ADS-66-HDBK
29 May 2003
CAGE Code 81996

AERONAUTICAL DESIGN STANDARD

HANDBOOK

GUIDANCE FOR DATA FOR SAFETY OF FLIGHT AIRWORTHINESS RELEASE FOR HELICOPTER AIRCRAFT SURVIVABILITY EQUIPMENT (ASE)

AMSC N/A
DISTRIBUTION STATEMENT A. Approved for public release, distribution is unlimited.

AERONAUTICAL DESIGN STANDARD (ADS)

GUIDANCE FOR DATA FOR SAFETY OF FLIGHT AIRWORTHINESS RELEASE FOR HELICOPTER ASE

FUNCTIONAL DIVISION:

LEWIS E. WILLIAMS
Chief, Mission Equipment
Division

SUBMITTED BY:

Dennis S. Powelson
Director of Aviation Engineering

APPROVED BY:

Phillip W. Hodges
AMCOM and PEO, Aviation
Standards Executive

DATE: 17 JUL 03

Board date: _____
Document Identifier and Title:

ADS, Aeronautical Design Standard, Handbook, GUIDANCE FOR DATA FOR SAFETY OF FLIGHT AIRWORTHINESS RELEASE FOR HELICOPTER ASE.

Prepared by: Ozlem Williams

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
AMCOM Standardization Branch Chief William J. Smith	✓		6/13/03
Division Chief-Mission Equipment Division Lewis E. Williams	✓		6/24/03
Director, Aviation Engineering Dennis S. Powelson	✓		6/27/03
AMCOM and PEO, Aviation Standards Executive Phillip W. Hodges	✓		17 JUL 03

(AR)

TABLE OF CONTENTS

PARAGRAPH

DATA AND TEST GUIDANCE FOR SAFETY OF FLIGHT AIRWORTHINESS RELEASE FOR HELICOPTER ASE

1.0 SCOPE. This handbook provides guidance for the ASE (Aircraft Survivability Equipment) data submittals, which will be completed prior to issue of a Safety of Flight (SOF) Release for testing of new/modified ASE equipment installed on U.S. Army aircraft. A combination of analyses, component testing, and ground testing will be used to issue the first release to test the system, which should be stipulated in each contract. The ADS-66 handbook would assist the contractor in determining the exact data/reports needed to assure airworthiness of the system.

ASE is generally defined as any piece of equipment that aids in the self-defense of an aircraft from ground-to-air or air-to-air threats, by limiting the ability of the threat to engage the aircraft. In broad terms, this includes missile detectors, threat jammers, and countermeasure dispensers. ASE generally does not encompass items that are intended to increase combat effectiveness, such as guns, fire control radars, friend-or-foe identification systems, weather radars, etc.

2.0 APPLICABLE DOCUMENTS.

2.1 General. The documents listed in this section are not necessarily all of the documents referenced herein, but are the ones that are needed in order to fully understand the information provided by this handbook.

2.2 Government documents.

2.2.1 Specifications, Standards, Guides, and Handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the Aeronautical Design Standard (ADS).

MIL-STD-810	Environmental Test Methods and Engineering Guidelines
MIL-STD-1472	Human Engineering Design Criteria for Military System, Equipment, and Facility
MIL-STD-464	Electromagnetic Environmental Effects Requirements for Systems

MIL-STD-461	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-E-7016	Electrical Load and Power Source Capacity Analysis
MIL-HDBK-1908	Definitions of Human Factors Terms
MIL-STD-3009	Lighting, Aircraft, Night Vision Imaging System (NVIS) Compatible
MIL-STD 7080	Selection and Installation of Aircraft Electronic Equipment
JSSG-2010-11	Emergency Egress Handbook
JSSG-2010-7	Crash Protection Handbook
JSSG-2010-1	Crew Systems Engineering Handbook
MIL-STD-882	System Safety Program Requirements

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein.

ADS-51-HDBK	Rotorcraft and Aircraft Qualification RAQ Handbook
ADS-37-PRF	Electromagnetic Environmental Effects Performance and Verification Requirements

(Unless otherwise indicated, copies of the above documents are available from the U.S. Army Aviation and Missile Command, Aviation Engineering Directorate, Redstone Arsenal, Alabama 35898.)

2.2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents, which are Department of Defense (DoD) adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation.

Society of Allied Weight Engineers (SAWE)

SAWE RP 7 SAWE Recommended Practice 7, Weight and Balance Control System (For Aircraft and Rotorcraft)

(Copies of the above specification may be obtained from the Society of Allied Weight Engineers (SAWE), 5530 Aztec Drive, La Mesa, CA 91942-2110.)

American National Standard for Safe Use of Lasers

ANSI Z136.1 American National Standard for Safe Use of Lasers, by the American National Standards Institute

(Copies of the above specification may be obtained from the ANSI, 11 West 42nd Street, New York, New York 10036.

2.2.4 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.

3.0 DEFINITIONS.

3.1 Abbreviations and Acronyms.

ADS	Aeronautical Design Standard
ASE	Aircraft Survivability Equipment
ANSI	American National Standard for Safe Use of Lasers
DoD	Department of Defense
DoDISS	Department of Defense Index of Specifications And Standards
EMI	Electromagnetic Interference
EMC	Electromagnetic Compatibility
NVG	Night Vision Goggles
RAP	Resonance Assessment Profile
SAWE	Society of Allied Weight Engineers
SOF	Safety of Flight
STE	Special Test Equipment

4.0 GENERAL GUIDANCE.

Drawings, optical schematics, and systems performance data should be provided according to the following:

4.1 Engineering Analyses. The following engineering analyses should be conducted:

4.1.1 Electrical Loads Analysis. An electrical loads analysis should use the guidance of MIL-E-7016. This analysis may be an update to an existing (baseline) electrical loads analysis. Per MIL-E-7016, the analysis should summarize the loads added and loads removed as a result of the addition of the ASE System.

4.1.2 Thermal Analysis. A thermal analysis should be conducted to indicate that thermal requirements of the ASE are compatible with the thermal environment of the platform.

4.1.3 Aerodynamic Analysis. An aerodynamic analysis should be conducted to determine the aerodynamic effect of the ASE components installed on the helicopter.

4.1.4 Structural Analyses. For the newly designed or modified components, the following analyses should be created/updated.

4.1.4.1 Fatigue Analysis. A fatigue substantiation analysis should demonstrate the impact of the ASE subsystem on component fatigue lives.

4.1.4.2 Loads and Stress Analysis. This analysis should be conducted for the newly installed equipment to verify that the new equipment meets or exceeds all aircraft system requirements.

4.1.5 Weight and Center-of-Gravity Analysis. Analysis of weight control should use the guidance of SAWE RP 7. The weight and center of gravity should remain within acceptable limits with the ASE installed.

4.1.6 Clearance Analysis. For any new/modified countermeasure dispensers, or for new types of countermeasure munitions, a clearance analysis should be performed to show that there is sufficient clearance (six inches or greater) from the aircraft structure when the munitions are launched/ejected.

4.1.7 Surrounding Equipment and Interoperability. Analysis should be used to show that the addition of the ASE system will cause no blockage or interference with other systems, and demonstrate that any negative effects are minimized.

4.1.8 Vibration Analyses. Analysis should be used to show that the newly installed equipment avoids the airframe critical frequencies.

4.1.9 Safety Assessment. All component tests and subsystem tests should be planned and conducted using the guidance of MIL-STD-882. A Safety assessment should be conducted to identify all hazards associated with the system, including the corrective action to either eliminate or reduce all hazards to an acceptable level. If the ASE contains a laser, the safety assessment should include an analysis of the emitted, scattered and reflected laser radiation to ensure safe operation. ANSI Z136.1 can be used as guidance.

4.1.10 Installation/Integration Analyses. This analysis should describe in detail the methods utilized to determine the optimum locations, design, installation, and test methods for the integration of the equipment onto the aircraft.

4.1.11 Human Factors Analyses. The following human factors analyses should be conducted if changes occur to the ASE controls and displays and/or the systems' interface with the crewmembers.

4.1.11.1 Gross Analysis of Tasks. This analysis should be performed for all mission scenarios where crew task loadings and coordination requirements approach maximum, MIL-HDBK-1908 can be used as guidance.

4.1.11.2 Crew Vision. Analysis and test should be used to demonstrate that vision required for safe flight is maintained during operation with and without Night Vision Goggles (NVG), only if configuration changes to the ASE controls and displays and/or the systems' interface with the crewmembers.

4.1.11.3 Lighting. Analysis and test should be used to demonstrate that the lighting requirements of MIL-STD-3009 are met. The test should include Normal Readability, Sunlight Readability, and NVG compatibility.

4.1.11.4 Emergency Egress. An emergency egress analysis should be conducted using the guidance of MIL-STD-1472. The JSSG-2010-11 may be used as a guide for this task.

4.1.11.5. Crashworthiness. A crashworthiness test should be conducted and JSSG-2010-7 may be used as a guide for this task.

4.1.11.6. Workload Analysis. A workload analysis should be conducted using the guidance of MIL-STD-1472. JSSG-2010-1 may be used as a guide for this task.

5.0 SAFETY OF FLIGHT GUIDANCE.

5.1 Test Methods. The handbook, ADS-51-HDBK, should be used as a guide for specifying data collection, analysis, instrumentation, and test equipment in the test specification.

5.2 Lab and Ground Testing. Lab and Ground tests should be conducted to substantiate safe and satisfactory ASE subsystem operation. Ground tests should be also conducted to verify safety of flight requirements. Required tests include, but are not limited to, the following:

5.2.1 Software Verification Testing. Component level and aircraft level software regression testing should be used to verify that any new or modified software does not adversely affect the safe operation of the aircraft.

5.2.2 Aircraft Handling Qualities/Performance Testing. Based on the aerodynamic analysis of paragraph 4.2.3, an aircraft handling qualities/performance flight test may be required to assess the impact on the aircraft of externally mounted ASE.

5.2.3 Environmental Conditions. Component level testing in accordance with MIL-STD-810 should be performed to verify correct operation throughout the range of conditions specified in the aircraft system specification and the environmental conditions needed for SOF are as follows:

5.2.3.1 Explosive Atmosphere. Analysis and/or testing in MIL-STD-810 should be used to demonstrate the ability of the ASE equipment to operate in a flammable atmosphere without causing an explosion.

5.2.3.2 Temperature/Altitude. Temperature and altitude testing per MIL-STD-810 should be performed to verify the safe operations of the ASE in these environments.

5.2.3.3 Vibration Testing. Component level vibration testing should be performed using MIL-STD-810 to verify that the safe operation of the ASE equipment in that environment.

5.2.4 Airframe Vibration Testing/Resonance Assessment Profile (RAP). Vibration testing should be performed with the ASE system installed on the aircraft to verify that the integration of the system met or exceeded all of the system to aircraft requirements.

5.2.5 Safety Of Flight (SOF) Electromagnetic Interference (EMI) Test. Component level EMI testing should be conducted to demonstrate that the ASE meets the EMI SOF requirements of MIL-STD-461 and MIL-STD-464. As a minimum, the following should apply:

a. All equipment and subsystems should be tested using CE101, CE102 and RE102 prior to flight.

b. All flight and safety critical equipment and subsystems should be tested using CS101, CS114, CS115, and RS103 prior to flight.

5.2.6 Safety of Flight (SOF) Electromagnetic Compatibility (EMC) Test (System Level). EMC SOF should be assured for each aircraft. Prior to the first flight, an EMC SOF Test should be conducted on the aircraft using ADS-37-PRF to ensure that the ASE system is electromagnetically compatible with other aircraft subsystems, prior to flight tests. This testing should consist of ground and flight testing.

a. Transmitters should be transmitted on each frequency to be used during the test program.

b. All flight critical and flight essential equipment and subsystems should be tested as victims versus all equipment that will be operated during the flight test program, including all flight test instrumentation.

c. Safety margins should be established for all safety critical ordnance prior to their use.

d. In-flight evaluation of all anomalies experienced during the ground portion of the testing as well as those equipment and subsystems that cannot be fully tested on the ground.

6.0 NOTES.

6.1 ASE Package Description and Installation. Drawings, schematics, and performance data should describe all items of the entire ASE systems/subsystems. The data should identify each item of the system/subsystem and should include the functional relationship and purpose of each item. A typical ASE installation may consist of any or all of the following: sensors/threat detectors, a control unit/main processor, an operator control panel/display, a jamming system, and a countermeasure dispensing system. The installation drawing packages should also include details of support items such as new/modified circuit breaker panels and any Special Test Equipment (STE). Documentation should be provided describing the interface between the new ASE equipment and existing platform avionics for aircrew warning, control, power, platform data, and integration with other equipment. The interconnections to systems, such as structural mounting surface, electrical, and optical requirements should be provided. The structural attachment details should be provided and all loaded joints clearly shown. Mounting details depicting the system/subsystem to brackets or pallets or rack attachments to the aircraft should be provided. Electrical schematics and wire diagrams internal to the system/subsystem and wire diagrams/cable connections should be provided. Electrical schematics/cable connectors, and wire run diagrams should be provided using MIL-STD 7080.