other external/internal stores.
f. Armament firing footprint and safety fan for firing from hovering and moving helicopter.
g. Aircraft safe firing envelope considering all aircraft flight maneuvers/launch conditions. Any firing restrictions, misfire situations, duty cycles, warnings, cautions and advisories (WCA) should be defined.
h. Minimum separation time between firing two different weapons.
i. Pre-detonation of a round of ammunition within a gun system.
j. Safe exhaust from the aircraft or containment of ammunition cases/links during firing of gun systems.
k. Sufficient ventilation in the proximity of gun systems to prevent the accumulation of an explosive gas mixture from gun gases.
l. Loading and unloading of ordnance.
m. Potential for aircraft self-damage due to the down-range detonation of munitions launched by the test aircraft; commonly referred to as "safe escape".
n. Safe arming – assessment of minimum safe arming distance, fuze arm time settings and "safe and arm" devices to protect the firing aircraft from early detonation of munitions.
o. Armament static and dynamic clearances from worse case rotor blade position, aircraft surface and aircraft components. See MIL-STD-1289 for guidance.
p. Any crashworthiness degradation to the aircraft and crew/troops due to the armament installation. Special attention should be given to any potential occupant strike hazard from sighting equipment or egress blockage. See JSSG-2010-7 for guidance.
q. Any degradation to the aircraft sensor system, including crew vision, night vision or night vision goggles and other devices. See ADS-62-SP for guidance.
r. Potential hazards due to the use of lasers or interfaces with lasers. See MIL-STD-1425 and MIL-STD-1472 for guidance.
s. Potential hazards due to inadequate electrical bonding and grounding, such as shock hazards, inadvertent ignition of ordnance or flammable vapors, and failure of circuit protection devices.
t. Safe operation on or in close proximity to naval ships.
u. Potential hazards due to safety-critical hardware/software interfaces.

5.1.2 Weight and balance analysis. This analysis should show accurate and complete weight and balance calculations for the armament system. Tables should include the weights, moments of inertia, and center of gravity (c.g.) for armament, as well as weights empty, gross weights, and c.g. for aircraft. See SAWE RP7 for guidance. Formatting should be in accordance with the applicable aircraft operator's weight and balance chapter.

5.1.3 Loads and stress analysis. This analysis should be conducted on the armament, internal and external stores, mounts/launchers, and the aircraft support structure. It should be performed for all critical conditions throughout the aircraft/armament operational envelope, including takeoff and landing, jettison, and firing conditions. Crashworthiness should be assessed using the aircraft system requirements. This analysis should consider the structural loading effects of the armament on the aircraft and support structure, and the effects of the aircraft and support structure on the armament. For crew-served weapons (such as door guns), crew handling loads should be considered; e.g. leaning and pushing. The analysis should also include munition hangfire conditions. See MIL-A-8591 for guidance on aircraft stores, stores racks and interfaces. Guidance on helicopter structural integrity is contained in ADS-51-HDBK.

5.1.4 Preliminary dynamic analysis. A preliminary dynamic analysis should be performed to determine the fundamental dynamic properties of the armament system/subsystem. These properties should include, as a minimum, but should not be limited to: (1) the resonant frequencies, damping, and mode shapes of the installed system; (2) the forced response of the installed system with the forcing frequencies of the host equal to the primary forcing frequencies of 1P, nP, 2nP, 3nP, and 4nP (where n = number of blades, P = rotor angular velocity); and (3) the installed system dynamic effect on the aircraft.

5.1.5 Electrical load analysis. Electrical loads analysis data should be prepared using MIL-E-7016 as a guide. The analysis may be presented as an update to an existing approved electrical loads analysis. The purpose of the analysis is to demonstrate that adequate electrical power is available for the various modes of operation of both the armament system and the aircraft. (Most Army aircraft have an electrical loads analysis which has already been submitted to the airworthiness authority, and it may serve as a baseline to such an update.) In the event flight test instrumentation is also being installed on the test aircraft, then the update must include that equipment. Updates may be submitted as letter reports with reference to the existing electrical loads analysis; i.e., a formal revision to the report is generally not necessary.

5.1.6 Electromagnetic compatibility (EMC) analysis. Analysis should address potential interference effects of the new or modified armament system on critical aircraft systems. The effects might be influenced by the duration and timing of armament system operations and the recovery times of aircraft equipment that could be upset or damaged by such EMI. Aircraft system operations should also be analyzed with respect to safety critical effects on the armament system. Analysis should also substantiate that the armament is compatible with aircraft power furnished using MIL-STD-704. (The specific revision of MIL-STD-704 that applies is dependent on which aircraft model is being used.) Analyses should pay particular attention to electrical transients caused by armament system operations. Results of these analyses should be considered during the planning of the EMC test of paragraph 5.2.1.3; e.g., it might be appropriate for the electrical power buses to be monitored for the presence of interfering and, possibly, damaging transient effects. The analytical report should summarize how the results of the analysis have influenced the installation design and subsequent E3 testing.

5.1.7 Electromagnetic vulnerability (EMV)/hazards of electromagnetic radiation to ordnance (HERO) analysis. The flight test area must be surveyed for electromagnetic emitters with respect to helicopter operations. The results should be analyzed in the context of armament system EMI susceptibility data and/or helicopter platform EMV and HERO data. The intent is to minimize the risk of an unacceptable response or malfunction of either the armament or an aircraft system that may jeopardize aircraft safety, the safety of ground systems and personnel, or adversely affect the flight test program. Full use will be made of susceptibility test data obtained previously on the armament system or helicopter platform; e.g., EMV and HERO data at the aircraft level (reference paragraphs 4.4 and 4.6.1 of ADS-37A-PRF) and RS103 data at the component level (reference paragraph 4.2 of ADS-37A-PRF). Where such data are not available, the use of Electromagnetic Radiation Ordnance (EMRO) and Electromagnetic Radiation Hazard (EMRH) data for the armament system should be considered (reference TR-RD-TE-97-01).

5.1.8 Radiation hazards to personnel analysis. Electromagnetic radiation data (frequency, antenna patterns and effective radiated power) must be provided for any newly added transmitters and antennas associated with the armament system (or flight instrumentation). The analysis will include evaluation of potential hazards to operating/maintenance personnel. Results of the analysis will also include descriptions of design features and/or procedures that will be put in place to prevent harmful radiation from injuring personnel. See paragraph 3.6.3 of ADS-37A-PRF.

5.1.9 Electrostatic discharge (ESD)/lightning hazards analysis. The ESD and lightning hazards (reference paragraphs 3.7 and 3.8 of ADS-37A-PRF) must be analyzed with respect to inadvertent ignition of safety-critical ordnance. Weapon round test data might be available for mature weapon systems that would be pertinent to these analyses. These hazards are generally addressed through design and operational constraints prior to the initiation of the qualification process.

5.1.10 Clearance analysis. A clearance analysis should be provided to document and ensure safe clearance between the rotors/fuselage and the weapons trajectories using MIL-STD-1289. The analysis should include captive carriage, firing trajectories, debris trajectories/impingement, jettison and the aircraft's landing operations.

5.1.11 Missile/rocket launch transient analysis. A launch transient analysis should assess the potential interaction of the aircraft, launcher and missile/rocket during the launch phase. The purpose of the analysis is to substantiate that there is little or no risk of an unsafe separation from the aircraft or risk of an errant missile/rocket that can exceed the test site's surface danger zone (SDZ). The analysis should include, but not be limited to, the aircraft's natural and induced environment on the munitions at launch, aircraft launch constraints and data latency, store payload configurations, structural stiffness of the aircraft/store system (aircraft, weapon pylon, store rack, munition, etc.), freeplay between store and aircraft, and transient effects on the munition's guidance and control subsystem. In addition to aircraft safety, separation acceptance criteria also require that the transient store motions do not unacceptably degrade the weapon's ability to perform its mission. The analysis cannot be used under every circumstance, thus prior to performing this analysis, it should be approved by the procuring activity.

5.1.12 Blast overpressure analysis. A blast overpressure analysis should be provided that describes the armament firing effects on fuselage, structure, engines and crew, including their day and night vision. The analysis should also address effects like chemical composition, debris, flames, smoke, acoustic pressure, and temperature.

5.1.13 Preliminary human engineering analysis. A preliminary human engineering analysis should be provided that examines all effects which could impair the crew, their sight and ability to fly safely. The analysis should include consideration of blast overpressure, noise, toxic emissions, and expected gas concentration in the cockpit. Consideration should also be given to Man-Machine Interface (MMI) and ease of operation for crew and maintenance personnel. See MIL-STD-1472 for guidance.

5.1.14 Software integration analysis. Software integration analysis, including aircraft data bus communications, should be performed to ensure proper armament functioning, safety and no adverse effects on other aircraft subsystems. Special attention should be placed on weapon inhibits, limits and interrupts (WILI). Weapon inhibits should be differentiated between performance and safety constraints. The software should be configured to allow the aircraft crew to override the performance inhibits, but not the safety inhibits. Safety-critical hardware/software interfaces will require the application of a failure modes, effects and criticality analysis during design. See FMASAP: 1-1 for guidance.

5.1.15 Environmental analysis. A SOF environmental analysis (MIL-STD-810) should be conducted to ensure that no environmental hazards exist during flight testing. Potential armament effects and failure modes due to environmental conditions should be assessed. Any environmental/flight test restrictions or precautions should be provided for insertion in the flight test AWR. See paragraph 5.2.1.1 for the minimum SOF environmental test requirements.

5.1.16 Unmanned Air Vehicle (UAV) integration analysis. Additional safety assessment will be required if the helicopter is used as a UAV or if the manned helicopter teams with a UAV or has a UAV integrated within the ownship. Any aircraft and crew safety implications should be identified and mitigated. Factors to assess should include the loss of data link or loss of control of the UAV or its weapon system, if the UAV is armed. See JSSG-2001B for guidance on air vehicle/UAVs.

5.2 Tests. The scope of tests required prior to an AWR for flight test depends on the nature, magnitude and complexity of the new or modified armament system. The results of the analyses conducted using paragraph 5.1 might necessitate the need for additional tests beyond those required herein. For example, missile launch transient tests might be required from a ground test stand prior to an AWR for the first aircraft launch of a new or modified missile. Another example is that safe separation tests (jettison and launch) might be required, using dummy rounds and Eject Test Vehicles (ETV, a missile without an explosive warhead but with correct mass properties), prior to an AWR for the first aircraft launch of an All-Up-Round (AUR)."

5.2.1 SOF tests. The SOF tests should consist of limited environmental and E3 tests. However verification by analysis or similarity might be allowed. Related analysis requires evaluation by the Government. Verification by similarity requires the submission of a similarity analysis report to the Government.

5.2.1.1 Environmental tests. Temperature (operational), Vibration, Shock Crash Hazard (breakaway or breakup hazard to aircraft or crew), Altitude and Explosive Atmosphere test data using MIL-STD-810 will demonstrate the flight worthiness of the armament system and associated flight test instrumentation.

5.2.1.2 Electromagnetic interference (EMI) test. According to ADS-37A-PRF (paragraphs 3.2 and 4.2), the minimum SOF EMI data required is conducted and radiated emission data (i.e., CE101, CE102 and RE102 of MIL-STD-461). If the armament system contains a transmitter or receiver, then CE106 will also be applicable. For flight and safety-critical equipment, conducted and radiated susceptibility data (i.e., CS101, CS114, CS115 and RS103 of MIL-STD-461) are also required. If the armament system contains a safety-critical transmitter or receiver, then CS103, CS104 and CS105 will also be applicable. These data are required to support planning of EMC testing of the armament system on the helicopter platform as well as enable evaluation of the susceptibility of the installed armament system in the electromagnetic environment of the test area where the armament system will be evaluated. There is a two-fold concern: (1) that the armament system does not cause unacceptable interference to other aircraft systems, and (2) that the armament system does not fall into an unsafe condition due to other sources of interference, whether onboard or external to the helicopter platform. Conducted and radiated data may also be required for selected flight test instrumentation, depending on past history with usage of that instrumentation on the helicopter platforms. Tailoring of these requirements may be justified to take into consideration how the armament is electrically connected to the aircraft and the timing of its operations relative to aircraft operations, which could mitigate the effects of EMI.

5.2.1.3 EMC test. The contractor should conduct an SOF EMC test using paragraph 4.3.1 of ADS-37A-PRF, prior to first flight, including establishing safety margins for safety-critical ordnance using paragraph 3.1 of ADS-37A-PRF. The purpose is to demonstrate (qualitatively) that the operation of the new or modified armament system, existing aircraft subsystems, and flight test instrumentation do not result in an unacceptable response or malfunetion that may jeopardize aircraft safety, the safety of ground systems and personnel, or adversely affect the flight test program. Bonding measurements should also be performed using paragraph 4.10 of ADS-37A-PRF prior to the EMC test for all newly installed and re-installed equipment to minimize risk of an EMC test failure or operational hazard.

5.2.2 Software verification and integration tests. Software verification tests should be conducted on each CSCI to ensure performance, interface and safety. Software integration tests should be conducted in an Avionics Integration Lab (AIL), Software Integration Lab (SIL) or on a "hot bench". The objectives are to ensure that the armament and interfacing subsystems function as an integrated system, to validate the WILIs, and to prevent degradation to other aircraft subsystems. All safety-related PCRs should be resolved prior to flight test.

5.2.3 Aircraft ground test. Prior to flight test, a Form, Fit and Function Test of the installed armament system, including fire control, should be conducted with the aircraft on the ground in order to check the integrated system. Ground firing tests may be required to verify armament functionality, trajectory clearance, debris pattern and clearance, blast overpressure, gas accumulation and noise level in the cockpit/cabin. See MIL-HBBK-1763.

5.2.4 Aircraft non-firing flight test. Non-firing flight test should be conducted prior to flight firing test. It should consist of captive-carriage tests with captive flight trainers, training missiles and dummy ordnance in lieu of live ordnance. The non-firing tests should confirm safe functionality prior to the start of airborne firing tests.

5.3 Reviews that support Airworthiness Releases (AWRs). Reviews may be conducted to support the issuance of an AWR or Contractor Flight Release for flight test of armament, whether the tests are firing or non-firing captive carriage. The reviews are at the discretion of the procuring activity and should be specified in the contract. Their performance, formality or informality, depends on the complexity/risk associated with the new or modified armament system and its aircraft integration. Lead-times for reviews and supporting data submission prior to flight test should be coordinated between the aircraft PM and the airworthiness authority.

5.3.1 First Flight Design Review (FFDR). The purpose of a FFDR is to substantiate that the new or modified armament system is ready and safe to conduct the first airborne non-firing test. The FFDR should be conducted at least thirty (30) days prior to the first armament captive carriage flight test (non-firing) for the purpose of issuing an AWR for the first flight test. Documentation resulting from the requirements of this ADS must be submitted to the Government at least thirty (30) days prior to the FFDR.

5.3.2 Firing Readiness Review (FRR). The purpose of a FRR is to substantiate that the new or modified armament system is ready and safe to conduct the first airborne firing test. The FRR is required to be conducted at least thirty (30) days prior to the first airborne firing of a new or major armament modification. Documentation

resulting from the requirements of this ADS must be submitted to the Government at least thirty (30) days prior to the FRR.

5.4 Flight test plan. A test plan for the AWR should be submitted which describes the armament flight tests, including flight maneuvers. The test plan scope will affect the Government's review of the documentation that supports the AWR, since safety is paramount. The ADS-51-HDBK may be used as a guide for specifying data collection, analysis, instrumentation and test equipment. The test plan should follow AWR/Contractor Flight Release (CFR) guidelines. Also see MIL-HDBK-1763 for guidance on armament stores.

5.5 Documentation. The contractor/vendor will provide complete documentation that addresses all the data, analyses and tests listed in this ADS, as tailored by the procuring activity. The documentation will enable Government representatives to judge the aircraft-integrated armament and to lay down a basis for granting an AWR for testing.

6.0 NOTES.

6.1 Intended use. This ADS is used to obtain required data, analyses and test documentation to substantiate the safety of a new or modified armament system prior to flight test on an Army aircraft. The documentation is used to support the preparation and staffing of an AWR or CFR for airborne test of armament. The focus of this ADS is on guns, missiles and rockets for manned aircraft. It does not contain any special provisions for "non-lethal weapons" and contains limited provisions for UAV and directed energy weapons. As these armament technologies become more mature, there might have to be additional provisions to insure safety and performance on Army aircraft. However, the AWR process will likely be quite similar. This ADS can also be used for the aircraft integration of other armament and related systems such as mine-dispensing systems, weapon carriage/release equipment, and weapon control systems.

6.2 Information documents. The following document is listed as a reference for information only, and is not mandatory.

AR 70-62 Airworthiness of Qualification of U.S. Army Aircraft Systems

Copies of the above document may be obtained from the following website: http://www.apd.army.mil

6.3 International standardization agreements. Certain provisions of this document are the subjects of international standardization agreements. Examples of international standardization documents are NATO STANAG 3899 and Air Standardization Coordinating Committee AIR STD 20/21, each for Airborne Stores Ground Fit and Compatibility Criteria. When preparing program requirements or statements of work, care should be taken to accommodate any required international standardization agreements.

6.4 Subject term (key word) listing.

Helicopter
Rotorcraft
Rotary Wing
Airworthiness Release
Flight Release
Armament, helicopter
Weapon, helicopter
Fire control, helicopter
Stores, helicopter