FOOT-POUND

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AERONAUTICS DESIGN STANDARD

STANDARD PRACTICE

DATA AND TEST REQUIREMENTS FOR AIRWORTHINESS RELEASE FOR HELICOPTER SENSOR DATA AND TESTING REQUIREMENTS IN DEVELOPMENT STAGE

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DATA AND TEST REQUIREMENTS FOR AIRWORTHINESSS RELEASE
FOR HELICOPTER SENSOR DATA AND TESTING REQUIREMENTS
IN DEVELOPMENT STAGE

FUNCTIONAL DIVISION _____

SUBMITTED BY: _____
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DATE: _____

Certification Record

Board Date: 29 June 2001

Document Identifier and Title:

ADS-62-SP, Aeronautical Design Standard, Standard Practice, Data and Test Requirements for Airworthiness Release for Helicopter Sensor Data and Testing Requirements in Development Stage

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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CONTENTS

1.0 SCOPE. This standard establishes design and documentation requirements which shall be completed prior to issue of a Flight Release or Airworthiness Release (AWR) to conduct helicopter Flight Testing on Pilotage and Target Acquisition/Designator System Sensors. It includes statements, analyses and preliminary analyses presenting the Pilotage and Target Acquisition Designation System/subsystem and guarantees a certain safety standard. The requirements may be tailored for each test.

2.0 APPLICABLE DOCUMENTS.

2.1 General. The documents listed in this section are specified in sections 3, 4, and 5 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3, 4, and 5 of this standard, whether or not they are listed.

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. 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 solicitation.

MIL-STD-461	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-464	Electromagnetic Environmental Effects Requirements for Systems
MIL-STD-810	Environmental Engineering Considerations and Tests
MIL-STD-1425	Military Lasers and Associated Support Equipment, Safety Design Requirements for
MIL-STD-1472	Human Engineering
MIL-E-7016	Electrical Load and Power Source Capacity, Aircraft, Analysis of
MIL-STD-7080	Selection and Installation of Aircraft Electronic Equipment
MIL-A-8591	Airborne Stores, Suspension Equipment and Aircraft Store Interface (Carriage Phase); General Criteria for

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. Unless otherwise specified, the issues are those cited in the solicitation.

ADS-37-PRF	Electromagnetic Environmental Effects (E3) Mangement, Design, and Test Requirements
AMCP 706-203	Engineering Design Handbook - Helicopter Engineering – Part Three – Quality Assurance

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 DoD adopted are those listed in the issue of DoDISS cited in the solicitation. Unless otherwise specified, the issues of the documents not listed in DoDISS are the issues of the documents cited in the solicitation.

SAE-AS-50881	Wiring, Aerospace Vehicle
SAWE-RP7	Weight and Balance Control Data (for Airplanes and Helicopters)

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 Acronyms use in this standard. The acronyms used in this standard are defined as follows:

ADS	Aeronautic Design Standard
AMCP	Army Material Command Pamphlet
AWR	Airworthiness Release
CFE	Contractor Furnished Equipment
DoDISS	Department of Defense Index of Specifications and Standards
EMI	Electromagnetic Interference
FLIR	Forward Looking Infra-red
GFE	Government Furnished Equipment
NOE	nap of the earth
SAE	Society of Automotive Engineers
SAWE	Society of Allied Weight Engineers

4.0 GENERAL REQUIREMENTS.

Electro-optical drawings, optical schematics, and systems performance data shall be provided according to the following :

4.1 Sensor package description and installation. Drawings, schematics, and performance data shall describe all items of the entire sensor systems/subsystems. The data shall identify by Governmental nomenclature, each item of the system/subsystem and shall include the functional relationship and purpose of the items. The interconnections to systems, such as structural mounting surface, electrical, and optical requirements shall be provided. Structural attachment details of the sensor turret system (Pilotage and Target Acquisition/ Designator) to the aircraft shall be shown. The structural attachment details shall be provided and all loaded joints clearly shown. Mounting details depicting the system/subsystem to brackets or pallets or rack attachments to the aircraft shall be provided. Electro-optical and optical description/analysis/diagrams shall be provided to indicate the performance requirements for safety are met (Pilotage/Laser subsystem). Electrical schematics and wire diagrams internal to the system/subsystem and wire diagrams/cable connections shall be provided. Electrical schematics/cable connectors, and wire run diagrams shall be provided using SAE-AS-50881and MIL-STD-7080 as guides.

4.2 Location of sensor package. Equipment installations and arrangement drawings showing the location of all major items of the sensor equipment for which provisions has been made and any exterior equipment shall be provided.

4.3 Equipment furnished to contractor. Contractor-furnished-equipment (CFE) sensor design/analysis/test design data, shall be required when such equipment is furnished as CFE Sensor equipment systems/subsystems, or if modification of the Government-Furnished Equipment (GFE) is made.

4.4 Analysis Requirements.

4.4.1 Safety statement/hazard analysis. Analysis of the helicopter design shall assure that all provided Pilotage/ Target Acquisition/Designation System/Subsystem are in accordance with the safety criteria of AMCP 706-203. Hazard analyses shall be prepared and submitted. This analysis data shall include, but not be limited to:

4.4.1.1 Pilotage night vision systems. Pilotage night vision systems such as Forward Looking Infra-red (FLIR) coupled to a helmet mounted display or helmet mounted night vision goggle with a pointing Fire Control System in the aircraft shall be designed and evaluated by analysis. The analysis shall provide sufficient field of view and resolution to allow safe flying of the aircraft in marginal light conditions and marginal weather and at nap of the earth (NOE) or above altitudes.

4.4.1.2 Laser rangefinder/designator system. The laser rangefinder/designator system in a stabilized turret shall be designed to meet the U.S. Army Laser Safety Office criteria. Laser systems installed on aircraft shall meet the safety requirements specified in MIL-STD-1425 and MIL-STD-1472. A safety analysis shall be performed to include, but not be limited to the following :

a) Laser beam divergence, and power for the 1.06 micron and Eye Safe selectable mode. The Eye Safe Mode must pass an safety analysis.
b) Safety interlocks on the high voltage laser electronics unit box (usually mounted off gimbal). Weight on wheels helicopter switch for disabling the possibility that the 1.06 micron laser may fire when near maintenance personnel. An override on the switch allows ground testing of laser functions provided all personnel has laser goggle protection (optical density of 4.0 or better).
c) A fail-safe switch shall be provided for selection of either 1.06 or 1.57 micron eye safe beam. A feedback sensor shall be used to determine if the correct selection switch has been activated.
d) A software inhibit shall control the laser field of regard (FOR) so the beam will not fire into any helicopter or turret obstruction. Laser energy shall not be reflected back into the pilots eye's.
e) The laser shall not randomly fire due to electromagnetic interference (EMI).

4.4.2 Aircraft strike analysis. Analysis shall demonstrate that crashworthiness has not been degraded below the requirements, or levels appropriate to the particular aircraft. (The hazards are defined within the airworthiness qualifications specifications (AQS) and Safety Assessment for each aircraft.) The analysis shall demonstrate that hazards do not exist because of potential strike areas due to sensor turret structure or any egress blockage by the sensor installation.

4.4.3 Mechanical load analysis. The mechanical load analysis shall demonstrate the structural integrity of the sensor turret itself and supporting structure on the aircraft. The expected loads shall not exceed critical limits and shall meet the requirements of AMCP 706-203.

4.4.4 Weights and balance report. This report shall show accurate and complete weight and balance calculations of the sensor system. Tables shall include the weight, moment of inertia, and center of gravity (c.g.) for the sensor system and sub systems, as well as weights empty, gross weights, and c.g. for the aircraft. Reporting shall be in accordance with SAWE-RP7.

4.4.5 Stress analysis. The stress analysis shall be performed in accordance with MIL-A-8591

for all critical conditions throughout the aircraft/sensor operational envelope, including takeoff and landing, This analysis shall consider the structural loading effects of the sensor system and mounting bracket on the aircraft , and the effects of the aircraft and mounting bracket on the sensor function.

4.4.6 Preliminary dynamic analysis. A preliminary dynamic analysis shall be performed to determine the fundamental dynamic properties of the sensor system/subsystem. These properties shall include, as a minimum, but not be limited to: (1) the resonant frequencies, damping, and the 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 weapon and host system.

4.4.7 Electrical load analysis. An electrical load and power source capacity analysis shall be prepared in accordance with MIL-E-7016. This analysis shall determine for each electrical system that adequate electrical sources are present for all system loading conditions under all operating conditions.

4.4.8 Clearance analysis. A clearance analysis shall prove that there is sufficient clearance between the rotors and the sensor packages and between the sensor system and the weapons trajectories. During landing operations in all environmental conditions the sensor package shall be provided necessary ground clearance to prevent any collision accidents.

4.4.9 Blast overpressure analysis. The blast overpressure analysis shall describe the effects on the sensor system/subsystems due to blast overpressure from firing the armament systems/subsystems. The launch effects from smoke, flames, and temperature deltas on the visual/infrared optics in the sensor system also shall be characterized to determine any operational effects on mission.

4.4.10 Preliminary human engineering analysis. This preliminary human engineering analysis shall give a prognosis of all affects which could impair the crew, their sight and ability to fly safely, concerning or caused by blast overpressure, noise, toxic emissions, and expected gas concentration in the cockpit. Consideration shall also be given to Man-Machine-Interface (MMI) and ease of operation for crew and maintenance personnel.

4.4.11 Electromagnetic design and analysis. The sensor package shall be designed and analyzed per the requirements of Aeronautical Design Standard (ADS) 37-PRF for electromagnetic interference and electromagnetic compatibility.

5.0 DETAIL REQUIREMENTS

5.1 Test specifications. The test specifications shall include a test plan to describe in detail how tests will be conducted and define also criteria for a suitable documentation of all realized tested The design handbook, AMCP 706-203, shall be used as a guide for specifying data collection, analysis, instrumentation, and test equipment in the test specification.

5.2 Explosive atmosphere. The test for an explosive atmosphere per MIL-STD-810 shall be performed on the new sensor boxes such as the laser high voltage system to prevent any possible ignition of gaseous aircraft fuel vapors in the close quarters of the storage areas in the helicopter.

5.3 Pilotage night vision systems. such as Forward Looking Infra-red (FLIR) with a helmet mounted display system or a helmet or body mounted night vision goggle, or helmet mounted displays (HMDs) alone shall be laboratory and flight tested to insure sufficient field of view and resolution to allow safe flying of the aircraft in marginal light conditions and marginal weather ,and at nap of the earth (NOE) or above altitudes.

5.4 The laser rangefinder/designator system. The laser rangefinder/designator system in a stabilized turret shall be tested and data presented that the system meets the U.S. Army Laser Safety Office criteria (see 6.0). The following items shall be considered as part of this test :

a) Laser beam divergence, and power for the 1.06 micron and EyeSafe selectable mode. The Eye Safe Mode shall pass an safety analysis.

b) Safety interlocks on the high voltage laser electronics unit box (usually mounted offgimbal). Weight on wheels helicopter switch for disabling the possibility that the 1.06 micron laser may fire when near maintenance personnel. An override on the switch allows ground testing of laser functions provided all personnel has laser goggle protection (optical density of 4.0 or better).

c) A fail safe switch shall be provided for selection of either 1.06 or 1.57 micron eyesafe beam. A feedback sensor shall be used to determine if the correct selection switch has been activated.

d) A software inhibit shall control the laser field of regard (FOR) so the beam will notfire into any helicopter or turret obstruction. Laser energy shall not be reflected back into the pilots eye's.

e) The laser shall not randomly fire due to electromagnetic interference (EMI).

5.5 Limited vibration. Limited vibration testing per the requirements in 4.4.6 above shall be performed to determine the mechanical integrity of the sensor package.

5.6 High and low temperature testing. Limited temperature cycling per the U.S. Army's environmental specification MIL-STD-810 shall be performed to verify the survivability of the sensor package during flight tests.

5.7 Electromagnetic interference / electromagnetic compatibility testing. In addition to the standard pre-flight checkout by the test pilot of EMC problems, these EMI/EMC test shall be performed on the sensors package prior to developmental flight testing. The sensor system shall be designed to meet all of the EMI requirements of MIL-STD-461 as modified by Section 4.2, Electromagnetic Interference (EMI), in ADS-37-PRF {Electromagnetic Environmental Effects, Performance and Verification Requirements}. The RS103 test will utilize the modulations in ADS-37-PRF, Table Titles: Standard World-Wide Electromagnetic RF Environmental (External to Aircraft) Modulation Parameters (Excluding Pulse) and Pulse Modulation Parameters and full field levels from MIL-STD-464 Table: External EME for Systems Capable of Shipboard Operations (including topside equipment and aircraft operating from ships) and Ordnance..

The sensor system, when installed in the aircraft, shall be electromagnetically compatible with the existing aircraft system equipment IAW ADS-37-PRF Electromagnetic Compatibility (EMC) Verification of electromagnetic compatibility shall be IAW System Electromagnetic Compatibility of ADS-37-PRF.

The sensor system, when installed in the aircraft, shall be tested to show that it can survive and meet performance requirements while subjected to the electromagnetic environment utilizing the modulations of ADS-37-PRF Standard World-Wide Electromagnetic RF Environmental (External to Aircraft) Modulation Parameters (Excluding Pulse) and Pulse Modulation Parameters. Parts Vulnerability testing shall be IAW with, Electromagnetic Vulnerability (EMV) Evaluation ADS-37-PRF. Standard World-Wide Electromagnetic RF Environmental (External to Aircraft) Modulation Parameters (Excluding Pulse) and Pulse Modulation Parameters, and the field levels of MIL-STD-464 Table: External EME for Systems Capable of Shipboard Operations (including topside equipment and aircraft operating from ships) and Ordnance. Verification of this Vulnerability testing shall be IAW with Electromagnetic Vulnerability (EMV) Evaluation ADS-37-PRF.

The following tests shall be performed and passed in order for a limited release to flight test in a test area with a maintenance pilot.

a) EMI Test Proceedure 60 days in advance of testing to consist of:

1) Conducted Emissions (MIL-STD-461) CE01,CE02, (or MIL-DTD-461 equivalent tests) CE101, CE102..

2) Radiated Emissions (MIL-STD-461)RE02, or (MIL-STD-461 equivalent tests) RE102.

b) Flight Test Plan 60 days prior to testing.

c) The following information, for the changed or modified areas of the aircraft, shall be presented for review.
   1) Equipment location-Location of all modified or add-on equipment,

   2) Wire Routing-All signal and power lines,

   3) Schematics-Provide detailed wiring schematics showing cable shielding, connectors, filters etc.,

   4) Electrical Load-Provide an Electrical Load Analysis.

6. NOTES.

The following points of contact at the Government may be contacted for futher help with the following Paragraphs:

1) Paragraph 4.4.6 Preliminary Dynamic Analysis-----Dr. Samuel Crews , AMCOM Aeromechanics Branch(AMSAM-RD-AE-A), 256/313-4950,

2) Paragraphs 4.4.11 & 5.7 EMI Compatibility Analysis and Testing-----Mr. Fred Reed III , AMCOM Mission Equipment Division, (AMSAM-RD-AE-S-E), 256/313-4886.

3) Paragraph 5.4 Laser Range Finder/Designator System-----U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM), MCHB-TS-OLO Attention: Mr. Rodney Wood, Bldg: E 1950, 5158 Blackhawk Road, Aberdeen Proving Ground, Maryland 21010-5422, Telephone: 410/436-5052.