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ARMY MILITARY AIRWORTHINESS CERTIFICATION CRITERIA (AMACC)

Prepared by:

U.S. Army Combat Capabilities Development Command (DEVCOM)

Aviation & Missile Center (AvMC)

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APPROVAL AND CONCURRENCE

REVIEWED BY: Signature on file

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SUMMARY OF CHANGE MODIFICATIONS

AMACC Revision X Change X incorporates *summary.* The changes to the AMACC can be identified by the use of a vertical change bar in the applicable left margins.

Section	Brief Description of Change
Global	Criteria identified or removed that pertain to performance
Global	change CCDC to DEVCOM
Global	change “manned/unmanned” to “crewed/uncrewed”
Global	Added specificity to 14 CFR references in sub-sections
Global	MIL-DTL-32742 replaced ADS-33E-PRF
2.1.	Reference document number/title corrections and additions
3.1.	updated definition “Critical Safety Item (CSI)” to “Aviation Critical Safety Item”
4.1.6., 6.1.	Content updated and clarified for Commercial Derivative Aircraft
5.1.-5.1.1.	Wording updated to match MIL-STD-1530 and MIL-STD-3063
5.2.4.1.	Added clarity to model characteristic expectations
5.3.2.7.,5.2.3.8., 5.3.3.2., 5.3.5.2.	Clarification of government test witnessing and unlimited data usage rights
6.2., 6.3.	MoC updated for AVTD
6.12.1. - 6.12.4.	Evaluation of Mass Properties clarified
6.13.1.	Performance Planning Information clarified
6.13.6.	Stall performance MoC information added
6.13.7.	Criteria added for Maximum Takeoff Weight
6.13.8.	Criteria added for Service Ceiling
6.18.	Removed ADS-33 wording
6.19.	Additional MoC information for Cargo/Utility/Attack platforms
6.24.	Additional detail added to Criteria and MoC
6.26.	Additional detail on data transport delays, redundancy design
7.1.-7.2.	Major additional criteria to Propulsion sections
7.3.4.1.5.-7.5.13.	New Criterion and updated information for APUs, Reciprocating Engines, and Electrified Propulsion
Section 8	Minor Changes throughout
Section 9	Section totally revised
Section 11	Minor changes throughout
Section 12	Section totally revised
Section 13	Totally rewritten
14.4.5.	New Criteria for Machine Learning Hazards
Section 15	Totally rewritten

17.2.-17.2.4.	Rewrite of EO/IR and Laser Criterion
17.3.2.2	Requirement rewritten
17.3.2.8	Requirement rewritten
17.3.3.2.	Boresight merged into 17.3.2.2.
17.4.-17.4.13.	Rewrite of ASE Criterion
17.4.3.1.,17.4.3.2, 17.4.4.1..17.4.4.2.	New Criteria for Safety Inhibits to control Dispensing and Emitting
17.4.5.	Removed Power Up and Power Down Cycles
17.4.6.	Removed Built In Test
17.4.10.	Removed Emitter Verification
17.5.5.	Removed Hazards of Electromagnetic Radiation to Ordnance (remains as 17.1.4.)
17.5.6.	Removed Personnel Electrostatic Discharge
Section 18	Minor changes
18.2.3	Requirement rewritten
18.2.4	Requirement rewritten
19.1.4.	New Criteria Selection Rationale for Materials, Processes, and Joining Methods
Section 20	Totally rewritten
Section 21	Minor changes throughout
Appendix A	Additional sections on information management, fusion, and human tasks
Appendix D	Major additions and revisions
Appendix E	Multiple additions and revisions
Appendix F	Major rewrite
Appendix G	Minor revisions
Appendix H	Minor revisions
Appendix I	Minor revisions
Appendix L	Removed. Changed to DI-SESS-82321
Appendix M	Minor revisions
Appendix N	Removed. Requirements incorporated into main body.
Appendix T	Minor additions
Appendix U	New Appendix for Reciprocating Engines
Appendix V	New Appendix for Electrified Propulsion

FOREWORD

1. This document is approved for use by the U.S. Army Combat Capabilities Development Command Aviation & Missile Center (DEVCOM AvMC) and is available for use by Aviation and Missile Command (AMCOM), Program Executive Office (PEO) Aviation and all Departments and Agencies of the Department of Defense (DoD).

2. This document describes the U.S. Army Aviation Airworthiness processes and the criteria, standards and methods of compliance necessary for airworthiness assessment on U.S. Army manned and unmanned aircraft systems. The document is intended for use by:

a. Aircraft life cycle management personnel defining airworthiness requirements in existing or new acquisition programs. This AMACC document should be used as a foundation for airworthiness to ensure that the resulting program meets Army requirements for design, production and continuing airworthiness.

b. Contractors incorporating an airworthiness program into existing or new acquisition programs for U.S. Army aircraft system equipment. In most cases, an Airworthiness Qualification Specification (AQS) should be submitted to the Government as part of the Statement of Work for the acquisition, as required by the Request for Proposal or Contract. The AQS applies to aircraft systems, subsystems, and aircraft. The AQS will outline the contractor’s proposed methods for achieving airworthiness listed in the Request for Proposal and the management control actions which guide implementation.

3. The AMACC leverages technical standards and specifications in use at the time of its publication for the purpose of providing process and requirements guidance in terms of criteria, standards, and methods of compliance to be used in development of data, software, and equipment to support systems, subsystems, components of U.S. Army crewed Aircraft Systems and, Uncrewed Aircraft Systems (UAS). As technical standards and specifications evolve, the potential exists that the AMACC may not adequately harmonize with another technical document. In such an event, the DEVCOM AvMC should be consulted. This AMACC document also describes airworthiness artifacts that DEVCOM AvMC will assess to determine airworthiness.

4. Comments, suggestions, or questions on this document should be addressed to U.S. Army Combat Capabilities Development Command Aviation & Missile Center, FCDD-AMA, Redstone Arsenal, AL 35898.

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Appendix B: Avionics
Appendix C: Navigation Equipment
Appendix D: Engines, Aircraft, Turboshaft
Appendix E: Engine Control System Components and Engine Accessories
Appendix F: Ground and Flight Tests
Appendix G: Rotorcraft Drive Systems
Appendix H: Hydraulic Systems
Appendix I: Propulsion Systems
Appendix J: Fuel Systems
Appendix K: Structural Demonstration for Rotorcraft
~~Appendix L~~: Deleted.
Appendix M: Modal Testing
~~Appendix N:~~ Deleted. The HUMS/HAS Requirements Appendix is deleted, and all requirements are contained within the body of the AMACC.
Appendix O: Aircraft Combat Survivability
Appendix P: Armor Airworthiness Qualification
Appendix Q: Criticality Determination and Critical Characteristic Selection Criteria
Appendix R: AQS and Component Verification Matrix
Appendix S: Aircraft, Auxiliary, Gas Turbine
Appendix T: Design Reviews for Developmental Systems

1. SCOPE

1.1. Scope

This Army Military Airworthiness Certification Criteria (AMACC) establishes the airworthiness certification criteria, standards and methods of compliance to be used in the determination of airworthiness of all manned and unmanned, fixed and rotary wing air systems IAW Army Regulation (AR) 70-62. The AMCOM Commanding General is the Army's Airworthiness Authority; however, responsibilities of the airworthiness authority have been delegated per AR 70-62 paragraph 1-4.c.(8) to the Director, DEVCOM AvMC Systems Readiness Directorate. The delegated Airworthiness Authority shall have the engineering cognizance and provide the airworthiness assessment against the substantiated data. As used throughout the remainder of the AMACC, all references to DEVCOM AvMC SRD shall be understood to be a reference to the Army's delegated Airworthiness Authority unless stated otherwise.

Airworthiness qualification (or certification) is a progressive assessment process performed at the component, subsystem, and system levels to ensure that a system meets airworthiness requirements. The assessments will result in determination of safe operating envelopes and any limit actions to assure safe operation. The process of airworthiness qualification includes engineering analysis, formal inspections, design reviews, safety assessments, contractor demonstrations, modeling and simulation, and contractor and Government qualification tests. The requirements for the airworthiness qualification for an individual program are documented in a DEVCOM AvMC SRD Airworthiness Qualification Plan (AQP) analysis, tests, demonstrations, modeling and simulations, and documentation necessary for qualification. The methods of qualification shall be planned and conducted. Requirements cited herein, when applicable, are to be considered the minimum to substantiate airworthiness qualification. Airworthiness qualification will be granted upon successful completion of the airworthiness assessment on all substantiation data.

The information contained in the AMACC identifies the requirements stated in terms of criteria, standard, and method of compliance. Using the AMACC and the AQP, the airworthiness substantiation shall include substantiated evidence through an Airworthiness Qualification Specification (AQS). The AQS shall define and describe in detail how each of the requirements specified in the AQP will be satisfied along with the method of qualification. The DEVCOM AvMC will perform the airworthiness assessment against the submitted data.

The substantiation data delivered against the requirements will be used to perform an airworthiness assessment and determine if any potential hazard exists. Limitations or restrictions could be levied on the aircraft if the substantiation data does not satisfy the requirement.

The AMACC is a foundational document and together with the AQP shall be used by the Procuring Activities and industry to understand DEVCOM AvMC requirements and the airworthiness certification process. This AMACC document explains the processes,

identifies the requirements and technical data needed for DEVCOM AvMC to assess airworthiness.

1.2. Applicability

This AMACC document should be applied at any point throughout the life cycle of an air system when an airworthiness determination is necessary, especially whenever there is a change to the functional or product baseline.

Each air system configuration, including but not limited to crewed, uncrewed, fixed or rotary-wing demands unique airworthiness certification requirements. Therefore, unique criteria are included for these types of systems to ensure that minimum levels of design, production and maintenance are established for safe operation. For uncrewed aircraft systems (UAS), risks associated with loss of aircrew may not apply. However, as with crewed aircraft, risk associated with personnel, damage to equipment, property, and/or environment must be considered. UAS which carry aircrew or passengers are subject to the same airworthiness certification requirements as crewed aircraft. Any aircraft which may carry personnel (for example, passengers, patients, and special mission personnel) are subject to certification requirements for passenger aircraft.

A UAS is comprised of individual elements consisting of the uncrewed air vehicle (UAV), the control station, and any other support elements necessary to enable operation including, but not limited to data links, communications systems/links, and UAS-unique launch and recovery equipment. UAV types vary greatly in size, weight, and complexity. Consideration should be given to the environment in which the UAS will be operated (controlled test range, national airspace, fleet usage, including ship-based applications), to the life expectancy of the system for which it is designed, and to the “expendability” of the UAV.

Similarly, aircraft intended for use aboard ships have unique requirements in areas such as structural integrity, propulsion system dynamic response and tolerance to steam ingestion, control systems response to approach and landings in high turbulence conditions, electromagnetic environmental effects, deck handling, support and servicing, and pilot field of view.

Commercial derivative aircraft (CDA) are initially approved for safety of flight by the Federal Aviation Administration (FAA) and may have an FAA approved Type Certificate. Any non-FAA approved alteration to a CDA may render all FAA certifications invalid. While alterations to CDA are covered by rules unique to each branch of service, the operating service always has the responsibility for the airworthiness certification approval under public aircraft rules. Therefore, when planning any alterations to an FAA certified CDA, the modifier should, at the earliest opportunity, contact the FAA Military Certification Office in Wichita, KS.

1.3. Tailoring to Create the Certification Basis

Not all the airworthiness criteria apply to every type of air system and unique platform. Previously undefined criteria may need to be added to fully address safety aspects of unique configurations. Therefore, tailoring of the total set of criteria to identify a complete

(necessary and sufficient) subset of applicable airworthiness criteria will be done, creating the system's certification basis. This certification basis should be fully documented and maintained under strict configuration control.

Tailoring rules are as follows:

a. Identify each criterion as applicable, partially applicable or non-applicable, considering system or product complexity, type, data, and intended use. Document the rationale for identifying any criterion as applicable, partially applicable or non-applicable.

b. Fully applicable criteria may not be deleted or modified in any manner.

c. If a portion of a criterion partially applies, identify the applicable or non-applicable portion. Document the rationale for identifying any criterion as partially applicable.

d. Supplement applicable or partially applicable criteria where appropriate for any capabilities or systems not fully addressed by the criteria contained in this AMACC.

e. Develop additional criteria, as appropriate. Document the rationale for any capabilities or systems not fully addressed by the criteria contained in this AMACC. Consider whether such criteria should be submitted for future inclusion in this AMACC.

f. Standards and methods of compliance may be tailored, considering system type, capabilities and intended use.

1.4. Cross References and Technical Points of Contact

The criteria included in this document are written with the intent that an experienced engineer, trained in the specific technical area under consideration, should be able to interpret, tailor, apply, and evaluate a particular system's compliance with the criteria.

To assist in this effort, military and civil references are included with the specific criteria.

For CDA aircraft, contact the FAA Military Certification Office point of contact.

1.5. Information Sources

Where applicable, reference documents are identified for each Airworthiness Certification Criterion. Source reference documents may include, but are not limited to the following:

International Standardization Agreements
Federal Specifications
Federal Standards
Commercial Item Descriptions
DoD Specifications
Department of Defense Standards
Department of Defense Handbooks
Other Government documents, drawings and publications
Non-Government standards and other publications

2. APPLICABLE DOCUMENTS

Unless specified, the most current version of the reference document shall be used.

2.1. Required Publications – AMACC

The documents listed below are all the documents referenced in this AMACC document and needed to understand the information provided herein. The ADS documents can be located at: https://www.avmc.army.mil/Directorates/SRD/TechDataMgmt/

Army Aeronautical Design Standards (ADS)

ADS-1B-PRF	Rotorcraft Propulsion Systems, Airworthiness Qualification Requirements, Ground & Flight Test Surveys & Demonstrations
ADS-13F-HDBK	Air Vehicle Material and Processes
ADS-20F-HDBK	Armament / Fire Control System Survey for Army Aircraft
ADS-24	Structural Demonstration
ADS-27A-SP	Requirements for Rotorcraft Vibration Specifications, Modeling and Testing
ADS-29	Structural Design Criteria for Rotary Wing Aircraft
~~ADS-33E-PRF~~	~~Handling Qualities Requirement for Military Rotorcraft~~ (replaced by MIL-DTL-32742)
ADS-37A-PRF	Electromagnetic Environmental Effects (E3) Performance Verifications Requirements
ADS-44-HDBK	Armament Airworthiness Qualification for Army Aircraft
ADS-45-HDBK	Data Requirements for Airworthiness Release for Helicopter Armament Testing (Guns, Rockets, Missiles)
ADS-50-PRF	Rotorcraft Propulsion, Performance Qualification Requirements, and Guidelines
ADS-51-HDBK	Rotorcraft and Aircraft Qualification Handbook ADS-62-SP Standard Practice Data and Test Requirements for Airworthiness Release for Helicopter Sensor Data and Testing Requirements in Development Stage
ADS-63-SP	Radar Systems Airworthiness Qualification and Verification Requirements
ADS-65A-HDBK	Data and Test Guidance for Qualification of Sensor Systems on Aircraft
ADS-66-HDBK	Guidance for Data for Safety of Flight Airworthiness Release for Helicopter Aircraft Survivability Equipment (ASE)
ADS-71-SP	Environmental Airworthiness and Qualification Requirements for Electronics, Avionics, and Mission Equipment Installed on Army Aircraft
ADS-74-SP	U.S. Army Aircraft Lighting
ADS-79E	Condition Based Maintenance System for U.S. Army Aircraft
JSSSEH	Joint Software Systems Safety Engineering Handbook

AMCOM Regulations

AMCOMR 385-17	AMCOM Software System Safety Policy
AMCOMR 702-7	Aviation Critical Safety Items, Critical Application Items, and New Source Testing Program Management
QE-STD-1	Critical Safety Items Critical Characteristics New Manufacture
QE-STD-2	Critical Safety Items Critical Characteristics Maintenance & Overhaul

Army Regulations

AR 5-11	Management of Army Models and Simulation
AR 70-1	Army Acquisition Policy
AR 70-38	Research, Development, Test and Evaluation of Materiel for Worldwide Use
AR 70-62	Airworthiness of Aircraft Systems
AR 95-1	Aviation Flight Regulations
AR 385-10	The Army Safety Program
AR 750-1	Army Materiel Maintenance Policy

DA Pamphlet

PAM 70-3	Army Acquisition Procedures
PAM 95-9	Management of Aviation Critical Safety Items

U.S. Army Materiel Command

AMCP 706-201	Engineering Design Handbook, Helicopter Engineering. Part One. Preliminary Design
AMCP 706-203	Engineering Design Handbook, Helicopter Engineering, Part Three, Qualification Assurance

American National Standards

ANSI/ASA S3.2	Methods for Measuring the Intelligibility for Speech Over Communication Systems
ANSI/EIA-649	Configuration Management Standard

American Society of Mechanical Engineers (ASME)

ASME Y14.24	Drawing Types and Applications of Engineering Drawings
ASME Y14.34	Associated Lists
ASME Y14.35	Drawings, Engineering, and Associated Documents, Revision of
ASME Y14.37	Composite Part Drawings
ASME Y14.41	Digital Product Definition Data Practices
ASME Y14.5	Geometric Dimensioning and Tolerancing
ASME Y14.100	Engineering Drawing and Related Documentation Practices

ASTM International

ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM D3762	Adhesive-Bonded Surface Durability of Aluminum
ASTM D4762	Standard Guide for Testing Polymer Matrix Composite Materials
ASTM D4896	Standard Guide for Use of Adhesive-Bonded Single Lap-Joint Specimen Test Results
ASTM D5229	Standard Test Method for Moisture Absorption Properties and Equilibrium Conditioning of Polymer Matrix Composite Materials
ASTM D5528	Standard Test Method for Mode I Interlaminar Fracture Toughness of Unidirectional Fiber-Reinforced Polymer Matrix Composites
ASTM D5592	Standard Guide for Material Properties Needed in Engineering Design Using Plastics
ASTM D5687	Standard Guide for Preparation of Flat Composite Panels with Processing Guidelines for Specimen Preparation
ASTM D6856	Standard Guide for Testing Fabric-Reinforced “Textile” Composite Materials
ASTM E2533	Standard Guide for Nondestructive Testing of Polymer Matrix Composites Used in Aerospace Applications
ASTM F330	Standard Test Method for Bird Impact Testing of Aerospace Transparent Enclosures
ASTM G85	Standard Practice for Modified Salt Spray (Fog)

Data Item Descriptions (DIDs)

DI-EMCS-80199	Electromagnetic Interference Control Procedures (EMICP)
DI-EMCS-80200	Electromagnetic Interference Test Report
DI-EMCS-80201	Electromagnetic Interference Test Procedures (EMITP)
DI-EMCS-81540	Electromagnetic Environmental Effects (E3) Integration and Analysis Report (E3IAR)
DI-EMCS-81541	Electromagnetic Environmental Effects (E3) Verification Procedures (E3VP)
DI-EMCS-81542	Electromagnetic Environmental Effects Verification Report (E3VR)
DI-GDRQ-80650	Design Data and Calculations
DI-HFAC-81399	Critical Task Analysis Report
DI-IPSC-81427	Software Development Plan (SDP)
DI-IPSC-81428	Software Installation Plan (SIP)
DI-IPSC-81429	Software Transition Plan (STRP)
DI-IPSC-81430	Operational Concept Description (OCD)
DI-IPSC-81431	System/Subsystem Specification (SSS)
DI-IPSC-81432	System/Subsystem Design Description (SSDD)
DI-IPSC-81433	Software Requirements Specification (SRS)
DI-IPSC-81434	Interface Requirements Specification (IRS)
DI-IPSC-81435	Software Design Description (SDD)
DI-IPSC-81436	Interface Design Description
DI-IPSC-81437	Database Design Description (DbDD)

DI-IPSC-81438	Software Test Plan (STP)
DI-IPSC-81439	Software Test Description (STD)
DI-IPSC-81440	Software Test Report (STR)
DI-IPSC-81441	Software Product Specification (SPS)
DI-IPSC-81442	Software Version Description (SVD)
DI-IPSC-81443	Software User Manual (SUM)
DI-IPSC-81488	Computer Software Product
DI-IPSC-82134	Software Sustainability Package
DI-MFFP-81402	Finish Specification
DI-MFFP-81403	Corrosion Prevention and Control Plan (CPCP)
DI-MFFP-82119	Program-Unique Material or Process Specifications
DI-MGMT-81502	Sample Chart A and Chart E Report for Aircraft
DI-MGMT-81452	Mass Properties Control and Management Process
DI-MGMT-81501	Weight and Balance Report for Aircraft
DI-MGMT-81504	Inertia (Mass Properties) Report for Aircraft
DI-MGMT-81861	Integrated Program Management Report
DI-MGMT-81911	Work Management Plan
DI-MGMT-82184	Quality Management System
DI-MISC-80508	Technical Report – Study/Services
DI-MISC-80711	Scientific and Technical Reports
DI-MISC-81283	Specification Requirement Verification Matrix
DI-NDTI-80566	Test Plan
DI-NDTI-80603	Test Procedure
DI-NDTI-80809	Test/Inspection Report
DI-NDTI-81895	Engine Control System Component Test Plan Documentation Requirements
DI-NDTI-81896	Engine Control System Component Similarity Argument Report Documentation Requirements
DI-NDTI-81897	Engine Control System Component Test Report Documentation Requirements
DI-QCIC-80278	Calibration and Measurement Requirements Summary
DI-QCIC-80809	Technical Report - Study/Services
DI-QCIC-81722	Quality Program Plan
DI-RELI-80322	Quality Conformance Inspection and Test Procedures
DI-RELI-81498	Structural Design Criteria Report
DI-SAFT-80101	System Safety Hazard Analysis Report (SSHA)
DI-SAFT-80102	Safety Assessment Report (SAR)
DI-SAFT-80105	System Safety Program Progress Report
DI-SAFT-80106	Health Hazard Assessment Report (HHAR)
DI-SAFT-81626	System Safety Program Plan (SSPP)
DI-SAFT-81932	Critical Safety Item (CSI)/Critical Application Item (CAI) List
DI-SDMP-81464	Detail Specification Documents
DI-SDMP-81465	Performance Specification Documents
DI-SESS-80198	Internal Loads and Static Strength Analysis Report
DI-SESS-80508	Technical Report-Study/Services
DI-SESS-80567	Subsystem Design Analysis Report

DI-SESS-80776	Technical Data Package
DI-SESS-80858	Supplier's Configuration Management Plan
DI-SESS-81000	Product Drawings/Models and Associated Lists
DI-SESS-81012	Proposed Critical Manufacturing Process Description
DI-SESS-81248	Interface Control Document
DI-SESS-81495	Failure Modes, Effects, and Criticality Analysis Report
DI-SESS-81603	Maintainability and Built in Test Demonstration Report
DI-SESS-81704	Test Plans / Test Procedures
DI-SESS-81983	Durability and Damage Tolerance (DADT) Analysis Report
DI-SESS-82039	Force Structural Maintenance Plan
DI-SESS-82123	Strength Summary and Operating Restrictions (SSOR) Report
DI-SESS-82238	Technical Data Package List
DI-SESS-82291	Air Vehicle Technical Description Report for Rotorcraft and Propeller-Driven Fixed-Wing Aircraft
DI-SESS-82321	Air Vehicle Flight Performance Report for Rotorcraft and Propeller-Driven Fixed-Wing Aircraft
DI-TMSS-80067	Contractor Furnished Aeronautical Equipment or Contractor Furnished Equipment (CFAE/CFE) Notice
DI-TMSS-80527	Commercial Off-The-Shelf (Cots) Manuals and Associated Supplemental Data
DI-TMSS-81675	Equipment Technical Manual
DI-TMSS-81676	Subsystem Technical Manual (Sanitized)
DI-TMSS-81677	System Technical Manual
DI-TMSS-81814	Interactive Electronic Technical Manual (IETM)
DI-TMSS-81818	Technical Manual Validation Plan
DI-TMSS-81819	Technical Manual Validation Certificate
DI-TMSS-81820	Technical Manual Verification Discrepancy/Disposition Report
DI-TMSS-81821	Technical Manual Verification Incorporation Certificate
DI-IPSC-81430	Operational Concept Description
DI-MGMT-81503	Weight and Balance Report for Aircraft
DI-NDTI-81284	Test and Evaluation Program Plan
DI-GDRQ-81257	Mathematical Model Finite Element Analysis Report
DI-GDRQ-81256	Mathematical Model Finite Element Structure Report

Department of Defense Publications

DFARS 252.204-7008	Compliance with Safeguarding Covered Defense Information Controls
DFARS 252.204-7012	Safeguarding of Unclassified Controlled Technical Information
DFARS 207.105	Content of Acquisition Plans
DFARS 252.239-7018	Supply Chain Risk
DFARS 252.227-7013	Rights in Technical Data-Noncommercial Items
DFARS 252.227-7014(b)	Rights in Noncommercial Computer Software and Noncommercial Computer Software Documentation

DoDD 5030.61	DoD Airworthiness Policy
DoDI 6055.11	Protecting Personnel from Electromagnetic Fields
DoDI 8510.01	Risk Management Framework (RMF) for DoD Information Technology
DoDM 4120.24	Defense Standardization Program (DSP) Procedures
AIMS 03-1000B	Technical Standard for the ATCRBS/IFF/Mark XIIA Electronic Identification System and Military Implementation of Mode S
AIMS 17-1000	IFF Equipment Certification Process
AIMS 03-1101	DoD International AIMS Program IFF Transponder Box Test Procedures
AIMS 03-1102	DoD International AIMS Program IFF Platform Integration Test Procedures
AIMS 03-1103	DoD International AIMS Program IFF Flight Test Procedures

Federal Aviation Administration (FAA) Advisory Circulars

AC 00-31	National Aviation Standard for the Very High Frequency Omnidirectional Radio Range (VOR)/Distance Measuring Equipment (DME)/Tactical Air Navigation (TACAN) Systems
AC 20-42	Hand Fire Extinguishers for Use in Aircraft
AC 20-68	Recommended Radiation Safety Precautions for Ground Operation of Airborne Weather Radar
AC 20-107	Composite Aircraft Structure
AC 20-115	Best Practices for Airborne Software Development Assurance Using EUROCAE ED-12 and RTCA DO-178
AC 20-135	Powerplant Installation and Propulsion System Component Fire Protection Test Methods, Standards and Criteria
AC 20-136	Aircraft Electrical and Electronic System Lightning Protection
AC 20-138	Airworthiness Approval of Positioning and Navigation Systems
AC 20-148	Reusable Software Components
AC 20-152	RTCA, INC., Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware
AC 20-153	Acceptance of Aeronautical Data Processes and Associated Databases
AC 20-165	Airworthiness Approval of Automatic Dependent Surveillance
AC 20-167	Airworthiness Approval of Enhanced Vision System, Synthetic Vision System, Combined Vision System, and Enhanced Flight Vision System Equipment
AC 20-170	Integrated Modular Avionics Development. Verification, Integration and Approval using RTCA/DO-297 and Technical Standard Order C153
AC 20-182	Airworthiness Approval for Aircraft Weather Radar Systems
AC 21-26	Quality Control for the Manufacture of Composite Structures

AC 23.1311-1	Installation of Electronic Display in Part 23 Airplanes
AC 23-20	Acceptance Guidance on Material Procurement and Process Specifications for Polymer Matrix Composite Systems
AC 25-11	Electronic Flight Displays
AC 25.613-1	Material Strength Properties and Material Design Values
AC 25-7D	Flight Test Guide for Certification of Transport Category Airplanes
AC 27-1	Certification of Normal Category Rotorcraft
AC 29-2	Certification of Transport Category Rotorcraft
AC 43-206	Inspection, Prevention, Control, and Repair of Corrosion on Avionics Equipment
AC 43-214	Repairs and Alterations to Composite and Bonded Aircraft Structure
AC 65-33	Development of Training/Qualification and Certification Programs for Composite Maintenance Technicians
AC 120-76	Authorization for Use of Electronic Flight Bag
DOT/FAA/AR --02/110	Guidelines for the Development of Process Specifications, Instructions, and Controls for the Fabrication of Fiber-Reinforced Polymer Composites
DOT/FAA/AR --03/19	Material Qualification and Equivalency for Polymer Matrix Composite Material Systems
DOT/FAA/AR --06/10	Guidelines and Recommended Criteria for the Development of a Material Specification for Carbon Fiber/Epoxy Fabric Prepregs
DOT/FAA/AR --06/25	Preliminary Guidelines and Recommendations for the Development of Material and Process Specifications for Carbon Fiber-Reinforced Liquid Resin Molded Materials
DOT/FAA/AR-06/10	Guidelines And Recommended Criteria for the Development of Material Specifications for Carbon Fiber/ Epoxy Prepregs
DOT/FAA/AR-06/25	Preliminary Guidance and Recommendations the Development of Material and Process Specifications for Carbon Fiber reinforced Liquid Molded Materials
DOT/FAA/AR--07/3	Guidelines and Recommended Criteria for the Development of a Material Specification for Carbon Fiber/Epoxy Unidirectional Prepregs Update
DOT/FAA/TC-15/62	Single Event Effects Mitigation Techniques Report
FAA/TC-16/56	Human Factors Considerations in the Design and Evaluation of Flight Deck Displays and Controls
MMPDS	Metallic Materials Properties Development and Standardization Handbook
MSO-C145a	Airborne Navigation Sensors Using the Global Positioning System (GPS)

Federal Aviation Orders

FAA Order 8110.105	"Simple and Complex Electronic Hardware Approval Guidance" to the Federal Aviation Administration (FAA) Advisory Circulars

Federal Aviation Administration (FAA) Federal Aviation Regulations (FAR)

14 CFR Part 23	Airworthiness Standards: Normal Category Airplanes
14 CFR Part 25	Airworthiness Standards: Transport Category Airplanes
14 CFR Part 27	Airworthiness Standards: Normal Category Rotorcraft
14 CFR Part 29	Airworthiness Standards: Transport Category Rotorcraft
14 CFR Part 33	Airworthiness Standards: Aircraft Engines
14 CFR Part 35	Airworthiness Standards: Propellers
21 CFR Part 1040	Performance Standards for Light-Emitting Products

Federal Aviation Administration (FAA) Policy Statement

PS-ASW-27, 29-09	Rotorcraft Advanced Flight Controls (AdFC) Handbook

Institute of Electrical and Electronics Engineers (IEEE)

IEEE 1063-2001	Standard for Software User Documentation
IEEE 12207-2017	Software Life Cycle Processes
IEEE 1228-1994	Standard for Software Safety Plans
IEEE C95.1-2005	Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
IEEE C95.1-2345-2014	Standard for Military Workplaces--Force Health Protection Regarding Personnel Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz

International Standards Organization (ISO)

ISO 9001	Quality Management
ISO 10303	Standard for the Exchange of Product Model Data (STEP)
ISO 14644	Cleanrooms and Associated Controlled Environments

Joint Service Specification Guides (JSSG)

JSSG 2001	Air Vehicle
JSSG 2005	Avionic Subsystem
JSSG 2006	Department of Defense Joint Service Specification Guide: Aircraft Structures
JSSG 2008	Department of Defense Joint Service Specification Guide: Vehicle Control and Management System
JSSG 2009	Department of Defense Joint Services Specification Guide: Air Vehicle Subsystems
JSSG 2010	Crew Systems
JSSG 2010-7	Crew Systems Crash Protection Handbook

Military Technical Standards

MIL-A-8868	Airplane Strength and Rigidity Data and Reports
MIL-C-675	Coating of Glass Optical Elements (Anti-Reflection)
MIL-C-81774	Control Panel, Aircraft, General Requirements For
MIL-D-23222	Demonstration Requirements for Helicopters
MIL-DTL-27422	Tank, Fuel, Crash-Resistant, Ballistic-Tolerant, Aircraft
MIL-DTL-32403	Fire Extinguisher, Employing HFC-227ea Agent Enhanced with Special Sodium Bicarbonate Powder (HFC-22ea/SBCS), Portable, with Bracket
MIL-DTL-32412	HFC-227EA Fire Extinguishing Agent Enhanced with Special Sodium Bicarbonate Powder (HFC-227EA/SBCs)
MIL-DTL-5002	Surface Treatments and Inorganic Coatings for Metal Surfaces of Weapon Systems
MIL-DTL-53039	Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant
MIL-DTL-53072	Chemical Agent Resistant Coating (CARC) System Application Procedures and Quality Control Inspection
MIL-DTL-64159	Camouflage Coating, Water Dispersible Aliphatic Polyurethane, Chemical Agent Resistant
MIL-DTL-85025	Tops Program Technical Publications and Products; Style, Format, And Common Technical Content
MIL-DTL-87268	Interactive Electronic Technical Manuals - General Content, Style, Format, And User Interaction Requirements
MIL-DTL-9479	Seat System, Upward Ejection, Aircraft, General Specification For
MIL-DTL-32742	Handling Qualities Requirement for Military Rotorcraft
MIL-E-7016	Electric Load and Power Source Capacity, Aircraft, Analysis of
MIL-E-85583	Fuel Systems, Aircraft, Installation and Test Of
MIL-F-17874	Fuel Systems, Aircraft, Installation and Test of
MIL-G-5572	Gasoline, Aviation: Grades 80/87, 100/130, 115/145 (No S/S Document)
MIL-L-85314/1	Light Systems, Aircraft, Anti-Collision, Strobe, Dual (Red and White) Mode, Fuselage Mounted
MIL-L-85762A	Lighting, Aircraft, Interior, Night Vision Imaging System (NVIS) Compatible
MIL-PRF-21480	Generator System, Electric Power, 400 Hertz, Alternating Current, Aircraft; General Specification for
MIL-PRF-32216	Evaluation of Commercial Off-The-Shelf (COTS) Manuals and Preparation of Supplemental Data
MIL-PRF-46103	Armor: Lightweight, Composite (No S/S Document)
MIL-PRF-46108	Armor: Transparent
MIL-PRF-5096	Manuals, Technical-Inspection and Maintenance Requirements; Acceptance and Functional Check Flight Procedures and Checklists; Inspection Work Cards; and Checklists; Preparation of

MIL-PRF-63029	Performance Specification: Manuals, Technical: Requirements for Operator Manuals and Checklists for Manned and Unmanned Aircraft Systems
MIL-PRF-7032	Inverters, Aircraft, General Specification for
MIL-PRF-7115	Converters, Aircraft, General Specification for
MIL-PRF-85676	Lighting, Emergency Egress, Subassembly
MIL-R-8236	Reel, Shoulder Harness, Inertia Lock
MIL-S-85510	Seats, Helicopter Cabin, Crashworthy, General Specification for
MIL-S-8698	Structural Design Requirements, Helicopters
MIL-T-5624	Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-T-5842B	Transparent Areas on Aircraft Surfaces (Windshields and Canopies), Rain Removing and Washing Systems for, De-Frosting, De-Icing, Defogging, General Specification for
MIL-T-83133	Turbine Fuel, Aviation, Kerosene Type, JP-8 (NATO F-34), NATO F-35, and JP-8+100 (NATO F-37)
MIL-T-8679	Test Requirements, Ground, Helicopter
MIL-W-5664	Webbing, Textile, Elasticity
MIL-W-81752	Windshield Systems, Fixed Wing Aircraft - General Specification

Military Handbooks

MIL-HDBK-61	Configuration Management Guidance
MIL-HDBK-240	Hazards of Electromagnetic Radiation to Ordnance Test Guide
MIL-HDBK-244	Guide to Aircraft/Stores Compatibility
MIL-HDBK-310	Global Climatic Data for Developing Military Products
MIL-HDBK-338	Electronic Reliability Design Handbook
MIL-HDBK-454	General Guidelines for Electronic Equipment
MIL-HDBK-516	Airworthiness Certification Criteria
MIL-HDBK-522	Guidelines for Inspection of Aircraft Electrical Wiring Interconnect System
MIL-HDBK-523	Guide to the General Style and Format of S1000d Technical Manual Data Modules
MIL-HDBK-704-1	Guidance for Test Procedures for Demonstration of Utilization Equipment Compliance to Aircraft Electrical Power Characteristics (Part 1 of 8 Parts)
MIL-HDBK-704-2	Guidance for Test Procedures for Demonstration of Utilization Equipment Compliance to Aircraft Electrical Power Characteristics Single Phase, 400 HZ, 115 Volt (Part 2 of 8 Parts)
MIL-HDBK-704-3	Guidance for Test Procedures for Demonstration of Utilization Equipment Compliance to Aircraft Electrical Power Characteristics Three Phase, 400 HZ, 115 Volt (Part 3 of 8 Parts)

MIL-HDBK-704-4	Guidance for Test Procedures for Demonstration of Utilization Equipment Compliance to Aircraft Electrical Power Characteristics Single Phase, Variable Frequency, 115 Volt (Part 4 of 8 Parts)
MIL-HDBK-704-5	Guidance for Test Procedures for Demonstration of Utilization Equipment Compliance to Aircraft Electrical Power Characteristics Three Phase, Variable Frequency, 115 Volt (Part 5 of 8 Parts)
MIL-HDBK-704-6	Test Procedures for Demonstration of Utilization Equipment Compliance to Aircraft Electrical Power Characteristics Single Phase, 60 HZ, 115 Volt (Part 6 of 8 Parts)
MIL-HDBK-704-7	Guidance for Test Procedures for Demonstration of Utilization Equipment Compliance to Aircraft Electrical Power Characteristics 270 VDC, (Part 7 of 8 Parts)
MIL-HDBK-704-8	Guidance for Test Procedures for Demonstration of Utilization Equipment Compliance to Aircraft Electrical Power Characteristics 28 VDC, (Part 8 of 8 Parts)
MIL-HDBK-759	Human Engineering Design Guidelines (No S/S Document)
MIL-HDBK-799	Fire Control Systems - General
MIL-HDBK-828	Range Laser Safety
MIL-HDBK-1222	Guide to The General Style and Format of U.S. Army Work Package Technical Manuals
MIL-HDBK-1280	Keyboard Arrangements
MIL-HDBK-1760	Aircraft/Store Electrical Interconnection System
MIL-HDBK-1763	Aircraft/Stores Compatibility: Systems Engineering Data Requirements and Test Procedures
MIL-HDBK-1823	Nondestructive Evaluation (Nde) System, Reliability Assessment
MIL-HDBK-2069	Aircraft Survivability
MIL-HDBK-6870	Nondestructive Inspection Program Requirements for Aircraft and Missile Materials and Parts

Military Standards

MIL-STD-188-141	Interoperability and Performance Standards for Medium and High Frequency Radio Systems
MIL-STD-188-181	Interface Standard Interoperability Standard for Single-Access 5-Khz and 25-Khz Uhf Satellite Communications
MIL-STD-188-182	Interoperability Standard for UHF Satcom Dama Orderwire Messages and Protocols
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-188-185	Interoperability Standard for UHF MISALTCOM DAMA Control System

MIL-STD-188-220	Interoperability Standard for Digital Message Transfer Device Subsystems
MIL-STD-188-241	Interoperability and Performance Standards for Tactical Single Channel Very High Frequency
MIL-STD-188-242	Interoperability and Performance Standards for Tactical Single Channel Very High Frequency
MIL-STD-250	Aircrew Station Controls and Displays for Rotary Wing Aircraft
MIL-STD-291	Standard Tactical Air Navigation (TACAN) Signal
MIL-STD-411	Aircrew Station Alerting Systems
MIL-STD-461	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-662	V50 Ballistic Test for Armor
MIL-STD-704	Aircraft Electric Power Characteristics
MIL-STD-810	Environmental Engineering Considerations and Laboratory Tests
MIL-STD-850	Aircrew Station Vision Requirements for Military Aircraft
MIL-STD-882	System Safety
MIL-STD-889	Galvanic Compatibility of Electrically Conductive Materials
MIL-STD-961	Defense and Program – Unique Specifications Format and Content
MIL-STD-1289	Airborne Stores, Ground Fit and Compatibility Requirements
MIL-STD-1290	Light Fixed and Rotary-Wing Aircraft Crash Resistance
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-1333	Aircrew Station Geometry for Military Aircraft (No S/S Document)
MIL-STD-1399-300	Electric Power, Alternating Current
MIL-STD-1425	Safety Design Requirements for Military Lasers and Associated Support Equipment
MIL-STD-1472	Human Engineering
MIL-STD-1474	Noise Limits
MIL-STD-1530	Aircraft Structural Integrity Program
MIL-STD-1568	Materials and Processes for Corrosion Prevention and Control in Aerospace Weapons Systems
MIL-STD-1587	Material and Process Requirements for Aerospace Weapon Systems
MIL-STD-1591	Command, Control, and Communications (C3) System and Component Fault Diagnosis, Subsystems, Analysis/Synthesis of
MIL-STD-1629	Procedures for Performing a Failure Modes, Effects, and Criticality Analysis
MIL-STD-1760	Aircraft/Store Electrical Interconnection System
MIL-STD-1787	Aircraft Display Symbology
MIL-STD-1839	Calibration and Measurement Requirements

MIL-STD-203	Aircrew Station Controls and Displays: Location, Arrangement and Actuation of, for Fixed Wing Aircraft
MIL-STD-2105	Hazard Assessment Tests for Non-Nuclear Munitions
MIL-STD-2169	High Altitude Electromagnetic Pulse (HEMP) Environment
MIL-STD-2218	Thermal Design, Analysis, and Test Procedures for Airborne Electronic Equipment (inactive for new design)
MIL-STD-2525	Joint Military Symbology
MIL-STD-3008	Interactive Electronic Technical Manual (IETM) Technical Data Requirements to Support the Global
MIL-STD-3009	Lighting, Aircraft, Night Vision Imaging System (NVIS) Compatible
MIL-STD-3013	Glossary of Definitions, Ground Rules, And Mission Profiles to Define Air Vehicle Performance
MIL-STD-3031	Army Business Rules for S1000d: International Specification for Technical Publications Utilizing A Common Source Data Base
MIL-STD-3063	Rotorcraft Structural Integrity Program
MIL-STD-31000	Technical Data Packages
MIL-STD-38784	Manuals, Technical: General Style and Format Requirements
MIL-STD-40051-1C	Technical Manuals General Preparation and Assembly Information
MIL-STD-40051-2	Preparation of Digital Technical Information for Page-based Technical Manuals
MIL-STD-464C	Electromagnetic Environmental Effects Requirements for Systems
MIL-STD-46855	Human Engineering Requirements for Military Systems, Equipment, and Facilities
MIL-STD-6016	**Standard: Department of Defense Interoperability Tactical Data Link (TDL) LINK-16 Message Standard**
MIL-STD-7179	Finishes, Coatings, and Sealants, for the Protection of Aerospace Weapons Systems
MIL-STD-8591	Airborne Stores, Suspension Equipment and Aircraft - Store Interface (Carriage Phase)

NATO Standardization Agreements

STANAG-3105	Pressure Refueling Connections and Defueling for Aircraft
STANAG-3212	Diameters for Gravity Filling Orifices
STANAG-3294	Aircraft Fuel Caps and Fuel Cap Access Covers
STANAG-3632	Aircraft and Ground Support Equipment Electrical Connections for Static Grounding
STANAG 3899	Ground Fit and Compatibility Criteria for Aircraft Stores
STANAG 4241	Bullet Impact, munition Test Procedures
STANAG 4586	Standard Interfaces of UAV Control System (UCS) for NATO UAV Interoperability

National Institute of Standards and Technology

NIST 800-18	Guide for Developing Security Plans for Federal Information Systems
NIST 800-37	Guide for Applying the Risk Management Framework to Federal Information Systems
NIST 800-161	Supply Chain Management Practices for Federal Information Systems
NIST 800-171	Protecting Controlled Unclassified Information in Nonfederal Information Systems

Radio Technical Commission for Aeronautics - RTCA

RTCA/DO-143	Minimum Performance Standards - Airborne Radio Marker Receiving Equipment Operating on 75 Megahertz
RTCA/DO-160	Environmental Conditions and Test Procedures for Airborne Equipment
RTCA/DO-178	Software Considerations in Airborne Systems and Equipment Certification
RTCA/DO-179	Minimum Operational Performance Standards for Automatic Direction Finding (ADF) Equipment
RTCA/DO-186	Minimum Operational Performance Standards for Airborne Radio Communications Equipment
RTCA/DO-187	Minimum Operational Performance Standards for Airborne Area Navigation Equipment Using Multi-Sensor Inputs
RTCA/DO-189	Minimum Operational Performance Standards for Airborne Distance Measuring Equipment (DME) Operating within the Radio Frequency Range of 960-1215 MHz
RTCA/DO-192	Minimum Operational Performance Standards for Airborne ILS Glide Slope Receiving Equipment Operating within the Radio Frequency Range of 328.6-335.4 Megahertz
RTCA/DO-195	Minimum Operational Performance Standards for Airborne ILS Localizer Receiving Equipment Operating within the Radio Frequency Range of 108- 112 Megahertz
RTCA/DO-196	Minimum Operational Performance Standards for Airborne VOR Receiving Equipment Operating within the Radio Frequency Range of 108- 117.95 Megahertz
RTCA/DO-200	Standards for Processing Aeronautical Data
RTCA/DO-208	Minimum Operational Performance Standards for Airborne Supplemental Navigation Equipment Using Global Positioning System (GPS)
RTCA/DO-214	Audio Systems Characteristics and Minimum Operational Performance Standards for Aircraft Audio Systems and Equipment
RTCA/DO-219	Minimum Operational Performance Standards for ATC Two-Way Data Link Communications

RTCA/DO-229	Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment
RTCA/DO-236	Minimum Aviation System Performance Standards: Required Navigation Performance for Area Navigation
RTCA/DO-248	Supporting Information for DO-178C and DO-278
RTCA/DO-254	Design Assurance Guidance for Airborne Electronic Hardware
RTCA/DO-255	Requirements Specification for Avionics Computer Resource (ACR)
RTCA/DO-278	Guidelines for Communications, Navigation, Surveillance, and Air Traffic Management (CNS/ATM) Systems Software Integrity Assurance
RTCA/DO-297	Integrated Modular Avionics (IMA) Development Guidance and Certification Considerations
RTCA/DO-311	Minimum Operational Performance Standards for Rechargeable Lithium Battery Systems
RTCA/DO-316	Minimum Operational Performance Standards (MOPS) for Global Positioning System/Aircraft Based Augmentation System Airborne Equipment
RTCA/DO-326	Airworthiness Security Process Specification
RTCA/DO-330	Software Tool Qualification Considerations
RTCA/DO-331	Model-Based Development and Verification Supplement to DO-178C and DO-278A
RTCA/DO-332	Object-Oriented Technology and Related Techniques Supplement to DO-178C and DO-278A
RTCA/DO-333	Formal Methods Supplement to DO-178C and DO-278A

Society of Allied Weight Engineers (SAWE)

SAWE RP A-7	Management and Control for Military Aircraft
SAWE RP A-8	Weight and Balance Data Reporting Forms for Aircraft (including Rotorcraft and Air-Breathing Unmanned Aerial Vehicles.

SAE International

CMH-17	Composite Materials Handbook
SAE AIR5431	Repair Tooling
SAE ARP1870	Aerospace Systems Electrical Bonding and Grounding for Electromagnetic Compatibility and Safety
SAE ARP4754	Guidelines for Development of Civil Aircraft and Systems
SAE ARP4761	Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment
SAE ARP4916	Masking and Cleaning of Epoxy and Polyester Matrix Thermosetting Composite Materials
SAE ARP4977	Drying of Thermosetting Composite Materials

SAE ARP4991	Core Restoration of Thermosetting Composite Components
SAE ARP5089	Composite Repair NDT/NDI Handbook
SAE ARP5143	Vacuum Bagging of Thermosetting Composite Repairs
SAE ARP5144	Heat Application for Thermosetting Resin Curing
SAE ARP5256	Mixing Resins, Adhesives and Potting Compounds
SAE ARP5319	Impregnation of Dry Fabric and Ply Lay-Up
SAE ARP5412	Aircraft Lightning Environment and Related Test Waveforms
SAE ARP5414	Aircraft Lightning Zoning
SAE ARP5580	Recommended Failure Modes and Effects Analysis (FMEA) Practices for Non-Automobile Applications
SAE ARP5583	Guide to Certification of Aircraft in a High Intensity Radiated Field (HIRF) Environment
SAE ARP5764	Aerospace Active Inceptor Systems for Aircraft Flight and Engine Controls
SAE ARP8615	Fuel System Components: General Specification For
SAE AS1055	Fire Testing of Flexible Hose, Tube Assemblies, Coils, Fittings and Similar System Components
SAE AS4273	Fire Testing of Fluid handling Components for Aircraft Engines and Aircraft Engine Installations
SAE AS50881	Wiring, Aerospace Vehicle
SAE AS5726	Interface Standard, Interface for Micro Munitions
SAE AS6081	Fraudulent/Counterfeit Electronic Parts: Avoidance, Detection, Mitigation, and Disposition - Distributors
SAE AS6174	Counterfeit Materiel; Assuring Acquisition of Authentic and Conforming Materiel
SAE AS8049	Performance Standards for Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft
SAE AS9017	Control of Aviation Critical Safety Items
SAE AS9100	Quality Systems – Aerospace – Model for Quality Assurance in Design, Development, Production, Installation and Servicing
SAE AS9110	Quality Maintenance Systems – Aerospace – Requirements for Maintenance Organizations
SAE AS94900	Aerospace-Flight Control Systems - Design, Installation and test of Piloted Military Aircraft, General Specification for

Technical Manuals and Reports

TM 1-1500-204-23-11	Advanced Composite Material General Maintenance and Practices
NAVAIR 00-80T-122	Helicopter Operating Procedures for Air-Capable Ships NATOP Manual
NAVAIR EC-434-000-003	Prohibited/Restricted Materials

NAVSEA OP 3565	Technical Manual: Electromagnetic Radiation Hazards (Hazards to Personnel, Fuel and Other Flammable Material)
NAVSEA S9310-AQ-SAF-010	Technical Manual for Navy Lithium Battery Safety Program Responsibilities and Procedures
ATPD 2352N	Purchase Description Transparent Armor
AVSCOM TR 89-D-22A	Aircraft Crash Survival Design Guide
TC 3-04.45 (FM 3-04.140)	U.S. Army Training Circular, Combat Aviation Gunnery
UAAAMRDL TR 71-41	Survivability Design Guide for U.S. Army Aircraft
NATICK/TR-89/044	Anthropometric Survey of U.S. Army Personnel – Methods and Summary Statistics (ANSUR II)
TOP 7-3-529	Ingress, Emergency Egress, and Emergency Evacuation Testing of Army Aircraft

2.2. Required Publications - Appendices

The documents listed below are all of the documents referenced within the AMACC Appendices not otherwise identified in Applicable Document sections of the specific appendices and are needed to understand the information provided by this criteria document.

Data Item Descriptions (DIDs)

DI-HFAC-80742	Human Engineering Simulation Concept
DI-HFAC-80743	Human Engineering Test Plan
DI-HFAC-80745	Human Engineering Systems Analysis Report
DI-SESS-80198	Internal Loads and Static Strength Analysis Report
DI-SESS-81704	Test Plans/Test Procedures
DI-TMSS-81675	Equipment Technical Manual
DI-TMSS-81676	Subsystem Technical Manual
DI-TMSS-81677	System Technical Manual
DI-TMSS-81814	Interactive Electronic Technical Manual (IETM)
DI-TMSS-81818	Technical Manual Validation Plan
DI-TMSS-81819	Technical Manual Validation Certificate
DI-TMSS-81820	Technical Manual Verification Discrepancy/ Disposition Record
DI-TMSS-81821	Technical Manual Verification Incorporation Certificate
DI-HFAC-80744	Human Engineering Test Report
DI-HFAC-8074	Human Engineering System Analysis Report

Federal Aviation Administration (FAA) Advisory Circulars

AC 20-115	Airborne Software Development Assurance Using EUROCAE ED-12( ) and RTCA DO-178( )
AC 20-165	Airworthiness Approval of Automatic Dependent Surveillance – Broadcast OUT Systems

Radio Technical Commission for Aeronautics - RTCA

RTCA/DO-181	Minimum Operational Performance Standards for Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment
RTCA/DO-260	Minimum Operational Performance Standards for 1090 MHZ Extended Squatter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B)

3. DEFINITIONS AND ACRONYMS

3.1. Definitions

Advisory Circular (AC). Federal Aviation Administration (FAA) publication providing guidance for compliance with regulations, standards, and rules within Title 14 of the Code of Federal Regulations (14 CFR).

Aircraft. Synonymous with Air Vehicle.

Aircraft Operation. Any operation of an air vehicle that requires a rated crew member or special authorization to perform the operation in accordance with the aircraft operator's or maintenance manual (for example, flight, engine runs, and taxi).

Aircraft subsystem. Equipment that is installed as an integral part of an aircraft system that, if inoperable or removed, will prevent the aircraft from flying or make it unsafe (for example, helicopter tail rotor assembly).

Air System. An air vehicle plus the training and support systems for the air vehicle (e.g., communications, control, ground/surface/control station, launch and recovery, and support elements), and any weapons to be employed on the air vehicle. (Reference: JSSG-2000). An air vehicle, manned or unmanned, is a subset of its associated air system.

Air Vehicle. The installed equipment (hardware and software) for airframe, propulsion, on-board vehicle and applications software, communications/identification, navigation/guidance, central computer, fire control, data display and controls, survivability, reconnaissance, automatic flight control, central integrated checkout, antisubmarine warfare, armament, weapons delivery, auxiliary equipment, and all other installed equipment. (JSSG-2001)

Airworthiness. The property of an air system configuration to safely attain, sustain, and complete flight in accordance with approved usage limits.

Airworthiness approval. Any technical document that provides operating instructions, procedures, and limitations necessary for safe flight of an aircraft system, subsystem, component or allied equipment. As used herein it refers to approval from an airworthiness authority other than the Army.

Airworthiness assessment. A systems level engineering analysis to verify that the configuration and limitations of the aircraft and air systems are airworthy with respect to the airworthiness criteria defined by the airworthiness authority.

Airworthiness authority. A Government agency having engineering cognizance over a particular aircraft system, subsystem, or component and responsibility for determining the capability of that aircraft system, subsystem or component to function satisfactorily when used within prescribed limits. Also includes any foreign authority whose airworthiness approval has been accepted by the Army airworthiness authority.

Airworthiness determination. The process of assessing the capability of the aircraft system and/or subsystem to meet the approved airworthiness standards and design specifications. Applicable military and commercial standards and design specifications will be used as a basis for airworthiness evaluation during design, production, and operation of the system and/or subsystem.

Airworthiness Certification. A repeatable process implemented to verify that a specific air system can be, or has been, safely maintained and operated within its described flight envelope. The two necessary conditions for issuance and maintenance of an airworthiness certification are: (1) the air system must conform to its type design; and (2) the air system must be in a condition for safe operation.

Airworthiness Qualification. A progressive assessment process performed at the component, subsystem, and system levels to ensure that a system meets all applicable airworthiness requirements.

Aviation Critical Safety Item (CSI). A part, an assembly, installation equipment, launch equipment, recovery equipment, or support equipment for an aircraft or aviation weapon system if the part, assembly, or equipment contains a characteristic any failure, malfunction, or absence of which could cause a catastrophic or critical failure resulting in the loss of or serious damage to the aircraft or weapon system, an unacceptable risk of personal injury or loss of life, or an uncommanded engine shutdown that jeopardizes safety.

Certification Basis. The complete (necessary and sufficient), documented set of airworthiness criteria, standards and methods of compliance utilized to assess the airworthiness and safety of flight of a specific system design.

Component. As applied to Computer Systems and Software: Any item that is used to construct an element.

Computer Software Configuration Item (CSCI). An aggregation of software that satisfies an end use function and is designated for separate configuration management by the acquirer.

Configuration Item (CI). Any hardware, software, or combination of both that satisfies an end use function and is designated for separate configuration management. Configuration items are typically referred to by an alphanumeric identifier which also serves as the unchanging base for the assignment of serial numbers to uniquely identify individual units of the CI. (MIL-HDBK-61)

Continued (design) Airworthiness. All tasks to be carried-out to verify that the conditions under which a design airworthiness approval has been granted continue to be fulfilled at any time during its period of validity.

Continuing Airworthiness. Compliance with the processes (for example, aircraft maintenance, operator and maintainer training and certification, sourcing of spare parts, and configuration management) to ensure that, at any time in its life cycle an aircraft

complies with the technical conditions established at the issuance of the AWR or SAQ and is in a condition for safe operation.

Control Station. A facility or device, consisting of hardware and software, from which one or more unmanned aircraft are controlled and/or monitored for any phase of flight operations. The control station may be stationary, mobile as carried by another ground vehicle, aircraft, or naval vessel, or carried by ground personnel.

Crew Station. The physical environment in which a pilot, crew member, or operator performs mission duties.

Crewmember. As applied to Crew Systems, Section 9: Any person on the air vehicle who performs mission duties.

Criteria. The functionality, property**,** or the characteristic of interest.

Element. As applied to Computer Systems and Software: A logically grouped collection of items having a definitive interface and functional purpose.

Firmware. The combination of a hardware device and one or more of the following: computer instructions, computer data, and programmable hardware logic. The programming/data is not readily capable of being changed. NOTE: For the purposes of this document, the functionality of firmware defined by the programmable hardware logic is considered to be hardware; and functionality of firmware with computer instructions/data is treated as software.

Flight Critical. A term applied to any condition, event, operation, process, or item whose proper recognition, control, performance, or tolerance is essential to achieving or maintaining controlled flight of an aircraft.

Hazard. A real or potential condition that could lead to an unplanned event or series of events (i.e. mishap(s)) resulting in death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment. (MIL-STD-882).

Instructions for Continuing Airworthiness. Set of instructions typically in a series of manuals identifying all airworthiness limitations, inspections, maintenance, repair, overhaul and replacement times for systems, subsystems and parts necessary to maintain airworthiness over the life cycle.

Interlock. System design feature to enable or disable systems, functions, subsystems, or modes at given times and conditions.

Method of Compliance (MoC). A logical or systematic means to demonstrate or verify compliance with airworthiness criteria and standards. Method(s) of compliance will generate artifacts and objective evidence used in an airworthiness authority's determination of airworthiness. The MOC is the “proof” required by the airworthiness evaluator.

Mishap. An event or series of events resulting in unintentional death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment. For the purposes of this document, the term “mishap” includes negative environmental impacts from planned events. (MIL-STD-882)

Operator. Person who performs critical air vehicle tasks such as controlling manned or unmanned aircraft, payload(s), radar, communication, navigation and/or weapon system deployment.

Partitioning. As applied to Computer Systems and Software: A technique for providing system resource (e.g., memory throughput) isolation to a given piece of software.

Passenger. Any person on board an air vehicle who is not mission trained regarding the passenger safety/emergency capabilities of that particular air vehicle and mission. For a specific flight, this includes any person who does not have active crewmember duties and is not essential for accomplishing mission tasks. Mission training constitutes specialized air vehicle training beyond preflight safety briefings.

Performance. A quantitative or qualitative measure characterizing a physical or functional attribute relating to the execution of an operation or function. Performance attributes include quantity (how many or how much), quality (how well), coverage (how much area, how far), timeliness (how responsive, how frequent), and readiness (availability, mission/operational readiness). Performance is an attribute for all systems, people, products, and processes including those for development, production, verification, deployment, operations, support, training, and disposal. Supportability parameters, manufacturing process variability, reliability, and so forth are all performance measures.

Policy Statement (PS). Federal Aviation Administration (FAA) publication providing guidance for compliance with regulations, standards, and rules within Title 14 of the Code of Federal Regulations (14 CFR).

Product Baseline. The approved technical documentation which describes the configuration of a CI during the production, fielding/deployment and operational support phases of its life cycle. The product baseline prescribes all necessary physical or form, fit, and function characteristics of a CI, the selected functional characteristics designated for production acceptance testing, and the production acceptance test requirements (MIL-HDBK-61). When used for re-procurement of a CI, the product baseline documentation also includes the allocated configuration documentation to ensure that performance requirements are not compromised.

Qualified. The resulting state or condition from a formal verification process being applied to hardware and/or software systems to verify that requirements have successfully been met.

Redundancy. Utilization of two or more components, subsystems, or channels so that the functions that they support are capable of being sustained in the event of a failure.

Safety Critical. A condition, event, operation, process, or item whose mishap severity consequence is either Catastrophic or Critical. (MIL-STD-882).

Safety Critical Function (SCF). A function whose failure to operate or incorrect operation will directly result in a mishap of either Catastrophic or Critical severity. (MIL-STD-882).

Safety interlocks. An interlock that is necessary for the operation of one or more safety critical functions.

Situational Awareness. The ability to identify, process, and comprehend critical, perceived elements of information in one's environment in order to make decisions about a future state and/or needed actions. Any information that is presented to the pilot, operator, and crewmember can, or will, affect situational awareness.

Software Architecture. The organizational structure and interrelationship of software that identifies its components, interfaces, and the control/flow of execution.

Standard. The bar or verifiable level of performance that ensures the criteria has been satisfied.

System. A specific grouping of end-items, subsystems, components, or elements designed and integrated to perform a function.

System Safety. The application of engineering and management principles, criteria, and techniques to achieve acceptable risk within the constraints of operational effectiveness and suitability, time, and cost throughout all phases of the system life cycle. (MIL-STD-882).

Traceability. The ability to take a particular piece of development or design information and trace it to related information (examples: System level requirements to subsystem level requirements, software requirements to software design components, hardware component requirements to hardware test cases, function to sub-function, sub-function to hardware and software components that support the sub-function). Bi-directional traceability is the ability to make the trace in both directions.

Type Certification. A repeatable process implemented to verify that an air system design conforms to its type design. Type certification does not verify that the system has been properly maintained or operated in accordance with its technical data. (See airworthiness certification.)

Type Design. The type design consists of:

a. The drawings and specifications, and a listing of those drawings and specifications, necessary to define the configuration and the design features of the air system shown to comply with the airworthiness criteria applicable to the air system.

b. Information on dimensions, materials, materiel properties, and processes necessary to define the structural strength of the product.

c. Any airworthiness limitations required for safe operation and maintenance.

d. Any other data necessary to allow, by comparison, the determination of the airworthiness, noise characteristics, fuel venting, and exhaust emissions (where applicable) of later products of the same type.

Uncrewed Air Vehicle (UAV). A remotely piloted/operated, semi-autonomous, or autonomous air vehicle and its on-board operating system. This does not include air vehicles designed for one-time use as weapons (e.g., cruise missile).

Uncrewed Aircraft (UA). See Uncrewed Air Vehicle.

Uncrewed Air System (UAS). A UAS is comprised of individual elements consisting of the UAV, the control station, and any other support elements necessary to enable operation including, but not limited to data links, communications systems/links, and UAV-unique launch and recovery equipment. There may be multiple unmanned aircraft, control stations, and support elements within a UAS. The control station may be located on the ground (stationary or mobile), on a ship, submarine, aircraft, etc.

3.2. Abbreviations and Acronyms

3D	Three Dimensional
ACE	Avionics Communications Equipment
ACR	Avionics Computer Resource
ADF	Automatic Direction Finder
ADS	Aeronautical Design Standard
AFHA	Aircraft Functional hazards Assessment
AGL	Above Ground Level
AHO	Altitude Height above Obstacles
AHSS	Abnormal High Steady State
AHSS	Abnormal High Steady State
AIL	Aircraft Integration Lab
AIMS	Air Traffic Control Radar Beacon System, Identification Friend or Foe, Mark XII/Mark XIIA, Systems
ALSE	Aviation Life Support Equipment
ALSS	Abnormal Low Steady State
AMACC	Army Military Airworthiness Certification Criteria
AMT	Accelerated Mission Test
ANVIS	Aviation Night Vision System
APU	Auxiliary Power Unit
AQP	Airworthiness Qualification Plan
AQS	Airworthiness Qualification Specification
AQSR	Airworthiness Qualification Substantiation Report

AR	Army Regulation
ASAM	Aircraft Security Architecture and Measures
ASE	Aircraft Survivability Equipment
ASIP	Aircraft Structural Integrity Program
ASME	American Society of Mechanical Engineers
ASOG	Aircraft Security Operator Guidance
ASRA	Aircraft Security Risk Assessment
ASSD	Aircraft Security Scope Definition
ASV	Aircraft Security Verification
AT	Acceptance Test
AT	Autonomous
ATC	Air Traffic Control
ATCRBS	Air Traffic Control Radar Beacon System
ATP	Acceptance Test Procedure
ATTC	Army Technical Test Center
AUR	All-Up-Round
AvMC	Aviation & Missile Center
AVO	Air Vehicle Operator
AVSCOM	Aviation Systems Command
BFEA	Blue Force Electronic Attack
BIT	Built in Test
BLOS	Beyond-Line-of-Sight
BMU	Battery Management Unit
BPS	Ballistic Protection System
C&A	Controls and Accessories
CAD/CAM	Computer Aided Design/Computer Aided Manufacturing
CAE	Computer-Aided Engineering
CAGE	Commercial and Government Entity
CAI	Critical Application Item
CAST	Certification Authorities Software Team
CBM	Condition Based Maintenance
CBRN	Toxicology/Health/ Chemical Biological Radiological Nuclear
CC	Critical Characteristics
CCA	Common Cause Analysis
CCB	Contractor’s Control Board
CCs	Critical Characteristics
CDA	Commercial Derivative Aircraft
CDR	Critical Design Review
CEP	Circular Error Probability
CFR	Code of Federal Regulation
CG	Center of Gravity
CI	Configuration Item
CIA	Change Impact Analysis

CMH	Composite Materials Handbook
CNS	Communications, Navigation, Surveillance
COMM	Commercial
COTS	Commercial off the Shelf
CPCP	Corrosion Prevention and Control Plan
CRP	Critical Reaction Point
CSCI	Computer Software Configuration Item
CSI	Aviation Critical Safety Item
CSIs	Critical Safety Items
CSU	Computer Software Unit
CSWG	Crew Station Working Group
CTA	Critical Task Analysis
CTAR	Critical Task Analysis Report
CVM	Component Verification Matrix
CW	Continuous Wave
DAL	Development Assurance Level
DAMA	Demand Assigned Multiple Access
dB	Decibel
DbDD	Database Design Description
DC	Direct Current
DCPH-A	US Defense Centers for Public Health-Aberdeen
Def Stan	Defense Standards
DEVCOM	Combat Capabilities Development Command
DEWs	Directed Energy Weapons
DFARS	Defense Federal Acquisition Regulation Supplement
DHA	Defense Health Agency
DoD	Department of Defense
DSL	Direct-strike lightning
DVE	Degraded Visual Environments
E3	Electromagnetic Environmental Effects
E3IA	E3 Control Plan/Integration Analysis
E3IAR	Effects Integration and Analysis Report
E3RB	Electromagnetic Environmental Effects Requirements Board
E3WG)	E3 Working Group
EASA	European Aviation Safety Agency
ECCM	Electronic Counter-Counter Measures
ECP	Engineering Change Proposal
ECS	Environmental Control System
EFB	Electronic Flight Bags
EHMS	Engine Health Monitoring System
EHSS	Emergency High Steady State
EID	Electronically Initiated Device
ELA	Electrical Loads Analysis

ELSS	Emergency Low Steady State
ELT	Emergency Locator Transmitter
EMC	Electromagnetic Compatibility
EMCAB	Electromagnetic Compatibility Advisory Board
EMCON	Emission Control
EME	Electromagnetic Environment
EMI	Electromagnetic Interference
EMP	Electromagnetic Pulse
EMS	Engine Monitoring System
EMV	Electromagnetic Vulnerability
ENCU	Environmental Control Unit
EO/IR	Electro-Optical/Infra-Red
EO/IR)	Electro-Optical/Infrared
ESD	Electrostatic Discharge
EUT	Equipment under Test
EWIS	Electrical Wiring Interconnect System
FAA	Federal Aviation Administration
FADEC	Full Authority Digital Engine Control
FAR	Federal Aviation Regulation
FCS	Fly-by-Wire Flight Control Subsystem
FDE	Fault Detection and Exclusion
FEM	Finite Element Model
FHA	Functional Hazard Analysis
FHA	Functional Hazards Assessment
FLIR	Forward Looking Infrared
FMEA	Failure Modes and Effects Analysis
FMECA	Failure Modes, Effects, and Criticality Analysis
FOD	foreign object damage
FOR	Field of Regard
FORSCOM	United States Army Force Command
FOV	Field of View
FQT	Formal Qualification Test
FTA	Fault Tree Analysis
GAG	Ground-Air-Ground
GAMA	General Aviation Manufacturers Association
GATM	Global Air Traffic Management
GC	Gyro Compass
GCS	Ground Control Station
GFE	Government Furnished Equipment
GPS	Global Positioning System
GS	Glide Slope
HALT	Highly Accelerated Life Test
HAS	Hardware Accomplishment Summary

HATC	Hardware Acceptance Test Criteria
HATC	Hardware Acceptance Test Criteria
HCF	High Cycle Fatigue
HCFA	Hazard Causal Factor Analysis
HCI	Human Computer Interaction
HCM	Hardware Configuration Management
HCMP	Hardware Configuration Management Plan
HDD	Hardware Design Description
HDP	Hardware Design Plan
HEDAD-O	Human Engineering Design Approach Document- Operator
HEMP	High Altitude Electromagnetic Pulse
HERF	Volatile Materials
HERF	Hazards of Electromagnetic Radiation Fuel
HERO	Hazards of Electromagnetic Effects Ordinance
HERP	Hazards of Electromagnetic Radiation to Personnel
HESD	Helicopter ESD
HF	High Frequency
HHA	Health Hazard Assessment
HHAR	Health Hazard Assessment Report
HID	Hardware Interface Description
HMD	Helmet Mounted Display
HMI	Hazardously Misleading Information
HMS	Health Monitoring System
HOGE	Hover Out Of Ground Effect
HPA	Hardware Process Assurance
HPAP	Hardware Process Assurance Plan
HPM	High-Power Microwave
HRAP	Hardware Review and Analysis Procedures
HRAR	Hardware Review and Analysis Results
HRS	Hardware Requirements Specification
HSI	Human System Integration
HTP	Hardware Test Procedures
HTR	Hardware Test Results
HTrP	Hardware Transition Plan
HTS	Hazard Tracking System
HUMS/HAS	Health and Usage Monitoring System
HValP	Hardware Validation Plan
HVerP	Hardware Verification Plan
HWCI	Hardware Configuration Items
IAW	in accordance with
IBF	Inlet Barrier Filter
ICA	Instructions for Continuing Airworthiness

ICAO	Instructions for Continuing Airworthiness
ICD	Interface Control Document
ICS	Inter/Intra Communication System
IDD	Interface Design Description
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IFF	Identification, Friend or Foe
IFR	Instrument Flight Rules
IFSD	In Flight Shut Down
IFSDs	Flight Shut Downs
IFSDs	In Flight Shut Downs
ILS	Instrument Landing System
IMA	Integrated Modular Avionics
IMC	Instrument Meteorological Conditions
INR	Initial Nuclear Radiation
INS	Inertial Navigation System
IPS	Inlet Particle Separator
IPT	Integrated Product Team
IR	Infrared
IRS	Interface Requirements Specification
ISO	International Organization of Standardization
JACG	Joint Aeronautical Commanders Group
JSSG	Joint Services Specification Guide
JSSSEH	Joint Software Systems Safety Engineering Handbook
LCF	Low Cycle Fatigue
LFT&E	Live Fire Test and Evaluation
LLR	Low-Level Requirements
LLRs	low-level requirements
LNAV	lateral navigation
LOA	Letter of Acceptance
LoA	Letter of Authorization
LOC	Localizer
LOR	Level of Rigor
LOS	Line of Sight
LPA	Lightning Protection Analysis
LRU	Line Replaceable Unit
MB	Marker Beacon
MCP	Multi-Core Processer
MIL Docs	Military Documents
MMPDS	Metallic Materials Properties Development and Standardization
MOSA	Modular Open Systems Approach
MPCMP	Mass Properties Control and Management Process

MPE	Maximum Permissible Exposure
MPS	Minimum Performance Standards
MRO	Maintenance Repair and Overhaul
MRT	Modified Rhyme Test
MWO	Modification Work Orders
MWOs	Modification Work Orders
MWS	Mini Weapons Survey
NATO	North Atlantic Treaty Organization
NATOPS	Naval Aviation Training and Operating Procedures Standardization
NAVAIR	Naval Air Systems Command
NBC	Nuclear Biological Chemical
NDB	Non-Directional Beacon
NDI	Non-Destructive Inspection
NHSS	Normal High Steady State
NIST	National Institute of Standards and Technology
NLSS	Normal Low Steady State
NOE	Nap-of-the–Earth
NPSP	Net Positive Suction Pressure
NSI	No Safety Impact
NSL	Near-strike lightning
NVG	Night Vision Goggles
NVIS	Night Vision Imaging System
OAS	Obstacle Avoidance System
OCD	Operational Design Concept
OEI	One-Engine-Inoperative
OEM	Original Equipment Manufacturer
OVI	Operator-Vehicle Interface
PAD	Production Airworthiness Determination
PASA/PSSA	Preliminary Aircraft Safety Assessment / Preliminary System Safety Assessment
PASRA	Preliminary Aircraft Security Risk Assessment
PED	Portable Electronic Device
PEO AVN	Program Executive Office - Aviation
PESD	Personnel Electrostatic Discharge
PFR	Preliminary Flight Rating
Ph	Probability of Hit
PHA	Preliminary Hazard Analysis
PHAC	Plan for Hardware Aspects of Certification
PHAS	Programmable Hardware Accomplishment Summary
PHATC	Programmable Hardware Acceptance Test Criteria
PHC	Public Health Command
PHCM	Programmable Hardware Configuration Management

PHCMP	Programmable Hardware Configuration Management Plan
PHDD	Programmable Hardware Design Description
PHDP	Programmable Hardware Design Plan
PHID	Programmable Hardware Interface Description
PHPA	Programmable Hardware Process Assurance
PHPAP	Programmable Hardware Process Assurance Plan
PHRAP	Programmable Hardware Review and Analysis Procedures
PHRAR	Programmable Hardware Review and Analysis Results
PHRS	Programmable Hardware Requirements Specification
PHTP	Programmable Hardware Test Procedures
PHTR	Programmable Hardware Test Results
PHTrP	Programmable Hardware Transition Plan
PHValP	Programmable Hardware Validation Plan
PHVerP	Programmable Hardware Verification Plan
Pk	Probability of Kill
PM	Program Manager
PMIs	Patient Movement Items
POA&M	Plan of Action and Milestone
PPIP	Program Protection Implementation Plan
PPS	Precise Positioning Service
PR	Preliminary Rating
PR/CR	Problem Report/ Change Report
PR/CR /	Programmable Hardware Problem Reports / Change Requests
PSAC	Plan for Software Aspects of Certification
PSecAC	Plan for Security Aspects of Certification
P-static	Precipitation Static
PTO	Power Takeoff
PVI	Pilot Vehicle Interface
QT	Qualification Test
RAIM	Receiver Autonomous Integrity Monitoring
RAR	Risk Assessment Report
RDECOM	Research, Development and Engineering Command (Renamed Combat Capabilities Development Command (DEVCOM))
RDGT	Reliability Development and Growth Test
RF	Radio Frequency
RFT	Redundant Fault Tolerant
RNAV	aRea NAVigation
RNP	Required Navigation Performance
RP	Recommended Practice
RSIP	Rotorcraft Structural Integrity Program
RTCA	Radio Technical Commission for Aeronautics
RVM	Requirements Verification Matrix
S4	Stockpile-to-Safe Separation Sequence

SA	Situational Awareness
SAE	Society of Automotive Engineers
SAQ	Statement of Airworthiness Qualification
SAR	Safety Assessment Report
SART	Situational Awareness Rating Technique
SAS	Software Accomplishment Summary
SAT	Semi- Autonomous
SATCOM	Satellite Communications
SAWE	Society of Allied Weight Engineers
SBAS	Space Based Augmentation System
SCA	Structural Coverage Analysis
SCF	Safety Critical Function
SCG	Security Classification Guide
SCM	Software Configuration Management
SCMP	Software Configuration Management Plan
SDD	Software Design Description
SDP	Software Development Plan
SE	Sensor Effectivity
SecAR	Security Assessment Report
SecP	Security Plan
SEP	Spherical Error Probability
SFC	Specific Fuel Consumption
SHATR	Software Hazard Analysis Tracking Report
SHCI	Software Hazard Criticality Index
SI	System Integrator
SIL	Systems Integration Laboratory
SINCGARS	Single Channel Ground and Airborne Radio System
SINPO	Signal, Interference, Noise, Propagation, and Overall
SIP	Software Installation Plan
SIT	Software Integration Test
SITPr	Software Integration Test (SIT) Procedures
SITR	Software Integration Test Report
SM	Software Metrics
SOT	Simulated Operational Test
SPGS	Self Protection Gun System
SPS	Software Product Specification
SPS	Standard Positioning Service
SQA	Software Quality Assurance
SQAP	Software Quality Assurance Plan
SRD	Systems Readiness Directorate
SRS	Software Requirements Specification
SSA	System Safety Assessment
SSAM	System Security Architecture and Measures

SSCFA	Software Safety Critical Function Analysis
SSDD	System/Subsystem Design Document
SSHA	System Safety Hazard Analysis
SSOR	Strength Summary and Operating Restrictions
SSPP	System Safety Program Plan
SSRA	System Security Risk Assessment
SSS	System/Subsystem Specification
SSV	System Security Verification
STANAG	Standardization Agreement (in NATO)
STD	Software Test Description
STP	Software Test Plan
STPA	System Theoretical Process Approach
STR	Software Test Report
STrP	Software Transition Plan
SUM	Software User Manual
SV	Satellite Vehicle
SVD	Software Version Description
SVP	Software Verification Plan
SW FMECA	Software Failure Modes, Effects, and Criticality Analysis
SwCI	Software Criticality Index
SWFMEA	Software Failure Modes and Effects Analysis
TA	Terrain Avoidance
TACAN	Tactical Air Navigation
TAS	Tool Accomplishment Summary
TC	Tool Code
TCDS	Type Certificate Data Sheet
TCI	Tool Configuration Index
TCM	Tool Configuration Management
TCMP	Tool Configuration Management Plan
TD	Tool Design
TDD	Tool Design Description
TDL	Tactical Data Link
TDP	Tool Development Plan
TF	Terrain Following
TIR	Tool Installation Report
TLCEI	Tool Life Cycle Environment Configuration Index
TMDE	Test Measurement and Diagnostic Equipment
TOP	Test Operations Procedure
TOR	Tool Operational Requirements
TOVVCP	Tool Operational Verification and Validation Cases and Procedures
TOVVR	Tool Operational Verification and Validation Results
TPR	Tool Problem Report

TQA	Tool Quality Assurance
TQAP	Tool Quality Assurance Plan
TQL	Tool Qualification Level
TQP	Tool Qualification Plan
TR	Tool Requirements
TRR	Test Readiness Review
TSO	Technical Standard Order
TSPS	Tool Software Product Specification
TTC	Time to Criticality
TV	Television
TVCP	Tools Verification Cases and Procedures
TVP	Tool Verification Plan
TVR	Tool Verification Report
UA	Unmanned Aircraft
UAS	Unmanned Aircraft System
UAV	Unmanned Air Vehicle
UHF-AM	Ultra-High Frequency- Amplitude Modulated
UML	Unified Modeling Language
USAAMRDL	U.S. Army Air Mobility Research and Development Laboratory
USAR	United States Army Regulation
V/L	Vapor Volume to Liquid Volume
V50	Velocity 50%
VBA	Verification by Analysis
VBS	Verification by Similarity
VCF	Vehicle Control Function
VDC	Volts Direct Current
VG	Variable Geometry
VHF	Very High Frequency
VHF-AM	Very High Frequency- Amplitude Modulated
Vne	Velocity Never Exceed
VOR	VHF Omni-Range
VSWR	Voltage Standing Wave Ratio
Vy	Velocity, Vertical
WAAS	Wide Area Augmentation System
WCA	Warning, Caution and Advisory
WCET	Worst-Case Execution Time
WIL	Weapon Integration Lab
WILI	Weapon Inhibits, Limits, and Interrupts

4. SYSTEMS LEVEL REQUIREMENTS, PROCESSES AND ENGINEERING COGNIZANCE

This paragraph contains the Systems level requirements, processes for determining design, production and continuing airworthiness, and information the Airworthiness Authority requires to gain engineering cognizance necessary to perform an airworthiness assessment. Through satisfaction of the criterion in this section and all subsequent sections of this AMACC and any Airworthiness Qualification Plans, the Airworthiness Authority will acquire and maintain sufficient technical awareness and knowledge of the design, function, and performance of the system in order to perform an assessment and make an airworthiness determination. The assessment will result in determination of prescribed limits required for design, production and continuing airworthiness.

4.1. Design Airworthiness Determination

An airworthiness determination of the design shall be made based on assessment of all data provided in order to satisfy the criteria provided in the AMACC. The product design will be completely defined and then frozen in the configuration assessed for airworthiness determination.

4.1.1. Airworthiness Qualification Specification (AQS)

An Airworthiness Qualification Specification will be developed between the materiel developer and the airworthiness authority. The AQS defines all tests, analyses, demonstrations, similarity information and data necessary to satisfy all applicable airworthiness criteria from this AMACC, AQP's and the Aircraft System Specification.

Criteria:
All technical data necessary to substantiate airworthiness shall be defined and documented in an AQS.

Standard:
ADS-51-HDBK, Appendix B (use as a guide)
AMACC, Appendix R (use as a guide)
FAA AC 21-16G
RTCA/DO-160(G)

Method of Compliance:
The airworthiness substantiation shall include an AQS IAW DI-SDMP-81464 (See Appendix R) which validates airworthiness qualification efforts to meet the requirements of this AMACC, any AQP issued for the program and the aircraft system specification. The AQS shall describe and provide the processes, methodologies and activities that will be used for each component/subsystem/system to meet the airworthiness criteria. The AQS will also identify all technical data to be delivered to the government to demonstrate the airworthiness criterion are met. Upon approval by the Airworthiness Authority, the AQS becomes the document by which airworthiness qualification is tracked. If an AQS is not delivered to and approved by the Airworthiness Authority, the AQP will be the document by which airworthiness qualification is tracked. Airworthiness assessment of verification technical data against AQS requirements will be utilized by the airworthiness authority to write the Statement of Airworthiness Qualification (SAQ) and Airworthiness

Qualification Substantiation Record (AQSR). All technical data used for the airworthiness qualification effort shall be reported to the Airworthiness Authority, including all applicable legacy data and data used for verification by similarity. In addition, an integrated Master Schedule and a Component Verification Matrix shall be incorporated into the AQS. Airworthiness assessment will be provided, and qualification will be determined based on the review of the substantiating data. The Airworthiness substantiation shall address and develop procedures, test plans and tests required for all equipment, including the aircraft (manned and unmanned), UAS Ground Control Stations (GCS) or airborne UAS crew control stations, and all network links used to communicate between the aircraft and the GCS. The airworthiness substantiation shall include an Airworthiness Qualification Specification prepared IAW DI-SDMP-81464.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

4.1.2. Component Verification Matrix (CVM)
The CVM will accompany the AQS and define the method of airworthiness verification for all components and systems of the Aircraft.

Criteria:
The method of airworthiness verification for all components and systems of the aircraft has been defined.

Standard:
Process is in place to track component airworthiness verification status.

Method of Compliance:
The airworthiness substantiation shall include a Component Verification Matrix IAW DI-MISC-81283 (See Appendix R) which validates airworthiness verification efforts to meet the requirements of this AMACC, AQP's and the aircraft system specification. It shall also contain the specific verification method of analysis, test, demonstration, survey and similarity through a CVM and identify the intersection between system requirement and the method of Military Airworthiness Authority verification. The CVM shall include the certification status of all Line Replaceable Units (LRU), boxes, and components to include prior airworthiness assessments. The airworthiness substantiation shall include a Component Verification Matrix Report prepared IAW DI-MISC-81283.

Verification Methods. The Airworthiness substantiation shall show verification methods of similarity, analysis, test, demonstration, simulation or inspection for the airworthiness substantiation. Verification by test is the standard and most accurate method of verification.

a. Verification by Similarity (VBS). VBS may be proposed for components or systems that have been previously qualified for unrestricted use on U.S. Army aircraft. ADS-51-

HDBK should be used for reference and information regarding VBS. When VBS is proposed, reports shall be prepared including all supporting data and reports to verify compliance with the AQP. VBS reports should be submitted prior to the qualification test plan package. This approach will facilitate a timely review of the similarity report which, if disapproved, will provide sufficient time to revise the similarity report, or develop the appropriate test plans to perform the required qualification testing. The Electromagnetic Environmental Effects (E3) requirements shall not be verified by similarity. The rules of similarity are as follows:

(1) The component to be verified shall be similar to a verified component and not to another VBS component. Similarity statements shall give a detailed accounting of any differences between the two components. Any aspect of the two components that is not identical shall be disclosed and rationale provided as to how the non-identical aspects may affect qualification. Any differences in manufacturing processes, cleaning methods, protective coating methods, materials, etc., shall be addressed as non-identical aspects.

(2) The verified component to which similarity is being claimed shall have passed tests that are the same as or similar to the test requirements being substantiated. Differences in test environment, criteria, or method shall be clearly delineated. If test failures occurred during the original qualification, such shall be properly documented, including corrective action and successful retests.

(3) The two components shall be operated in similar environments with similar performance and duty cycle requirements. Significant differences in operating environment shall be discussed and rationale for similarity given.

(4) Similarity data should be supplemented with supporting analysis to address each non-identical aspect of the similarity claim. Test data from the unit being used as the basis for similarity shall also be provided

b. Verification by Analysis (VBA). VBA involves proving an item meets its design requirements by a technical evaluation of the electrical, aeromechanical, propulsive, and structural capabilities of the installed system. All requirements being verified by analysis shall be addressed and shown to comply with their respective system specification, requirements documents and AQP. Analysis reports shall be submitted prior to the verification test plan package. This approach will facilitate a timely review of the analysis report which, if disapproved, will provide sufficient time to revise the analysis or develop the appropriate test plans to perform the required verification testing.

c. Verification by Testing. Formal verification testing shall be used for component, subassembly and systems that do not meet verification by similarity or analysis standards. Formal testing shall include test plans, test procedures, test reports, and Government witnessing (as required).

d. Verification by Demonstration. Verification by demonstration are detailed tests that shall be conducted to show the capability of the system or subsystem, to comply with the requirements of the System Performance Specification. Surveys may be conducted to

obtain technical data information that has no defined pass or fail criteria; however, if data is collected during the survey that meets the performance requirements that satisfy the demonstration, the requirements of the demonstration can be considered completed. A survey shall be conducted to show the maximum capability of the system or subsystem.

e. Verification through Simulation. Verification through Simulation includes verification through the use of mathematical models incorporated into a simulation which replicate the operation or performance of the equipment being evaluated, the threat and environment in which the equipment shall operate; and various combinations of the equipment, threat, and environmental conditions. Verification and Validation of Models and Simulation shall follow AR 5-11 and RTCA/DO-331 and the DIDs called out in the appropriate sections of the AQP for Tool Qualification and Models Simulation. Verification by simulation is an expansion on verification by demonstration. Verification by demonstration requires that the activity or feature be performed in flight appropriately. Verification by simulation uses a simulated environment (generally a live hardware simulator) to achieve three certification goals:

(1) Simulation verifies that the appropriate cross section of U.S. Army aviators (5^{th} percentile female to 95th percentile male) will be able to perform the demonstrated tasks.

(2) Simulation allows operator reactions to degraded modes to be evaluated, including degraded modes, during critical phases of flight where demonstration would be impossible due to safety concerns.

(3) Simulation allows a wider variety of operator inputs and mission selections confirming that the correct behavior and interface requirements are present in the software design specifications.

Simulation may be conducted either before or after the relevant flight tests, but care must be taken that the demonstration flight test has the same behavior as the simulated system, including live aircraft hardware and identical system software loads.

f. Verification by Inspection. Inspections as defined in MIL-STD-961E shall be performed to determine if the system or subsystem complies with the requirements of the System Performance Specifications.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 21-16G, AC 21-50, AC 23-15A, AC23-17C, AC 27-1B, AC 29-2CRTCA/ Do-160(G)		

4.1.3. Design Criteria and Operating Environment

The design constraints for operating, maintaining, storing, and transporting the aircraft must be defined and controlled throughout the program. The airworthiness assessment will be against the defined design criteria and operating environment.

Criteria:
The design criteria including natural and induced environments that the aircraft and ground control station equipment must operate in shall be described to include the Meteorological Conditions.

Standard:
Aircraft System Specification

Method of Compliance:
The design of the aircraft and ground control station shall show ability to operate in the natural and induced environments IAW the aircraft system specification. The natural environments include the Meteorological Conditions. The airworthiness substantiation shall be prepared IAW DI-MISC-80711 (analyses). The airworthiness substantiation shall include a Design Criteria Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	AR 70-38 MIL-STD-810	AC 21-16G., AC 21-50 4 CFR 25.603 4 CFR 27.603 4 CFR 29.603 4 CFR 23.2260 (MOC ASTM 3264-19, Section 6.13)		

4.1.4. Drawings

The airworthiness determination will be against a product baseline defined by drawings and/or models that completely represent the system. These drawings and models are required by the airworthiness authority for engineering cognizance in the airworthiness assessment. See also paragraph 5.2.4.1. for related structural requirements.

Criteria:
The system shall be completely represented by drawings and/or models.

Standard:
ASME Y14.24
ASME Y14.37

Method of Compliance:
The Airworthiness substantiation shall include a Drawing Tree for the unique configuration IAW DI-SESS-81000 including a complete set of mechanical and electrical drawings of the newly designed or modified equipment. Product Drawings and Associated Lists for the unique configuration, including detail, assembly, installation, control, interface, electrical and special application drawings as defined in ASME Y14.24 shall be prepared IAW DI-SESS-81000. Electrical drawings shall be prepared IAW AS50881. Control Drawings and their associated parts lists shall be prepared for full disclosure and identification of purchased items or assemblies meeting ASME Y14.24 descriptions and definitions of Procurement Control, Vendor Control, Source Control or Envelope Drawings. Interface Control Drawings for Government Furnished Equipment (GFE) items shall be coordinated to obtain supplier concurrence prior to submittal. Kit Drawings shall be provided IAW ASME Y14.24 for A-kit and/or B-kit documentation. The drawings shall address all system unique features and interfaces with the aircraft. All drawings for parts manufactured from composites shall be IAW ASME Y14.37 and prepared IAW DI-SESS-81000.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
EIA-649		14 CFR 21.31, AC 21-50		STANAG-4427

4.1.5. Interface Control Documentation
The Interface Control Document (ICD) provides a record of all interface information (such as drawings, diagrams, tables, and textual information) for the design.

Criteria:
All interfaces between systems, subsystems and components shall be defined.

Standard:
ANSI/EIA-649

Method of Compliance:
The contractor provides an ICD IAW DI-SESS-81248 containing the following:

a. The ICD shall define and document the physical, environmental, signal characteristics, logic interfaces, sensitivities, and special data requirements for the various systems, subsystems, and components.

b. The ICD shall define and document the electrical requirements for the interfaces between various systems, subsystems, and components.

c. The ICD shall include all the airworthiness specifics and details that are critical to forward development of the system architecture. The airworthiness substantiation shall include an ICD prepared IAW DI-SESS-81248.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
EIA-649		AC 21-50		STANAG-4427

4.1.6. Commercial Derivative Aircraft

The airworthiness criteria satisfied for civil airworthiness certification shall be demonstrated as fully or partially satisfying the military airworthiness criteria. All instances where gaps exist between the civil and military criteria shall be identified for acceptance within the military certification program.

The purpose of CDA and/or Propeller Type Certification Substantiating Data is to document the substantiating data used for Federal Aviation Administration (FAA) aircraft and/or propeller airworthiness certification and continued compliance for CDA, aircraft systems, propellers, engines, and components. This data is used for airworthiness qualification, modifications, testing, and flight clearance substantiation for CDA owned or operated by the U.S. Army IAW AR 70-62.

Criteria:

All airworthiness criteria satisfied by civil airworthiness certifications are defined and accepted. The civil documentation for a CDA and/or propeller FAA Type Certification and continued compliance substantiates safe flight for the intended usage.

Standard:

The applicability of existing civil certification data is demonstrated for 14 CFR Parts 23, 25, 27, 29, and/or 35, as applicable to the design and intended usage.

Method of Compliance:

The civil airworthiness substantiation shall include data to substantiate that the aircraft meets the CDA FAA Type Certification requirements in 14 CFR Parts 23, 25, 27, 29, and/or 35, as applicable to the design and intended usage. The data shall be prepared IAW DI-SAFT-80901C. Manuals for commercial derivative aircraft and/or propellers shall be delivered IAW DI-TMSS-80527 (aircraft) or DI-TMSS-80067 (propeller or other components).

For commercial derivative aircraft, the airworthiness substantiation shall provide the aircraft's certification basis addressing all design criteria appropriate for the planned Army usage. The airworthiness substantiation shall ensure the intended Army utilization, design criteria and flight envelope of the aircraft are shown to be wholly within the existing commercial certification basis and identify any military "delta" airworthiness criteria, conditions and environments over and above those covered by the commercial certification. The assessment of the applicable civil criteria and identification of military

delta criteria shall be documented in FAA Form 8130-31 and reported IAW with DI-MISC-80711 (analyses). The airworthiness substantiation shall include a Military Delta Airworthiness Criteria Report prepared IAW with DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (4.1.3) ADS-51-HDBK (2-7) AR 70-62 MIL-PRF-32216	FAA FORM 8130-31 14 CFR Part 21 Subpart H, FAA Type Certificate Data Sheet		

4.1.7. Availability of Technical Data for Assessment

The data necessary for an airworthiness assessment by the Airworthiness Authority will be made available to the government throughout the life cycle. The data will be provided with appropriate licenses and data rights for the airworthiness assessment.

Criteria:

All data necessary for an airworthiness assessment by the Airworthiness Authority shall be made available to the government throughout the life cycle.

Standard:

Processes are in place to make necessary airworthiness data available for assessment.

Method of Compliance:

The airworthiness substantiation shall include the Government license with appropriate data rights IAW DFARS 252.227-7014(b) to any algorithms that are necessary for the government to assess the airworthiness of the system. The airworthiness substantiation shall include the government license with appropriate data rights IAW DFARS 252.227-7013 to any technical data necessary for the government to assess the airworthiness of the system. The airworthiness substantiation shall include a series of formal and informal reviews during the program to establish a foundation for airworthiness substantiation and ensure airworthiness. The Technical Reviews shall be held periodically during the program to evaluate the state of the system, ensure compliance with all airworthiness requirements and to re-direct activity if necessary. Appendix T, Design Reviews for Developmental Systems, provides information for the system developer on documentation necessary for an airworthiness assessment at various points in the design to assist the development process by identifying airworthiness issues early in the program.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 21-50 14 CFR Part 21 Subpart H,		

4.2. Tool and Database Processes

All tools used to represent the design need to be validated and verified to be an accurate representation of the design.

Criteria:

All tools, methods, and databases used in the requirements management, design, risk control and assessments of safety shall be applied appropriately and exhibit accuracy commensurate with their application.

Standard:

Processes are in place to ensure that all analysis, modeling and simulation tools and databases are of appropriate accuracy and fidelity, are validated for the intended applications, and are configuration controlled. Requirements definition/traceability, design and performance analysis tools, prediction methods, models and simulations are applied appropriately, and exhibit accuracy commensurate with their applications.

Method of Compliance:

The airworthiness substantiation shall demonstrate that all analysis tools, models, simulations and databases are validated, under configuration control, applied appropriately, and are of appropriate accuracy and fidelity for the intended applications per AR 5-11 Management of Army Models and Simulation and RTCA/DO-331, Model-Based Development and Verification Supplement to DO-178C and DO-278. The airworthiness substantiation shall ensure the validation basis of design analysis, models and simulations is substantiated and based on actual hardware/software test data and system verification results are compared with design analysis, modeling and simulation tool results and databases for validation purposes. The airworthiness substantiation shall be prepared IAW AR 5-11, DO-331, and the DID's called out in the appropriate sections of the AQP for Tool Qualification and Models and Simulation. The airworthiness substantiation shall include an Airworthiness Tools Validation Report prepared IAW DI-MISC-80711 (analyses).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 20-115D AC 20-152 14 CFR 21.31		

4.3. Production Airworthiness Determination

A suitable process must be in place at the manufacturer to ensure that the as-built configuration matches the configuration for which design airworthiness was determined and will be produced consistently.

Criteria:

The manufacturing processes and quality controls shall be defined and in place to ensure that the as-built configuration matches the configuration for which design airworthiness was determined and will be produced consistently.

Standard:

Processes are in place to ensure the vehicle will be manufactured to the design definition and repeatable throughout the production run.

Method of Compliance:

A production airworthiness determination (PAD) of a principal manufacturing facility that controls the design and quality of the product will be performed through the assessment of the facility's configuration management system, manufacturing process control system, quality assurance system, and the manufacturing site physical characteristics. A production airworthiness determination approval memo will be issued by the appropriate airworthiness authority when a PAD Integrated Product Team (IPT) determines that the manufacturing facility has the necessary controls in place to meet production airworthiness requirements. The PAD approval memo will not replace existing production oversight and verification processes, but rather validate and document that such processes utilized have verified the product conforms to the type design during production. The airworthiness substantiation of the information and processes to perform the PAD shall be prepared IAW DI-MISC-80711 (analyses). The airworthiness substantiation shall include a Production Airworthiness Determination Approval Memo prepared IAW DI-MISC-80711 (analyses).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		FAA Order 8110.4C 14 CFR Part 21 Subparts F, G		

4.4. Configuration Management

Once airworthiness has been determined for the aircraft configuration, that configuration shall be brought under configuration control to preclude unauthorized changes. Any subsequent changes to the configuration must be assessed for impacts to the system airworthiness.

Criteria:

The configuration control processes shall be defined and in place to maintain the design in an airworthy state.

Standard:

Processes are in place to maintain the configuration in an airworthy state.

Method of Compliance:

The airworthiness substantiation shall include a product baseline that is properly documented, established and brought under configuration control. The airworthiness substantiation shall include the methods to establish, maintain and amend configuration control of the airworthy baseline. The configuration management system shall have the capability to track the configuration of all safety critical items. The airworthiness substantiation of the configuration control process shall be prepared IAW DI-SESS-80858 (analyses).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
EIA-649	AR 70-1 (4–4.) DA PAM 70-3 (6-8) MIL-HDBK-516 (4.6)	14 CFR Part 21 FAA Order 8110.4C		STANAG-4427

4.5. Continued/Continuing Airworthiness

The continued airworthiness process provides for design approval whereas the Continuing Airworthiness Process will define all Instructions for Continuing Airworthiness (maintaining conformance with the approved Type Design (ICA). The ICA includes all airworthiness limitations, inspections, maintenance, repair, overhaul and replacement

times for systems, subsystems and parts necessary to maintain airworthiness over the life cycle.

4.5.1. Operator's Manuals and Checklists
All operational procedures, cautions, warnings, limitations, and performance data necessary to maintain the airworthiness must be defined and documented in the appropriate operators manuals and checklists.

Criteria:
All operational procedures, notes, cautions, warnings, limitations, and performance data necessary to maintain airworthiness shall be defined and documented in the appropriate operators manuals and checklists.

Standard:
MIL-PRF-63029

Method of Compliance:
The airworthiness substantiation shall define in the operator's manuals and checklists the system and sub-system envelopes, limits, notes, cautions, warnings and performance data resulting from the design airworthiness documentation. The airworthiness authority may define additional limits, notes, cautions and warnings based on the airworthiness determination. Operator's Manuals and checklists shall be prepared IAW MIL-PRF-63029.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 26-1 14 CFR 27/29- 14 CFR 23.1529 1541-1589 14 CFR 21.50 AC27-1B AC29-2B 14 CFR 27.1529 14 CFR 29.1529 AA Order 8110.4C		

4.5.2. Maintenance Manuals
All maintenance actions necessary to maintain the design and production airworthiness of the vehicle throughout its lifecycle must be defined and provided in appropriate manuals.

Criteria:
All maintenance actions necessary to maintain the design and production airworthiness of the vehicle throughout it lifecycle shall be defined and documented in maintenance and overhaul manuals. See paragraph 5.4.2.1. for related structural requirements.

Standard:
MIL-STD-40051-1 (IETMs)
MIL-STD40051-2 (ETMs)

Method of Compliance:
The airworthiness substantiation shall define in the Instructions for Continuing Airworthiness (ICA) the maintenance actions and procedures from unit level to depot level overhaul required to maintain airworthiness throughout the life-cycle. Additional criteria for airworthiness and sustainment engineering are contained in paragraph 16 below.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		FAA Order 8110.4C AC 20-77B AC 26-1 AC27-1B AC29-2B 14 CFR 27.1529 14 CFR 29.1529 14 CFR 23.1529 (ASTM F3264-19, Section 10.6)		

5. STRUCTURES

This section provides the set of airworthiness requirements related to ensuring structural integrity of the aircraft via establishment of a structural integrity program. The requirements are listed in accordance with the supported structural integrity program tasks, which include requirements for design information, design analysis and developmental testing, full-scale testing, fielding with instructions for Continuing Airworthiness (ICA), and fleet management. Generally speaking, the criteria supporting these structural integrity program tasks include development of planning and design criteria, verification of structural component durability and reliability, verification of strength within the structural envelope, definition and documentation of the fielded structural configuration(s) to ensure development of relevant test and analysis data, implementing prudent structural-flight-test envelope expansion, and demonstrating structural military suitability.

5.1. Design Information

In the structural integrity program, design information includes requirements related to the development of criteria applied during design, ensuring that the aircraft maintains structural integrity at desired levels of reliability.

5.1.1. Rotorcraft Structural Integrity Program Planning and Design Criteria

For rotorcraft, the Rotorcraft Structural Integrity Program (RSIP) defines the requirements necessary to substantiate and maintain structural integrity. MIL-STD-3063 documents the standard practice for RSIP. The design information task of a structural

integrity program includes documentation of design criteria IAW the aircraft system specification.

5.1.1.1. Rotorcraft Structural Integrity Program (RSIP) Master Plan

The purpose of the RSIP Master Plan is to define and document the specific approach to accomplish the various RSIP tasks throughout the life-cycle of each rotorcraft.

Criteria:
The rotorcraft structural integrity program plan shall be defined.

Standard:
MIL-STD-3063
Aircraft System Specification

Method of Compliance:
The RSIP Master Plan shall be coordinated with the PM and DEVCOM AvMC IAW MIL-STD-3063 and IAW the requirements of the Aircraft System Specification using section 7-6 of ADS-51-HDBK as a guide. The RSIP Master Plan shall define and document the specific approach to accomplish the various RSIP tasks throughout the life-cycle of each rotorcraft. The plan shall incorporate RSIP task elements IAW section 5 of MIL-STD-3063 for design, development, testing, fielding, and fleet management. The plan shall also include a discussion of unique features, exceptions to MIL-STD-3063 and the associated rationale including risk assessments, and any problems anticipated in the execution of the plan. The plan shall document prerequisites to each task element of the plan, including the necessary technical reviews and Government approvals. The plan shall document the RSIP schedule. The development of the schedule shall consider all interfaces, the impact of schedule delays (e.g., delays due to test failure), mechanisms for recovery programming, and any other problem areas. The airworthiness substantiation shall include the RSIP Master Plan IAW DI-MGMT-81911. The airworthiness substantiation may leverage DI-SESS-81956 as a guide to content and format requirements after tailoring with MIL-STD-3063 content used in place of any MIL-STD-1530 references. The RSIP Master Plan shall be updated IAW section 4 of MIL-STD-3063.DEVCOMSRD

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-51-HDBK Section 7-6 NAVAIR AR-56 para 3.7.2. NAVAIR AR-89 MIL-STD-1530 (for USAF)	14 CFR 21 Subpart B 14 CFR 23 14 CFR 27, 29.21, 307, 601, 1501 CS content corresponding to the 14 CFR reference(s) provided 14 CFR 25 Transport Aircraft	Part 7, Leaflet 100, 200, 201, 202, 732, 1000, 1008, 1015, and 1017 UK MoD Regulatory Article RA 5720 "Structural Integrity Management"	

5.1.1.2. Structural Design Criteria

The purpose of the structural design criteria is to establish detailed structural characteristics and standards used to confirm airworthiness for the air-vehicle structural design. The structural design criteria are established in accordance with the requirements of the aircraft system specification and include design criteria for the structural design envelope, loads, strength, deformation, durability, fatigue fracture, tolerances, mass properties, dynamics, and survivability.

Criteria:
The air-vehicle structural design criteria shall be defined.

Standard:
MIL-STD-3063, section 5.1.3.,
MIL-STD-3063, section 5.1.2.
Aircraft System Specification

In addition:

(1) Ultimate and yield factors of safety shall be IAW the aircraft system specification (or 1.5 and 1.15, respectively, when ultimate and yield factors of safety are not otherwise defined in the aircraft system specification). The 1.15 yield factor of safety applies to limit loads to ensure the structure is protected against detrimental deformations, including delamination as referenced in MIL-HDBK-516 and JSSG-2006.

(2) Deleterious oscillatory loads shall not occur in steady state operating conditions during authorized usage. Fatigue critical components shall not incur damage during steady state operations. A steady state operation is any flight maneuver that can be sustained over a specified amount of time.

(3) Structural reliability shall be IAW the aircraft system specification (or as required with 95% confidence for less than one catastrophic failure of rotorcraft structure

during authorized usage for every 20 million aircraft flight hours when structural reliability is not otherwise defined in the aircraft system specification).

Method of Compliance:
The airworthiness substantiation shall include Structural Design Criteria IAW section 5.1.3. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification using chapter 5 of MIL-HDBK-516, ADS-29, chapter 4 of AMCP 706-201, and section 3.4. of MIL-A-8868 as guides. The Structural Design Criteria normal load factor for asymmetric flight of rotorcraft shall be the same as for symmetric flight. The Structural Design Criteria shall incorporate structural reliability requirements IAW the aircraft system specification (or as required with 95% confidence for less than one catastrophic failure of rotorcraft structure during authorized usage for every 20 million aircraft flight hours when structural reliability is not otherwise defined in the aircraft system specification). The Structural Design Criteria shall incorporate ultimate and yield factors of safety IAW the aircraft system specification (or 1.5 and 1.15, respectively, when not otherwise defined in the aircraft system specification). The Structural Design Criteria shall incorporate provisions to avoid the occurrence of deleterious oscillatory loads in steady state operating conditions during authorized usage. All adhesive bond lines should have designs based on best practices (surface prep, materials, clean conditions, cure cycle, etc.) and quality control so that they will last the design service life of the component. For critical load paths fail safe requirements will apply (100% limit load capability without bond line) and an inspection interval shall be substantiated. The Structural Design Criteria shall require use of strength properties and design values IAW 14 CFR 29.613 paragraphs (a) through (c), using ADS-29 paragraph 4.1.10. as a guide. The contractor may also use MIL-S-8698 as a guide, except that a 1.0 multiplier shall be substituted for the rolling pullout load factor guidance in paragraph 3.2.3.1. The airworthiness substantiation shall include a Structural Design Criteria Report prepared IAW DI-RELI-81498.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 Ch. 5 ADS-29 ADS-51-HDBK para 4-9.2., 7-6 AMCP 706-201 Ch. 4 MIL-A-8868 para 3.4. MIL-S-8698 (except substitute normal load factor of 1.0 in para 3.2.3.1. to match ADS-29 criteria) NAVAIR AR-56 (except substitute normal load factor of 1.0 in para 3.2.3.1. to match ADS-29 criteria) -- see especially para 3.7.4.1. through 3.7.4.6. MIL-STD-8591 (for interface to stores) MIL-STD-1290 (for survivability criteria) RDECOM TR 12-D-12 (for survivability criteria) USAAVSCOM TR 89-D-22A through E (for survivability criteria) JSSG 2006 (for fixed wing) MIL-STD-1530 section 5.5.6		Part 7, Leaflet 109, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 300, 301, 302, 304, 305, 306, 307, 308, 309, 310, 403, 709, 710, 714, 720, 722, 723, 732, and 800	

5.1.2. Design Information for Structural Durability and Reliability

As part of the first task of a structural integrity program, design information required for generating an airworthy aircraft design includes detailed documentation of approved methods for meeting the durability and reliability requirements for the aircraft structure.

5.1.2.1. Fatigue and Fracture Methodologies

The purpose of the fatigue and fracture methodologies is to document the procedure for establishing the service life, retirement intervals, inspection intervals, inspection procedures, and associated probabilities of detection for the aircraft structure in accordance with the requirements of the system specification.

Criteria:

The air-vehicle structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063, section 5.1.5.
MIL-STD-3063, section 5.1.5.1
MIL-STD-3063, section 5.1.5.2.
MIL-STD-3063, section 5.1.5.3.
MIL-STD-3063, section 5.2.5.
Aircraft System Specification

In addition: (1) deleterious oscillatory loads shall not occur in steady state operating conditions during authorized usage; and (2) structural reliability shall be IAW the aircraft system specification (or as required with 95% confidence for less than one catastrophic failure of rotorcraft structure during authorized usage for every 20 million aircraft flight hours when structural reliability is not otherwise defined in the aircraft system specification).

Method of Compliance:
The airworthiness substantiation shall include the fatigue methodologies used in establishing service life, retirement intervals, inspection intervals, inspection procedures, probabilities of detection and associated confidence IAW section 5.1.5. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification. The fatigue and fracture methodologies shall include methodologies for safe life, enhanced safe life, durability and damage tolerance, as applicable for the rotorcraft, IAW sections 5.1.5.1., 5.1.5.2., and 5.1.5.3., respectively, of MIL-STD-3063, as well as identification of the rotorcraft structure for which each methodology is applicable IAW the Aircraft System Specification. Unless otherwise specified in the Aircraft System Specification, the fatigue and fracture methodologies shall incorporate enhanced safe life IAW MIL-STD-3063 to establish retirement intervals of replaceable Safety of Flight Structures under significant high-frequency loading (such as rotor and control mechanism components) with a high likelihood of damage based on the threat assessment IAW section 5.2.5. of MIL-STD-3063. Unless otherwise specified in the Aircraft System Specification, the methodology shall incorporate design service life testing IAW MIL-STD-3063 of the Safety of Flight Structures not managed by a safe life or enhance safe life retirement interval (such as fuselage, tail cone, wing, and empennage structures) to verify the rotorcraft design-service-life requirement unless otherwise specified in Aircraft System Specification. The Fatigue and Fracture Methodologies shall incorporate structural reliability requirements IAW the aircraft system specification (or as required with 95% confidence for less than one catastrophic failure of rotorcraft structure during authorized usage for every 20 million aircraft flight hours when structural reliability is not otherwise defined in the aircraft system specification). The Fatigue and Fracture Methodologies shall incorporate provisions to avoid the occurrence of deleterious oscillatory loads in steady state operating conditions during authorized usage. The airworthiness substantiation shall include a Fatigue and Fracture Methodology Report(s) IAW DI-MISC-80711. The airworthiness substantiation may combine and fracture methodologies into a single report or establish a separate methodology report for each area of safe life methodology, enhanced safe life methodology, and durability and damage tolerance methodology. The AQS shall specify whether the airworthiness substantiation shall is provided a single combined report or separate reports to detail the

approach to safe-life fatigue, enhanced safe-life fatigue, and durability and damage tolerance.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
NAS410 (for NDI inspector qualifications)	ADS-51-HDBK para 4-9.4., 7-6 AMCP 706-201 Ch. 4 NAVAIR AR-56 para 3.7.4.6. NAVAIR AR-89 para 3.12.2.1 MIL-HDBK-1823 (for NDI) TM 1-1500-335-23 (for NDI) MIL-STD-1530 sections 5.1.3.4., 5.1.3.5., 5.1.4., 5.5.6. JSSG 2006		Part 7, Leaflet 200, 201, 203, 204, 205, 207, 209, 301, 308, 309, 403, 723, 732, and 802	

5.1.3. Reserved

(Paragraph reserved for identification of design information required to substantiate a structural envelope that ensures airworthiness, other than already included in the structural design criteria)

5.1.4. Design Information for Structural Configuration Definition and Development

As part of a structural integrity program, design information required for generating an airworthy aircraft design includes definition of the structural configuration via structural description and selection rationale for design details.

5.1.4.1. Structural Description including List of Materials

The purpose of the structural description is to provide a detailed description of the aircraft structure, including the selected materials, processes, joining methods, and structural concepts.

Criteria:

The analyzed, tested and fielded structural configuration(s) shall be defined.

Standard:

MIL-STD-3063, section 5.1.9.
MIL-STD-3063, section 5.4.1
NAVAIR Engineering Circular EC-434-000-003, section 2.2.
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall include a detailed description of the rotorcraft structure designed IAW the requirements of the Aircraft System Specification including the selected materials, processes, joining methods, and structural concepts. The airworthiness substantiation shall include material selections IAW section 5.1.9. of MIL-STD-3063 and the design driven constraints identified in section 2.2. of NAVAIR Engineering Circular EC-434-000-003. The airworthiness substantiation should leverage section 3.3. of MIL-A-8868 as a guide. The airworthiness substantiation shall include a Rotorcraft Structural Design Description Report prepared IAW DI-MISC-80711. The report shall be updated IAW section 5.4.1. of MIL-STD-3063. The Structural Description Report shall include the following content:

a. Reduced-size drawings/models, perspectives, sketches, or other data as necessary to permit review by the procuring activity of related structural design and analysis data.

b. Information concerning the general arrangement, inboard profile, rotor system, drive system, fuselage, empennage, power-plant installation, armament arrangement, landing gear, and operation of the control systems.

c. Clear depictions of structural location, size and gauge, material and material condition, and method of attachment of major components.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-A-8868 section 3.3. NAVAIR AR-56 para 3.7.3. MIL-STD-3063, Section 6 MIL-STD-1530		Part 7, Leaflet 400, 402, and 403	

5.1.4.2. Selection Rationale for Structural Design Details
The purpose of providing the selection rationale is to allow for verification of the manufacturing stability, producibility, characterization of mechanical and physical material properties, predictability of structural performance, and supportability of the selected structural design details.

Criteria:
The analyzed, tested and fielded structural configuration(s) shall be defined.

Standard:
MIL-STD-3063, section 5.1.9.
NAVAIR Engineering Circular EC-434-000-003, section 2.2.
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall include selection rationale for structural design details IAW section 5.1.9. of MIL-STD-3063, IAW the requirements of the Aircraft System Specification, and IAW the design driven constraints identified in section 2.2. of NAVAIR Engineering Circular EC-434-000-003. The airworthiness substantiation shall include a Selection Rationale for Materials, Processes, Joining Methods, and Structural Concepts report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 DoD Instruction 5000.02 (for assessment of technology and manufacturing readiness) MIL-HDBK-896 (for manufacturing readiness) MIL-STD-1530		Part 7, Leaflet 200, 201, 307, 400, 402, 403, 406, 407, 408, 409, 712, and 732	

5.2. Design Analysis and Developmental Testing
In the structural integrity program, design analysis and developmental testing allows the program to develop the design through testing and analysis. In support of the design, analysis, and testing program activities, the program uses design analysis and developmental testing to characterize the specified design usage and environment.

5.2.1. Design Analysis for Design Criteria Development
As part of a structural integrity program, the program uses design analysis to develop, refine, and characterize details necessary to apply design information in accordance with the aircraft system specification.

5.2.1.1. Design Usage Environment Spectra
The purpose of the design-usage-environment spectra is to characterize details related to the intensity, duration, and frequency of occurrence of various environmental conditions experienced by the structure in accordance with the aircraft system specification. Detailed characterization of the design usage environment supports design, analysis, and testing program activities. Environmental conditions may be natural or induced and include conditions related to temperature, altitude, precipitation, humidity, chemical, abrasive, vibratory, and corrosive environments.

Criteria:
The rotorcraft structural design criteria shall be defined.

Standard:
MIL-STD-3063, section 5.2.4.
MIL-STD-3063, section 5.4.1.
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall include a Design Usage Environment Spectra analysis for the rotorcraft structure IAW section 5.2.4. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification, using MIL-HDBK-310 as a guide. Environments covered in the spectra shall include exposure to rain, sand, corrosion, temperature, moisture absorption, ice, and snow. Unless otherwise specified in the Aircraft System Specification, the airworthiness substantiation may leverage simplified analysis based on environmental extremes that envelop the design-usage-environment spectra, with appropriate documentation in the structural design criteria. The design usage environment spectra and associated environmental extremes shall be updated IAW section 5.4.1. of MIL-STD-3063. When not incorporated into the structural design criteria, the airworthiness substantiation shall include a design usage environment spectra analysis report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 MIL-HDBK-310 MIL-STD-1530 JSSG 2006 (for fixed wing)		Part 7, Leaflet 101, 201, 203, 300, and 732	

5.2.1.2. Threat Assessment
The purpose of the threat assessment is to identify potential damaging threats that the aircraft could experience during its design service life. The assessment considers aircraft exposure to threats such as fatigue, environmental effects, intrinsic and discrete anomalies, impacts, accidental damage, operational threats, and hostile threats.

Criteria:
The rotorcraft structural design criteria shall be defined.

Standard:
MIL-STD-3063, section 5.2.5.
MIL-STD-3063, section 5.4.1.
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall include a threat assessment IAW section 5.2.5. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification. The airworthiness substantiation may leverage sections 29.571B.f(5) and 29.573.f(6)(ii)(C) of FAA AC 29-2 as a guide for assessment of threats related to damage, and sections 9-14

and 11-6 of ADS-51-HDBK as a guide for assessment of hostile threats. The airworthiness substantiation shall include a Threat Assessment Report IAW DI-MISC-80711. The report shall be updated IAW section 5.4.1. of MIL-STD-3063.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 ADS-51-HDBK para 11-6 (for threat assessment of hostile threats) JSSG 2006 (for fixed wing) MIL-STD-1530		Part 7, Leaflet 200, 201, 206, 209, 403, 408, 409, and 715	

5.2.2. Design Analyses for Structural Durability and Reliability

As part of an air-vehicle structural integrity program, design analysis includes various coordinated analyses working together to meet the durability and reliability requirements of the aircraft system specification.

5.2.2.1. Design Loads Spectra

The purpose of the design loads spectra is to encompass operational usage and establish the spectrum of loads for each air-vehicle load path to support analysis of fatigue and fracture failure modes and to enable reliable structural component design.

Criteria:

The air-vehicle structure shall meet the specified durability and reliability requirements.

Standard:

MIL-STD-3063, section 5.2.3.
MIL-STD-3063, section 5.3.10.
MIL-STD-3063, section 5.4.1.
Aircraft System Specification

Method of Compliance:

The airworthiness substantiation shall include a Design Loads Spectrum Analysis for each load path of the rotorcraft structure IAW section 5.2.3. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification. Prior to completion of the flight load survey testing IAW section 5.3.10. of MIL-STD-3063, the airworthiness shall develop the design loads spectra using loads analysis and legacy flight test loads. The airworthiness substantiation shall include a Design Loads Spectra Analysis Report IAW DI-MISC-80711. After completion of the flight load survey testing, the spectra and report shall each be updated IAW sections 5.3.10. and 5.4.1. of MIL-STD-3063.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 ADS-51-HDBK para 4-9.4., 7-6 AMCP 706-201 Ch. 4 NAVAIR AR-56 para 3.7.4.6. MIL-STD-1530		Part 7, Leaflet 201, 204, 205, 301, 310, and 723	

5.2.2.2. Damage Tolerance Analyses

The purpose of damage tolerance analysis is to substantiate that the structural design meets damage tolerance requirements in accordance with the aircraft system specification and damage tolerance methodology, including requirements related to structural reliability, service life, retirement intervals, threat exposure, and inspection intervals and procedures.

Criteria:
The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063, section 5.2.7.
MIL-STD-3063, section 5.4.1.
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall include damage tolerance analysis of specified rotorcraft structure IAW section 5.2.7. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification and IAW the Durability and Damage Tolerance Methodology for the Rotorcraft. IAW sections 5.2.7. and 5.4.1. of MIL-STD-3063, the analysis shall be validated, correlated, corrected, and updated based on data from damage tolerance testing and structural flight testing. The airworthiness substantiation shall include a Damage Tolerance Analysis Report IAW DI-SESS-81983. The report shall be updated IAW section 5.4.1. of MIL-STD-3063.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 MIL-STD-1530 JSSG 2006 (for fixed wing)	14 CFR 29.307, 571, 573, 611 CS content corresponding to the 14 CFR reference(s) provided	Part 7, Leaflet 201	

5.2.2.3. Safe Life and Enhanced Safe Life Analyses

The purpose of safe life and enhance safe life analysis is to substantiate that the structural design meets safe life and enhanced safe life requirements in accordance with the aircraft system specification and fatigue methodology, including requirements related to structural reliability, service life, retirement intervals, threat exposure, and inspection intervals and procedures.

Criteria:
The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063, section 5.2.8.
MIL-STD-3063, section 5.2.9.
MIL-STD-3063, section 5.4.1.
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall include safe life or enhanced safe life analysis, as applicable, of specified rotorcraft structure IAW sections 5.2.8. and 5.2.9., respectively, of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification and IAW the Fatigue and Fracture Methodologies for the Rotorcraft. IAW sections 5.2.8., 5.2.9., and 5.4.1. of MIL-STD-3063, the analysis shall be validated, correlated, corrected, and updated based on data from applicable safe life or enhanced safe life testing and structural flight testing. The airworthiness substantiation shall include a safe life analysis report and an enhanced safe life analysis report, each IAW DI-MISC-80711. The reports shall be updated IAW section 5.4.1. of MIL-STD-3063.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 NAVAIR AR-56 para 3.7.6. (fatigue analysis reports) AMCP 706-201 Ch. 4 ADS-51-HDBK para 4-9.4., 7-6 MIL-STD-1530	14 CFR 29.307, 571, 573 CS content corresponding to the 14 CFR reference(s) provided14 CFR 23	Part 7, Leaflet 201	

5.2.2.4. Design Service Life Analysis

The purpose of design service life analysis is to substantiate that the structural design meets design service life requirements in accordance with the aircraft system specification and durability methodology, including requirements related to structural

reliability, service life, retirement intervals, threat exposure, and inspection intervals and procedures.

Criteria:
The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063, section 5.2.10.
MIL-STD-3063, section 5.4.1.
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall include design service life analysis of specified rotorcraft structure IAW section 5.2.10. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification and IAW the Durability Methodology for the Rotorcraft (see section 5.1.5.3. of MIL-STD-3063). IAW sections 5.2.10. and 5.4.1. of MIL-STD-3063, the analysis shall be validated, correlated, corrected, and updated based on data from design service life testing and structural flight testing. The airworthiness substantiation shall include a design service life analysis report (or durability report) IAW DI-SESS-81983. The report shall be updated IAW section 5.4.1. of MIL-STD-3063.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 NAVAIR AR-56 para 3.7.6. (fatigue analysis reports) JSSG 2006 (durability for fixed wing) MIL-STD-1530 (durability for USAF)	14 CFR 29.307, 571, 573 CS content corresponding to the 14 CFR reference(s) provided 14 CFR 23	Part 7, Leaflet 201 and 709	

5.2.2.5. Mechanical Endurance Assessment

The purpose of the mechanical endurance assessment is to evaluate the structural design for wear and degradation of components during the required service life, retirement intervals, and inspection intervals. The development or modification program uses the mechanical endurance assessment to identify wear and degradation susceptible components and implements control measures to ensure that wear and degradation will not invalidate loads and structural analyses of safety critical components, including adjacent components.

Criteria:
The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063, section 5.2.11
MIL-STD-3063, section 5.4.1
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall include a mechanical endurance assessment IAW section 5.2.11. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification. The airworthiness substantiation shall include a mechanical endurance assessment report IAW DI-MISC-80711. The report shall be updated IAW section 5.4.1. of MIL-STD-3063.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 ADS-51-HDBK para 7-8.1 MIL-STD-1530	14 CFR 29.307, 571, 573, 611 CS content corresponding to the 14 CFR reference(s) provided14 CFR 23	Part 7, Leaflet 722, 732, 800, and 802	

5.2.2.6. Identification of Structural CSIs and Critical Characteristics
The purpose of identifying recommended aviation CSIs and associated Critical Characteristics (CCs) as part of a structural integrity program is to ensure that the program documents the recommendations of Prime Developer structural integrity experts for full consideration by authorities determining the CSIs and CCs in accordance with public law.

Criteria:
The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063, section 5.2.18
MIL-STD-3063, section 5.4.1.
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall include analysis of the rotorcraft structure and provide recommendations regarding CSIs and Critical Characteristics IAW section 5.2.18. of MIL-STD-3063, IAW the requirements of the Aircraft System Specification, IAW DA PAM 95-9, and IAW AMCOM Regulation 702-7, using the Joint Aeronautical Commanders' Group (JACG) Aviation Critical Safety Item Management Handbook and section 3-13 of ADS-51-HDBK as guides. The airworthiness substantiation should include CSI-related recommendations leveraging Failure Modes, Effects, and Criticality Analysis (FMECA) to identify failure modes and consequences. The airworthiness substantiation shall include a CSI recommendations report IAW DI-MISC-80711. If the airworthiness substantiation leverages FMECA to substantiate the recommendations, the

airworthiness substantiation shall include a FMECA report IAW DI-SESS-81495. The report(s) shall be updated IAW section 5.4.1. of MIL-STD-3063.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 10 USC 2319 DFARS 209.270 Public Law 108-136, Section 802 DA PAM 95-9 AMCOM Reg 702-7 ADS-51-HDBK para 3-13 JACG CSI Management Handbook MIL-STD-1530	14 CFR 29.602 CS content corresponding to the 14 CFR reference(s) provided14 CFR 23	Part 7, Leaflet 400, 404, and 732	

5.2.2.7. Structural Usage Monitoring Algorithm Development

The purpose of developing algorithms for structural usage monitoring is to enable inclusion of Condition Based Maintenance (CBM) regime recognition, loads monitoring and estimation, and related fatigue life management technologies as part of the structural integrity sustainment plan. See paragraphs 14, 15, and 20.1. for related system safety, software and cybersecurity requirements.

Criteria:

The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:

MIL-STD-3063, section 5.1.8.
MIL-STD-3063, section 5.2.19
MIL-STD-3063, section 5.4.3.5.
Aircraft System Specification

Method of Compliance:

The airworthiness substantiation shall include structural usage monitoring algorithms to perform regime recognition, loads monitoring and estimation, or both, IAW sections 5.2.19. and 5.4.3.5. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification, using ADS 79-HDBK appendices A, B, and C as a guide. The algorithms shall be developed IAW the CBM Management Plan (see section 5.1.8. of MIL-STD-3063 and section 5.7. of ADS-79-HDBK). For any flight critical or mission critical functions, the airworthiness substantiation shall include assessment of system reliability, calibration requirements, software airworthiness, and cybersecurity of the design of the structural usage monitoring system, including algorithms, software, hardware, and sensors. The performance of the algorithms and sensors shall subsequently be validated using flight testing and updated IAW section 5.4.3.5. of MIL-STD-3063. The airworthiness substantiation shall include a software sustainability package IAW DI-IPSC-82134.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 ADS-79-HDBK section 5.7. and appendices A, B, C MIL-STD-1530	14 CFR 29.307, 571, 573 CS content corresponding to the 14 CFR reference(s) provided14 CFR 23	Part 7, Leaflet 201, 727, and 732	

5.2.3. Design Analyses for Structural Envelope Evaluation

As part of an air-vehicle structural integrity program, design analysis includes various coordinated analyses working together to meet the structural-envelope requirements of the aircraft system specification.

5.2.3.1. External Loads Analysis

The purpose of the external loads analysis is to determine the magnitude and distribution of externally applied design loads encountered by the air-vehicle structure when operating within the structural design envelope established by the aircraft system specification and structural design criteria.

Criteria:

The rotorcraft structure shall have strength in accordance with the structural envelope.

Standard:

MIL-STD-3063, section 5.2.2.
MIL-STD-3063, section 5.4.1.
Aircraft System Specification

Method of Compliance:

The airworthiness substantiation shall include External Loads Analysis IAW section 5.2.2. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification and IAW the Structural Design Criteria for the Rotorcraft. The airworthiness substantiation may leverage chapter 5 of MIL-HDBK-516, chapter 4 of AMCP 706-201, and section 3.5. of MIL-A-8868 as guides. The Structural Design Criteria normal load factor for asymmetric flight of rotorcraft shall be the same as for symmetric flight. The airworthiness substantiation shall include an External Loads Analysis Report IAW DI-MISC-80711. The report(s) shall be updated IAW section 5.4.1. of MIL-STD-3063. The External Loads Analysis Report shall include the following content:

a. Detailed magnitudes and distributions of the external loads resulting from the application of all conditions defined in the Structural Design Criteria such as flight, landing, ground handling, transporting, and weapons firing.

b. Detailed explanation of the use of conventional methods and the development of any new or unconventional methods of determining air or ground loads, or load distributions used in the structural design.

c. Wherever possible, correlation of methods and assumptions with wind tunnel or flight test data, or both, with detailed explanation and data correlations presented in Appendices to the appropriate loads reports, or in separate reports.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 MIL-HDBK-516 Ch. 5 AMCP 706-201 Ch. 4 NAVAIR AR-56 para 3.7.4.7. MIL-A-8868 para 3.5. MIL-STD-1530	14 CFR 29.25-33, 141(b), 301-551, 659, 865, 1501-1509, 1519, 1527-1545, 1581, 1583 CS content corresponding to the 14 CFR reference(s)	Part 7, Leaflet 200, 202, 203, 204, 205, 207, 208, 308, 309, 310, 709, 710, 720, 722, and 723	

5.2.3.2. Internal Loads Analysis

The purpose of the internal loads analysis is to determine the magnitude and distribution of design loads within each load path internal to the air-vehicle structure when operating within the structural design envelope established by the system specification and structural design criteria.

Criteria:

The rotorcraft structure shall have strength in accordance with the structural envelope.

Standard:

MIL-STD-3063, section 5.2.6.
MIL-STD-3063, section 5.4.1.
Aircraft System Specification

In addition: ultimate and yield factors of safety shall be IAW the aircraft system specification (or 1.5 and 1.15, respectively, when ultimate and yield factors of safety are not otherwise defined in the aircraft system specification).

Method of Compliance:

The airworthiness substantiation shall include internal loads analysis of the rotorcraft structure IAW section 5.2.6. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification and IAW the Structural Design Criteria for the Rotorcraft. The contractor may use chapter 5 of MIL-HDBK-516 as a guide. The airworthiness substantiation shall include an internal loads analysis report IAW DI-SESS-80198, excluding section 3.6., unless combined with the strength analysis report. If the

airworthiness substantiation leverages finite element modeling (FEM) in the analysis, the airworthiness substantiation shall include Mathematical Model reports IAW DI-GDRQ-81256 and DI-GDRQ-81257 containing the finite element structure and the FEM based stress analysis, respectively. The internal loads analysis report and mathematical model reports shall show correlation to the static test article. The report(s) shall be updated IAW section 5.4.1. of MIL-STD-3063.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 MIL-HDBK-516 Ch. 5 NAVAIR AR-56 para 3.7.5. MIL-STD-1530	14 CFR 29.301-551, 659, 681, 865, 873 CS content corresponding to the 14 CFR reference(s) provided 14 CFR 23	Part 7, Leaflet 200, 202, 203, 204, 308, 309, 310, 722, and 723	

5.2.3.3. Finite Element Models, Description and Substantiation
The purpose of providing, describing, and substantiating finite element models used in substantiation of the rotorcraft structure is to provide an understanding of the capabilities and limitations of the finite element method utilized as well as how the model was substantiated to represent the design being evaluated. Additional understandings include defining the accuracy of the FEM results, along with methods utilized to minimize variations in results due to modeling error, discretization error and solution error. Provision of finite element models and descriptions will also reduce sustainment costs related to designing and substantiating structural repairs and other maintenance actions.

Criteria:
The rotorcraft structure shall have strength in accordance with the structural envelope.

Standard:
MIL-STD-3063, section 5.2.6.
MIL-STD-3063, section 5.2.16.1.
MIL-STD-3063, section 5.4.1.

Method of Compliance:
The airworthiness substantiation shall include executable finite element models used in substantiation of the rotorcraft structure, including cases where the airworthiness substantiation leverages FEM for structural analysis, such as internal loads analysis, strength analysis, or crashworthiness analysis performed IAW requirements of sections 5.2.6. and 5.2.16.1. of MIL-STD-3063 (including analysis updates performed IAW section 5.4.1). Also, report(s) shall be prepared to substantiate that the model(s) represent the structural load paths of the design adequately for establishing internal loads that are suitable for strength and/or fatigue analyses. The report shall include identification of the possible failure modes of the design in the discussion of the overall “philosophy” of element selection. The report shall provide an understanding of the capabilities and limitations of the finite element method utilized as well as how the model was

substantiated to represent the design being evaluated. The accuracy of the FEM results shall be defined along with methods utilized to minimize variations in results due to modeling error, discretization error and solution error. The convergence check(s) performed to evaluate the finite element mesh shall be provided. The model must be explained in sufficient detail to define how the model was created, what it consists of, and the source for key properties. The type and order of elements should be clearly explained, along with the rationale for their use. The report must state why the element choice is appropriate for the intended use of results. The external loads applied to the model must be identified and described. Likewise, the boundary conditions (model constraints) must be identified. The boundary conditions shall be explained in sufficient detail that the intent and application of the constraints justifies their use for representing the stiffness of any interfacing structure. Post-run checks that were performed to ensure that no unintended constraints were generated that would react load or restrain movement shall be identified. Also, any solver-generated constraints shall be identified and explained. An example of load equilibrium considering applied loads and reactions shall be provided. The results of mesh checks shall be provided as verification that the elements provide appropriate accuracy of results. The report shall contain either a verification or convergence summary and discussion. The airworthiness substantiation shall include warnings that may affect the accuracy of the results and potential errors reported by the solver. Any such messages shall be presented and discussed in the report. The report shall indicate where internal loads are extracted from the model and how the extraction was performed. The report must clearly state what stress output is used (orthogonal normal stress, von Mises stresses, principal stresses, etc.). The report shall provide justification for the selected stress output, discussing how the model output is to be used for the selected critical failure mode. In addition to the above content of the report to substantiate the model, additional report content shall be IAW DI-GDRQ-81256 and DI-GDRQ-81257. The airworthiness substantiation shall include the model(s) and report(s). The model(s) and report(s) shall be updated IAW section 5.4.1. of MIL-STD-3063.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 ADS-51-HDBK 4-9.2. (analytical models) MIL-STD-1530	14 CFR 29.301-563, 659, 681, 865, 873 CS content corresponding to the 14 CFR reference(s) provided 14 CFR 25 Transport Aircraft14 CFR 23	Part 7, Leaflet 200 and 201	

5.2.3.4. Strength Analysis
The purpose of strength analysis is to substantiate that the structural design meets structural requirements of the aircraft system specification and structural design criteria for peak static loads when operated in accordance with the design usage and throughout the structural design envelope, without yielding, detrimental deformations and detrimental damage at design limit loads and without structural failure at design ultimate loads.

Criteria:
The rotorcraft structure shall have strength in accordance with the structural envelope.

Standard:
MIL-STD-3063, section 5.2.6.
MIL-STD-3063, section 5.3.10.2.
MIL-STD-3063, section 5.4.1.
Aircraft System Specification

In addition: ultimate and yield factors of safety shall be IAW the aircraft system specification (or 1.5 and 1.15, respectively, when ultimate and yield factors of safety are not otherwise defined in the aircraft system specification).

Method of Compliance:
The airworthiness substantiation shall include strength analysis of the rotorcraft structure IAW section 5.2.6. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification and IAW the Structural Design Criteria and Internal Loads Analysis for the Rotorcraft. The airworthiness substantiation may leverage chapter 5 of MIL-HDBK-516, chapter 4 of AMCP 706-201, and section 3.8. of MIL-A-8868 as guides. The airworthiness substantiation shall include a strength analysis reports IAW DI-SESS-80198, excluding sections 3.4. and 3.5, unless combined with the external loads and internal loads analysis reports. The airworthiness substantiation may include the reports for each area, such as rotor systems, controls, airframe, miscellaneous structures, *etc*. Strength reports shall include analysis for fuselage, tailboom or tailcone, empennage, wings, stabilizers, stabilators, sponsons, landing gear, interfaces and provisions, rotor components, rotating and non-rotating rotor control mechanism components, propellers, proprotors, and any transmission and drive-systems components that experience flight-maneuver loads, control-surface induced loads, or loads imparted by fuselage, tailboom or tailcone, empennage, or flight-control mounts. The strength reports shall address the worst-case loading per the loads reports and report the margins of safety for yield and ultimate conditions. For cases where crash loads derive the lowest margin, a margin shall be reported for operational loads other than crash. Special factors, such as but not limited to casting, bearing, fitting, and control system joint factors shall be used on applicable structure and their origin referenced. The strength analysis shall incorporate ultimate and yield factors of safety IAW the aircraft system specification (or 1.5 and 1.15, respectively, when not otherwise defined in the aircraft system specification). The strength reports shall be updated IAW section 5.4.1. of MIL-STD-3063 based on interpretation and evaluation of structural demonstration (Appendix K) flight test data to establish safe flight within the structural envelope IAW

section 5.3.10.2. of MIL-STD-3063. If the airworthiness substantiation leverages FEM in the analysis, the airworthiness substantiation shall include Mathematical Model reports IAW DI-GDRQ-81256 and DI-GDRQ-81257 containing the finite element structure and the FEM based stress analysis, respectively.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 MIL-HDBK-516 Ch. 5 AMCP 706-201 Ch. 4 NAVAIR AR-56 para 3.7.6. (stress analysis reports) MIL-A-8868 para 3.8. JSSG 2006 (for fixed wing) MIL-STD-1530	14 CFR 29.301-551, 659, 681, 865, 873CS content corresponding to the 14 CFR reference(s) provided	Part 7, Leaflet 200, 203, 403, and 500	

5.2.3.5. Blade Stall and Compressibility Analysis

For rotorcraft, the purpose of the blade stall and compressibility analysis is to identify flight conditions within the structural envelope for which the rotor components, and other components in the same load path, would experience an increase in vibratory loads due to the onset of rotor retreading blade stall or advancing blade compressibility. In the identified flight conditions, envelope limitations may be required to avoid introducing deleterious oscillatory loads in sustained steady state maneuvers.

Criteria:

The rotorcraft structure shall have strength in accordance with the structural envelope.

Standard:

MIL-STD-3063, section 5.2.13.1.
MIL-STD-3063, section 5.4.1.
Aircraft System Specification
In addition: deleterious oscillatory loads shall not occur in steady state operating conditions during authorized usage.

Method of Compliance:

The airworthiness substantiation shall include a blade stall and compressibility analysis IAW section 5.2.13.1. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification. IAW sections 5.2.13.1. and 5.4.1. of MIL-STD-3063, the analysis shall be validated, correlated, corrected, and updated based on data from structural flight testing. The airworthiness substantiation shall include a blade stall and compressibility analysis report IAW DI-MISC-80711. The report shall be updated IAW section 5.4.1. of MIL-STD-3063.

Additional Information

Comm Docs	*DoD/MIL Docs*	*FAA/EASA*	*Def-Stan 970*	*STANAG*
	MIL-STD-3063 Section 6 ADS-51-HDBK para 4-9.1. and 9-4.1. AMCP 706-201 para 4-2 and 4-9 MIL-S-8698 para 6.3.32 ADS 24 appendix A para 3.0 item j ADS 29 para 3.24.1. NAVAIR AR-56 para 6.4.32 MIL-STD-1530	14 CFR 29.25-33, 251, 309, 629, 659, 865, 1501-1509, 1519, 1527-1545, 1581, 1583 CS content corresponding to the 14 CFR reference(s) provided 14 CFR 25 Transport Aircraft	Part 7, Leaflet 500, 601, and 732	

5.2.4. Design Analysis and Developmental Testing for Structural Configuration Definition and Design

As part of a structural integrity program, design analysis and developmental testing includes definition of the airworthy structural configuration via engineering product definition and design development tests.

5.2.4.1. Drawings/Models and Associated Lists

The purpose of drawings/models and associated lists is to define the structural configuration substantiated as airworthy by the structural integrity program using industry standard methods of detailed engineering product definition. Drawings/models and associated lists are used to ensure that analysis and test configurations are relevant to the documented product definition intended for fielding. See System Engineering Paragraph 4 for related requirements.

Criteria:

The analyzed, tested and fielded structural configuration(s) shall be defined.

Standard:

MIL-STD-3063, section 5.2.6.
MIL-STD-3063, section 5.4.
MIL-STD-3063, section 5.5.
Aircraft System Specification
MIL-STD-31000
ASME Y14.100
ASME Y14.100, Appendix B through E
ASME Y14.5.
ASME Y14.24
ASME Y14.34
ASME Y14.35
ASME Y14.37

ASME Y14.41
ISO 10303 STEP Application Protocol AP209 ed2, or subsequent version of AP209 that also incorporates AP242

Method of Compliance:
The airworthiness substantiation shall include definition of the rotorcraft structure IAW MIL-STD-31000 IAW the requirements of the Aircraft System Specification. At a minimum, the airworthiness substantiation shall include specifications, quality assurance provisions, supplementary technical data, developmental design drawings/models and associated lists for all rotorcraft structure IAW DI-SESS-81002 to support design analysis and full-scale testing, and product drawings/models and associated lists for all rotorcraft structure IAW DI-SESS-81000 to support fielding with ICA. Alternatively, these items may be prepared as part of a production level technical data package IAW MIL-STD-31000 and DI-SESS-80776. Drawings/models and associated lists shall be prepared IAW ASME Y14.100 and appendices B through E, Y14.5, Y14.24, Y14.34, Y14.35, and Y14.41. For parts manufactured from composites, drawings/models and associated lists shall be prepared IAW ASME Y14.100 and appendices B through E, Y14.5, Y14.24, Y14.34, Y14.35, Y14.37, and Y14.41. When three dimensional digital drawings/models and associated lists are prepared, SRD will have direct access to configuration management (CM) controlled parts, assemblies, lists and metadata, including as built, as assembled, and all effectivities in the native format using native tools. SRD will be able to access, interrogate, export, locally store and manipulate component and assembly models at every level of the drawing tree. The method of access and/or delivery shall be by a mutually agreed method between SRD and the contractor. To allow for concurrent review, delivery of developmental design drawings/models and associated lists shall be coordinated with delivery and review of associated strength analysis described in section 5.2.6. of MIL-STD-3063. To allow for concurrent review, delivery of product drawings/models and associated lists for *Safety of Flight Structure* shall be coordinated with delivery and review of items related to fielding with instructions for Continuing Airworthiness as described in section 5.4. of MIL-STD-3063.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
ASME Y14.100 and appendices B through E, Y.14.5, Y14.24, Y14.34, Y14.35, Y14.37, and Y14.41 ISO 10303 STEP AP209 ed2, incorporating AP242	MIL-STD-3063 Section 6 ADS-51-HDBK 4-9.2., 4-11 MIL-STD-1530	14 CFR 21.31 14 CFR 29.307, 601, 603-607 CS content corresponding to the 14 CFR reference(s) provided	Part 7, Leaflet 400, 402, 403, and 805	

5.2.4.2. Design Development Tests

The purpose of design development tests is to establish design allowables related to selected materials, processes, joining methods, and structural concepts; develop, validate, and correct analysis methods and procedures; and provide any other test data necessary for design or risk reduction prior to full-scale testing. Development tests allow early evaluation of allowable stress levels, material selection, joining methods, the effect of the design usage environment spectra, as well as corrosion resistance, strength, durability, fatigue, and damage tolerance capabilities.

Criteria:
The analyzed, tested and fielded structural configuration(s) shall be defined.

Standard:
MIL-STD-3063, section 5.2.17
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall include design development testing IAW section 5.2.17. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification, using ADS-13, MMPDS, and CMH-17 as guides. Design development testing shall include testing used for substantiation of the design and any repair concepts. Delivered design development test plans and reports are not required. However, for development tests intended as a basis for structural design criteria, fatigue and fracture methodologies, AQS requirements, or tailoring of MIL-STD-3063, Government representative test witnesses are required, and technical interchange meetings or design reviews shall incorporate test plan details and significant results, including provision of substantiating raw test data.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
MMPDS CMH-17	MIL-STD-3063 Section 6 ADS-13-HDBK ADS-51-HDBK para 4-7.2., 4-7.8. NAVAIR AR-56 para 3.7.7. MIL-STD-1530	14 CFR 21.31 14 CFR 29.307, 601, 603-607, 613 FAA AC 29-2 (for guidance on design development tests using the building block approach) CS content corresponding to the 14 CFR reference(s) provided	Part 7, Leaflet 402 and 403	

5.2.5. Reserved

(Paragraph reserved for identification of design analysis and developmental testing required for flight-test-envelope definition and expansion)

5.2.6. Design Analyses for Structural Military Suitability

As part of a structural integrity program, design analysis and developmental testing includes ensuring that survivability and crashworthiness characteristics are suitable for military service with anticipated hostile threats.

5.2.6.1. Crashworthiness Analysis of the Rotorcraft Structure

The purpose of crashworthiness analysis is to substantiate that the structural design meets crashworthiness requirements of the system specification and structural design criteria.

Criteria:

The rotorcraft structure shall be suitable for military operation.

Standard:

MIL-STD-3063, section 5.2.16.1.
MIL-STD-3063, section 5.4.1.
Aircraft System Specification

Method of Compliance:

The airworthiness substantiation shall include crashworthiness analysis of the rotorcraft structure IAW section 5.2.16.1. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification, using RDECOM TR 12-D-12 and MIL-STD-1290 as guides. Analysis shall include a structural nonlinear transient-response analysis that substantiates the ability of the rotorcraft structure to maintain a protective shell around occupants during specified crash impacts. Analysis shall consider landing gear performance, fuselage flexibility, and fuselage energy absorption. The airworthiness substantiation shall prove that the design provides sufficient rollover structure to protect the occupants. The airworthiness substantiation shall include correlation and correct analysis based on rotorcraft drop-test results. The airworthiness substantiation shall include static strength analysis to substantiate that high mass items such as the rotors, engines, and transmissions do not intrude upon the occupied space when subjected to survivable crash loads or blade strikes. The airworthiness substantiation shall include a report(s) on the crashworthiness analysis of the rotorcraft structure IAW DI-MISC-80711. The airworthiness substantiation may distribute the transient analysis of protective shell and static analysis of mass retention in separate reports or appendices. If the airworthiness substantiation leverages FEM in the analyses, the airworthiness substantiation shall include Mathematical Model reports IAW DI-GDRQ-81256 and DI-GDRQ-81257 containing the finite element structure and the FEM based analysis, respectively. The report(s) shall be updated IAW section 5.4.1. of MIL-STD-3063.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 MIL-STD-1290 RDECOM TR 12-D-12 MIL-STD-1530	14 CFR 29.307, 561-563 14 CFR 23 14 CFR 27	Part 7, Leaflet 105, 206, 209, 307, 714, 715, 720, and 725	

5.2.6.2. Finite Element Models for Military Suitability

The purpose of providing, describing, and substantiating finite element models used in substantiation of the rotorcraft structure is to provide an understanding of the capabilities and limitations of the finite element method utilized as well as how the model was substantiated to represent the design being evaluated. Additional understandings include defining the accuracy of the FEM results, along with methods utilized to minimize variations in results due to modeling error, discretization error and solution error. Provision of finite element models and descriptions will also reduce sustainment costs related to designing and substantiating structural repairs and other maintenance actions.

Criteria:
The rotorcraft structure shall be suitable for military operation.

Standard:
MIL-STD-3063, section 5.2.6.
MIL-STD-3063, section 5.2.16.1.
MIL-STD-3063, section 5.4.1.

Method of Compliance:
See AMACC section 5.2.3.3. for method of compliance and .

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

5.2.6.3. Survivability Analysis

The purpose of the survivability analysis is to ensure that the air-vehicle structure can maintain required performance in a military operational environment.

Criteria:
The rotorcraft structure shall be suitable for military operation.

Standard:
MIL-STD-3063, section 5.2.16
MIL-STD-3063, section 5.4.1.

Method of Compliance:
See Paragraphs 17 and 18 for requirement.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 MIL-STD-1289 NAVAIR AR-56 para 3.7.10. MIL-STD-1530	14 CFR 29.307, 609, 610	Part 7, Leaflet 206, 209, and 715	

5.3. Full-Scale Testing

In the structural integrity program, full-scale testing allows the program to verify that the design meets the requirements of the system specification. Full-scale testing includes flight, ground, and laboratory tests.

5.3.1. Reserved

(Paragraph reserved for identification of full-scale testing required to establish design criteria)

5.3.2. Full Scale Testing for Structural Durability and Reliability

As part of an air-vehicle structural integrity program, full-scale testing includes coordinated flight, ground, and laboratory tests to verify that the design meets the durability and reliability requirements of the aircraft system specification.

5.3.2.1. Damage Tolerance Tests

The purpose of damage tolerance tests is to validate, correlate, or correct the corresponding analysis and to verify the damage growth and residual strength properties required to ensure the structural integrity and safety by inspection in the specified structure in accordance with the aircraft system specification and damage tolerance methodology.

Criteria:

The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:

MIL-STD-3063, section 5.3.2.
MIL-STD-3063, section 5.3.7.
MIL-STD-3063, section 5.3.14
Aircraft System Specification

Method of Compliance:

The airworthiness substantiation shall include damage tolerance testing on specified rotorcraft structure IAW sections 5.3.2., 5.3.7., and 5.3.14. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification and the rotorcraft Durability and Damage Tolerance Methodology, using chapter 5 of MIL-HDBK-516 and section 7-6 of ADS-51-HDBK as guides. Damage tolerance testing shall include testing used to verify that inspection intervals ensure structural integrity in the specified structure, including any approved repair concepts. Government representative test witnesses are required.

The airworthiness substantiation shall include test plans and reports IAW DI-NDTI-80566 and DI-NDTI-80809, respectively.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 MIL-HDBK-516 Ch. 5 ADS-51-HDBK para 7-6 NAVAIR AR-56 para 3.7.8. NAVAIR AR-89 Table XIII item 6 JSSG 2006 (for fixed wing) MIL-STD-1530	14 CFR 23, 29.307, 571, 573, 602, 611	Part 7, Leaflet 201, 301, 403, and 732	

5.3.2.2. Safe Life and Enhanced Safe Life Tests

The purpose of safe life and enhanced safe life tests is to validate, correlate, or correct the corresponding analysis and to verify the fatigue strength required to ensure the structural integrity and safety by retirement in the specified structure in accordance with the aircraft system specification and safe life and enhanced safe life methodologies.

Criteria:

The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:

MIL-STD-3063, section 5.3.3.
MIL-STD-3063, section 5.3.4.
MIL-STD-3063, section 5.3.7.
MIL-STD-3063, section 5.3.14
Aircraft System Specification

Method of Compliance:

The airworthiness substantiation shall include safe life or enhanced safe life testing, as applicable, on specified rotorcraft structure IAW sections 5.3.3., 5.3.4., 5.3.7., and 5.3.14. of MIL-STD-3063, the requirements of the Aircraft System Specification and the rotorcraft Fatigue and Fracture Methodologies. The airworthiness substantiation may leverage chapter 5 of MIL-HDBK-516, section 7-6 of ADS-51-HDBK, and section 3.10. of MIL-A-8868 as guides. Safe life and enhanced safe life testing shall include testing used to demonstrate sufficient fatigue strength to ensure structural integrity over the retirement interval for the specified structures, respectively, including any approved repair concepts. Government representative test witnesses are required. The airworthiness substantiation shall include test plans and reports IAW DI-NDTI-80566 and DI-NDTI-80809, respectively.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 MIL-HDBK-516 Ch. 5 ADS-51-HDBK para 4-9.4., 7-6 AMCP 706-201 Ch. 4 MIL-A-8868 para 3.10. NAVAIR AR-56 para 3.7.8. NAVAIR AR-89 MIL-T-8679 MIL-D-23222 MIL-T-8679 MIL-D-23222 MIL-STD-1530		Part 7, Leaflet 201, 301, 403, and 732	

5.3.2.3. Design Service Life Tests

The purpose of design service life tests is to validate, correlate, or correct the corresponding analysis and to verify the required service life and continued validity of safety by inspection throughout the service life in the specified structure in accordance with the aircraft system specification and damage tolerance methodology.

Criteria:

The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:

MIL-STD-3063, section 5.3.5.
MIL-STD-3063, section 5.3.7.
MIL-STD-3063, section 5.3.14
Aircraft System Specification

The airworthiness substantiation shall include design service life testing on specified rotorcraft structure IAW sections 5.3.5. and 5.3.7. of MIL-STD-3063, the requirements of the Aircraft System Specification and the rotorcraft Durability and Damage Tolerance Methodology, using section 7-6 of ADS-51-HDBK, and section 3.10. of MIL-A-8868, and durability requirements in chapter 5 of MIL-HDBK-516 as guides. Government representative test witnesses are required. The airworthiness substantiation shall include test plans and reports IAW DI-NDTI-80566 and DI-NDTI-80809, respectively.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 MIL-HDBK-516 Ch. 5 (durability subsection) ADS-51-HDBK para 7-6 MIL-A-8868 para 3.10. NAVAIR AR-56 para 3.7.8. NAVAIR AR-89 para 3.12.3. JSSG 2006 (durability tests for fixed wing) MIL-STD-1530	14 CFR 29.307, 571, 573	Part 7, Leaflet 201, 301, 403, and 732	

5.3.2.4. Component Endurance Bench Tests

The purpose of component endurance bench testing is to demonstrate that specified design criteria, inspections, and the applicable retirement interval or design service life combine to ensure structural integrity in the presence of component wear and degradation resulting from authorized usage. In addition, the tests provide data to assess wear and degradation control measures intended to ensure that loads and structural analyses remain valid for safety critical components, including adjacent components.

Criteria:

The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:

MIL-STD-3063, section 5.3.6.
MIL-STD-3063, section 5.3.7.
MIL-STD-3063, section 5.3.14
Aircraft System Specification

Method of Compliance:

The Airworthiness substantiation shall include a component endurance bench testing on specified rotorcraft structure IAW section 5.3.6., 5.3.7., and 5.3.14. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification. Government representative test witnesses are required. The airworthiness substantiation shall include test plans and reports IAW DI-NDTI-80566 and DI-NDTI-80809, respectively.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 ADS-51-HDBK para 7-8.1. NAVAIR AR-56 para 3.7.8. MIL-T-8679 MIL-STD-1530	14 CFR 29.307, 571, 573, 602, 611, 923	Part 7, Leaflet 301 and 732	

5.3.2.5. Flight Maneuver Standards for Structural Flight Testing

The purpose of flight maneuver standards is to ensure collection of repeatable data for each type of structural flight test based on procedures and parameter tolerances.

Criteria:

The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:

MIL-STD-3063, section 5.3.10.
Aircraft System Specification

Method of Compliance:

The airworthiness substantiation shall include flight maneuver standards for structural flight testing IAW section 5.3.10. of MIL-STD-3063, the requirements of the Aircraft System Specification and the operating conditions defined in the rotorcraft Design Usage, Structural Design Criteria, and Fatigue and Fracture Methodologies. The flight maneuver standards shall provide pilot instructions, procedures, and parameter tolerances intended to ensure reliability and repeatable data for operating conditions corresponding to the loads analysis and design loads spectra. The airworthiness substantiation shall include a flight maneuver standards guide IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 ADS-51-HDBK para 9-4 MIL-STD-1530	14 CFR 29.307, 571, 573	Part 7, Leaflet 1000	

5.3.2.6. Instrumentation and Calibration for Structural Flight Testing

The purpose of instrumentation and calibration planning is to ensure collection of repeatable data for each type of structural flight test based on application of metrology standard practices.

Criteria:

The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063, section 5.3.10.
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall include an instrumentation plan and calibration criteria for structural flight testing IAW section 5.3.10. of MIL-STD-3063, The requirements of the Aircraft System Specification and the operating conditions defined in the rotorcraft Design Usage, Structural Design Criteria, and Fatigue and Fracture Methodologies. The instrumentation plan shall identify sensors, parameter value ranges, frequency ranges, instrumentation purpose, instrumentation priority, necessary instruments for each test, and telemetry requirements for each test. The plan shall also incorporate back up gages to minimize technical and schedule risks. Loads instrumentation and calibration used in the flight load survey shall correspond to identical instrumentation and calibration used in the full-scale safe life, enhanced safe life, and damage tolerance testing. The airworthiness substantiation shall include calibration and measurement traceability requirements for the structural flight test instrumentation, including calibration intervals, accuracy requirements, and allowed test uncertainty. The airworthiness substantiation shall include analysis of the effect of accuracy requirements and the allowed test uncertainty on retirement intervals, inspection intervals, and allowable flight envelope determined based on structural flight test data. The airworthiness substantiation shall include a structural-flight-test instrumentation plan and calibration criteria report IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 ADS-51-HDBK para 5-4, 9-4.3. MIL-D-23222 MIL-STD-1530	14 CFR 29.307, 571, 573	Part 7, Leaflet 200, 1000, 1015, and 1017	

5.3.2.7. Flight Loads Survey
The purpose of the flight load survey is to obtain mean and oscillatory load data for each flight condition in the design usage spectrum with sufficient replicates as required for the program to substantiate required durability, reliability, and confidence. In addition, the flight load survey obtains load data for test configurations and conditions necessary to validate the engineering tolerance criteria.

Criteria:
The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063, section 5.3.10.1.
MIL-STD-3063, section 5.3.14
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall include a flight loads survey flight test IAW section 5.3.10.1. and 5.3.14. of MIL-STD-3063, the requirements of the Aircraft System Specification and the operating conditions defined in the rotorcraft Design Usage, Structural Design Criteria, Fatigue and Fracture Methodologies, and Maneuver Standards Guide. The airworthiness substantiation may leverage chapter 5 of MIL-HDBK-516, section 9-4 of ADS-51-HDBK, and section 3.11. of MIL-A-8868 as guides. The objective of the flight loads survey shall be to collect flight test loads required for fatigue analysis IAW the rotorcraft Fatigue and Fracture Methodologies, including all configurations and flight conditions representative of design usage, with sufficient replication of critical flight conditions to characterize load variability and to substantiate the required confidence in loads. Government representative participation and witness are required. In accordance with DFARS 252.227, delivery of technical flight test data with unlimited government usage rights is also required. The airworthiness substantiation shall include test plans and reports IAW DI-NDTI-80566 and DI-NDTI-80809, respectively.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 MIL-HDBK-516 Ch. 5 ADS-51-HDBK para 9-4 MIL-A-8868 para 3.11 MIL-D-23222 NAVAIR AR-89 Tables XII, XIV, and XV MIL-STD-1530	14 CFR 29.301,29.571 14 CFR 27 307,	Part 7, Leaflet 205, 207, 732, 1000, 1008, 1009, 1015, and 1017	

5.3.2.8. Structural Usage Monitoring Algorithm Validation
The purpose of validating algorithms for structural usage monitoring is to enable inclusion of CBM regime recognition, loads monitoring and estimation, and related fatigue life management technologies as part of the structural integrity sustainment plan.

Criteria:
The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063, section 5.3.10.3.
MIL-STD-3063, section 5.3.14
Aircraft System Specification

Method of Compliance:
In coordination with the flight loads survey and structural demonstration (Appendix K), the airworthiness substantiation shall include structural flight tests necessary for

validation of the structural usage monitoring algorithm(s), sensors, and other elements of the structural usage monitoring system that perform regime recognition, loads monitoring and estimation, or both, IAW section 5.3.10.3. and 5.3.14. of MIL-STD-3063, the requirements of the Aircraft System Specification and using ADS-79-HDBK appendix B as a guide. Validation efforts shall incorporate comparison of structural loads measured during validation testing and the resulting fatigue damage fractions to those assessed by the structural usage monitoring system. Government representative participation and witness are required. In accordance with DFARS 252.227, delivery of technical flight test data with unlimited government usage rights is also required. The airworthiness substantiation shall include test plans and reports IAW DI-NDTI-80566 and DI-NDTI-80809, respectively.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 ADS-79-HDBK Appendix B MIL-STD-1530	14 CFR 29.307, 571, 573 CS content corresponding to the 14 CFR reference(s) provided 14 CFR 25 Transport Aircraft 14 CFR 23	Part 7, Leaflet 201, 727, and 732	

5.3.2.9. Mechanical Endurance Surveillance

The purpose of mechanical endurance surveillance is to validate, correlate, or correct the corresponding assessment results and demonstrate operational availability of the rotorcraft based on degradation impacts. In addition, the surveillance provides data to assess wear and degradation control measures.

Criteria:

The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:

MIL-STD-3063, section 5.3.13
MIL-STD-3063, section 5.3.14
MIL-STD-3063, section 5.4.5.
MIL-STD-3063, section 5.5.4.
Aircraft System Specification

Method of Compliance:

The airworthiness substantiation shall include mechanical endurance surveillance IAW section 5.3.13. and 5.3.14. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification. The airworthiness substantiation shall include a mechanical

endurance surveillance report IAW DI-MISC-80711. Additional reports shall be prepared IAW the process developed to meet requirements of sections 5.4.5. and 5.5.4. of MIL-STD-3063.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
NAS410 (for NDI inspector qualifications)	MIL-STD-3063 Section 6 MIL-D-23222 ADS-51-HDBK para 11-2.7. NAVAIR AR-89 MIL-HDBK-1823 (for NDI) TM 1-1500-335-23 (for NDI) MIL-STD-1530		Part 7, Leaflet 301 and 732	

5.3.3. Full-Scale Testing for Structural Envelope Demonstration
As part of an air-vehicle structural integrity program, full-scale testing includes coordinated flight, ground, and laboratory tests to demonstrate that the design meets the structural-envelope requirements of the aircraft system specification.

5.3.3.1. Static Tests
The purpose of static tests is to validate, correlate, or correct the corresponding analysis and to demonstrate that the air-vehicle structure meets performance requirements for static loads, including specified design limit and ultimate loads throughout the structural envelope in accordance with the system specification and structural design criteria.

Criteria:
The rotorcraft structure shall have strength in accordance with the structural envelope.

Standard:
MIL-STD-3063, section 5.3.1.
MIL-STD-3063, section 5.3.7.
MIL-STD-3063, section 5.3.14
Aircraft System Specification

In addition: ultimate and yield factors of safety shall be IAW the aircraft system specification (or 1.5 and 1.15, respectively, when ultimate and yield factors of safety are not otherwise defined in the aircraft system specification).

Method of Compliance:
The airworthiness substantiation shall include static testing on all primary rotorcraft structure IAW sections 5.3.1., 5.3.7., and 5.3.14. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification, using chapter 5 of MIL-HDBK-516, sections 7-6 and 9-2.1. of ADS-51-HDBK, and section 3.10. of MIL-A-8868 as guides.

Static testing shall include testing used for substantiation of the design and any repair concepts. Government representative test witnesses are required. The airworthiness substantiation shall include test plans and reports IAW DI-NDTI-80566 and DI-NDTI-80809, respectively.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 MIL-HDBK-516 Ch. 5 ADS-51-HDBK para 7-6; 9-2.1. MIL-A-8868 para 3.10. NAVAIR AR-56 para 3.7.8. NAVAIR AR-89 MIL-T-8679 JSSG 2006 (for fixed wing) MIL-STD-1530	14 CFR 29.301-307, 29.659, 29.681, 29.865, 29.681, 29.873	Part 7, Leaflet 200, 301, and 403	

5.3.3.2. Structural Demonstration

The purpose of the structural demonstration (Appendix K) is to demonstrate safe operation to the maximum operating limits, demonstrate that loads in structural analyses and tests are not exceeded within the design envelope, and establish allowable flight envelope limits and the critical conditions for strength, rigidity and operation.

Criteria:

The rotorcraft structure shall have the strength in accordance with the structural envelope.

Standard:

MIL-STD-3063, section 5.3.10.2.
MIL-STD-3063, section 5.3.14
Appendix K of this AMACC, ADS-24
Aircraft System Specification

In addition: (1) Ultimate and yield factors of safety shall be IAW the aircraft system specification (or 1.5 and 1.15, respectively, when ultimate and yield factors of safety are not otherwise defined in the aircraft system specification). The 1.15 yield factor of safety applies to limit loads to ensure the structure is protected against detrimental deformations, including delaminations as referenced in MIL-HDBK-516 and JSSG-2006. and (2) Deleterious oscillatory loads shall not occur in steady state operating conditions during authorized usage

Method of Compliance:
The airworthiness substantiation shall include structural demonstration flight test IAW section 5.3.10.2. and 5.3.14. of MIL-STD-3063, Appendix K: ADS-24 draft, the requirements of the Aircraft System Specification, the structural design envelope defined in the rotorcraft Design Usage, Structural Design Criteria, and Maneuver Standards Guide, using chapter 5 of MIL-HDBK-516 and section 9-4 of ADS-51-HDBK. Government representative participation and witness are required. In accordance with DFARS 252.227, delivery of technical flight test data with unlimited government usage rights is also required. The airworthiness substantiation shall include test plans and reports IAW DI-NDTI-80566 and DI-NDTI-80809, respectively. The objective of the structural demonstration shall be to ensure that structural loads experienced in service will not exceed those used as the basis for airworthiness qualification. The testing shall:

a. Demonstrate safe operation of the rotorcraft to the maximum attainable operating limits consistent with the structural design envelope.

b. Demonstrate that loads used in the structural analyses and tests are not exceeded during operation of the rotorcraft at the structural design limits of the flight envelope.

c. Establish the allowable flight envelope at the critical conditions for strength, rigidity, and operation in cases where the loads used in the structural analyses and tests are exceeded.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 MIL-HDBK-516 Ch. 5 ADS-24 ADS-51-HDBK para 9-4 MIL-D-23222 MIL-STD-1530	14 CFR 29.25-33, 141(b), 251, 305-309, 337, 629, 659, 681, 873, 1501-1509, 1519, 1527-1545, 1581, 1583 14CFR 25.21-255 14CFR 27.21-25 14 CFR 23.2235	Part 7, Leaflet 200, 500, 900, 905, 1000, 1015, and 1017	

5.3.4. Reserved.
(Paragraph reserved for identification of full-scale testing required to define the structural configuration)

5.3.5. Full-Scale Testing for Flight-Test Envelope Definition and Expansion
As part of an air-vehicle structural integrity program, full-scale testing includes coordinated flight, ground, and laboratory tests necessary to define and progressively expand a safe envelope for flight tests.

5.3.5.1. First Flight Verification Tests

The purpose of first flight verification tests is to establish an initial safe envelope for flight tests and to establish flight test limitations for subsequent use in monitoring instrumentation during structural flight tests.

Criteria:

The rotorcraft structure shall have safe flight test envelope expansion.

Standard:

MIL-STD-3063, section 5.3.9.
MIL-STD-3063, section 5.3.14
Aircraft System Specification

Method of Compliance:

The airworthiness substantiation shall include first flight verification testing IAW section 5.3.9. and 5.3.14. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification, using section 5.6. of MIL-HDBK-516 and sections A.3.10.5., A.3.10.7., A.3.10.8., A.4.10.5.3., A.4.10.5.4., A.4.10.7., and A.4.10.8. of JSSG 2006 as guides. Government representative test participation and witnesses are required. The airworthiness substantiation shall include test plans and reports IAW DI-NDTI-80566 and DI-NDTI-80809, respectively.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 MIL-HDBK-516 para 5.6. JSSG 2006 para A.3.10.5., A.3.10.7., A.3.10.8., A.4.10.5.3., A.4.10.5.4., A.4.10.7., and A.4.10.8. NAVAIR AR-89 MIL-T-8679 MIL-D-23222 ADS-51-HDBK 7-6.1.3. MIL-STD-1530	14 CFR 21.33, 35, 39, 191-195; 14 CFR 29.307, 571, 573 14 CFR 25-7D, 23-8C, 25.307, 25.571 AC 25-7D, 23-8C 14CFR 27.307, 27.571, 27.57 14 CFR 23.2135, 23.2140, 23.2145, 23.2150, 23.2155, 23.2160, 23.2165	Part 7, Leaflet 207, 1008, 1010, and 1015	

5.3.5.2. Envelope Expansion Program

The purpose of the envelope expansion program is to ensure incremental, controlled, and prudent exploration of the envelope during flight tests for a new development aircraft.

Criteria:
The rotorcraft structure shall have safe flight test envelope expansion.

Standard:
MIL-STD-3063, section 5.3.10.
MIL-STD-3063, section 5.3.14
Aircraft System Specification

In addition: (1) flight test instrumentation, monitoring, and envelopes shall ensure maintenance of ultimate and yield factors of safety IAW the aircraft system specification (or 1.5 and 1.15, respectively, when ultimate and yield factors of safety are not otherwise defined in the aircraft system specification); (2) flight test instrumentation, monitoring, and envelopes shall ensure that deleterious oscillatory loads do not occur in steady state operating conditions; and (3) flight test component fatigue damage fractions shall be constrained to less than half of the accumulated damage fraction for a 95% confidence of less than one catastrophic failure of rotorcraft structure during the duration of the flight test program.

Method of Compliance:
The airworthiness substantiation shall include structural envelope expansion flight testing IAW section 5.3.10. and 5.3.14. of MIL-STD-3063, the requirements of the Aircraft System Specification, the structural design envelope defined in the rotorcraft Design Usage, Structural Design Criteria, and Maneuver Standards Guide, using chapter 5 of MIL-HDBK-516 and section 9-4 of ADS-51-HDBK. The testing shall incrementally expand and clear the structural envelope based on engineering reviews of flight test data, including comparison to predicted structural loads, structural limitations, and flight characteristics. The airworthiness substantiation shall include structural limitations and associated methodologies necessary to maintain safe flight during structural flight tests based on load or displacement measurements from static tests, damage tolerance tests, safe life tests, or enhanced safe life tests. The team performing structural envelope expansion flight test shall track or otherwise bound component fatigue damage fractions such that accumulated damage fractions never exceed 0.5 during the test program. The flight test team shall perform damage fraction calculations IAW an approved methodology with structural reliability and 95% confidence for less than one catastrophic failure of rotorcraft structure during the duration of the flight test program. Limitations related to each instrument may be included for steady state conditions, transient maneuvers, or both. Examples of limitations include endurance limits, cautions, warnings, and alerts for oscillatory loads and cautions, warnings, and alerts for peak static loads. Government representative participation and witness are required. In accordance with DFARS 252.227, delivery of technical flight test data with unlimited government usage rights is also required. The airworthiness substantiation shall include discussion of structural limitations and associated methodologies, including detailed calculations based on available structural test data, into technical interchange meetings or design reviews. The airworthiness substantiation shall include a report on structural limitations and associated methodologies IAW DI-MISC-80711. The airworthiness substantiation shall include test plans and reports IAW DI-NDTI-80566 and DI-NDTI-80809, respectively.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 MIL-HDBK-516 Ch. 5 ADS-51-HDBK para 9-4 MIL-D-23222 JSSG 2006 (for fixed wing) MIL-STD-1530		Part 7, Leaflet 900, 902, 905, 907, 1000, 1008, 1010, and 1015	

5.3.6. Full-Scale Testing for Structural Military Suitability

As part of an air-vehicle structural integrity program, full-scale testing includes coordinated ground and laboratory tests necessary to ensure that survivability and crashworthiness characteristics are suitable for military service with anticipated hostile threats.

5.3.6.1. Landing Gear Drop Tests

The purpose of the landing gear drop tests is to validate or correct landing gear interface loads used in the structural substantiation.

Criteria:

The rotorcraft structure shall be suitable for military operation.

Standard:

MIL-STD-3063, section 5.3.8.1.
MIL-STD-3063, section 5.3.14
Aircraft System Specification

Method of Compliance:

The airworthiness substantiation shall include landing gear drop testing IAW sections 5.3.8.1. and 5.3.14. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification, using chapter 5 of MIL-HDBK-516 and section 8-6 of ADS-51-HDBK as guides. Government representative test witnesses are required. The airworthiness substantiation shall include test plans and reports IAW DI-NDTI-80566 and DI-NDTI-80809, respectively.

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 MIL-HDBK-516 Ch. 5 ADS-51-HDBK para 8-6 NAVAIR AR-89 MIL-STD-1530		Part 7, Leaflet 301 and 304	

5.3.6.2. Rotorcraft Drop Tests

The purpose of the rotorcraft drop tests is to validate or correct landing loads used in the structural substantiation, including testing for internal rotorcraft structural loads and

external applied loads. Rotorcraft drop tests include testing for critical crash landing cases.

Criteria:
The rotorcraft structure shall be suitable for military operation.

Standard:
MIL-STD-3063, section 5.3.8.2.
MIL-STD-3063, section 5.3.14
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall include rotorcraft drop testing IAW section 5.3.8.2. and 5.3.14. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification, using MIL-STD-1290, JSSG 2010-7, and sections 7-6.5. and 11-6 of ADS-51-HDBK as guides. Government representative test witnesses are required. The airworthiness substantiation shall include test plans and reports IAW DI-NDTI-80566 and DI-NDTI-80809, respectively.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 MIL-STD-1290 JSSG 2010-7 ADS-51-HDBK para 7-6.5. and 11-6 NAVAIR AR-89 MIL-STD-1530	14 CFR 29.307, 561-563, 723-727	Part 7, Leaflet 307	

5.4. Fielding with ICA
In the structural integrity program, fielding with ICA allows the program to substantiate a statement of airworthiness qualification (for materiel release) and to document fleet management requirements for continuing airworthiness.

5.4.1. Reserved
(Paragraph reserved for identification of requirements related to establishment of design criteria based on structural integrity efforts during fielding with instructions for continuing airworthiness)

5.4.2. ICA for Structural Durability and Reliability
As part of an air-vehicle structural integrity program, fielding with instructions for Continuing Airworthiness includes substantiation that the service life, retirement intervals, inspection intervals, inspection procedures, and associated probabilities of detection for the aircraft structure meet the durability and reliability requirements of the aircraft system specification.

5.4.2.1. Structural Integrity Sustainment Plan
The purpose of the structural integrity sustainment plan is to define when, where, and how maintainers must perform inspections, maintenance actions, repairs and modifications as well as recurring structural maintenance instructions.

Criteria:
The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063, section 5.4.3.
MIL-STD-3063, section 5.4.6.
MIL-STD-3063, section 5.5.
Aircraft System Specification

In addition: (1) ultimate and yield factors of safety shall be IAW the aircraft system specification (or 1.5 and 1.15, respectively, when ultimate and yield factors of safety are not otherwise defined in the aircraft system specification); (2) deleterious oscillatory loads shall not occur in steady state operating conditions during authorized usage; and (3) structural reliability shall be IAW the aircraft system specification (or as required with 95% confidence for less than one catastrophic failure of rotorcraft structure during authorized usage for every 20 million aircraft flight hours when structural reliability is not otherwise defined in the aircraft system specification).

Method of Compliance:
The airworthiness substantiation shall include a structural integrity sustainment plan for the rotorcraft IAW section 5.4.3. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification for implementation IAW section 5.5. of MIL-STD-3063. The airworthiness substantiation may leverage section 7-6 of ADS-51-HDBK, A4A MSG-3 Volume 2, SAE JA1011, and SAE JA1012 as guides. The structural integrity sustainment plan shall incorporate inspection intervals and procedures, retirement intervals, rotorcraft design service life, and repair limits and processes IAW the damage tolerance substantiation of inspection intervals and procedures, the fatigue substantiation of component retirement intervals and rotorcraft design service life, and the structural substantiation of damage repair limits and processes. Maintenance actions required IAW substantiations in the structural integrity sustainment plan shall be included in the Paragraph 4.5.2. Maintenance Manuals for the rotorcraft IAW section 5.4.6. of MIL-STD-3063. The structural integrity sustainment plan shall describe the implementation of structural usage monitoring algorithms, rotorcraft tracking, and component tracking to adjust the inspection, modification, overhaul, and replacement times based on regime recognition, loads monitoring and estimation, structural health monitoring, or any combination of these techniques. The airworthiness substantiation shall include the structural integrity sustainment plan IAW DI-MISC-80711. The airworthiness substantiation may leverage DI-SESS-82039 as a guide for content and format requirements after tailoring with MIL-STD-3063 content used in place of any MIL-STD-1530 references.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
A4A MSG-3 Vol. 2 SAE JA 1011 SAE JA1012	MIL-STD-3063 Section 6 ADS-51-HDBK para 7-6 ADS-79 HDBK appendices A and C (for applications of CBM structural health monitoring) MIL-STD-1530 (Force Structural Maintenance Plan for USAF) MIL-STD-1530 section 5.5.6. (for structural reliability)	14 CFR 29.307, 571, 573, 602, 611, 923, 1529	Part 7, Leaflet 103, 201, 210, 303, 732, 800, and 802	

5.4.2.1.1. Damage Tolerance Substantiation of Inspection Intervals and Procedures

The purpose of the damage tolerance substantiation is to establish inspection intervals and procedures necessary to ensure structural integrity in accordance with the fatigue and fracture methodologies. The choice of airworthiness substantiation via damage tolerance must include considerations for fleet maintenance strategies IAW the Aircraft System Specification and should include considerations for cost and schedule in the decision to substantiate via damage tolerance versus other fatigue methodologies.

Criteria:
The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063, section 5.4.3.1.
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall include damage tolerance substantiation of inspection intervals and procedures IAW section 5.4.3.1. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification. The damage tolerance substantiation shall be IAW the fatigue and fracture methodologies and shall be based on the damage tolerance analysis and testing. The airworthiness substantiation shall include a damage tolerance substantiation report IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
NAS410 (for NDI inspector qualifications)	MIL-STD-3063 Section 6 TM 1-1500-335-23 (for NDI) TM 1-1500-366-23 (for NDI) MIL-STD-1530	14 CFR 29.307, 571, 573, 602, 611, 1529	Part 7, Leaflet 201, 732, and 802	

5.4.2.1.2. Fatigue Substantiation of Component Retirement Intervals and Rotorcraft Design Service Life

The purpose of the fatigue substantiation is to establish retirement intervals and service lives necessary to ensure structural integrity in accordance with the fatigue and fracture methodologies.

Criteria:
The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063, section 5.4.3.2.
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall include fatigue substantiation of retirement intervals and procedures IAW section 5.4.3.2. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification. The fatigue substantiation shall be IAW the fatigue and fracture methodologies and shall be based on the safe life analysis, the enhanced safe life analysis, and associated safe life and enhanced safe life testing. The airworthiness substantiation shall include a fatigue substantiation report(s) IAW DI-MISC-80711. The airworthiness substantiation may combine the reports into a single report or maintain as separate reports for each area, such as rotor systems, controls, airframe, miscellaneous structures.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 ADS-51-HDBK para 4-9.4., 7-6 AMCP 706-201 Ch. 4 MIL-STD-1530		Part 7, Leaflet 201, 303, 732, and 802	

5.4.2.1.3. Mechanical Endurance Substantiation

The purpose of the mechanical endurance substantiation is to establish inspection intervals and procedures necessary to ensure structural integrity of all wear and degradation susceptible areas of rotorcraft structure.

Criteria:
The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063, section 5.4.3.3.
MIL-STD-3063, section 5.4.5.
MIL-STD-3063, section 5.5.4.
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall include mechanical endurance substantiation of design criteria, inspections for wear and degradation, and the applicable requirement interval or design service life IAW section 5.4.3.3. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification. The airworthiness substantiation shall include a mechanical endurance substantiation report IAW DI-MISC-80711. The report shall be updated based on surveillance data for fielded aircraft IAW sections 5.4.3.3., 5.5.4., and 5.4.5. of MIL-STD-3063.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
NAS410 (for NDI inspector qualifications)	MIL-STD-3063 Section 6 ADS-51-HDBK para 7-8.1. MIL-HDBK-1823 (for NDI) TM 1-1500-335-23 (for NDI) MIL-STD-1530		Part 7, Leaflet 301, 732, 800, and 802	

5.4.2.1.4. Structural Substantiation of Damage Repair Limits and Processes

The purpose of the structural substantiation of damage repair limits and processes is to develop the damage limit and growth rate analysis and test basis for approving repair concepts for structural components and assemblies, and to provide detailed repair procedures for specified repair cases.

Criteria:
The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063, section 5.4.3.4.

Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall establish repairable damage limits, repair concepts, and associated post-repair inspection requirements IAW section 5.4.3.4. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification. The damage limits and repair concepts shall be substantiated IAW the structural design criteria and the fatigue and fracture methodologies. The airworthiness substantiation may leverage analysis supported by testing of representative coupons, elements, or subcomponents to substantiate the structural integrity of local repairs. The airworthiness substantiation shall leverage full-scale testing to substantiate repair of critical safety items and principal structural elements. The airworthiness substantiation shall leverage full scale testing to substantiate major repairs which impact stiffness and load distribution in multiple load path structure. To avoid the need for segregated logistics based on unique part numbers assigned to repaired components, the airworthiness substantiation shall establish that damage limits and repair concepts maintain baseline retirement intervals with baseline structural reliability and confidence. The airworthiness substantiation shall include a structural damage and repair substantiation report IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 ADS-51-HDBK para 9-2.1. MIL-STD-1530		Part 7, Leaflet 210, 732, 800, and 803	

5.4.2.1.5. Updated Structural Usage Monitoring Algorithms and Calibration
The purpose of updating algorithms for structural usage monitoring and establishing calibration and measurement traceability is to enable inclusion of CBM regime recognition, loads monitoring and estimation, and related fatigue life management technologies as part of the structural integrity sustainment plan.

Criteria:
The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063, section 5.4.3.5.
Aircraft System Specification
MIL-STD-1839

Method of Compliance:
The airworthiness substantiation shall update and revise the structural usage monitoring algorithms that perform regime recognition, loads monitoring and estimation, or both, IAW section 5.4.3.5. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification. The substantiation shall base updates on interpretation and evaluation of

corresponding test results. The airworthiness substantiation shall include a revised software sustainability package IAW DI-IPSC-82134. In addition, the airworthiness substantiation shall meet MIL-STD-1839 requirements for calibration and measurement traceability of the usage monitoring system. The airworthiness substantiation shall include a calibration and measurements requirements summary for the usage monitoring system IAW DI-QCIC-80278.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 ADS-79 HDBK Appendices A, B, and C		Part 7, Leaflet 201 and 727	

5.4.2.1.6. Structural Integrity Sustainment Plan Update Criteria

The purpose of establishing criteria for updates to the structural integrity sustainment plan is to define a means to assess the significance of potential future modifications or changes that could degrade structural integrity and invalidate the structural integrity sustainment plan.

Criteria:
The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063, section 5.4.3.8.
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall establish criteria for updating the structural integrity sustainment plan IAW section 5.4.3.8. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification. The sustainment-plan update criteria shall incorporate the limits of validity of the structural integrity substantiation for the baseline rotorcraft. When establishing limits of validity, the airworthiness substantiation should include consideration of parameters associated with applicability of the structural integrity sustainment plan to foreseeable modifications or changes, including field incidents, changes in service use, changes in configuration, changes in external stores, changes in flight control laws, and changes in rotorcraft, engine, or transmission performance. The airworthiness substantiation shall include a sustainment-plan update criteria report IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 ADS-51-HDBK 7-6.1. MIL-STD-1530		Part 7, Leaflet 100, 200, 201, 202, 732, 905, 1000, 1015, and 1017	

5.4.2.2. Mechanical Endurance Surveillance Process Development for Fielded Aircraft

The purpose of mechanical endurance surveillance of fielded aircraft is to validate, correlate, or correct the corresponding assessment results and verify operational availability of the rotorcraft based on degradation impacts. In addition, the surveillance of fielded aircraft provides field data to assess wear and degradation control measures.

Criteria:
The rotorcraft structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063, section 5.3.13
MIL-STD-3063, section 5.4.5.
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall establish a mechanical endurance surveillance process for fielded aircraft IAW sections 5.3.13. and 5.4.5. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification. The mechanical endurance surveillance process shall include mechanical endurance surveillance and resulting updates to the mechanical endurance substantiation. The airworthiness substantiation shall include a mechanical endurance process development report IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
NAS410 (for NDI inspector qualifications)	MIL-STD-3063 Section 6 ADS-51-HDBK para 11-2.7. MIL-HDBK-1823 (for NDI) TM 1-1500-335-23 (for NDI) MIL-STD-1530		Part 7, Leaflet 301 and 732	

5.4.3. ICA for Structural Envelope Limitations and Restrictions

As part of an air-vehicle structural integrity program, fielding with instructions for Continuing Airworthiness includes substantiation that the structural integrity for the

aircraft structure matches the structural envelope limitations and restrictions communicated to the user.

5.4.3.1. Updated Structural Analyses
The purpose of updated structural analyses is to incorporate interpretation and evaluation of corresponding test results and any specification or design changes into the structural analyses, as necessary to substantiate the strength summary and operating restrictions, the structural integrity sustainment plan, the technical manuals, or other aspects of the instructions for continuing airworthiness.

Criteria:
The rotorcraft structure shall have strength in accordance with the structural envelope.

Standard:
MIL-STD-3063, section 5.4.1.
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall update and revise the structural description, drawings, models, and analyses IAW section 5.4.1. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification. The airworthiness substantiation shall base updates on interpretation and evaluation of corresponding test results. In addition to any updates required to assess or mitigate potential airworthiness impacts discovered since the most recently updated RSIP Master Plan, the scope of required updates shall be IAW the RSIP Master Plan. The airworthiness substantiation shall include revised data items of similar format as the baseline items.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 MIL-STD-1530 para 5.4.1. (for USAF) ADS-51-HDBK para 7-3.1., 7-6.1.3., 7-6.1.4., 7-13, 9-16		Part 7, Leaflet 200 and 201	

5.4.3.2. Strength Summary and Operating Restrictions (SSOR)
The purpose of documenting the strength summary and operating restrictions is to provide rapid visibility of the important structural characteristics, limitations, and capabilities of the aircraft in terms of operational parameters such as speed, acceleration, altitude, center-of-gravity location, and gross weight.

Criteria:
The rotorcraft structure shall have strength in accordance with the structural envelope.

Standard:
MIL-STD-3063, section 5.4.2.
MIL-STD-3063, section 5.4.6.
MIL-STD-3063, section 5.5.

Aircraft System Specification In addition: (1) ultimate and yield factors of safety shall be IAW the aircraft system specification (or 1.5 and 1.15, respectively, when ultimate and yield factors of safety are not otherwise defined in the aircraft system specification); and (2) deleterious oscillatory loads shall not occur in steady state operating conditions during authorized usage.

Method of Compliance:
The airworthiness substantiation shall summarize the rotorcraft structural characteristics, limitations, and capabilities in terms of operating parameters IAW section 5.4.2. of MIL-STD-3063 and IAW the requirements of the Aircraft System Specification for implementation IAW section 5.5. of MIL-STD-3063. Limitations identified from the strength summary and operating restrictions effort shall be included in the Paragraph 4.5.1. Operators Manual for the rotorcraft IAW section 5.4.6. of MIL-STD-3063. The airworthiness substantiation shall include a SSOR Report IAW DI-SESS-82123.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-3063 Section 6 NAVAIR AR-56 para 3.7.9. MIL-D-23222 MIL-STD-1530 JSSG 2006 para A.4.10.8. (for fixed wing)		Part 7, Leaflet 103, 200, 500, 727, 732, 900, 902, and 905	

6. AEROMECHANICS

This paragraph comprises the flight mechanics functional areas consisting of stability & control, flying qualities, vehicle management functions, flight control functions, aerodynamics, flight performance, vehicle and component dynamics, and mass properties. The following criteria, standards and methods of compliance represent the minimum requirements necessary to establish, verify, and maintain airworthiness of the aircraft and demonstrate the performance capabilities of the system. The substantiation data delivered against the requirements will be used to perform an airworthiness assessment and determine if a potential hazard exists. A limitation or restriction could be levied on the aircraft if the substantiation data does not satisfy the requirement.

6.1. Commercial Off-the-Shelf (COTS) Propeller/Fan Substantiating Data

The purpose of COTS propeller's/fan's Substantiating Data is to document technical data substantiating the propeller's/fan's physical characteristics and performance for non-developmental items used on aircraft, such as Unmanned Air Vehicles (UAVs) and fixed-wing aircraft, owned and/or operated by the U.S. Army IAW AR 70-62. This technical data is used for airworthiness qualification, flight clearance, testing, and modifications substantiation for air vehicles.

Criteria:

The documentation for a propeller/fan shall substantiate safe flight within operational limits for the intended aircraft design and usage.

Note: For a FAA commercial aircraft, the Type Certificate Data Sheet (TCDS) provides the regulations that the aircraft was shown compliant to during its certification. The TCDS also lists the airplane performance parameters. There will be TCDSs listed for the airplane, engine, and propeller as applicable to a specific CDA. When applicable, substantiating technical data for propellers/fans possessing an FAA Type Certificate in accordance with 14 CFR Part 35 shall be delivered in accordance with Section 4.1.6. of this document when not otherwise delivered under that section.

Standard:

JSSG-2009 (Appendix L)
14 CFR Part 21..31

Method of Compliance:

The airworthiness substantiation shall include data to substantiate that the aircraft meets the CDA FAA Type Certification requirements in 14 CFR Parts 23, 25, 27, 29, and/or 35, as applicable. The data shall be prepared IAW DI-SAFT-80901C. Manuals for commercial derivative aircraft and/or propellers shall be delivered IAW DI-TMSS-80527 (aircraft) or DI-TMSS-80067 (propeller or other components).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 ADS-51-HDBK (2-7) AR 70-62 MIL-PRF-32216	14 CFR 21.31		

6.2. Air Vehicle Technical Descriptions

The purpose of the air vehicle technical description is to provide a clear description of the proposed aircraft and its constituent components at a level of detail consistent with the current stage of its design. This data is used as partial substantiation of AQS compliance for the issuance of AWRs and SAQs.

Criteria:

The technical characteristics of vehicle, systems, subsystems, and components shall be documented in the context of the integrated air vehicle.

Standard:

DI-SESS-82291 (Supersedes ADS-10D-SP)

Method of Compliance:

Substantiating data for airworthiness specification compliance shall include an Air Vehicle Technical Description Report IAW DI-SESS-82291 as tailored by the procuring contract/agreement. Where applicable, the report shall include CAE Models (CAD-based and physics-based simulation models) which may be attached as a supplement (not a substitute) to the report IAW DI-SESS-82238 and DI-SESS-80776.

The air vehicle technical description is a living document that is intended to be updated at the following times during the air vehicle's lifecycle:

a. Major design changes that require a certification effort to show compliance with affected regulations;

b. Significant events throughout the acquisition program (such as formal technical reviews); and/or

c. Inflection points when the design is significantly altered, or design fidelity is significantly increased, (such as when aerodynamic outer mold lines are lofted by CAD/CAM for production manufacturing, analytical data is supplemented or replaced with test data, etc.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (4.5.2) MIL-STD-31000 MIL-PRF-63029 ADS-51-HDBK paragraph 4-11	14 CFR §21.31 Regulation (EU) No. 748/2012, Annex I (Part 21) (§21.A.31.a(1.))		

6.3. Air Vehicle Flight Performance Description

The purpose of the air vehicle flight performance description is to document the flight performance capabilities and limitations of the proposed aircraft and its constituent components at a level of detail consistent with the current stage of its design. This data is used as partial substantiation of AQS compliance for the issuance of AWRs and SAQs.

Criteria:

The performance characteristics of the vehicle, systems, subsystems, and components shall be documented in the context of integrated air vehicle flight performance.

Standard:

DI-SESS-82321 (Supersedes ADS-40A-SP)
CDA: 14 CFR §21.31
Normal Category Airplanes: 14 CFR §23.2100 – 23.2165
Transport Category Airplanes: 14 CFR §25.21 – 25.255
Normal Category Rotorcraft: 14 CFR §27.21 – 27.251
Transport Category Rotorcraft: 14 CFR §29.21 – 29.251

Method of Compliance:

The airworthiness substantiation shall include an air vehicle flight performance description report IAW DI-SESS-82321 as tailored by the procuring contract/agreement. The air vehicle flight performance description is a living document that is intended to be updated in conjunction with updates of the Air Vehicle Technical Description report (Paragraph 6.2) and deliveries of weight reports (Paragraph 6.12).

Updates to the report and databases should be prepared and submitted by the contractor throughout the life cycle unless specified otherwise by the Procuring Agency. Updates are required when directed by the Procuring Agency, at formal technical reviews, and whenever significant changes in vehicle configuration or data occur; for example:

a. Major design changes that require a certification effort to show compliance with affected regulations;

b. Change in vehicle dimensions;

c. A change in power plant designation, augmentation, or rating;

d. The addition of configuration items affecting performance, such as external stores or other items that change the outer mold line; and/or

e. The availability of test data or new test data showing significant performance change.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	AR 70-38 AR 70-62, 11 May 2016, (2-5j) MIL-STD-3013A MIL-HDBK-516 (6.3) MIL-PRF-63029 (3.5.11.1) JSSG-2001B Appendix D MIL-STD-810	EASA CS-23, CS-25, CS-27, CS-29, Performance		

6.4. Rotor Blade Clearance

The purpose of the clearance analysis and test is to provide a measure of the minimum clearance between the rotor blades and other parts of the aircraft structure for the full range of motion under both loaded and unloaded conditions.

Criteria:

There shall be sufficient clearance between the rotor blades and other parts of the aircraft to prevent the blades from striking any part of the aircraft during any operating condition approved for operation.

Standard:

14 CFR 29.661
ADS-51-HDBK, Paragraph 6-4.4.1.

Method of Compliance:

The airworthiness substantiation shall demonstrate that there is sufficient clearance between the rotor blades and other parts of the aircraft to prevent the blades from striking the aircraft at any operating condition IAW 14CFR 29.661 and ADS-51-HDBK, Paragraph 6-4.4.1. The airworthiness substantiation shall include a Blade Clearance Preliminary Analysis Report, prepared IAW DI-MISC-80711, that predicts clearances at the most critical conditions. In addition, the substantiation shall include a Blade Clearance Flight Test Plan prepared IAW DI-NDTI-80566, a Blade Clearance Flight Test Report prepared IAW DI-MSC-80711, and a Blade Clearance Final Analysis Report prepared IAW DI-MISC-80711. The Final Analysis Report shall include test results that substantiate the ability to predict clearances at critical conditions.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		EMACC (6.2.2.4) 14 CFR 29.661 14 CFR 27.661		

6.5. Static Divergence and Aeroelastic Instability

The purpose of the static divergence and aeroelastic instability analysis and testing is to show that the aircraft is free from flutter and divergence at all conditions approved for operation.

Criteria:

The aircraft shall be free of static divergence and aeroelastic instability at all conditions approved for operation.

Standard:

14 CFR 29.629
AC 25.335
AC 25.629
ADS-51-HDBK, Paragraph 9-5.3.

Method of Compliance:

All rotors and aerodynamic surfaces must be free from static divergence, flutter and other aeroelastic instabilities for airspeeds up to 1.2 times the aircraft maximum design speed (Vd/Md or VNE). The airworthiness substantiation shall include a dynamics analysis that is performed using Paragraph 9-5.3. of ADS-51-HDBK as a guide. The analysis shall include flight test results that substantiate the analytical predictions. Stability at the most critical points determined by the analysis shall be demonstrated in flight test. The airworthiness substantiation shall include an Aeroelastic Stability Preliminary Analysis and Aerolastic Stability Final Analysis Report prepared IAW DI-ISC-80711, an Aeroelastic Stability Flight Test Plan prepared IAW DI-NDTI-80566, and an Aeroelastic Stability Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-A-8860 MIL-A-8870 MIL-STD-516 Para 5.2	EMACC 5.2.1. 14 CFR 23.2245 (MOC ASTM 3264-19, Section 6.10) 14 CFR 25.629 14 CFR 29.629 14 CFR 27.629 AC 23.629-1B		

6.6. Mechanical Instability

The purpose of the mechanical instability test is to show the aircraft has no dangerous tendencies to oscillate on the ground with the rotors turning.

Criteria:
The aircraft shall be free of mechanical instability (ground resonance) for all conditions approved for operation.

Standard:
14 CFR 29.241
ADS-51-HDBK, Paragraph 9-5.1.

Method of Compliance:
The rotorcraft shall have no dangerous tendency to oscillate on the ground with rotors turning. Positive damping shall be demonstrated for rotor speeds from 0-120% over the range of expected operating conditions, including operation with an improperly serviced landing gear strut. The airworthiness substantiation shall include a dynamics analysis that is performed using ADS-51-HDBK, paragraph 9-5.3. as a guide. Stability at the most critical points determined by the analysis shall be demonstrated in aircraft ground test. The airworthiness substantiation shall include a Dynamic Stability Analysis Report and Ground Test Analysis Report prepared IAW DI-MISC-80711, a Mechanical Stability Ground Test Plan prepared IAW DI-NDTI-80566, and a Mechanical Stability Ground Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (5.2.1., 7.3.1.2)	EMACC 5.2.1 14 CFR 29.241 14 CFR 27.241		

6.7. Rotor and Airframe Natural Frequencies

The purpose of the rotor and airframe natural frequencies analysis is to show the aircraft has adequate separation of rotor blade and airframe natural frequencies from rotor harmonic forcing frequencies.

Criteria:
Rotor and airframe natural frequencies shall have adequate separation from harmonic forcing frequencies.

Standard:
ADS-51-HDBK, Paragraph 9-7

Method of Compliance:
The airworthiness substantiation shall be provided of a dynamics analysis that demonstrates adequate separation of rotor blade and airframe natural frequencies from rotor harmonic forcing frequencies (ADS-51-HDBK, Paragraph 9-7). The analysis shall be supplemented by ground and flight test results that substantiate the analytical

predictions. The airworthiness substantiation shall include a Rotor/Airframe Dynamics Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (5.2., 7.3.1.2)	EMACC 5.2. 14 CFR 29.251 14 CFR 27.251		

6.8. Aircraft Vibration Environment

The purpose of the aircraft vibration test is to (a) show that the aircraft does not have excessive vibration, and (b) to provide data that can be used to assess the environmental qualification of installed components.

6.8.1. Component Vibration

Criteria:
Installed equipment shall meet its service life when subjected to the aircraft operational vibration environment.

Standard:
14 CFR 29.251
MIL-STD-810 Method 514, Procedure 1, Category 14, Annex D
ADS-27A Paragraphs 5.2. and 5.6.4.
Appendix M

Method of Compliance:
The airworthiness substantiation shall demonstrate that each part of the aircraft is free of excessive vibration at all conditions approved for operation (14 CFR 29.251).

Installed equipment shall operate satisfactorily for its specified service life when subjected to the vibration environment encountered during operational use of the aircraft. Component vibration tests shall be conducted IAW MIL-STD-810, Method 514, Procedure 1, Category 14, Annex D to demonstrate compliance with service life requirements using a representative vibration spectrum. In addition, results from frequency response/modal analysis (a.k.a. rap) testing shall be used to demonstrate dynamic compatibility of the installed equipment IAW Appendix M. The airworthiness substantiation shall include a Component Vibration Test Plan and a Rap Test Plan prepared IAW DI-NDTI-80566. The airworthiness substantiation shall also include a Component Vibration Test Report, a Rap Test Report, and an Installed Equipment Dynamic Compatibility Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160 (Section 8) EMACC, Paragraph 5.2.5	MIL-HDBK-516 (5.2.8)			

6.8.2. Flight Vibration Environment

Criteria:
The aircraft vibration environment shall be determined by flight survey.

Standard:
14 CFR 29.251
ADS-27A Paragraphs 5.2. and 5.6.4.
Appendix M

Method of Compliance:
The vibration environment shall be determined from a flight vibration survey IAW ADS-27A, Paragraph 5.6.4. The airworthiness substantiation shall include a Flight Test Vibration Survey Test Plan IAW DI-NDTI-80566 and a Flight Test Vibration Survey Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160 (Section 8)	MIL-HDBK-516 (5.2.8)	EMACC, Paragraph 5.2.5		

6.8.3. Critical Human Interface Vibration Levels

Criteria:
Aircraft vibration levels shall be below allowable levels at critical aircraft-human interface points to preclude vibration from reducing mission effectiveness.

Standard:
14 CFR 29.251
ADS-27A Paragraphs 5.2. and 5.6.4.
MIL-STD-1472
Appendix M

Method of Compliance:
The results of the vibration survey shall demonstrate that the measured vibration environment for the following are IAW MIL-STD-1472 and ADS-27A, Paragraph 5.2:

a. Pilots, weapons systems operators and troops.

b. Pilots and weapon systems operator's controls.

c. Instrument panels, instruments, displays and weapons sighting devices.

These results shall be included in the Flight Vibration Survey Test Report referenced in Paragraph 6.8.2.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160 (Section 8)	MIL-HDBK-516 (5.2.8)	EMACC, Paragraph 5.2.5		

6.8.4. Component Service Life Requirement

Criteria:
The aircraft and dynamic components shall meet their service life when subjected to the aircraft operational vibration environment.

Standard:
14 CFR 29.251
MIL-STD-810 Method 514, Procedure 1, Category 14, Annex D
ADS-27A Paragraphs 5.2. and 5.6.4.
Appendix M

Method of Compliance:
The aircraft structure and dynamic components shall be demonstrated to meet service life requirements in the aircraft vibration environment. The airworthiness substantiation shall include analyses IAW DI-MISC-80711, test plans IAW DI-NDTI-80566, and test reports IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160 (Section 8) EMACC, Paragraph 5.2.5. ASTM F30161/F3061M	MIL-HDBK-516 (5.2.8)			

6.9. Gunfire Shock
The purpose of the Gunfire Shock test is to demonstrate that installed equipment operate properly.

Criteria:
Installed equipment shall operate satisfactorily for its specified service life when subjected to the relatively infrequent, short duration transient high rate repetitive shock environment encountered due to firing guns.

Standard:

Method of Compliance:
Gunfire shock testing shall be conducted IAW MIL-STD-810, Method 519. Use of an experimentally measured profile per Method 519, Procedure I is the preferred approach for full qualification. Method 519, Procedure II may be necessary for safety critical items prior to the first flight including the firing of guns. The airworthiness substantiation shall include a Gunfire Shock Test Plan IAW DI-NDTI-80566, and a Gunfire Shock Test Reports IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (7.3.1.7)	EMACC (7.3.1.7)		

6.10. Rotor Track and Balance
The purpose of the rotor track and balance test is to demonstrate methodologies and procedures for field maintenance of rotor track and balance.

Criteria:
Aircraft once-per-revolution vibration shall be capable of being maintained within levels appropriate for safe operation of the aircraft throughout its service life.

Standard:
ADS-27A, Paragraph 5.6.4.1.

Method of Compliance:
The airworthiness substantiation shall be developed and demonstrate methodology and procedures for rotor track and balance IAW ADS-27A, Paragraphs 5.2.5. and 5.6.4.1. The airworthiness substantiation shall include the results of field trials that demonstrate the ability to use measured aircraft data to specify maintenance actions needed to bring rotor track and once-per-revolution vibration within prescribed limits. The airworthiness substantiation shall include a Rotor Track and Balance Flight Test Plan prepared IAW DI-NDTI-80566. The airworthiness substantiation shall also include a Rotor Track and Balance Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
EMACC (7.3.1.7)	MIL-HDBK-516 (7.3.1.7)	14 CFR 29.659 14 CFR 27.659		

6.11. Health and Usage Monitoring System /Health Awareness System (HUMS/HAS)
The purpose of HUMS/HAS tests, demonstrations and surveys is to substantiate that the system can be used to make maintenance decisions that support Continuing Airworthiness of the aircraft.

6.11.1. HAS Operational Concept Description

Criteria:
The operational concept of the HAS system relative to the aircraft system shall be defined.

Standard:

Method of Compliance:
The airworthiness substantiation shall include an Operational Concept Description (OCD) of the Health Awareness System prepared IAW DI-IPSC-81430. The document shall describe the proposed system in terms of intended use, capabilities and functions, and its relationship to other aircraft systems and procedures.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-79E-HDBK	AC 27-1 & 29-2, Change 3, Section MG 15 CS 29, Amendment 3. CS 29.1465 and AMC 29.1465		

6.11.2. HAS Software Development

Criteria:
The diagnostic software of the HAS systems shall be developed to the criticality and DAL levels identified by a safety assessment process.

Standard:
DO-178C for onboard software; DO-278A for ground station software
MIL-STD-882

Method of Compliance:
A Functional Hazard Assessment (FHA) should determine the Design Assurance Level (DAL) of the HAS. This system-determined level shall be a result of the end-to-end criticality assessment. The airworthiness substantiation shall include the Safety Assessment Report (SAR), which shall define the DAL and rationale. The airworthiness substantiation shall also include the Functional Hazard Assessment Report (FHA).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-79E-HDBK	AC 27-1 & 29-2, Change 3, Section MG 15 CS 29, Amendment 3. CS 29.1465 and AMC 29.1465		

6.11.3. HAS Validation

Criteria:
The procedures for validation of any credits or continuing airworthiness actionable information produced by the HAS system shall be defined and approved.

Standard:

Method of Compliance:
a. The airworthiness substantiation shall insure that a procedure to validate all credits, cockpit warnings, and continuing airworthiness aspects of the HAS is developed. This procedure shall be reviewed and approved by DEVCOM AvMC. If the validation being performed involves a CSI, then one of the following methods shall be used for validation:

b. Actual service experience on HUMS or HAS equipped aircraft.

c. “Seeded fault tests” (where the wear, defect or deterioration is introduced, allowed to develop, and the detection technique verified).

d. On-aircraft trials, investigation of cause and effect (e.g. introducing degrees of imbalance and calibrating the response).

e. The validations would include analysis such as Weibull to determine CI Probability/Confidence. CIs for CSI items shall have at least 90% Probability/Confidence.

f. Tests shall be representative of the aircraft for which the credit is being sought and of the conditions in the flight regime when data is normally gathered (e.g. cruise). It shall be established that the evidence gathered from on-aircraft trials or rig-based seeded fault tests is valid in flight. The airworthiness substantiation shall provide the following in the substantiation package:

g. Failure descriptions (teardown reports) and applicable sensor data collected during aircraft developmental and qualification testing, if any failures occur for monitored components.

h. The data shall be in a format readable by the HAS ground station software, or as .CSV files or other format used by MATLAB.

i. The airworthiness substantiation shall include HAS Validation Analyses, HAS Validation Test Plans prepared IAW DI-NDTI-80566, and HAS Validation Test Reports prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-79E-HDBK	AC 27-1 & 29-2, Change 3, Section MG 15 CS 29, Amendment 3. CS 29.1465 and AMC 29.1465		

6.11.4. HAS Item List

Criteria:
A list of items monitored by the HAS system shall be defined.

Standard:

Method of Compliance:
The airworthiness substantiation shall provide a list of all items that will be monitored with the HAS. The selection of components shall be based on the aircraft FMECA(s) and include estimated rate of progression for each failure mode when applicable. Required deliverables shall be submitted IAW DI-MISC-80711 (analyses) and shall include the rationale for the selection of each item.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-79E-HDBK	AC 27-1 & 29-2, Change 3, Section MG 15 CS 29, Amendment 3. CS 29.1465 and AMC 29.1465		

6.11.5. Maintenance Plan for Monitored Aircraft Components

Criteria:
The maintenance plan for monitored aircraft components shall be defined.

Standard:

Method of Compliance:
The airworthiness substantiation shall include a HAS Maintenance Plan for Monitored Components prepared IAW DI-SESS-81704 that specifies the maintenance requirement, technical approach, and monitoring criteria (such as intervals and regimes when data must be collected and how often it must be reviewed) for each item monitored by the HAS.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-79E-HDBK	AC 27-1 & 29-2, Change 3, Section MG 15 CS 29, Amendment 3. CS 29.1465 and AMC 29.1465		

6.11.6. HAS Hardware

Criteria:
All hardware utilized in the HAS system shall be defined.

Standard:

Method of Compliance:
The airworthiness substantiation shall provide documentation for the HAS hardware. The report shall include the following:

a. List of all Sensors and their specifications.

b. A sensors optimization study performed to identify the best type and mounting location for sensors on each monitored component. Sensor study shall consist of an initial analysis and subsequently verified by on-aircraft testing. Documentation shall include a description of each studied sensor and the testing that was performed, pictures or diagrams of the sensor locations that were tested, and the data plots (such as transmissibility).

c. All HAS drawings and applicable schematics.

The airworthiness substantiation shall include a HAS Hardware Analysis Report prepared IAW DI-MISC-80711, a HAS Sensor Optimization Test Plan prepared IAW DI-NDTI-80566, and a HAS Sensor Optimization Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
SAE AS5391A SAE AS5392	ADS-79E-HDBK	AC 27-1 & 29-2, Change 3, Section MG 15 CS 29, Amendment 3. CS 29.1465 and AMC 29.1465		

6.11.7. HAS Algorithms

Criteria:
All algorithms utilized in the HAS system shall be defined.

Standard:

Method of Compliance:
The airworthiness substantiation shall include a HAS Algorithm Analysis Report prepared IAW DI-MISC-80711. The report shall include the following: General description of the algorithms, including the systems where they reside, and data interfaces between all other aircraft systems.

a. Detailed description of each algorithm including

(1) simplified block diagrams to illustrate end to end processing;

(2) filtering methods;

(3) Analog to Digital conversion methods;

(4) Time Domain to Frequency Domain conversion processes;

(5) Sampling rates;

(6) all individual algorithms and

(7) all other pertinent algorithm features.

b. All parameters, such as frequency bandwidth, used for each algorithm and Condition Indicator.

c. Description of the development and verification of the HAS algorithms. Documentation shall include background information used to develop the CI. Testing shall verify that the CI detects the type of fault for which it was designed. For each application, evidence shall be provided that the physics involved is understood and therefore that the monitoring technique/algorithm/parameter, rejection criteria, and associated intervention actions are well chosen.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-79E-HDBK	AC 27-1 & 29-2, Change 3, Section MG 15 CS 29, Amendment 3. CS 29.1465 and AMC 29.1465		

6.11.8. Failures Impacting the HAS

Criteria:
The HAS system shall be capable of self-diagnosis and reporting of all hardware failures that effect prognostic and diagnostic output.

Standard:

Method of Compliance:
The airworthiness substantiation shall provide documentation (analysis and/or test) that demonstrates that HAS is capable of self-diagnosis and reporting of all hardware failures that effect prognostic and diagnostic output used for maintenance decisions. The document shall describe how each type of failure, e.g. one sensor becoming inoperable, impacts the function of the HAS. The airworthiness substantiation shall include a HAS Self-Diagnostic Analysis Report prepared IAW DI-MISC-80711, a HAS Diagnostic Test Plan prepared IAW DI-NDTI-80566, and a HAS Diagnostic Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-79E-HDBK	AC 27-1 & 29-2, Change 3, Section MG 15 CS 29, Amendment 3. CS 29.1465 and AMC 29.1465		

6.11.9. Operational Environment Demonstration

Criteria:
The HAS system shall maintain data integrity and signal quality in the aircraft operational environment.

Standard:

Method of Compliance:
The airworthiness substantiation shall provide documentation that demonstrate that the HAS functions are not adversely affected by the aircraft operational environment. On-aircraft testing shall verify that the fully integrated system does not have false positive indications, signal dropouts, or data loss during routine operations. The airworthiness substantiation shall include a HAS Operational Demonstration Analysis Report prepared IAW DI-MISC-80711, a HAS Operational Demonstration Test Plan prepared IAW DI-NDTI-80566, and a HAS Operational Demonstration Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
SAE AS5391A SAE AS5392	ADS-79E-HDBK	AC 27-1 & 29-2, Change 3, Section MG 15 CS 29, Amendment 3. CS 29.1465 and AMC 29.1465		

6.11.10. HAS Functional Demonstration

Criteria:
All functions of the HAS system shall be demonstrated.

Standard:

Method of Compliance:
The airworthiness substantiation shall demonstrate all functions of the HAS. The demonstration shall include acquiring data from all sensors via manual and automatic acquisitions on an aircraft, downloading the data, viewing the health indications in the ground station and via cockpit display if applicable, analyzing the raw data in the ground station, and implementing software/CI changes. The airworthiness substantiation shall include a HAS Functional Demonstration Procedure prepared IAW DI-NDTI-80603, and a HAS Functional Demonstration Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-79E-HDBK	AC 27-1 & 29-2, Change 3, Section MG 15 CS 29, Amendment 3. CS 29.1465 and AMC 29.1465		

6.11.11. HAS Software Deliverables

Criteria:
Software documentation and all software needed to configure the aircraft type and perform health diagnostics shall be provided.

Standard:
DO-178C for onboard software; DO-278A for ground station software

Method of Compliance:
The airworthiness substantiation shall provide supporting software and documentation:

a. The software needed to configure the aircraft type-specific software, which defines aircraft-specific functions such as CI names, CI parameters (e.g. frequency bandwidth), CI limits, regimes, and acquisition trigger times.

b. The Interface Control Documents (ICDs) for the HAS and all systems it communicates with. Deliverable shall be IAW DI-SESS-81248 (Interface Control Document.) The ICD shall define and document the physical, environmental, signal characteristics, logic interfaces, sensitivities, electrical requirements and special data requirements.

c. A software sustainability package IAW DI-IPSC-82134. Document should include the data structure of all input and output files for HAS.

d. The description of the HAS output files structure and shall provide any code needed to read the HAS output files for use the C++ or MATLAB.

e. The software documentation IAW DO-178C for onboard software, or DO-278A for ground station software.

The airworthiness substantiation shall include a HAS Software Deliverable Package.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-79E-HDBK	AC 27-1 & 29-2, Change 3, Section MG 15 CS 29, Amendment 3. CS 29.1465 and AMC 29.1465		

6.11.12. Overhaul and Repair Findings

Criteria:
All overhaul and repair findings from monitored components shall be made available.

Standard:

Method of Compliance:
Routine reporting of all overhaul/repair findings for each monitored aircraft component by Serial Number, specifying and describing what faults were found if any, shall be provided. This requirement continues for the duration of the program.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-79E-HDBK	AC 27-1 & 29-2, Change 3, Section MG 15 CS 29, Amendment 3. CS 29.1465 and AMC 29.1465		

6.12. Mass Properties
The purpose of the mass properties is to provide the center of gravity (CG) and inertia margins, a fuel system calibration methodology, and all required checklists and loading data necessary to conduct weight and balance checks.

6.12.1. Evaluation of Mass Properties
The purpose of the evaluation of mass properties is to evaluate a process to manage and control mass properties and report the activities and results produced by that process.

Criteria:
The mass properties must fully support safe vehicle operations for all defined mission requirements, variation in useful load, basing/deployment concepts, interfaces, and necessary maintenance.

Standard:
SAWE RP A-7
SAWE RP A-8

Method of Compliance:
The mass properties used in verifying compliance with defined mission requirements and conducting the design, analysis, and test of the aircraft are derived combinations of the operating weights, the defined payload, and the fuel configuration. The Mass Properties are verified to reflect the current configuration of the aircraft and comply with defined mission requirements through the master plan for controlling and managing Mass Properties IAW SAWE RP A-7 and prepared IAW DI-MGMT-81452. The Mass Properties Control and Management Process (MPCMP) Report contains elements for meeting program mass properties objectives and contractual requirements. Both technical and organizational needs are considered and necessary supporting plans for

sensing and correcting weight and balance trends are identified. The mass properties are verified by inspections, analyses, and actual vehicle weighing. Pieces and parts are verified by calculation as drawings are released and actual weighing when parts are available. A detailed breakout list of components by function is maintained in accordance with SAWE RP A-8. Each vehicle is weighed in a completely assembled and dry condition and the data assembled and reported as an Actual Weight Report IAW SAWE RP A-7 and prepared IAW DI-MGMT-81501, Weight and Balance Report for Aircraft. Estimates at program Award and PDR and calculations at program CDR of the Air Vehicle Mass Properties are verified and assembled into reports IAW SAWE-RP-A-7 and prepared IAW DI-MGMT-81501 (Estimated and Calculated Weight and Balance Report). Periodic Status changes are tracked, assembled, and reported IAW SAWE RP A-7 and prepared IAW DI-MGMT-81501 (Status Report). The airworthiness substantiation shall include; Weight and Balance Status Reports, Actual Weight Reports, Estimated Weight and Balance Reports, Calculated Weight and Balance Reports prepared IAW DI-MGMT-81501, and a Mass Properties Control and Management Process Report prepared IAW DI-MGMT-81452.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (5.5) JSSG-2006 (3.2.5) TM 55-1500-342-23, DI-MGMT-81452, DI-MGMT-81501	AC 120-27 14 CFR 25.1529 14 CFR 29.1529 14 CFR 27.1529 14 CFR 23.2100		

6.12.2. Aircraft Center of Gravity and Inertia Margins

The purpose of the aircraft CG and inertia margins is to define and report on the necessary limits to be used for safe operation of the aircraft, as well as the attributes of the aircraft itself.

Criteria:

The CG and Inertia margins must be properly defined to handle aerodynamic, CG, and inertia changes resulting from fuel usage, store expenditure, asymmetric fuel and store loading, fuel migration at high angle of attack and roll rates, and aerial refueling, and release of external sling loads, and air drop of internal cargo.

Standard:

SAWE RP A-7
SAWE RP A-8

Method of Compliance:

The aircraft CG and inertia must remain within the approved flight envelope for all mission scenarios. The CG and inertia envelopes are commensurate with the requirements at all weights, and account for manufacturing variations, addition of planned equipment, variations in payload, flight attitudes, density of fuel and fuel system failures. The CG and inertia is verified to remain in the approved envelope for all mission scenarios as described in the master plan for controlling and managing Mass Properties.

The provisions for determining the weight, CG, and inertias are verified to adhere to stated requirements through inspections, analysis, and test IAW SAWE RP A-7 and A-8. The inertias are verified and documented as an Inertia (Mass Properties) Report for Aircraft IAW SAWE RP A-7 and prepared IAW DI-MGMT-81504. The CG envelope and inertia are verified IAW SAWE RP A-7 and A-8 to encompass all possible mission and production variations to ensure safe flight. Mission calculations are verified and documented as part of Status, Estimated, Calculated, and Actual Weight Reports IAW SAWE RP A-7 and A-8. The airworthiness substantiation shall include; Weight and Balance Status Reports, Actual Weight Reports, Estimated Weight and Balance Reports, Calculated Weight and Balance Reports prepared IAW DI-MGMT-81501 and an Inertia (Mass Properties) Report prepared IAW DI-MGMT-81504.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (5.5) JSSG-2006 (3.2.6) TM 55-1500-342-23, DI-MGMT-81501 DI-MGMT-81504	14 CFR 25.1529 14 CFR 29.1529 14 CFR 27.1529 14 CFR 23.2100		

6.12.3. Fuel Weight and CG

The purpose of the fuel weight and CG is to define and verify the fuel quantity, type of fuel, and associated CG tables or graphs used for safe operation and maintenance of the aircraft.

Criteria:

A fuel system calibration methodology to determine the weight and CG of the fuel shall be defined.

Standard:

ADS-1B-PRF
SAWE RP A-7

Method of Compliance:

The airworthiness substantiation shall include a fuel system calibration methodology to determine the weight and CG of the fuel and shall be defined and verified by determination of trapped fuel weight and CG, determination of unusable fuel weight and CG, determination of the usable fuel mass properties (weight and CG), and comparison of onboard fuel indicating equipment to actual usable fuel mass properties. The airworthiness substantiation shall also include a Fuel Cell Calibration Test which is used to verify actual fuel system mass properties documented IAW SAWE RP A-7 and ADS-1B-PRF, a Fuel System Calibration Test Plan prepared IAW DI-NDTI-80566, and a Fuel Systems Calibration Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (5.5) JSSG-2006 (3.2.6) TM 55-1500-342-23 DI-NDTI-80566" DI-NDTI-80809	14 CFR 25.1529 14 CFR 29.1529 14 CFR 27.1529 14 CFR 23.2100		

6.12.4. Aircraft Manuals

The purpose of the aircraft manuals is to provide mass properties data for the safe operation and maintenance of the aircraft.

Criteria:

The flight and maintenance manuals shall provide checklists and loading data for weight and balance checks

Standard:

SAWE RP A-7
TM 55-1500-342-23

Method of Compliance:

The flight and maintenance manuals shall be consistent and contain all required checklists, weighing instructions, and loading data necessary to conduct weight and balance checks while complying with specific weight and balance requirements. The Inventory Data contained in the DD Form 365-1, Chart A, weighing instructions and data required to complete the DD Form 365-2, and loading data used on DD Form 365-4 through the Chart E are verified through analysis and test with actual part weights of inventory and loading items. The data to complete the DD Forms and manuals shall be IAW TM 55-1500-342-23 and are prepared IAW DI-MGMT- 81502 Sample Chart A & E Report. The airworthiness substantiation shall include the Sample Chart A & E Report documented IAW DI-MGMT- 81502.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (5.5) MIL-PERF-63029J DI-MGMT-81502 MIL-DTL-7700	FAA-H-8083-1B 14 CFR 25.1529 14 CFR 29.1529 14 CFR 27.1529 14 CFR 23.2100		

6.13. Flight Performance

6.13.1. Performance Planning Information

Performance Planning Information is the data and instructions for pilots to use in pre-mission flight performance planning. This information may take the form of charts in an Operator’s Manual or other document approved for use, or in the form of a software application providing flight performance calculations. These software applications are

commonly included in the aircraft's onboard system software and in Mission Planning Software. The criteria below applies to all approved sources, regardless of what document or systems hosts the information.

Criteria:
All Performance Planning Information provided to pilots and operators shall be derived from flight test reports when available IAW MIL-PRF-63029 §3.5.11.1.1. Exceptions to this may be authorized for new aircraft, provided adequate flight tests have been completed for the prototype. However, for these exceptions, an evaluation of all changes that affect performance planning shall be obtained by additional flight tests. When flight test reports are not available, referenced estimates shall be clearly identified as such. Conservative estimates shall be used until verified by flight test data. Data that are not based strictly on the particular aircraft shall be explained in detail. Each source shall provide consistent information when multiple sources of this information are available to pilots and operators

Standard:
DI-SESS-82321
AR 5-11
MIL-PRF-63029 (Limits: §3.5.9. and subsections; Performance: §3.5.11. and subsections)
CDA: GAMA Spec. No. 1, Rev. No. 2 (Limits: §2 and subsections; Performance: §5 and subsections)

Method of Compliance:
For each source of Performance Planning Information, the airworthiness substantiation shall include a report substantiating that all Performance Planning Information matches data provided in the Air Vehicle Flight Performance Description Report described in DI-SESS-82321 as tailored by the procuring contract/agreement that has been derived from flight test data. For software applications, the report shall describe the engineering specifications defining how the model calculates performance. The report shall substantiate agreement of predicted flight performance data to within specified tolerances of data prepared and submitted IAW DI-SESS-82321 as tailored by the procuring contract/agreement. Unless otherwise specified, the following tolerances shall apply:

a. Engine torque (+/- 1%).

b. Fuel flow (+/- 3%).

c. Airspeeds (+/- 2 knots).

d. Hover gross weight (+/- 0.5% of the Maximum Takeoff Weight).

For software applications, the system-level FHA required in paragraph 14.2.5. determines the equivalent criticality IAW RTCA/DO-278 (off-board software) or RTCA/DO-178 (on-board software). Paragraph 15.1. defines the artifacts required to

substantiate software airworthiness. Electronic models may be provided as a supplement (not a substitute) to the verification report. The airworthiness substantiation shall include a Performance Planning Information Report prepared IAW DI-MISC-80711, a Flight Performance Flight Test Plan IAW DI-NDTI-80566, and a Flight Performance Flight Test Report IAQ DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
GAMA Spec. No. 1, Rev. No. 2	MIL-HDBK-516 ((6.3.2; 6.3.3; 6.3.4) MIL-STD-3013 MIL-PRF-63029 AR 70-62 AR 5-11 DI-SESS-82321 (Supersedes ADS-40A-SP)	EMACC (6.3.2)		STANAG 4554 (Edition 2); Annex B (Para. C); ANNEX C (Para. C)

6.13.2. One-Engine-Inoperative (OEI) Climb Performance

The purpose of One-Engine-Inoperative (OEI) Climb Performance is to provide a clear and complete documentation of multi-engine aircraft flight performance should one engine fail during takeoff or cruise.

Criteria:

The airworthiness substantiation shall establish the OEI climb performance characteristics of the steady rate of climb (or descent), at the airspeed for the maximum rate of climb, V_y, (or at the airspeed for minimum rate of descent) for the aircraft.

Standard:

14 CFR Part 27.67

Method of Compliance:

Compliance shall be shown through test, similarity analysis, analysis, or a combination of methods. Analysis reports shall be prepared IAW DI-MISC-80711. Test Plans shall be prepared IAW DI-NDTI-80566 and Test Procedures IAW DI-NDTI-80603 prior to testing. Test Reports shall be prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
GAMA Spec. No. 1, Rev. No. 2	MIL-STD-3013			

6.13.3. Running Takeoff Performance

The purpose of Running Takeoff Performance is to provide a clear and complete documentation of rotorcraft, tilting-rotor aircraft, and airplane flight performance during running takeoffs.

Criteria:
The airworthiness substantiation shall establish the running takeoff performance characteristics of minimum takeoff distance and optimum airspeed to clear a 50 ft. obstacle at the maximum allowable takeoff gross weight through test, similarity analysis, analysis, or a combination of methods.

Standard:
14 CFR §23.2115 Non-transport airplane

Method of Compliance:
Compliance shall be shown through test, similarity analysis, analysis, or a combination of methods. The airworthiness substantiation shall include a Running Takeoff Performance Analysis Report prepared IAW DI-MISC-80711, a Running Takeoff Performance Test Plan prepared IAW DI-NDTI-80566, a Running Takeoff Performance Test Procedures Report prepared IAW DI-NDTI-80603 and a Running Takeoff Performance Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
GAMA Spec. No. 1, Rev. No. 2				

6.13.4. Running Landing Performance
The airworthiness substantiation shall establish the running landing performance characteristics of minimum landing distance and optimum airspeed after clearing a 50 ft. obstacle at the maximum allowable landing gross weight.

Criteria:
The airworthiness substantiation shall establish the running landing performance characteristics of minimum landing distance and optimum airspeed to clear a 50 ft. obstacle at the maximum allowable takeoff gross weight through test, similarity analysis, analysis, or a combination of methods.

Standard:
14 CFR §23.2130 Non-transport airplane

Method of Compliance:
Compliance shall be shown through test, similarity analysis, analysis, or a combination of methods. Analysis reports shall be prepared IAW DI-MISC-80711. Test Plans shall be prepared IAW DI-NDTI-80566 and Test Procedures IAW DI-NDTI-80603 prior to testing. Test Reports shall be prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
GAMA Spec. No. 1, Rev. No. 2	MIL-STD-3013			

6.13.5. Autorotation Performance

The purpose of Autorotation Performance is to provide a clear and complete documentation of rotorcraft, tilting-rotor aircraft, and tail-sitter aircraft flight performance during autorotation.

Criteria:
The airworthiness substantiation shall establish the autorotation performance characteristics of minimum rate of descent airspeed and best angle-of-glide airspeed for the aircraft.

Standard:
14 CFR §27.71 Single-engine and non-transport helicopters
14 CFR §29.71 Transport helicopters

Method of Compliance:
Compliance shall be shown through test, similarity analysis, analysis, or a combination of methods. Analysis reports shall be prepared IAW DI-MISC-80711. Test Plans shall be prepared IAW DI-NDTI-80566 and Test Procedures IAW DI-NDTI-80603 prior to testing. Test Reports shall be prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
GAMA Spec. No. 1, Rev. No. 2	MIL-STD-516C Para 6.1.14.11			

6.13.6. Stall Performance

Criteria:
The contactor shall demonstrate through flight test that the stall characteristics of the aircraft are IAW 14 CFR 25.201

Standard:
14 CFR 25.201

Method of Compliance:
The airworthiness substantiation shall also include a Stall Performance Flight Test Report prepared IAW DI-NDTI-80809.

The power-off and power-on stalling characteristics of the aircraft in the takeoff, landing, and cruise configurations shall be described. Stalling characteristics shall also be included for the approach configuration if sufficiently different from landing. A definition of power-off and power-on as used in the discussion shall be included. Normal and accelerated stalls shall be covered. For rotorcraft, appropriate information shall be included on blade stalls.

Stall Speeds: Data shall be presented as indicated airspeed and calibrated airspeed versus flap configurations (any flap position for which performance has been quoted) and

angle of bank at maximum weight with throttle closed. Altitude loss of more than 100 feet and pitch below the horizon of more than thirty degrees during recovery from stalls should be added if applicable.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
GAMA Spec. No. 1, Rev. No. 2 (Single engine: 5.37(d); Multi-engine: 5.41(d))	MIL-STD-516C Para 6.1.14.11 MIL-STD-516C Para 6.1.14.11 MIL-PRF-63029 Paras 3.5.12.5.1. and 3.5.12.5.2			

6.13.7. Maximum Takeoff Weight

Criteria:
The contactor shall substantiate maximum takeoff weight versus outside ambient temperature and pressure altitude for the aircraft's intended operational environments as required by Para. 1-6 of AR 70-38. The limiting constraint(s) (maximum turbine gas temperature, drive system torque limits, rotor controls, airframe structural limits, etc.) shall be clearly identified and denoted as applicable.

Standard:
GAMA Spec. No. 1, Rev. 2 (5.41(e))

Method of Compliance:
The airworthiness substantiation shall include a Flight Performance Limitations Description Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
GAMA Spec. No. 1, Rev. 2 (1.21; 1.29; 2.13)	MIL-PRF-63029J (3.5.9.5.2)	14 CFR §23.2100 14 CFR §25.25 14 CFR §27.25 14 CFR §29.25		

6.13.8. Service Ceiling

Criteria:
The contactor shall substantiate the maximum altitude at which the aircraft can maintain a 100 ft/min (CDA: 50 ft/min) rate-of-climb at the best rate-of-climb forward airspeed.

Standard:
MIL-PRF-63029 (§3.5.11.3.2.10)
CDA: GAMA Spec. No. 1, Rev. No. 2 (§5.41(i))

Method of Compliance:
Service ceilings shall be documented for 100 ft/min (CDA: 50 ft/min) best rate-of-climb airspeeds as a function of gross weight at MCP, IRP, MRP, and CP settings for: Standard Day conditions at pressure altitudes from 0 to at least 10,000 ft; and for 21°C and 35° C Day conditions at pressure altitudes from 0 to at least 8,000 ft. One engine proprotor/propeller shall be feathered for airplane-mode flight.

The airworthiness substantiation shall include a Service Ceiling Substantiation Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
GAMA Spec. No. 1, Rev. 2	MIL-PRF-63029	Normal Category Airplanes: 14 CFR §23.2120 Transport Category Airplanes: 14 CFR §25.117 Normal Category Rotorcraft: 14 CFR §27.65 and 27.67 Transport Category Rotorcraft: 14 CFR §29.64		

6.14. Controllability and Maneuverability
The purpose of the controllability and maneuverability test is to provide the data to show the aircraft is safely controllable and maneuverable.

Criteria:
The aircraft shall be safely controllable and maneuverable.

Standard:
14 CFR 29.143

Method of Compliance:
The airworthiness substantiation shall establish through flight test that the aircraft is safely controllable and maneuverable IAW 14 CFR 29.143. The low-speed directional controllability envelopes established according to 14 CFR 29.143(c) and (d) shall be included in the aircraft flight manual. If applicable for the aircraft configuration, high-speed controllability characteristics shall be established IAW 14 CFR 25.253. Additionally, wheeled aircraft must have sufficient directional control to safely execute all normal ground taxiing maneuvers in winds of 35 knots from any azimuth. The airworthiness substantiation shall include a Controllability and Maneuverability Analysis Report prepared IAW DI-MISC-80711. The airworthiness substantiation shall also include a Controllability and Maneuverability Flight Test Plan prepared IAW

DI-NDTI-80566. The airworthiness substantiation shall also include a Controllability and Maneuverability Flight Test Report prepared IAW and DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (6.2.6.7; 6.1.7.10; 6.1.14.3; 6.1.14.11)	Add AC 25-7D PS-ASW-27, 29-09		

6.15. Static Stability

The purpose of the aircraft static stability test is to demonstrate that the aircraft exhibits safe static stability characteristics.

Criteria:

The aircraft shall exhibit safe static stability.

Standard:

14 CFR 29.173
14 CFR 29.175
14 CFR 29.177
14 CFR 29 Appendix B IV
14 CFR 29 Appendix B V

Method of Compliance:

The airworthiness substantiation shall establish through flight test that the aircraft exhibits safe static stability. Static longitudinal stability shall comply with 14 CFR 29.173 and 14 CFR 29.175, and static directional stability shall comply with 14 CFR 29.177. Additionally, for instrument flight qualification, the requirements of 14 CFR 29 Appendix B IV and V apply. The airworthiness substantiation shall include a Static Stability Analysis Report prepared IAW DI-MISC-80711. The airworthiness substantiation shall also include a Static Stability Flight Test Plan prepared IAW DI-NDTI-80566. The airworthiness substantiation shall also include a Static Stability Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (6.1.6; 6.1.7)	AC 25-7D 14 CFR 25 PS-ASW-27, 29-09		

6.16. Dynamic Stability

The purpose of the aircraft dynamic stability test is to demonstrate that the aircraft exhibits safe dynamic stability characteristics.

Criteria:
The aircraft shall exhibit safe dynamic stability.

Standard:
14 CFR 29.181
14 CFR 29 Appendix B VI.

Method of Compliance:
A rotorcraft that meets the requirements of 14 CFR 29.181 to demonstrate that any short period oscillation occurring at any speed from Vy to Vne be positively damped with the primary flight controls free and in a fixed position shall be provided. Rotorcraft authorized for instrument flight shall meet the requirements of 14 CFR 29 Appendix B VI. The airworthiness substantiation shall include a Dynamic Stability Analysis Report prepared IAW DI-MISC-80711. The airworthiness substantiation shall also include a Dynamic Stability Flight Test Plan prepared IAW DI-NDTI-80566. The airworthiness substantiation shall also include a Dynamic Stability Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (6.1.6; 6.1.7)	AC 25-7D 14 CFR 25 PS-ASW-27, 29-09		

6.17. Maneuvering Stability
The purpose of the maneuvering stability test is to show the aircraft has positive maneuvering stability.

Criteria:
The aircraft shall have safe maneuvering stability characteristics.

Standard:
MIL-DTL-32742, Paragraph 3.4.1.3.

Method of Compliance:
The airworthiness substantiation shall establish through flight test that, between the airspeed for minimum power required and VNE, the aircraft meets the requirements of MIL-DTL-32742, Paragraph 3.4.1.3. which states that (a) the aircraft has positive maneuvering stability as indicated by increasing aft longitudinal stick force required for increasing steady-state load factor, and (b) that the stick-force-per-g curve must have no neutral or negative local gradients, and any nonlinearities in the curve must not result in unsafe flying characteristics. For those aircraft that undergo a conversion/transition (i.e., tiltrotor), this requirement shall also apply to the inceptors/controls that perform the conversion. The airworthiness substantiation shall include a Maneuvering Stability Analysis Report prepared IAW DI-MISC-80711. The airworthiness substantiation shall also include a Maneuvering Stability Flight Test Plan prepared IAW DI-NDTI-80566. The

airworthiness substantiation shall also include a Maneuvering Stability Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (6.1.6.1.8)	14 CFR 25		

6.18. Pilot-Induced Oscillations

The purpose of the pilot-induced oscillations test is to show the aircraft has no tendency for pilot-induced oscillations.

Criteria:

Pilot-induced oscillations (unintentional sustained or uncontrollable motions resulting from the efforts of the pilot to control the aircraft) shall not adversely affect the safety of the aircraft.

Standard:

MIL-HDBK-516
MIL-DTL-32742

Method of Compliance:

The airworthiness substantiation shall establish through flight test that the aircraft has no tendency for pilot-induced oscillations (unintentional sustained or uncontrollable motions resulting from the efforts of the pilot to control the aircraft). The airworthiness substantiation shall include a Pilot-Induced Oscillations Analysis Report prepared IAW DI-MISC-80711. The airworthiness substantiation shall also include a Pilot-Induced Oscillations Flight Test Plan prepared IAW DI-NDTI-80566. The airworthiness substantiation shall also include a Pilot-Induced Oscillations Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (6.1.5.6)	AC 25-7D PS-ASW-27, 29-09		

6.19. Flight Control Stability Margins

The purpose of the flight control stability margins test is to quantify aircraft stability margins and show that they are adequate for safe operation.

Criteria:

Flight control stability margins shall be adequate for safe operation.

Standard:

SAE AS94900A

Method of Compliance:
IAW SAE AS94900A, sec. 3.3.1.4. (all sub-sections) and Table 9, except as modified below:

For Cargo Class Rotorcraft:

a. Within the Operational Flight Envelope, for mode frequencies greater than or equal to 0.06 Hz and less than or equal to the First Aeroelastic Mode, the Stability Margins shall be at least ±6.0 dB gain margin and ±35 degrees phase margin for rate-command response types. For Flight Control Response Types other than Rate-Command the phase margin shall be at least ±30 degrees.

b. For all response-types in both the OFE and SFE, for mode frequencies greater than the first aeroelastic mode, the stability margins shall be at least ±6.0 dB gain margin and ±45 degrees phase margin.

For Utility/Attack class rotorcraft:

a. Within the Operational Flight Envelope, for mode frequencies greater than or equal to 0.06 Hz and less than or equal to the First Aeroelastic Mode and for Flight Control Response Types other than Rate-Command, the gain margin shall be at least ±6.0 dB gain margin and phase margin shall be at least ±40 degrees.

b. For all response-types in both the OFE and SFE, for mode frequencies greater than the first aeroelastic mode, the stability margins shall be at least ±6.0 dB gain margin and ±45 degrees phase margin.

For those aircraft that undergo a conversion/transition (i.e., tiltrotor), the stability margins shall be at least ±6 dB gain margin and ±30 deg phase margin within the conversion flight envelope.

For those aircraft designed for external load operations, analysis, simulation, and frequency-domain flight test shall be performed to quantify stability margins using a load-mass-ratio of 0.33. Additionally, analysis and flight demonstration of operational mission scenarios using maximum hook loading shall be accomplished. For both of the above, no unsafe stability margins shall exist.

The airworthiness substantiation shall include a Flight Control Stability Analysis Report prepared IAW with DI-MISC-80711. The airworthiness substantiation shall also include a Flight Control Stability Flight Test plan prepared IAW DI-NDTI-80566. The airworthiness substantiation shall also include a Flight Control Stability Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (6.2.5)	EMACC (6.2.2.7)		

6.20. Flight Control Mechanical Characteristics

The purpose of the flight control mechanical characteristics test is to demonstrate that the primary flight controls have safe mechanical characteristics.

Criteria:
The primary flight controls shall have safe mechanical characteristics.

Standard:
14 CFR 29.151

Method of Compliance:
The airworthiness substantiation shall establish through test that the primary flight controls (and any conversion/transition controls) comply with 14 CFR 29.151. The airworthiness substantiation shall include a Flight Controls Mechanical Characteristics Preliminary Analysis Report prepared IAW DI-MISC-80711. The airworthiness substantiation shall also include a Flight Controls Mechanical Characteristics Flight Test Plan prepared IAW DI-NDTI-80566. The airworthiness substantiation shall also include a Flight Controls Mechanical Characteristics Flight Test Report prepared IAW DI-NDTI-80809. The airworthiness substantiation shall also include a Flight Controls Mechanical Characteristics Final Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs		DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
SAE ARP5764		MIL-HDBK-516 (6.2.6)	14 CFR 23-63: 23.671(a) Amdt 23-64: 23.2300, ASTM F3232/F3232M 14 CFR 25.671(a) 14 CFR 27.671(a) 14 CFR: 29.671(a)		

6.21. Flight Control Trim System

The purpose of the flight control trim system test is to demonstrate that the aircraft flight control trim system has safe characteristics.

Criteria:
The flight control trim system shall have safe characteristics.

Standard:
14 CFR 29.161
14 CFR Appendix B III

Method of Compliance:
The airworthiness substantiation shall establish through flight test that the aircraft complies with 14 CFR 29.161. For instrument flight qualification, the aircraft shall also

comply with 14 CFR 29 Appendix B III. The airworthiness substantiation shall include a Flight Control Trim Systems Analysis Report prepared IAW DI-MISC-80711. The airworthiness substantiation shall also include a Flight Control Trim Systems Flight Test Plan prepared IAW DI-NDTI-80566. The airworthiness substantiation shall also include a Flight Control Trim Systems Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (6.1.13.1)			

6.22. Slope Landing Envelope

The purpose of the slope landing tests is to define an envelope for aircraft slope landing. This requirement applies only to aircraft that will make vertical takeoffs and landings on sloping terrain.

Criteria:

A slope landing envelope shall be defined for the aircraft.

Standard:

The slope landing envelope shall be defined for the most critical aircraft CG location.

Method of Compliance:

The airworthiness substantiation shall establish through flight test a slope landing envelope within which vertical takeoffs and landings can be safely performed at the most critical CG. Cyclic control margin must be sufficient for pitch and roll control throughout the landing and takeoff maneuvers. For wheeled rotorcraft, the brakes must be able to prevent the aircraft from rolling when on dry pavement at the maximum slope. The slope landing envelope shall be included in the aircraft flight manual. The airworthiness substantiation shall include a Slope Landing Preliminary Analysis Report prepared IAW DI-MISC-80711. The airworthiness substantiation shall also include a Slope Landing Flight Test Plan prepared IAW DI-NDTI-80566. The airworthiness substantiation shall also include a Slope Landing Flight Test Report prepared IAW DI-NDTI-80809. The airworthiness substantiation shall also include a Slope Landing Final Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (6.1.14.7)			

6.23. Height-Velocity Envelope

The purpose of the height-velocity tests is to define the aircraft height-velocity envelope.

Criteria:

A height-velocity envelope shall be defined for the aircraft.

Standard:
14 CFR 29.87

Method of Compliance:
The airworthiness substantiation shall establish height-velocity envelopes in accordance with 14 CFR 29.87. A takeoff corridor at least 10 knots wide must exist between the low-speed and high-speed avoid regions, and the low hover point must be no lower than 6 feet. The airworthiness substantiation shall verify the height-velocity envelopes through flight test. The height-velocity diagrams shall be included in the aircraft flight manual. The airworthiness substantiation shall include a H-V Preliminary Analysis Report prepared IAW DI-MISC-80711. The airworthiness substantiation shall also include a H-V Flight Test Plan prepared IAW DI-NDTI-80566. The airworthiness substantiation shall also include a H-V Flight Test Report prepared IAW DI-NDTI-80809. The airworthiness substantiation shall also include a H-V Final Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (6.1.14.11)			

6.24. Failures Affecting the Flight Control System
The purpose of the aircraft flight controls failure analysis, simulation and test is to show that failures of power-operated portions of the system do not cause unsafe handling qualities.

Criteria:
Flight Control System Failure conditions identified in the system safety assessment that are shown to have a probability greater than 1e-09 or extremely improbable, shall demonstrate through analysis, simulation, and test that the flight control system response is adequate for continued safe flight and landing.

Standard:
14 CFR 29.672
14 CFR 29 Appendix B VII
Section 14, System Safety

Method of Compliance:
Flight Control System failure conditions shall be evaluated in a Systems Integration Lab (SIL) with hardware in the loop. The flight control system on the aircraft shall meet the controllability and pilot vehicle interface requirements of 14 CFR 29.672 and the reliability and transient requirements of 14 CFR 29 Appendix B VII. (Note: The Stability Augmentation System requirements shall apply to any control system implementation). Additional guidance on means for determining aircraft airworthiness is found in PS-ASW-27, 29-09 and AC 25-7D. Section 14 System Safety process shall be used to identify appropriate failure conditions to be demonstrated. The airworthiness substantiation shall provide documentation that demonstrates compliance to the requirements above if

applicable to the flight control system used. Analyses, simulation, and tests shall be used to demonstrate that the rotorcraft meets the applicable requirements. A preliminary analysis shall be conducted to assess compliance with requirements and to identify appropriate conditions for flight testing. Following completion of the flight testing, the analysis shall be updated based on the test results and used to demonstrate compliance with requirements. The airworthiness substantiation shall include a Flight Controls Failure Preliminary Analysis Report prepared IAW with DI-MISC-80711. The airworthiness substantiation shall also include a Flight Controls Failure Flight Test Plan prepared IAW DI-NDTI-80566. The airworthiness substantiation shall also include a Flight Controls Failure Flight Test Report prepared IAW DI-NDTI-80809. The airworthiness substantiation shall also include a Final Flight Controls Failure Analysis Report prepared IAW with DI-MISC80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (6.1.2.4)	AC 25-7D PS-ASW-27, 29-09		

6.25. Flying and Handling Qualities Reporting

The purpose of the flying and handling qualities reports are to document the handling qualities of the aircraft.

Criteria:

The aircraft handling qualities shall be characterized.

Standard:

Aircraft System Specification

Method of Compliance:

The airworthiness substantiation shall include both a preliminary flying and handling qualities analysis report and a final flying and handling qualities report. The use of engineering analysis, modeling, and simulation to evaluate stability and control requirements and performance-based requirements throughout the range of ground and flight operations IAW the Aircraft System Specification. Preliminary flying and handling qualities analysis shall be conducted to assess compliance with requirements and to identify critical points for flight testing. Following completion of the flight testing, the preliminary flying and handling qualities analysis shall be updated based on the test results and used to assess final compliance to the Aircraft System Specification. The airworthiness substantiation shall include a Flying and Handling Qualities Preliminary Analysis Report prepared IAW DI-MISC-80711. The airworthiness substantiation shall also include a Flying and Handling Qualities Flight Test Plan prepared IAW DI-NDTI-80566. The airworthiness substantiation shall also include a Flying and Handling Qualities Flight Test Report prepared IAW DI-NDTI-80809. The airworthiness substantiation shall also include a Final Flying and Handling Qualities Analysis Report prepared IAW DI-MISC-80711.The flight test report shall discuss any discrepancies with the preliminary analysis.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (6.1.2)	EMACC (6.1.3)		

6.26. Aircraft Flight Control Laws

The purpose of the aircraft flight control laws report is to describe the design and analysis of the aircraft flight control laws.

Criteria:

The design and analysis of the aircraft flight control laws shall be described.

Standard:

DI-SESS-80567
DI-SESS-82291

Method of Compliance:

The airworthiness substantiation shall include a report describing the design and analysis of the aircraft control laws. The report shall include the following:

a. General description of the flight control system, to include component functionality and data interfaces between the components.

b. Description of the control laws, including simplified block diagrams to illustrate stabilization loops, control response-types, hold modes and other design features.

c. Description of control law inputs/outputs, including specification of data transport delays.

d. Description of redundancy design features for managing actuator and/or sensor failures.

e. Description of notch filters used to mitigate adverse interaction between the flight control system and other aircraft systems.

f. Complete Control Law drawings in electronic human-readable format as an enclosure. Simulink, CONDUIT, Matrix X, Control C or similar format is acceptable. The electronic flight control laws shall be executable in an environment that allows for observation of internal signals. This could be satisfied by a Simulink model, or C/C++ code in an interactive development environment, as examples. The electronic flight control laws must be capable of interfacing with a flight model for real-time operation, or be readily convertible (e.g. automated code generation) into a form having this capability.

g. Description of how the control laws were evaluated and optimized, including methodology, design requirements, and assumptions imposed on the analysis.

h. Description of the development and validation of the aircraft math model used in the analysis of the control laws. This information may be provided in a separate report.

i. Summary of the results of the analysis, including how the predicted performance compares to design requirements, design impacts to other aircraft systems, specific problems encountered or revealed, and recommended solutions.

j. For those aircraft that undergo a conversion/transition (i.e., tiltrotor), provide a description of the control laws and/or methodology governing the conversion process.

k. A description of active controls used to mitigate adverse interaction between flight control systems and other aircraft systems or structural mode.

l. The minimum requirements for control system stability margins.

The airworthiness substantiation shall include a Flight Control Laws Analysis Report prepared IAW DI-SESS-80567.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (6.2.1)	EMACC (6.2.1)		

6.27. C/C++ Static Libraries
The purpose of the C/C++ static libraries is to provide compiled flight control software code to support simulation and airworthiness evaluation.

Criteria:
C++ static libraries shall be provided.

Standard:
DI-SESS-81442A.

Method of Compliance:
C/C++ static libraries (auto-compiled is acceptable) shall be provided IAW DI-ISPC-81442A for the flight control software for integration into external simulation efforts. This auto-code shall be submitted to the DEVCOM AvMC at CDR and at the conclusion of developmental flight testing (for the "locked-down" design), and all subsequent software releases loaded on aircraft thereafter.

a. Validation input-output data sets shall be provided with each submission.

b. A description of the object code shall be provided that includes: a brief description of changes, interface requirements, a list of input / output variables (and a description for each - including engineering units), and a description of the input-output validation data sets.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (6.2.1)	EMACC (6.2.1)		

6.28. Flight Control System Operational Concept Description

The purpose of the operational concept document is to provide a top-level description of the flight control system and how it is to be used.

Criteria:
The oerational concept for the aircraft flight control system shall be described.

Standard:
DI-IPSC-81430.

Method of Compliance:
The airworthiness substantiation shall provide an Operational Concept Description (OCD) of the flight control system IAW DI-IPSC-81430. The document shall describe the proposed system in terms of intended use, capabilities and functions, and its relationship to other aircraft systems and procedures. Where applicable, electronic models may be provided as a supplement (not a substitute) to the technical description.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 (6.2.1)	EMACC (6.2.1)		

6.29. Icing Conditions

The purpose of the icing test is to ensure that the aircraft can operate safely in icing conditions.

Criteria:
The aircraft shall be operated safely in continuous maximum and intermittent maximum icing conditions.

Standard:
14 CFR Part 25.1419
14 CFR Part 25, Appendix C
14 CFR 29.1419
14 CFR Part 29, Appendix C

Method of Compliance:
The airworthiness substantiation shall provide an analysis to demonstrate the ability of the aircraft and its components to safely operate in continuous maximum and intermittent maximum icing conditions as defined in 14 CFR 25.1419 and Part 25, Appendix C for fixed wing aircraft or 14 CFR 27.1419 and 14 CFR Part 29, Appendix C for rotorcraft. Analyses shall be prepared IAW DI-MISC-80711. The aircraft and its components shall be flight tested in measured natural atmospheric icing conditions. Laboratory dry air or simulated icing tests, dry air flight tests, or flight tests in simulated icing conditions may be used to supplement natural icing conditions test flights. Test plans for all flight and ground testing shall be prepared IAW DI-NDTI-80566. Test reports shall be prepared

IAW DI-NDTI-80809. The airworthiness substantiation shall include an Icing Flight Test Plan prepared IAW DI-NDTI-80566. The airworthiness substantiation shall also include an Icing Flight Test Report prepared IAW DI-NDTI-80809. The airworthiness substantiation shall also include an Icing Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 23.1419 14 CFR 27.1419 AC20-73A		

6.30. Downwash and Outwash Environment

Downwash/ outwash wind forces from hovering rotorcraft and tilting-rotor aircraft can be hazardous for personnel located or operating in near proximity. Testing has shown a correlation between the maximum loads found during static testing and the true downwash forces on personnel. The limit for personnel to maintain stability in a downwash/ outwash environment is at 115 lbs. of peak force applied to the full body. Movement of personnel in this zone should not be attempted.

The caution zone is the area where peak forces are found to be above 87 lbs. and below the 115 lb. limit. This zone defines an area where all personnel will experience at least a moment of instability during downwash peak (gust) events. Trained personnel at weight percentiles greater than the 50th percentile should be able to maintain position and stability during gusting forces greater than 87 lbs. and should be able to continue to ingress after the gust has passed. Crewmembers in this zone should proceed with caution.

Criteria:

The airworthiness substantiation shall characterize hazardous regions of rotorcraft and tilting-rotor aircraft downwash/outwash environment

Standard:

NAWCAD/4.6.5.5/2008-003

Method of Compliance:

a. For cases of required rotorcraft and tilting-rotor aircraft shipboard capability/compatibility, the airworthiness substantiation shall characterize the downwash/outwash environment around hovering rotorcraft and tilting-rotor aircraft WRT human stability through test, similarity analysis, analysis, or a combination of methods. Destabilizing force shall be characterized WRT peak gust forces acting on the PAXMan anthropometric model. Peak gust forces shall be defined as the 98th percentile force value for gusts with a buffeting frequency on the order of 4 Hertz or lower. (Higher frequency gusts are typically not of sufficient duration to cause human destabilization issues.) The downwash-outwash flowfield environment shall be characterized by the use of NAVAIR-defined zone definitions. ‘Caution Zones’ shall include regions that produce

peak PAXMan model forces between 80-87 lbs. ‘Hazard Zones’ shall include regions that produce peak PAXMan model forces between 87-115 lbs. ‘Do-Not-Enter Zones’ shall include regions that produce peak PAXMan model forces of 115 lbs. or greater. The region of characterization shall extend from the center of the aircraft outwards, through the plane of maximum peak PAXMan model forces, to the distance where the peak PAXMan model forces finally drops below 80 lbs. The region of characterization shall include the full 360 azimuthal compass about the geometric center of the aircraft.

b. Single main rotor helicopters shall be analyzed or tested at the maximum vertical takeoff gross weight. Multirotor configurations such as tandem helicopters, tilting-rotor aircraft, etc., shall use vertical take-off gross weights and allowable center-of-gravity locations that produce the highest disk loading on each rotor individually for maximum radial outflow cases, and maximum vertical take-off gross weight with allowable center of gravity centered between the lift-producing rotors for maximum centerline outwash flow cases. Cases shall include a sweep of 5 evenly spaced alighting-gear heights from deck level with gear fully unloaded, to hover out of ground effect (HOGE; rotor height of approximately 2.0 times the primary lifting rotor’s diameter).

The airworthiness substantiation shall include a Downwash/Outwash Analysis Report prepared IAW DI-MISC-80711, a Downwash/Outwash Test Plan prepared IAW DI-NDTI-80566, a Downwash/Outwash Test Procedures Report prepared IAW DI-NDTI-80603 and a Downwash/Outwash Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DOT/FAA/RD-93/31,I DOT/FAA/RD-93/31,II	RDECOM TR-RDMR-AF-14-02 JSSG-2011			MPP-02, VOLUME I, Edition (H) Version (4)

7. PROPULSION AND PROPULSION INSTALLATIONS

This section establishes the requirements for the design, installation, arrangement and compatibility of the complete aircraft propulsion system and subsystem components. The requirements are those necessary to ensure that the engine and associated subsystems functionality, performance and operation allows safe operation of the aircraft. The scope of this section encompasses both installed and uninstalled propulsions system and covers:

a. Normal engine operation and performance;

b. Degraded engine operation and performance;

c. Consideration of all installation effects (functional, physical and compatibility) due to aircraft/engine integration;

d. Engine subsystems, components, computer resources and software;

e. Performance across all intended operational environments.

f. Drive Systems

g. Engine controls

7.1. Propulsion Specific Qualification/Certification.

It should be noted that, historically, propulsion systems have been qualified/certified as an individual system and then integrated into the airframe. Requirements development and/or derivation has therefore been somewhat agnostic or platform independent to allow a qualified system to be utilized in multiple platforms. Complete understanding of the intended installation, mission set, and programmatic needs throughout the life cycle of the overall weapon system is necessary to efficiently and effectively tailor requirements.

7.1.1. Engineering Evaluation Tests

Engineering evaluation tests shall be conducted for acquiring data (for safety, installation, maintainability, quality, etc.) demonstrating results to support analyses, and establishing an engine configuration capable of satisfactorily completing the PFR and QT. The configuration of each test article and its difference from the PFR or QT engine configuration shall be identified and justified in each test report. The engineering evaluation test reports shall be submitted as required by the applicable requirement or test paragraph for each test, or prior to the completion of PFR and QT as applicable, if no specific delivery dates are given. All required engineering evaluation tests shall be as specified in Section 4.4.

Criteria:

Engineering evaluation tests shall be conducted for acquiring data (for safety, installation, maintainability, quality, etc.) demonstrating results to support analyses, and establishing an engine configuration capable of satisfactorily completing the PFR and QT.

Standard:
Appendix D, paragraph 3.9.1

Method of Compliance:
Engineering evaluation tests per Appendix D, paragraph 3.9.1 shall be conducted for acquiring data (for safety, installation, maintainability, quality, etc.) demonstrating results to support analyses, and establishing an engine configuration capable of satisfactorily completing the PFR and QT. All required engineering evaluation tests shall be as specified in Section 4.4. The requirements for the test plans and test reports are identified in the individual Section 4.4 tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.1.2. Preliminary Flight Rating (PFR).
The acceptability of the engine for use in experimental flight testing shall be predicated on the satisfactory completion of all PFR analyses and tests in accordance with Appendix D, Addendum B and written acceptance by the Using Service of all test reports and analyses required for PFR.

Criteria:
The acceptability of the engine for use in experimental flight testing shall be predicated on the satisfactory completion of all PFR analyses and tests.

Standard:
Appendix D, paragraph 3.9.2

Method of Compliance:
Preliminary Flight Rating tests per Appendix D, paragraph 3.9.2 shall be conducted to demonstrate satisfactory completion of all PFR analyses and tests in accordance with Appendix D, Addendum B to support acceptability of the engine for use in experimental flight testing. Written acceptance by the Using Service of all test reports and analyses required for PFR is the method of compliance.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.1.3. Qualification Test Rating (QT)
QT shall be predicated on the satisfactory completion of all tests in accordance with Appendix D, Addendum C and written acceptance by the Using Service of all required qualification test and inspection reports, and analyses. Failure or deficiencies in any of the tests will be considered as a failure to qualify the engine model.

Criteria:
The acceptability of the engine for qualification shall be predicated on the satisfactory completion of all QT analyses and tests.

Standard:
Appendix D, paragraph 3.9.3

Method of Compliance:
Qualification tests per Appendix D, paragraph 3.9.3 shall be conducted to demonstrate satisfactory completion of all QT analyses and tests in accordance with Appendix D, Addendum C to support qualification of the engine for use in full deployment. Written acceptance by the Using Service of all test reports and analyses required for QT is the method of compliance.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.1.4. Acceptance Test (AT).
The purpose of this requirement is to define the engine acceptance test requirements.

Criteria:
A new engine submitted to the Using Service for delivery meets all applicable performance and operating requirements in the engine model specification.

Standard:
Appendix D, paragraph 3.9.7
Appendix D, paragraph 4.7

Method of Compliance:
An Acceptance Test shall be conducted on each engine submitted for delivery to the Using Service and shall consist of those requirements of Appendix D, paragraph 4.7. A detailed Acceptance Test Plan/Procedure shall be submitted to the Using Service for approval prior to PFR IAW DI-NDTI-80603. Engines submitted for PFR or QT testing need not be subjected to acceptance tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.1.5. Test Plans and Procedures

7.1.5.1. Components
Prior to start of any component test identified in Tables XX-A and XX-B, a single test plan shall be prepared in accordance with Appendix E, paragraph 5.10.3. Part 1 shall be submitted to the Using Service for approval prior to preparation and/or submittal of any Part 2 individual test procedures. Once the Part 1 summary is approved by the Using

Service, individual test procedures shall be prepared in accordance with Part 2 and submitted for approval. Upon approval, the individual test procedures shall be inserted within the previously approved Part 1 summary as uniquely identifiable test procedure subsections.

a. One test plan, in accordance with the requirements above, shall be submitted for the PFR group of tests specified in paragraph 4.5.2.5, excluding the software verification tests of 4.5.2.5.8.

b. One test plan, in accordance with the requirements above, shall be submitted for the QT group of tests specified in paragraphs 4.6.2.2, 4.6.2.3, 4.6.2.4, and 4.6.2.5.

Criteria:
The test plan and procedures shall comply with the applicable requirements for the individual test being performed under Appendix E, Paragraph 5.10.3

Standard:
Appendix E, paragraph 5.10.3

Method of Compliance:
A component test shall be completed IAW Appendix E, paragraph 5.10.3. The airworthiness substantiation shall be a Test Plan IAW DI-NDTI-80566.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.1.6. Reports

7.1.6.1. Test Reports
Following the completion of each separate engine or component test, demonstration or consecutive group of tests or demonstrations conducted on any single assembly or component, a report shall be submitted. These contractor reports shall be submitted to the using service for review and approval. Reports on component tests defined in Appendix E shall follow the format of Appendix E, paragraph 5.10.4. Otherwise, each report shall contain but is not limited to the following items:

a. Cover (title number and source of report, date, name(s) of the author(s), and contract number).

b. Title page (title number and source of the report, date, name(s) of the author(s), and contract number).

c. Abstract (a brief statement of the contents of the report, including the objective).

d. Table of contents.

e. List of illustrations providing figure numbers and captions of all illustrations. Photographs, charts, and graphs shall be treated as illustrations and given figure numbers. List of tables with associated captions. When used in a separate series, tables shall be given Roman numerals. Examples: Figure 1, Figure 2, etc., Table I, Table II, and Table III).

f. Summary (brief resume of the test conducted, including objective, procedure, results, conclusions, and recommendations referencing the applicable paragraph of the engine specification).

g. Body of the report.

(1) Brief general description of the engine or of the component and a detailed description of all parts which differ from the approved parts list, if applicable.

(2) List of all germane hardware and serial numbers, if applicable, specifically under test and a list of all engine parts (not necessarily germane to the test) which were utilized.

(3) List of all reference documents relied upon or referenced within the report body. (Report/document number, title, author, and publication date).

(4) If approval is being requested, without test, based on similarity to a component or assembly for which previous test approval was obtained, the requirements of paragraph 3.3.8.10.2.c shall be met including, but not limited to any physical or functional dissimilarities or differences in testing requirements with respect to the tested component and reference to the approved component test report shall be included. Rationale as to test similarity shall be provided.

(5) Method of test (general description of test facility, equipment and methods used in conducting the test).

(6) Record of test (chronological history of events and incidents in connection with all of the testing, including details of all leaks, vibrations and other irregular functioning, and any adjustments, repairs, replacements of parts and the corresponding engine operating time).

(7) Analysis of results (a complete discussion of all phases of the test, such as probable reason for failure or unusual wear, comparison in performance with previous models, analysis of general operation, and any items that are significant from an engineering viewpoint).

(8) Calibrations and recalibration data, for engine, assemblies, and components, including acceptance limits. (Data in uncorrected form and corrected form, if applicable, shall be provided in tabular form and shown by suitable curves. A plot of vibration characteristics in three planes shall be provided for both calibration and recalibration runs.)

(9) For the altitude tests specified in 4.5.3 and 4.6.3, the performance of 3.2.1 and 3.2.1.2 shall be verified.

(10) Tabulated data for all pertinent instrument readings and required instrument readings taken during the test.

(11) Description of the condition of the engine or components at disassembly inspection. A completed disassembly inspection and material discrepancy description shall be provided for each discrepancy.

(12) Conclusions and recommendations, with respect to approval of the engine or components tests, supplemented by such discussion as is necessary for their justification.

(13) Addendum (final approved test procedure).

Criteria:
The test report shall comply with the applicable requirements for the individual test being performed under Appendix D, Paragraph 4.4, 4.5, 4.6, 4.8 and 4.9 or Appendix E, Paragraph 5.10.3

Standard:
Appendix D, paragraph 4.3.6.1

Method of Compliance:
A test report shall be completed IAW Appendix D, paragraph 4.3.6.1 The airworthiness substantiation shall be a Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.1.6.2. Summary Reports
Following completion of the engine integrity test requirements and qualification requirements specified herein, a summary report for each shall be prepared.

These reports shall contain the following items:

a. Cover (title of report, number of the report, source of report, date, security markings).

b. Title page (title of the report, number of the report, source of report, name of authors, contract number).

c. Abstract (a brief statement of the contents of the report, including the objective).

d. Table of contents.

e. Summary (A brief resume and summary of each of the tests conducted, giving the title of each test, test report number, the items tested, dates of testing, and a general statement of the results).

f. Conclusions and recommendations.

Criteria:
The test report shall comply with the applicable requirements for the individual test being performed under Appendix D, Paragraph 4.4, 4.5, 4.6, 4.8 and 4.9 or Appendix E, Paragraph 5.10.3

Standard:
Appendix D, paragraph 4.3.6.2

Method of Compliance:
A test report shall be completed IAW Appendix D, paragraph 4.3.6.2 The airworthiness substantiation shall be a Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2. Engine Application
The engine and associated components will operate safely within the flight and maneuver envelope and operational environment.

7.2.1. Engine Noise Survey
The purpose of this test is to evaluate the capability of the engine and platform to meet the strength and durability requirements in the presence of the engine noise environment generated during engine operation. Engine acoustic signature noise represents a health hazard to personnel, an annoyance to civilian communities, and an observable that can be used to detect combat and search and rescue aircraft.

Criteria:
The engine shall operate such that the total engine noise is minimized.

Standard:
Appendix D, paragraph 3.2.5.7.

Standard:
Appendix D, paragraph 4.6.4.10.

Method of Compliance:
An engine noise survey shall be conducted to substantiate the requirements of Appendix D, paragraph 3.2.5.7. IAW Appendix D, paragraph 4.6.4.10. The airworthiness substantiation shall include an Engine Noise Analysis Report prepared IAW DI-MISC-80711, an Engine Noise Test Plan IAW DI-NDTI-80566, and an Engine Noise Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.2. Engine Smoke

The purpose of the engine smoke test is to demonstrate the engine does not emit visible smoke. Visible or detectable exhaust smoke trails or smoke puffs are observables and can be used to detect combat aircraft.

Criteria:

The engine shall not emit visible engine smoke at any power settings.

Standard:

Appendix D, paragraph 3.2.5.8.
Appendix D, paragraph 3.2.5.8.1.
Appendix D, paragraph 3.2.5.8.2.
Appendix D, paragraph 4.6.4.11

Method of Compliance:

An engine exhaust smoke and invisible exhaust mass emissions test shall be completed to substantiate the requirements of Appendix D, paragraph 3.2.5.8., 3.2.5.8.1. and 3.2.5.8.2. IAW Appendix D, paragraph 4.6.4.11. The airworthiness substantiation shall an Engine Exhaust Gas Emission Test Plan IAW DI-NDTI-80566, and Engine Exhaust Gas Emission Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.3. Engine Exhaust

The purpose of the engine exhaust test is to verify human safety requirements. Exhaust wake temperature and velocity profiles at operating conditions are measured to identify areas hazardous to personnel and equipment and provide data to ensure engine exhaust signature levels meet susceptibility requirements.

Criteria:

The engine and associated components shall operate safely with the flight and maneuver envelope and operational environment.

Standard:

Appendix D, 3.7.10.3.

Method of Compliance:

An engine exhaust test shall be conducted IAW Appendix D, paragraph 4.6.4.11. The airworthiness substantiation shall an Engine Exhaust Gas Emission Test Plan IAW DI-NDTI-80566, and Engine Exhaust Gas Emission Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.4. Engine Performance

Engine performance under various conditions and loads (i.e., altitude, Mach number, sea level, varying temperatures, bleed air extraction, power extraction, attitudes, power settings, etc.) as well as environmental conditions (icing, sand and dust, etc.) needs to be specified and measured to assess aircraft performance under these conditions.

7.2.4.1. Installed Performance

The data for assessment of installed propulsion system performance meets the applicable specification requirements. This includes consideration of all installation effects imposed by the air vehicle, and all intended operational environments.

7.2.4.1.1. Performance Model

The purpose of the engine performance model is to provide a means of assessing performance without actual testing of engine hardware. Engine performance information is of critical importance in the evaluation of the aircraft mission capability.

Criteria:

Engine power and fuel consumption shall be characterized.

Standard:

Appendix D, paragraph 3.2.1.2.
Appendix D, paragraph 3.2.1.2.1.
Appendix D, paragraph 3.2.1.2.2.
Appendix D, paragraph 3.2.1.3.

Method of Compliance:

A steady state performance program shall be developed based on engine and component testing and as well as performance analysis in accordance with Appendix D, para 3.2.1.2 and paragraph 3.2.1.2.1. The program shall be a thermodynamic cycle simulation in which component identity is maintained; e.g., the compressor, turbine, and combustor must each be identifiable as entities in the model logic as required to obtain and maintain an accurate simulation. An engine transient program shall be developed in accordance with paragraph 3.2.1.2.2. The steady-state and transient performance computer programs shall be prepared as separate deliverables IAW DI-IPSC-81488 and submitted to the Using Service for approval prior to PFR, after PFR Altitude Test, after QT Altitude Test, and as required by the Using Service. Computer programs and rating tables shall be updated after the Altitude Test(s) if the model and engine do not lapse within ±2% of each other. The lapse rates shall include Ng, shaft horsepower and Specific Fuel Consumption (SFC) independently with both ambient temperature and pressure altitude for all the rating table conditions. Additionally, airworthiness substantiation of the performance programs shall be IAW Appendix D, paragraph 3.2.1.3 prepared IAW DI-MISC-80711 and updated prior to PFR, after PFR Altitude Test, after QT Altitude Test, and as required by the Using Service. User's Manuals for the steady-

state and transient cycle models shall be submitted for approval with each cycle model submittal as a separate deliverable IAW Appendix D, paragraph 3.2.1.2.1 and DI-TMSS-81515.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.4.1.1.1. Measurement Uncertainty Analysis

The purpose of the Measurement Uncertainty Analysis is to ensure the accuracy of all test measurements taken in qualification and fielding efforts, or as a minimum, the level of uncertainty is characterized.

Criteria:
A detailed measurement uncertainty analysis addressing all elemental precision and bias errors shall be performed in accordance with ASME PTC 19.1 or equivalent and a Measurement Uncertainty Analysis Report approved by the Using Service.

Standard:
Appendix D, paragraph 4.3.5.3

Method of Compliance:
Prior to start of PFR a Measurement Uncertainty Analysis shall be conducted to demonstrate compliance with Appendix D section 4.3.5.3. A Measurement Uncertainty Analysis Report shall be submitted for approval by the Using Service prior to PFR IAW Appendix D, paragraph 4.3.5.3.1 and DI-NDTI- 80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.4.1.1.2. Torque Indication

The purpose of the Torque Indication requirement is to ensure an accurate torque measurement

Criteria:
The engine shall provide an accurate signal for operation of a torque indicator throughout the operating envelope of the engine.

Standard:
Appendix D, paragraph 3.7.6.6

Method of Compliance:
The engine shall provide a signal for operation of a torque indicator throughout the operating envelope of the engine. The type and range of engine furnished signal and the relationship of torque to signal shall be as specified. The specified accuracy shall be

maintained without recalibration after the torque sensor is replaced. The accuracy of the torque signal, from 50 percent output shaft speed to 110 percent rated output shaft speed, shall be:

a. Within plus or minus two percent of the torque at maximum continuous rated power from zero output shaft torque to the torque at maximum continuous rated power.

b. Within plus or minus two percent of the torque being measured, from the torque at maximum continuous rated power to the transient (0.2 minute) torque limit.

Comparison of engine torque vs facility torque system can be submitted in PFR and QT engine test reports such as Altitude and Endurance Test Reports.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.4.1.1.3. Verification of Correction Factors
When correction factors or engine models are used to convert engine performance data to standard conditions, sea level and altitude tests shall be conducted over the necessary range of environmental conditions as defined in appendix D paragraph 3.2.1.4.1 to verify the correction factors or engine models used to correct performance data.

Criteria:
The engine shall be tested prior to PFR to validate any correction factors or engine models used to convert performance data to standard conditions, sea level and altitude tests shall be conducted over the necessary range of environmental conditions as defined in appendix D paragraph 3.2.1.4.1.

Standard:
Appendix D, paragraph 4.4.10.

Method of Compliance:
An engine correction factor test shall be completed prior to PFR IAW Appendix D, paragraph 4.4.10. The airworthiness substantiation shall an Engine correction factors Test Plan IAW DI-NDTI-80566 and Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.4.1.2. PFR Altitude Tests
The purpose of the altitude test is to demonstrate the operation and air starting capability of the engine at altitude. Thorough testing of the engine around the envelope extremes in an altitude test facility has been a cost-effective method of reducing the possibility of encountering engine problems during initial flight testing of the weapon system.

Criteria:
The engine shall start and operate at altitude to ensure safe aircraft operation.

Standard:
Appendix D, paragraph 4.5.3.

Method of Compliance:
An engine, conforming to the same parts list and configuration as the endurance test engine, shall be subjected to altitude tests which consist of operation and air starting checks at several selected conditions within the engine operating envelope in accordance with Appendix D, paragraph 4.5.3. The airworthiness substantiation shall include an engine Altitude Analysis Report prepared IAW DI-MISC-80711, an engine Altitude Test Plan IAW DI-NDTI-80566, and an Engine Altitude Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR Part 33		

7.2.4.1.3. Pressure and Temperature Rate of Change
The purpose of the thermal distortion test is to evaluate the sensitivity of the engine to pressure and temperature changes. Early definition of the inlet distortion limits has proven to be necessary for successful integration of the engine into the aircraft and should be provided by the engine manufacturer as part of the tradeoffs that must be made during the design and development process.

Criteria:
The engine shall start and operate during and after engine inlet pressure and temperature changes to ensure safe aircraft operation.

Standard:
Appendix D, paragraph 3.1.2.10.4.
Appendix D, paragraph 4.9.1.7.

Method of Compliance:
An engine inlet thermal distortion test shall be conducted to establish distortion sensitivity to the pressure and temperature rate of change requirements in Appendix D, paragraph 3.1.2.10.4. IAW Appendix D, paragraph 4.9.1.7. The airworthiness substantiation shall include an Engine Thermal Distortion Test Plan IAW DI-NDTI-80566, and an Engine Thermal Distortion Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.4.1.4. Engine Back Pressure Test

The purpose of the Engine Back Pressure Test is to verify the engine capability to start and operate with exhaust backpressure distortion. Tail winds have adversely affected the starting performance of engines.

Criteria:
The engine shall start and operate during and after exhaust backpressure distortion to ensure safe aircraft operation.

Standard:
Appendix D, paragraph 4.9.1.9.

Method of Compliance:
An engine back pressure test shall be performed to determine sensitivity to exhaust back pressure IAW Appendix D, paragraph 4.9.1.9. The airworthiness substantiation shall include an Engine Back Pressure Distortion Test Plan IAW DI-NDTI-80566, and Back Pressure Distortion Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.4.1.5. QT Altitude Tests

The purpose of the altitude test is to demonstrate the operation and air starting capability of the engine at altitude. Thorough testing of the engine around the envelope extremes in an altitude test facility has been a cost-effective method of reducing the possibility of encountering engine problems during envelope expansion flight testing and deployment of the weapon system.

Criteria:
The engine shall start and operate at altitude to ensure safe aircraft operation.

Standard:
Appendix D, paragraph 4.6.3.

Method of Compliance:
An engine, conforming to the same parts list and configuration as the endurance test engine, shall be subjected to altitude tests which consist of operation and air starting checks at several selected conditions within the engine operating envelope IAW Appendix D, paragraph 4.6.3. The airworthiness substantiation shall include an engine Altitude Test Plan IAW DI-NDTI-80566, and an Engine Altitude Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.4.1.6. PFR Starting Torque
Prior to start of PFR endurance test an engine shall be tested to demonstrate compliance with the starting torque and speed requirements of Appendix D, paragraph 3.7.9.1.1.

Criteria:
The engine shall consistently start with the minimum torque requirements to ensure safe flight.

Standard:
Appendix D, paragraph 4.4.6

Method of Compliance:
An engine starting torque test shall be completed prior to PFR IAW Appendix D, paragraph 4.4.6. The airworthiness substantiation shall an Engine Starting Torque Test Plan IAW DI-NDTI-80566, and an Engine Starting Torque Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.4.1.7. QT Starting Torque
The engine shall be subjected to a test to demonstrate the starting torque and speed requirements of 3.7.9.1.1. The measurement procedures and the calibration and use of test equipment shall be defined in the pretest data. The test shall be conducted using MIL-PRF-5624 fuel, grade JP-4, JP-5 and MIL-DTL-83133H fuel, grade JP-8.

Criteria:
The engine shall start with minimum starting torque.

Standard:
Appendix D, paragraph 4.6.5.1.
Appendix D, paragraph 3.7.9.1.1.

Method of Compliance:
The starting torque and speed requirements shall be IAW Appendix D, paragraph 3.7.9.1.1. and shall be subjected to a test to demonstrate the starting torque and speed requirements IAW Appendix D, paragraph 4.6.5.1. The airworthiness substantiation shall include an engine Starting Torque and Speed Test Plan IAW DI-NDTI-80566, and an Engine Starting Torque and Speed Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.4.1.8. Low and High Temperature Starting and Acceleration Test

The purpose of this test is to ensure engine start and acceleration capability at low and high temperatures. Worldwide, all-weather operation and engine acceleration requires the use of specified fuels and oils under extreme hot and cold ambient temperature conditions.

Criteria:
The engine shall start, accelerate and operate during and after exposure to low and high temperatures.

Standard:
Appendix D, paragraph 4.6.4.1.

Method of Compliance:
An engine shall demonstrate low, high temperature starting and accelerating capability via testing IAW Appendix D, paragraph 4.6.4.1. The airworthiness substantiation shall include a Low and High Temperature Starting and Acceleration Test Plan IAW DI-NDTI-80566, and Low and High Temperature Starting and Acceleration Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.4.1.9. Environmental Icing

The purpose of the environmental icing test is to verify engine performance when operating in icing conditions prior to initial flight testing.

Criteria:
The engine shall start and operate during and after icing conditions.

Standard:
Appendix D, paragraph 3.2.5.2.
Appendix D, paragraph 4.9.1.2.

Method of Compliance:
The engine shall be designed to meet the engine environmental icing requirements of Appendix D, paragraph 3.2.5.2. and testing conducted for Preliminary Flight Rating (PFR) IAW Appendix D, paragraph 4.9.1.2. The airworthiness substantiation shall include an engine Environmental Icing Test Plan IAW DI-NDTI-80566, and an Engine Environmental Icing Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33.68.		

7.2.4.1.10. Maintenance

The purpose of this test is to verify the engine meets performance requirements after exposure and removal of environmental contaminants such as salt water, sand and dust particles during maintenance operations. The engine must remain serviceable after spraying of a washing medium of a prescribed composition onto the engine to remove contaminants.

Criteria:
The engine shall start and operate after maintenance operations are performed.

Standard:
Appendix E, paragraph 5.5.
Appendix E, paragraph 5.5.6.
Appendix E, paragraph 5.10.
Appendix F, paragraph 13.1

Method of Compliance:
The engine and its control system components shall be tested IAW E, paragraph 5.5 and 5.5.6. The airworthiness substantiation (IAW Appendix E, paragraph 5.10) shall include an engine Pressure Wash Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Engine Pressure Wash Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Augment Report prepared IAW DI-NDTI-81896.

The contractor shall demonstrate accessibility to, and usage of, engine water wash equipment; shall conduct actual main engine water wash functional checks, including verification of proper safety and clearance from rotating parts and adequate drainage of detergent IAW Appendix F 13.1. The contractor shall demonstrate testing of dry engine motoring capabilities and starter duty cycles IAW Appendix F 13.1.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 25 Appendix H.		

7.2.4.2. Degraded Performance

Installed engine thrust or power is characterized in backup control mode, at field removal limits (if defined), and meets applicable specification requirements after bird, ice, water and sand ingestion.

7.2.4.2.1. Environmental Icing

The purpose of the environmental icing test is to ensure the engine meets performance requirements when operating in icing conditions prior to the deployment of the weapon system. Engines that use compressor bleed air for anti-icing may have a variable capacity for anti-icing capability that must be identified during testing.

Criteria:
The engine shall start and operate during icing conditions.

Standard:
Appendix D, paragraph 3.2.5.2.
Appendix D, paragraph 4.6.4.2.
Appendix D, paragraph 4.9.1.2.

Method of Compliance:
The engine shall be designed to meet the engine environmental icing requirements of Appendix D, paragraph 3.2.5.2. and testing conducted for PFR IAW Appendix D, paragraph 4.9.1.2. and QT IAW Appendix D, paragraph 4.6.4.2. The airworthiness substantiation shall include an Environmental Icing Test Plan IAW DI-NDTI-80566, and an Engine Environmental Icing Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.4.2.2. Corrosion

The purpose of the corrosion requirement is to evaluate the susceptibility of the materials in the engine to corrosive attack. The air and gas path areas of the engine can be particularly susceptible to corrosive attack.

Criteria:
The engine shall start and operate in corrosive atmosphere conditions.

Standard:
Appendix D, paragraph 3.2.5.5.
Appendix D, paragraph 4.6.4.3.

Method of Compliance:
The engine shall be designed to meet the corrosion requirements of Appendix D, paragraph 3.2.5.5. and testing conducted IAW Appendix D, paragraph 4.6.4.3. The airworthiness substantiation shall include an engine Corrosion Test Plan IAW DI-NDTI-80566, and an Engine Corrosion Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.4.2.3. Bird Ingestion

The purpose of the complete engine bird ingestion test is to demonstrate the engine meets the bird strike requirement including all interactive effects. Engines must be capable of ingesting birds encountered during missions without significant power loss, deterioration, or safety implications.

Criteria:
The engine shall operate after bird ingestion.

Standard:
Appendix D, paragraph 3.2.5.6.1.
Appendix D, paragraph 4.6.4.4.

Method of Compliance:
The engine shall be designed to meet the bird ingestion requirements of Appendix D, paragraph 3.2.5.6.1. and testing conducted IAW Appendix D, paragraph 4.6.4.4. The airworthiness substantiation shall include an n engine Bird Ingestion Test Plan IAW DI-NDTI-80566, and an Engine Bird Ingestion Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.4.2.4. Foreign Object Damage (FOD)
The purpose of the FOD test is to demonstrate the engine has adequate tolerance to FOD. Engines frequently experience damage to compressor blades and other airfoils when foreign or domestic objects enter the flow path. Blades insufficiently designed for FOD considerations have caused In Flight Shut Downs (IFSDs) and costly damage to the engine.

Criteria:
The engine shall start and operate after FOD ingestion.

Standard:
Appendix D, paragraph 3.2.5.6.2.
Appendix D, paragraph 3.3.8.6.
Appendix D, paragraph 4.6.4.5.

Method of Compliance:
The engine shall be designed to meet the requirements of foreign object damage tolerance per Appendix D, paragraph 3.2.5.6.2. and 3.3.8.6; testing shall be conducted IAW Appendix D, paragraph 4.6.4.5. The airworthiness substantiation shall include an engine Foreign Object Analysis Report prepared IAW DI-MISC-80711, an engine Foreign Object Test Plan IAW DI-NDTI-80566, and an Engine Foreign Object Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.4.2.5. Hail and Ice Ingestion
The purpose of the hail and ice ingestion test is to demonstrate the structural capability to tolerate ingestion of environmentally generated ice (hailstones), ice shed from the aircraft, and engine inlet generated ice.

Criteria:
The engine shall start and operate during and after hail and ice ingestion.

Standard:
Appendix D, paragraph 3.2.5.6.3.
Appendix D, paragraph 4.6.4.6.

Method of Compliance:
The engine shall be designed to meet the hail and ice ingestion requirements of Appendix D, paragraph 3.2.5.6.3. and testing conducted IAW Appendix D, paragraph 4.6.4.6. The airworthiness substantiation shall include an engine Hail and Ice Ingestion Test Plan IAW DI-NDTI-80566, and an Engine Hail and Ice Ingestion Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.4.2.6. Sand and Dust Ingestion

The purpose of the test is to demonstrate starting and operating capability of the engine after sand and dust ingestion. The operation of aircraft in sand and dust environments can result in serious erosion damage to engine parts as well as substantial blockage of turbine cooling passages, resulting in significant performance loss.

Criteria:
The engine shall start and operate after and during sand and dust ingestion.

Standard:
Appendix H, paragraph 3.2.5.6.4.
Appendix H, paragraph 4.6.4.7.
Appendix H, paragraph 4.9.1.4.

Method of Compliance:
The engine shall be designed to meet the sand and dust ingestion requirements of Appendix D, paragraph 3.2.5.6.4. and testing conducted for PFR IAW Appendix H, paragraph 4.9.1.4. and for QT IAW Appendix H, paragraph 4.6.4.7. The airworthiness substantiation shall include a Sand and Dust Ingestion Test Plan IAW DI-NDTI-80566, and an Engine Sand and Dust Ingestion Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.4.2.7. Atmospheric Liquid Water Ingestion

The purpose of the test is to evaluate the effects of water ingestion on engine system performance. Large amounts of water in the engine inlet affect engine performance resulting in stall, rotor speed rollback or combustor blowout.

Criteria:
The engine shall start and operate during and after atmospheric water ingestion.

Standard:
Appendix D, paragraph 3.2.5.6.5.
Appendix D, paragraph 4.6.4.8.

Method of Compliance:
The engine shall be designed to meet the atmospheric liquid water ingestion requirements of Appendix D, paragraph 3.2.5.6.5. and testing conducted IAW Appendix D, paragraph 4.6.4.8. The airworthiness substantiation shall include an engine Atmospheric Liquid Water Ingestion Test Plan IAW DI-NDTI-80566, and an Engine Atmospheric Liquid Water Ingestion Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 23.1091 (23.2435 amend. 64), 14CFR 25.1091; 14CFR 27.1091, 14CFR Part 29; 29.1091.		

7.2.5. Engine Operability

Operability is the engine's ability to start, accelerate and decelerate within prescribed limits without compressor stall, surge or flameout. It must be verified that the engine has adequate aerodynamic stability margin exists throughout the operating envelope, even with degraded engine factors, such that there is no unacceptable loss of power or engine operation.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 23.1301 (23..2505 amdmt 64), 14CFR 25.1301, 14CFR; 27.1301, 14CFR 29.1301		

7.2.5.1. Stability Margin

Positive stability margin exists at all flight conditions or that placards are documented in the flight manual.

7.2.5.1.1. Engine Stability and Performance Assessment i.e. Stability Audit

The engine shall not surge, stall, flameout, or incur any damage with the steady state or time variant inlet distortion (pressure, temperature, or any combination of both) defined in Appendix D. Engine stability and performance assessments shall use the methodology and inlet distortion descriptors defined in Appendix D.

Criteria:

An engine stability and performance assessment for total pressure and total temperature distortion shall be performed

Standard:

Appendix D, paragraph 3.1.2.10.3.
Appendix D, paragraph 3.2.1.5.5.

Method of Compliance:

TThe engine stability and performance assessment shall be IAW Appendix D, paragraphs 3.1.2.10.3 and 3.2.1.5.5 and verified during the Altitude test per Appendix D, paragraph 4.6.3. The airworthiness substantiation shall include a PFR Stability Audit prepared IAW DI-MISC-80711, a PFR Engine Altitude Test Plan IAW DI-NDTI-80566, and a PFR Engine Altitude Test Report IAW DI-NDTI-80809. For full qualification, a QT Stability Audit prepared IAW DI-MISC-80711, a QT Engine Altitude Test Plan IAW DI-NDTI-80566, and a QT Engine Altitude Test Report IAW DI-NDTI-80809. The engine model specification shall be updated prior to PFR to include the inlet distortion descriptor methodology and distortion limits per Appendix D, paragraph 3.1.2.10.3.a.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.5.1.2. Emergency Fuel

The purpose of the test is to verify that the engine operates adequately and that all significant engine performance limitations are identified when using designated emergency fuels.

Criteria:

The engine shall start and operate when using an emergency fuel.

Standard:

Appendix D, paragraph 4.6.5.5.
Appendix D, paragraph 3.7.3.2.3.

Method of Compliance:

The engine shall function satisfactorily with emergency fuels IAW Appendix D, paragraph 3.7.3.2.3. and shall be subjected to emergency fuel tests to demonstrate emergency fuel capability IAW Appendix D, paragraph 4.6.5.5. The airworthiness substantiation shall include an engine Emergency Fuel Analysis Report prepared IAW DI-MIS-80711, an engine Emergency Fuel Test Plan IAW DI-NDTI-80566, and an Engine Emergency Fuel Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.5.2. Transient Operation

The engine must have adequate stability during throttle transients. The entire range of required transients should be considered, including those during land and ship approaches, aerial refueling, and quick stops; for rotorcraft, bob-up and remask, and nap of the earth ridgeline crossings.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 23.1301 (23..2505 amdmt 64), 14CFR 25.1301, 14CFR; 27.1301 14CFR 29.1301		

7.2.5.2.1. Rotor Droop and Overshoot

The purpose of the power transient assessment is to ensure the helicopter control systems provides adequate control of output shaft speed during power transients. The engine control has anticipators to increase transient response, decrease overshoots, and lower speed and performance droop that must be validated.

Criteria:
The engine shall operate satisfactorily during power transients.

Standard:
Appendix D, paragraph 3.2.1.5.8.
Appendix D, paragraph 4.5.3.

Method of Compliance:
Computer modeling using either a full, linearized rotor model or a lumped inertia model per Appendix D, paragraph 3.2.1.5.8. shall be used for the standard. The airworthiness substantiation shall include an engine droop analysis report substantiated with altitude test transient times prepared prior to the initiation of the PFR testing IAW DI-MISC-80711 and updated prior to the endurance portion of the qualification test. The airworthiness substantiation shall include an Engine Droop Analysis Report prepared IAW DI-MISC-80711, an Engine Altitude Test Plan prepared IAW DI-NDTI-80566, and an Engine Altitude Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 27.675 14CFR 29.675		

7.2.5.2.2. Engine Power Transients

The purpose of the power transients requirement is to ensure that the engine satisfactorily performs requested power transients throughout the operating envelope within the required transient times and does not result in unstable operation of the engine or cause engine damage.

Criteria:
The engine shall operate satisfactorily during power transients.

Standard:
Appendix D, 3.2.1.5.6.1.
Appendix D, 3.2.1.5.6.2.

Method of Compliance:
Verification of the engine transient times described in 3.2.1.5.6.1. shall be accomplished via the altitude test procedure described in 4.5.3.2. sub paragraph "b".

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 23.1301 (23..2505 amdmt 64), 14CFR 25.1301, 14CFR 27.1301 14CFR 29.1301		

7.2.6. Engine Structures

7.2.6.1. Structure
Verify that the engine structure does not exhibit detrimental permanent set or deflect to the extent that operation or performance is impaired when operated to limit load conditions (singly or in combination) within the flight and ground envelope. Verify that the engine structure does not experience catastrophic failure under ultimate load conditions or combinations of ultimate loading.

7.2.6.1.1. External Forces and Mounts
The purpose of this analysis is to ensure engine components are designed to withstand the relatively infrequent, non-repetitive shocks, or transient vibrations induced by the external forces during flight maneuvers.

Criteria:
The engine shall operate after external forces are induced and not degrade performance.

Standard:
Appendix D, paragraph 3.1.2.5.
Appendix D, paragraph 3.1.2.6.
Appendix D, Figure 1 (combined linear and angular effects)

Method of Compliance:
An analysis shall be performed that provides sufficient evidence that the engine shall function satisfactorily under the conditions specified in Appendix D, paragraph 3.1.2.5., 3.1.2.6. and Figure 1 (combined linear and angular effects) and that the engine shall withstand those conditions without permanent deformation and shall operate

satisfactorily thereafter. The airworthiness substantiation shall include an External Forces and Mounts Analysis Report prepared IAW DI-MISC-80711 prior to the initiation of the PFR testing.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.6.1.2. Static, Attitude and Impact Load Test
The purpose of this test is to demonstrate adequate structural capability prior to initial flight testing. The forces induced by acceleration can cause permanent deformations and fractures that disable or destroy equipment, fasteners and mounting hardware.

Criteria:
The engine shall operate after static, attitude and impact loads are induced.

Standard:
Appendix D, paragraph 4.5.4.3.
Appendix D, paragraph 4.5.4.4.
Appendix D, paragraph 4.5.4.6.

Method of Compliance:
The engine, cases and mounts of the endurance test configuration shall be subjected to a static test IAW Appendix D, paragraph 4.5.4.3., attitude test IAW Appendix D, paragraph 4.5.4.4. and impact load test per Appendix D, paragraph 4.5.4.6. The airworthiness substantiation shall include a Static, Attitude and Impact Load Test Plan IAW DI-NDTI-80566, and Static, Attitude and Impact Load Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.6.1.3. Static Load Test
The purpose of this test is to demonstrate that adequate structural capability of the engine and its supports during and after exposure to maximum externally applied forces. These forces include loads produced by takeoff, landing, in-flight maneuvers, gusts, vibration, installation, and crash conditions. These forces can cause permanent deformations and fractures that disable or destroy equipment, fasteners and mounting hardware.

Criteria:
The engine shall function satisfactorily during and after exposure to maximum externally applied forces.

Standard:
Appendix D, paragraph 4.6.6.5.1.

Method of Compliance:
Engine static load tests shall be conducted for qualification IAW Appendix D, paragraph 4.6.6.5.1. The airworthiness substantiation shall include an engine Static Load Test Plan IAW DI-NDTI-80566, and an Engine Static Load Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.6.1.4. Gyroscopic Test

The purpose of this test is to demonstrate the ability of the engine to withstand gyroscopic moments during normal operation. Bearing loads are greatly increased and forces on an individual rotor blade are significantly magnified during weapon system maneuvers.

Criteria:
The engine operates satisfactorily during and after gyroscopic moments.

Standard:
Appendix D, paragraph 4.6.6.7.

Method of Compliance:
Engine gyroscopic test shall be conducted for qualification IAW Appendix D, paragraph 4.6.6.7. The airworthiness substantiation shall include an engine Gyroscopic Test Plan IAW DI-NDTI-80566, and an Engine Gyroscopic Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.6.1.5. Inlet and Exhaust Connections

The purpose of this test is to ensure that the maximum allowable loads specified for the static (1g) axial, shear and overhung moment do not adversely affect the operation or durability of the engine. The interfaces between the aircraft and the engine must be established and controlled to ensure compatibility.

Criteria:
The engine inlet and exhaust duct connection loads shall not degrade performance.

Standard:
Appendix D, paragraph 3.1.2.10.2.
Appendix D, paragraph 3.7.10.1.
Appendix D, paragraph 4.3.4.2.

Method of Compliance:
The engine's inlet and exhaust connections shall meet the conditions of Appendix D, paragraph 3.1.2.10.2. and 3.7.10.1. and tested IAW Appendix D, paragraph 4.3.4.2. The airworthiness substantiation shall include an engine Inlet and Exhaust Connections Test Plan IAW DI-NDTI-80566, and an Engine Inlet and Exhaust Connections Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 25.941, 25.1123, 14CFR 27.1132 14CFR 29.1132		

7.2.6.1.6. Bleed Air Connections
The purpose of this test is to demonstrate that loads from the bleed air connections do not affect the operation and durability of the engine. Bleed air may be required for various purposes including environmental control and anti-icing.

Criteria:
The engine bleed air connection loads shall not degrade performance.

Standard:
Appendix D, paragraph 3.1.2.11.1.
Appendix D, paragraph 4.3.4.3.

Method of Compliance:
The engine's bleed air connections shall meet the conditions of Appendix D, paragraph 3.1.2.11.1. and tested IAW Appendix D, paragraph 4.3.4.3. The airworthiness substantiation shall include an engine Bleed Air Connections Test Plan IAW DI-NDTI-80566, and an Engine Bleed Air Connections Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.6.1.7. Engine Structure: Strength and Life Analysis
The engine shall meet or exceed the engine structural requirements in Appendix D, paragraph 3.3.8 and subsequent. Factors of safety applied to the design usage induced loads are IAW Appendix D, paragraph 3.3.8.4.1. Strength and life analysis is performed IAW Appendix D, paragraph 3.3.8.6 using material properties based on Appendix D, paragraph 3.3.8.5. Life predictions shall be determined for each potential failure mode to which the particular part is exposed, such as creep/stress rupture, corrosion, erosion, HCF and LCF. The analysis shall be written in accordance with Addendum E and address the requirements of Appendix D, paragraphs 3.3.8.1, 3.3.8.1.2, 3.3.8.3, 3.3.8.4, 3.3.8.4.1, 3.3.8.5, 3.3.8.6.1, 3.3.8.8, 3.3.8.9.1, 3.3.8.9.4, 3.3.8.11, 3.3.8.11.1 and 3.3.8.11.2.

Criteria:
The analysis shall address all requirements identified in Appendix D, paragraphs 3.3.8.1, 3.3.8.1.2, 3.3.8.3, 3.3.8.4, 3.3.8.4.1, 3.3.8.5, 3.3.8.6.1, 3.3.8.8, 3.3.8.9.1, 3.3.8.9.4, 3.3.8.11, 3.3.8.11.1 and 3.3.8.11.2.

Standard:
Appendix D, paragraph 3.3.8.1
Appendix D, paragraph 3.3.8.1.2
Appendix D, paragraph 3.3.8.3
Appendix D, paragraph 3.3.8.4
Appendix D, paragraph 3.3.8.4.1
Appendix D, paragraph 3.3.8.5
Appendix D, paragraph 3.3.8.6
Appendix D, paragraph 3.3.8.6.1
Appendix D, paragraph 3.3.8.8
Appendix D, paragraph 3.3.8.9.1
Appendix D, paragraph 3.3.8.9.4
Appendix D, paragraph 3.3.8.11
Appendix D, paragraph 3.3.8.11.1
Appendix D, paragraph 3.3.8.11.2

Method of Compliance:
The Strength and Life Report shall be completed prior to PFR IAW Appendix D, paragraphs 3.3.8.1, 3.3.8.1.2, 3.3.8.3, 3.3.8.4, 3.3.8.4.1, 3.3.8.5, 3.3.8.6.1, 3.3.8.8, 3.3.8.9.1, 3.3.8.9.4, 3.3.8.11, 3.3.8.11.1 and 3.3.8.11.2. The airworthiness substantiation shall be the Strength and Life Report IAW DI-NDTI- 80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.6.1.7.1. Design Service Life
Prior to the start of PFR analysis shall be conducted to identify the Design Service Life based on the requirements of Appendix D, paragraph 3.3.8.1

Criteria:
Define the Design Service Life of the engine

Standard:
Appendix D, paragraph 3.3.8.1

Method of Compliance:
An Engine Design Service Life Analysis shall be completed prior to PFR IAW Appendix D, paragraph 3.3.8.1. The airworthiness substantiation shall be included in the Strength and Life Report IAW DI-NDTI-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.6.1.7.2. Critical Safety Items List
Prior to the start of PFR a Critical Safety Items (CSI) list shall be created based on the requirements of Appendix D, paragraph 3.3.8.1.2

Criteria:
Creation of Critical Safety Items (CSI) list per MIL-STD-882

Standard:
Appendix D, paragraph 3.3.8.1.2.

Method of Compliance: :
An Engine Critical Safety Items (CSI) list shall be completed prior to PFR IAW Appendix D, paragraph 3.3.8.1.2. The airworthiness substantiation shall be included in the Strength and Life Report IAW DI-NDTI-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.6.1.7.3. Low Cycle Fatigue Life Analysis
Prior to the start of PFR a Low Cycle Fatigue Life Analysis shall be created based on the requirements of Appendix D, paragraph 3.3.8.3.

Criteria:
Perform Low Cycle Fatigue Life Analysis to establish the -3 σ LCF life of engine parts (except all turbine rotor blades and combustor liners) shall be 15,000 cycles. The minimum LCF life of turbine rotor blades and combustor liners shall be 7500 cycles.

Standard:
Appendix D, paragraph 3.3.8.3.

Method of Compliance:
An Engine Low Cycle Fatigue Life Analysis shall be completed prior to PFR IAW Appendix D, paragraph 3.3.8.3. The airworthiness substantiation shall be included in the Strength and Life Report IAW DI-NDTI-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.6.1.7.4. Strength Analysis
Prior to the start of PFR a Strength Analysis shall be performed based on the requirements of Appendix D, paragraph 3.3.8.4.

Criteria:
The engine shall meet the strength requirements at the end of its life as defined by Appendix D, paragraphs 3.3.8.1, 3.3.8.2, and 3.3.8.3.

Standard:
Appendix D, paragraph 3.3.8.4
Appendix D, paragraph 3.3.8.1
Appendix D, paragraph 3.3.8.2
Appendix D, paragraph 3.3.8.3

Method of Compliance:
An Engine Strength Analysis shall be completed prior to PFR IAW Appendix D, paragraph 3.3.8.4. The airworthiness substantiation shall be included in the Strength and Life Report IAW DI-NDTI-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.6.1.7.5. Creep Analysis
Prior to the start of PFR a Creep Analysis shall be performed based on the requirements of Appendix D, paragraph 3.3.8.8.

Criteria:
All engine parts (static and rotating) shall not creep to the extent that the engine does not meet the requirements as defined by Appendix D.
Standard:
Appendix D, paragraph 3.3.8.8
Appendix D, paragraph 3.3.8.1
Appendix D, paragraph 3.3.8.5
Appendix D, paragraph 3.3.8.6
Appendix D, paragraph 3.3.8.6.1

Method of Compliance:
An Engine Creep Analysis shall be completed prior to PFR IAW Appendix D, paragraph 3.3.8.8. The airworthiness substantiation shall be included in the Strength and Life Report IAW DI-NDTI-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.6.1.7.6. Containment Analysis
Prior to the start of PFR Containment Analysis shall be performed based on the requirements of Appendix D, paragraph 3.3.8.9.1.

Criteria:
The engine shall contain a compressor, IPS blower or turbine blade failure occurring at the blade root section in the fillet below the platform that is released within the engine.

Standard:
Appendix D, paragraph 3.3.8.9.1.
Appendix D, paragraph 3.2.1.4.6.
Appendix D, paragraph 3.7.4.1.1.
Appendix D, paragraph 3.3.8.5.

Method of Compliance:
An Engine Containment Analysis shall be completed prior to PFR IAW Appendix D, paragraph 3.3.8.9.1. The airworthiness substantiation shall be included in the Strength and Life Report IAW DI-NDTI-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.6.1.7.7. Disk Burst Analysis
Prior to the start of PFR Disk Burst Analysis shall be performed based on the requirements of Appendix D, paragraph 3.3.8.9.4

Criteria:
The analysis shall show that for compressor and gas generator rotors the disk burst speed shall be a minimum of 122% of max allowable steady state rotor speed. Gas generator and power turbine rotors disk burst speed margins shall be shown to conform to Appendix D, paragraph 3.3.8.9.4

Standard:
Appendix D, paragraph 3.3.8.9.4
Appendix D, paragraph 3.3.8.5
Appendix D, paragraph 3.2.1.4.6
Appendix D, paragraph 3.37.2.3.3.1
Appendix D, paragraph 3.37.2.3.3.2.1
Appendix D, paragraph 3.37.2.3.3.2.2

Method of Compliance:
An Engine Disk Burst Analysis shall be completed prior to PFR IAW Appendix D, paragraph 3.3.8.9.4. The airworthiness substantiation shall be included in the Strength and Life Report IAW DI-NDTI-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.6.1.7.8. High Cycle Fatigue Life

Prior to the start of PFR High Cycle Fatigue Life analysis shall be performed based on the requirements of Appendix D, paragraph 3.3.8.2

Criteria:
Engine parts shall not fail when subject to the maximum attainable combined steady state and vibratory stresses. Parts that are subjected to LCF loads in addition to HCF loads shall be designed considering the effect of low cycle fatigue (LCF) damage on the material HCF life.

Standard:
Appendix D, paragraph 3.3.8.2 Appendix D, paragraph 3.2.5.6.2 Appendix D, paragraph 3.3.8.10.2

Method of Compliance:
High Cycle Fatigue Life analysis shall be completed prior to PFR IAW Appendix D, paragraph 3.3.8.2. The airworthiness substantiation shall be included in the Strength and Life Report as well as the Vibration and Stress Analysis Report IAW DI-NDTI-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.6.1.8. Vibration and Stress
The purpose of this test is to ensure the engine is free of detrimental resonances prior to initial flight testing. Lightweight, flexible structures which operate at elevated temperatures and high rotor speeds combine to make it impossible to design aerodynamic surfaces (blades and vanes) with resonant frequencies beyond the operating range.

Criteria:
The engine shall be free of damaging vibration and dynamic response.

Standard:
Appendix D, paragraph 3.3.8.10.
Appendix D, paragraph 3.3.8.10.1.
Appendix D, paragraph 3.3.8.10.2.
Appendix D, paragraph 4.5.4.1.

Method of Compliance:
Dynamic models shall be developed for major engine parts and components IAW Appendix D, paragraph 3.3.8.10. Critical speeds shall be determined and shall meet or exceed the speed margins specified in Appendix D, paragraph 3.3.8.10.1. Vibration test conducted per Appendix D, paragraph 4.5.4.1. The airworthiness substantiation shall include an Engine Vibration and Stress Analysis Report prepared IAW DI-MISC-80711, an Engine Vibration and Stress Test Plan IAW DI-NDTI-80566, and an Engine Vibration and Stress Test Report IAW DI-NDTI-80809; to be updated prior to Qualification Test

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.6.1.9. Containment

The purpose of this analysis is to determine that the engine has adequate containment capability prior to initial flight testing. For safety of personnel and equipment, it is imperative to contain all blade failures.

Criteria:

The engine shall have containment capability.

Standard:

Appendix D, paragraph 3.3.8.9.1.

Method of Compliance:

An analysis shall be performed that provides sufficient evidence that the engine shall function satisfactorily under the conditions specified in Appendix D, paragraph 3.3.8.9.1. The analysis shall contain the methodology and relevant data points used in the determination. The airworthiness substantiation shall include a Containment report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.6.1.10. Containment Capability

The purpose of these tests and analyses is to demonstrate that the engine has adequate containment capability prior to deployment of the weapon system. For safety of personnel and equipment, it is imperative to contain all blade failures.

Criteria:

The engine shall have containment capability prior to weapon system deployment.

Standard:

Appendix D, para, 4.6.6.3.

Method of Compliance:

An engine test shall be conducted to demonstrate containment capability IAW Appendix D, paragraph 4.6.6.3. The airworthiness substantiation shall include an engine Containment Capability Analysis Report prepared IAW DI-MISC-80711, an engine Containment Capability Test Plan IAW DI-NDTI-80566, and an Engine Containment Capability Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.6.1.11. Rotor Integrity

The purpose of the Rotor integrity requirements are to evaluate the operational margin for rotor structural integrity while allowing continued use. The field often experiences over temperature and overspeed events that may be pilot induced or a result of a material failure.

Criteria:
The engine rotors shall retain its structural integrity during overspeed and over temperature.

Standard:
Appendix D, paragraph 3.3.8.9.2.

Method of Compliance:
An analysis and subsequent engine testing shall be performed to demonstrate the engine rotors meets the integrity requirements of Appendix D, paragraph 3.3.8.9.2. The airworthiness substantiation shall include an engine Rotor Integrity Analysis Report prepared IAW DI-MISC-80711, an engine Rotor Integrity Test Plan IAW DI-NDTI-80566, and an Engine Rotor Integrity Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.6.1.12. PFR Overspeed

The purpose of the overspeed test is to evaluate the overspeed capability of the engine prior to the initial flight testing to ensure adequate margin exists for the entire flight testing program.

Criteria:
The engine shall have adequate overspeed capability to ensure safe flight.

Standard:
Appendix D, paragraph 4.5.4.2.

Method of Compliance:
An engine overspeed test shall be completed prior to PFR IAW Appendix D, paragraph 4.5.4.2.1. The airworthiness substantiation shall include an engine Overspeed Analysis Report prepared IAW DI-MISC-80711, an engine Overspeed Test Plan IAW DI-NDTI-80566, and an Engine Overspeed Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.6.1.13. QT Overspeed

The purpose of the overspeed tests is to ensure adequate structural margin exists between published speed limits and rotor speed capability. Past experience indicates that the engine can overspeed due to control system malfunctions or sudden loss of load.

Criteria:
The engine shall be capable of withstanding an overspeed event.

Standard:
Appendix D, paragraph 4.6.6.4.1.

Method of Compliance:
An engine overspeed test shall be completed for Qualification IAW Appendix D, paragraph 4.6.6.4.1. The airworthiness substantiation shall include an engine Overspeed Analysis Report prepared IAW DI-MISC-80711, an engine Overspeed Test Plan IAW DI-NDTI-80566, and an Engine Overspeed Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.6.1.14. PFR Overtemperature

The purpose of the overtemperature test is to evaluate the overtemperature capability of the engine prior to initial flight testing. Overtemperature events are likely during developmental flight testing.

Criteria:
The engine shall have an overtemperature capability.

Standard:
Appendix D, paragraph 4.5.4.2.2.

Method of Compliance:
An engine overtemperature test will be completed for PFR IAW Appendix D, paragraph 4.5.4.2.2. The airworthiness substantiation shall include an engine Overtemperature Analysis Report prepared IAW DI-MISC-80711, an engine Overtemperature Test Plan IAW DI-NDTI-80566, and an Engine Overtemperature Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.6.1.15. Overtemperature Structural Margin

The purpose of the overtemperature testing is to demonstrate adequate structural margin exists between published temperature limits and hot section temperature capability.

Engines experience overtemperature excursions due to control system malfunctions or intended pilot actions to obtain additional torque.

Criteria:
The engine shall be capable of withstanding an overtemperature event.

Standard:
Appendix D, paragraph 4.6.6.4.2.

Method of Compliance:
An engine overtemperature test shall be completed for Qualification IAW Appendix D, paragraph 4.6.6.4.2. The airworthiness substantiation shall include an engine Overtemperature Analysis Report prepared IAW DI-MISC-80711, an engine Overtemperature Test Plan IAW DI-NDTI-80566, and an Engine Overtemperature Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.6.1.16. Blade Failure
The purpose of the analysis and tests is to demonstrate that the engine possesses adequate structural integrity after blade loss so that a stable time period exists without uncontained catastrophic destruction to allow time for pilot awareness and appropriate action.

Criteria:
The engine shall not experience an uncontained fire, catastrophic rotor or mount failure due to a single blade failure.

Standard:
Appendix D, paragraph 3.3.8.9.3.

Method of Compliance:
An analysis and subsequent engine testing shall be performed to demonstrate the engine blade out capability meets the requirements of Appendix D, paragraph 3.3.8.9.3. The airworthiness substantiation shall include an engine Blade Failure Analysis Report prepared IAW DI-MISC-80711, an engine Blade Failure Test Plan IAW DI-NDTI-80566, and an Engine Blade Failure Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 25.362, 14CFR 27.903 14CFR 29.908 14CFR Part 33		

7.2.6.1.17. PFR Output Shaft Static Torque Test

The purpose of the test is to demonstrate that the output shaft can safely operate within prescribed limits to ensure safe operation during initial flight testing. Past experience indicates that the engine output shaft torque can increase because of a malfunction or other anomaly.

Criteria:
The engine output shaft system shall not exhibit detrimental permanent set or deflection to the extent that operation or performance is impaired.

Standard:
Appendix D, paragraph 4.5.2.5.7.

Method of Compliance:
The engine output shaft system shall be subjected to testing at the maximum allowable output torque IAW Appendix D, paragraph 4.5.2.5.7. The airworthiness substantiation shall include an engine Output Shaft Static Torque Test Plan IAW DI-NDTI-80566, and an Engine Output Shaft Static Torque Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 25.362, 14CFR 27.903 14CFR 29.908 14CFR Part 33		

7.2.6.1.18. QT Output Shaft Static Torque Test

The purpose of the test is to demonstrate that the torque shaft can safely operate within prescribed limits to ensure safe operation prior to deployment of the weapon system. Past experience indicates that the engine output shaft torque can increase because of a malfunction or other anomaly.

Criteria:
The engine output shaft system shall not exhibit detrimental permanent set or deflection to the extent that operation or performance is impaired.

Standard:
Appendix D, paragraph 4.6.2.4.6.

Method of Compliance:
The engine output shaft system shall be subjected to testing at the maximum allowable output torque IAW Appendix D, paragraph 4.6.2.4.6. The airworthiness substantiation shall include an engine Output Shaft Static Torque Test Plan IAW DI-NDTI-80566, and an Engine Output Shaft Static Torque Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 25.362, 14CFR 27.903 14CFR 29.908 14CFR Part 33		

7.2.6.1.19. PFR Attitude Test

The purpose of the attitude test is to demonstrate the engine systems can successfully operate at anticipated attitudes during initial flight testing. Extended flight operation at certain weapon system attitudes has resulted in oil system malfunctions, such as oil starvation, bearing sump flooding, gearbox flooding, oil foaming problems, and seal leaks.

Criteria:
The engine shall be capable of operating at specified attitudes.

Standard:
Appendix D, paragraph 4.5.4.4.

Method of Compliance:
The engine shall be subjected to an attitude test to demonstrate satisfactorily operation IAW Appendix D, paragraph 4.5.4.4. The airworthiness substantiation shall include an engine Attitude Analysis Report prepared IAW DI-MISC-80711, an engine Attitude Test Plan IAW DI-NDTI-80566, and an Engine Attitude Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 23.1301 (23..2505 amdmt 64), 14CFR 25.1301, 14CFR 27.1301 14CFR 29.1301		

7.2.6.1.20. QT Attitude Test

The purpose of the attitude test is to demonstrate the engine systems can operate at anticipated attitudes prior to deployment of weapon system. Extended flight operation at certain weapon system attitudes has resulted in oil system malfunctions, such as oil starvation, bearing sump flooding, gearbox flooding, oil foaming problems, and seal leaks.

Criteria:
The engine shall be capable of operating at specified attitudes prior to weapon deployment.

Standard:

Appendix D, paragraph 4.6.4.12

Method of Compliance:
The engine shall be subjected to an attitude test to demonstrate satisfactorily operation IAW Appendix D, paragraph 4.6.4.12. The airworthiness substantiation shall include an engine Attitude Analysis Report prepared IAW DI-MISC-80711, an engine Attitude Test Plan IAW DI-NDTI-80566, and an Engine Attitude Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 23.1301 (23..2505 amdmt 64), 14CFR 25.1301, 14CFR 27.1301 14CFR 29.1301		

7.2.6.1.21. Disk Burst Test
The purpose of the disk burst test is to demonstrate the disk burst margin to prevent the occurrence of a catastrophic failure. Engines are not designed to contain disks, so it is essential that the disk burst margin is well understood.

Criteria:
The engine shall have adequate disk burst margin.

Standard:
Appendix D, paragraph 3.3.8.9.4.
Appendix D, 4.6.6.4.3.

Method of Compliance:
The engine disk burst requirements are defined in Appendix D, paragraph 3.3.8.9.4. and testing shall be completed IAW Appendix D, 4.6.6.4.3. The airworthiness substantiation shall include a Disk Burst Analysis Report prepared IAW DI-MISC-80711, a Disk Burst Test Plan IAW DI-NDTI-80566, and Disk Burst Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.6.1.22. Emergency Power Demonstration Test
The purpose of the emergency power test is to demonstrate emergency power capability of the engine and that any subsequent failure modes are sufficiently benign to preclude any platform catastrophic damage or injury to personnel.

Criteria:
The engine shall be capable of operating at emergency power conditions.

Standard:
Appendix D, paragraph 4.6.6.1.

Method of Compliance:
An emergency power demonstration test shall be conducted IAW Appendix D, paragraph 4.6.6.1. The airworthiness substantiation shall include an engine Emergency Power Demonstration Test Plan IAW DI-NDTI-80566, and an Engine Emergency Power Demonstration Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 23.1301 (23..2505 amdmt 64), 14CFR 25.1301, 14CFR 27.1301 14CFR 29.1301		

7.2.6.1.23. PFR Engine Low Cycle Fatigue Test
The purpose of the LCF test is to demonstrate that rotating parts that are subjected to mechanical and thermal stresses during engine operation have sufficient LCF capability prior to initial flight testing. Low cycle fatigue is the damage generated in a material by cyclic load reversals, which cause repeated plastic deformation.

Criteria:
The engine shall not experience a low cycle fatigue failure.

Standard:
Appendix D, paragraph 3.3.8.3.
Appendix D, paragraph 4.3.5.
Appendix D, paragraph 4.5.4.8.
Appendix D, paragraph 3.3.8.6.

Method of Compliance:
An engine low cycle fatigue test showing compliance with Appendix D, paragraph 3.3.8.3. shall be conducted for PFR IAW Appendix D, paragraph 4.3.5. and 4. 5.9.1.1. The airworthiness substantiation shall include an engine Low Cycle Fatigue Test Plan IAW DI-NDTI-80566, and an Engine Low Cycle Fatigue Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.6.1.24. Low Cycle Fatigue Component Tests

Selected critical parts shall be subjected to testing to show compliance with Appendix D, paragraph 3.3.8.3 life requirements.

Criteria:

The selected parts shall be cycled at engine operating conditions to a level sufficient to demonstrate the -3sigma required life with a 95% confidence level.

Standard:

Appendix D, paragraph 4.6.6.2.1.

Method of Compliance:

This testing procedure, reviewed and approved by the Using Service, shall provide for a component "cleared life" for the life requirements specified in 3.3.8.3.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.6.1.25. QT Engine Low Cycle Fatigue Test

The purpose of the LCF testing and analyses is to ensure that generalized cracking will not occur prior to reaching the required design service life. Prediction of LCF life requires testing for increased confidence in predicted life limit.

Criteria:

The engine shall have sufficient LCF life to ensure safe flight.

Standard:

Appendix D, paragraph 3.3.8.3.
Appendix D, paragraph 4.3.5.
Appendix D, paragraph 4.6.6.2.
Appendix D, paragraph 4.9.2.2.
Appendix D, paragraph 3.3.8.6.

Method of Compliance:

An engine low cycle fatigue test showing compliance with Appendix D, paragraph 3.3.8.3. shall be conducted for qualification IAW Appendix D, paragraph 4.3.5., 4.9.2.2. and 4.6.6.2. The airworthiness substantiation shall include an Engine Low Cycle Fatigue Analysis as part of the Strength and Life Report, an Engine Low Cycle Fatigue Test IAW DI-NDTI-80566, and an Engine Low Cycle Fatigue Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.6.2. Durability

It must be shown that the engine has positive durability margins over the defined operational interval and duty cycle to preclude adverse safety, economic, or operational effects.

7.2.6.2.1. PFR Structural Life

The purpose of the structural life assessment is to ensure an adequate level of durability prior to initial flight testing. Complete failure of test engines has occurred in past development programs due to undetected damage growth.

Criteria:
The engine shall be durable.

Standard:
Appendix D, paragraph 3.3.5.
Appendix D, paragraph 3.3.8.
Appendix D, paragraph 3.3.8.11.
Appendix D, paragraph 4.3.5.
Appendix D, paragraph 4.5.1.
Appendix D, paragraph 4.9.1.3.

Method of Compliance:
The engine structural life shall meet the requirements of Appendix D, paragraph 3.3.8. including material corrosion, creep, stress rupture and other failure mechanisms. Interchangeability requirements of the engine shall meet the requirements of Appendix D, paragraph 3.3.5. Fracture safety and mission critical engine parts shall be damage tolerant in accordance with Appendix D, paragraph 3.3.8.11. Engine endurance testing shall be completed for PFR IAW Appendix D, paragraph 4.3.5., 4.5.1., and 4.9.1.3. The airworthiness substantiation shall include an engine Endurance Test Plan IAW DI-NDTI-80566, and an Engine Endurance Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.6.2.2. QT Structural Life

The purpose of the structural life qualification to ensure that cracking or other structural or material degradation which could result in functional impairment or excessive in-service maintenance problems does not occur during the design service life.

Criteria:
The engine shall function with positive durability margins to preclude adverse safety, economic or operational effects.

Standard:
Appendix D, paragraph 3.3.8.
Appendix D, paragraph 3.3.8.11.
Appendix D, paragraph 4.3.5.

Appendix D, paragraph 4.6.1.
Appendix D, paragraph 4.9.2.1.

Method of Compliance:
The engine structural life shall meet the requirements of Appendix D, paragraph 3.3.8. including material corrosion, creep, stress rupture and other failure mechanisms. Fracture safety and mission critical engine parts shall be damage tolerant IAW Appendix D, paragraph 3.3.8.11. Engine endurance testing shall be completed for QT IAW Appendix D, paragraph 4.3.5., 4.6.1. and 4.9.2.1. The airworthiness substantiation shall include an engine Endurance Test Plan IAW DI-NDTI-80566, and an Engine Endurance Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.6.2.3. Operating Limits
The purpose of operating limits is to provide and demonstrate the engine operating characteristics and limits for the operator to know the full range of engine capabilities.

Criteria:
The engine shall function with positive durability margins as installed in the aircraft.

Standard:
Appendix D, paragraph 3.2.1.4.

Method of Compliance:
All engine steady state and transient operating limits (maximum, minimum) shall be specified per Appendix D, paragraph 3.2.1.4. The specified limits shall be predicated on the most critical tolerances of the engine. The airworthiness substantiation shall include an engine operating limitation report, including engine turbine temperature correlation studies IAW Appendix D paragraph 3.2.1.4.5., prepared prior to the initiation of the PFR testing IAW DI-MISC-80711 and updated with revised correlation studies prior to the initiation of the Qualification test.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 23.1301 (23..2505 amdmt 64), 14CFR 25.1301, 14CFR 27.1301 14CFR 29.1301		

7.2.6.2.4. Vibration and Dynamic Response PFR.
The purpose of the survey is to demonstrate the engine is free of damaging dynamic response. Absence of damaging vibration and dynamic response is essential to maintain the desired mechanical and structural integrity of the engine prior to initial flight tests.

Criteria:
The engine shall be free of damaging vibration and dynamic response.

Standard:
Appendix D, paragraph 3.3.8.10.
Appendix D, paragraph 3.2.1.4.10.
Appendix D, paragraph 4.4.5.

Method of Compliance:
The engine design shall comply with the requirements of Appendix D, paragraph 3.3.8.10. and its maximum permissible engine vibration limits (overall velocity limits [true RMS]) at each sensor location on the engine shall be defined IAW Appendix D, paragraph 3.2.1.4.10. Engine vibration survey shall be completed IAW Appendix D, paragraph 4.4.5. The airworthiness substantiation shall include an Engine Vibration Report prepared IAW DI-MISC-80711, an Engine Vibration Test Plan IAW DI-NDTI-80566, and an Engine Vibration Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33.33		

7.2.6.2.5. Vibration and Stress Tests
The purpose of the vibration and stress tests is to demonstrate the engines capability to resist destructive vibrations. Instrumented engine tests are necessary to verify the dynamic response of the total engine system due to system analysis and modeling challenges.

Criteria:
The engine shall be capable to resist destructive vibrations and dynamic response.

Standard:
Appendix D, paragraph 4.6.6.6.1. thru paragraph 4.6.6.6.7.

Method of Compliance:
Engine and modular strain, bearing evaluation, and an Engine vibration tests shall be conducted for qualification IAW Appendix D, paragraph 4.6.6.6.1. thru 4.6.6.6.7. The airworthiness substantiation shall include an engine Vibration and an engine Vibration and Stress Test Plan IAW DI-NDTI-80566, and an Engine Vibration and Stress Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33.33		

7.2.6.2.6. Main Shaft Seals and Bearing Mechanical Tests
Prior to start of PFR the engine main shaft, seals, and bearing shall be subjected to mechanical tests IAW Appendix D, paragraph 4.5.4.9.

Criteria:
Pass the mechanical tests listed in Appendix D, paragraph 4.5.4.9.

Standard:
Appendix D, paragraph 4.5.4.9

Method of Compliance:
The Main Shaft Seals and Bearing Mechanical Tests shall be completed prior to PFR IAW Appendix D, paragraph 4.5.4.9. The airworthiness substantiation shall be in the Main Shaft Seals and Bearing Mechanical Tests Plan IAW DI-NDTI- 80566, and the Shaft Seals and Bearing Mechanical Tests Report IAW DI-NDTI- 80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33.33		

7.2.6.2.7. Mainshaft Bearing Assurance Testing
The purpose of the bearing assurance test is to demonstrate critical bearing capability. Prediction of bearing performance and/or life have not always been reliable, especially those bearings whose operating conditions exceed recent engine experience or whose designs are unusual.

Criteria:
The engine bearings shall be free of damaging vibration and dynamic response.

Standard:
Appendix D, paragraph 4.6.6.10.

Method of Compliance:
Engine Mainshaft bearings assurance testing shall be conducted IAW Appendix D, paragraph 4.6.6.10. The airworthiness substantiation shall include a Mainshaft Bearing Assurance Test Plan IAW DI-NDTI-80566, and Mainshaft Bearing Assurance Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33.33		

7.2.6.2.8. Gear Resonance Testing

The purpose of the gear resonance test is to demonstrate the gear system is free from resonant dynamic response. Resonance conditions should be identified and avoided so that amplified response and structural failures do not occur.

Criteria:
The engine gear system shall be free of damaging vibration and dynamic response.

Standard:
Appendix D, paragraph 4.6.6.11.

Method of Compliance:
Engine gear resonance testing shall be conducted IAW Appendix D, paragraph 4.6.6.11. The airworthiness substantiation shall include a Gear Resonance Analysis Report prepared IAW DI-MISC-80711, a Gear Resonance Test Plan IAW DI-NDTI-80566, and Gear Resonance Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33.33		

7.2.6.3. Material Characterization

The materials used in the engine need to be fully characterized using minimal allowables that are established considering statistical variability, the expected environments, fabrication processes, repair techniques, and quality assurance procedures. Verify that conditions and properties for material repairs satisfy design requirements.

7.2.6.3.1. Material and Processes

The purpose of the analysis is to ensure the materials and processes used during the design and manufacture of the engine will meet all specification requirements.

7.2.6.3.1.1. Adhesive and Sealants

The use, in any location, of adhesive or sealant compounds is permitted only upon specific application approval of the Using Service prior to its incorporation into the design of the engine and, as a minimum, shall be governed by the limitations listed in Appendix D, paragraph 3.3.1.1.1.

Criteria:
The engine materials, coatings and processes shall be corrosion and Nuclear, Biological and Chemical (NBC) resistant. Use of adhesives and sealants shall meet the requirements and must be approved by the Using Service.

Standard:
Appendix D, paragraph 3.3.1.1.
Appendix D, paragraph 3.3.1.1.1.

Method of Compliance:
The materials, adhesives, and sealants used in the engine shall meet the requirements of Appendix D, paragraph 3.3.1.1. and 3.3.1.1.1 The airworthiness substantiation shall include an analysis report of any engine manufacturer's documents that are used for materials and processes submitted prior to the initiation of the PFR testing IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33		

7.2.6.4. Design Service Life
The engine is designed such that pertinent environmental variables and all sources of repeated loads are considered and these considerations are included in the development of the design duty cycle.

7.2.6.4.1. Interchangeability
The purpose of the interchangeability requirement is to ensure that parts with the same part number are interchangeable to reduce logistic support requirements, minimize maintenance and repair problems, and assure that engine performance and operability are not compromised.

Criteria:
The engine components and individual parts shall be functionally and dimensionally interchangeable and replaceable with each other with respect to installation and performance.

Standard:
Appendix D, paragraph 3.3.5.

Method of Compliance:
The interchangeability requirements of the engine shall meet the requirements of Appendix D, paragraph 3.3.5. The airworthiness substantiation shall include an Interchangeability Analysis Report of any matched or selected fit parts as well as any module replacement limits prepared prior to the initiation of the PFR testing IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.6.5. Life Management
Inspection intervals and life-limited components must be identified in the technical manuals and a process to track life consumption must be operational and current.

7.2.6.5.1. Monitoring System

The purpose of the monitoring system requirement is to ensure the accuracy of information used to determine operation, maintenance and life limits. The engine monitoring system monitors and records parameters for safe platform operation, operational readiness improvements, and life limit updates.

Criteria:
The engine monitoring system shall monitor and calculate lives for life limited parts.

Standard:
Appendix D, paragraph 3.7.6.7.1.
Appendix D, paragraph 4.6.2.7.

Method of Compliance:
The EMS shall demonstrate compliance with Appendix D, paragraph 3.7.6.7.1. and accurately calculate lives IAW Appendix D, paragraph 4.6.2.7. The airworthiness substantiation shall include a Monitoring System Performance Analysis Report prepared IAW DI-MISC-80711, a Monitoring System Performance Test Plan IAW DI-NDTI-80566, and Monitoring System Performance Test Report IAW DI-NDTI-80809 and an EMS algorithm Validation, Verification, and Accreditation (VV&A) plan for the development of the engine algorithms prepared IAW DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7. Engine Subsystems

All engine parts and components which are engine manufacturer provided that are required for engine operation are considered subsystem. These often include the engine control system, fuel, lubrication, anti-icing and other necessary components.

7.2.7.1. Engine Component Tests

Engine components shall be tested as required per Appendix D, paragraph 4.5.2 and Table XX-A in accordance with AMACC Appendix E paragraph 5.2. All components shall conform to the same parts list and configurations as those used on the PFR endurance test engines. Controls and external component specification compliance shall be verified by test and inspection.

Criteria:
The engine components shall not be degraded after exposure to environments to ensure safe first flight.

Standard:
Appendix D, paragraph 4.5.2
Appendix E, paragraph 5.2
Appendix E, paragraph 5.10

Method of Compliance:
Engine components shall undergo the testing requirements defined in Appendix E, paragraph 5.2. The airworthiness substantiation (IAW Appendix E, paragraph 5.10) shall include an Engine Component Test Plan prepared IAW DI-NDTI- 81895 and an Engine Component Test Report prepared IAW DI-NDTI-81897.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.2. Previous Component Approval
Engine components requiring testing as specified herein may have these tests waived at the option of the Using Service if the component has been previously approved by the Using Service for use on another engine. All such components must conform to the same parts list and configuration as the components previously approved. To receive consideration for test waiver, a similarity argument report shall be prepared and submitted to the Using Service for approval.

Criteria:
Document that components and their operating environment are similar to previously approved components for use on another engine.

Standard:
Appendix D, paragraph 4.5.2.1.

Method of Compliance:
Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.3. Engine Control System
The engine control system maintains safe engine operation under all required conditions.

7.2.7.3.1. Engine Control System Impact Test
The purpose of the impact test is to demonstrate the ability of engine control system components, mounted in crew-occupied compartments, to withstand crash safety forces without becoming detached from their mounts.

Criteria:
The engine external components and accessories shall not present a safety risk to crew members during a hard/uncontrolled landing.

Standard:
Appendix E, paragraph 5.4.5.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine control components located in a crew compartment shall be subjected to an impact test IAW Appendix E, paragraph 5.4.5. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Engine Control System Impact Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Engine Control System Impact Test Report prepared IAW DI-NDTI-81897 or Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.3.2. Software

The purpose of the software verification is to ensure software functions as intended. Due to its increased complexity, amount of code and airworthiness implication, software verification and qualification is necessary.

Criteria:
The engine software shall properly function to ensure safe engine operation.

Standard:
Appendix E, paragraph 5.8.1.
DO-178C paragraph 15.0.

Method of Compliance:
The engine software shall be designed, developed and tested IAW RTCA/DO-178C, level A and Appendix E, paragraph 5.8.1. The airworthiness substantiation shall include documentation IAW paragraph 15.0., software airworthiness.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33.28		

7.2.7.3.3. Engine Control System Fail Safe Operation

The purpose of this testing is to demonstrate the design capability of the engine controls. Engine control system fault accommodation must be demonstrated when the electronic control unit is subjected to overheating.

Criteria:
The engine controls shall operate when exposed to abnormally high ambient temperatures due to an unrelated failure of surrounding components.

Standard:
Appendix D, paragraph 3.3.6.7.
Appendix E, paragraph 5.6.4.3.
Appendix E, paragraph 5.10.

Method of Compliance:
The engine control system shall be designed to the fail-safe requirements of Appendix D, paragraph 3.3.6.7. Overheat testing shall be conducted on all electronic engine control assemblies, unless the component is mounted in a location where the ambient environment surrounding the component cannot exceed the component limiting temperature even under failure conditions, IAW Appendix E, paragraph 5.6.4.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Engine Control System Fail Safe Operation Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Engine Control System Fail Safe Operation Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33.28, 33.75		

7.2.7.3.4. Engine Control System Highly Accelerated Life Testing (HALT)
The purpose of HALT is to identify potential shortcoming of the control system that can be found during extensive bench testing and can be addressed prior to fielding.

Criteria:
The engine control system components and accessories shall properly operate throughout their life cycle.

Standard:
Appendix E, paragraph 5.9.
Appendix E, paragraph 5.9.1.
Appendix E, paragraph 5.9.2.
Appendix E, paragraph 5.10.

Method of Compliance:
Designated engine control system components shall be designed to meet reliability growth goals and tested IAW Appendix E, paragraph 5.9./Table VIII and undergo highly accelerated life testing (HALT) for PFR IAW Appendix E, paragraph 5.9.1., and Reliability Development and Growth Testing (RDGT) prior to fielding IAW Appendix E, paragraph 5.9.2. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include Engine Control System HALT/CERT Plans prepared IAW DI-NDTI-81895 & DI-RELI-80322, and an Engine Control System HALT/CERT Reports prepared IAW DI-NDTI-81897.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33.28, 33.75		

7.2.7.3.5. Engine Control System Simulated Operational Test (SOT)

The purpose of the SOT is to demonstrate acceptable IOC life for all control system components. SOTs are used to verify that the components can operate reliably throughout all the missions and preclude early failures that may occur in service.

Criteria:
The engine control system components and accessories shall properly operate throughout their mission cycle.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.3.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine control system components and accessories shall operate satisfactorily when exposed to simulated operational environments IAW Appendix E, paragraph 5.1. and 5.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Engine Control System SOT Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Engine Control System SOT Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR P33.28		

7.2.7.3.6. Engine Control System PMA Short to Ground

The purpose of the PMA short to ground assessment is to ensure that control system components operate satisfactorily when exposed to shorts associated with the PMA. Electrical shorts to ground can lead to propagated control system damage and an Engine system failure.

Criteria:
The engine control system components shall properly function during a PMA electrical short to ground.

Standard:
Appendix E, paragraph 5.6.4.1.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine control system components which are powered directly by the engine PMA shall operate satisfactorily and/or not be damaged during and after exposure to shorts to ground of any one phase. Analysis and/or testing shall be IAW Appendix E, paragraph 5.6.4.1. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Engine Control System Short to Ground Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Engine Control System Short to Ground Test

Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR P33.28		

7.2.7.3.7. Engine Control System Environmental Performance

The purpose of component environmental testing is to ensure components will survive both real world and exaggerated environments while continuing to meet their individual performance requirements.

Criteria:

The engine control system components and accessories shall properly function throughout their environmental life cycle to ensure safe flight.

Standard:

Appendix E, paragraph 5.1.
Appendix E, paragraph 5.4.
Appendix E, paragraph 5.10.

Method of Compliance:

Engine control system components and accessories shall meet their individual performance requirements when tested IAW Appendix E, paragraph 5.1. and 5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include test plans/reports prepared prior to the initiation of the engine QT IAW Appendix E, paragraph 5.10. and DI-RELI-80322, DI-NDTI-81895, DI-NDTI-81896 and DI-NDTI-81897.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 23.1301 (23..2505 amdmt 64), 14CFR 25.1301, 14CFR 27.1301 14CFR 29.1301		

7.2.7.3.8. Overtemperature Control System

The purpose of the test is to ensure that the control system’s overtemperature control loop controls the engine as required and prevents overtemperature during starting and operation.

Criteria:

The engine overtemperature control system shall maintain safe engine operation.

Standard:

Appendix D, paragraph 4.6.6.8.

Method of Compliance:
An engine shall be tested to demonstrate the engine overtemperature control system IAW Appendix D, paragraph 4.6.6.8. The airworthiness substantiation shall include an Overtemperature Control System Test Plan IAW DI-NDTI-80566, and Overtemperature Control System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR P33.28		

7.2.7.3.9. Overspeed Control System

The purpose of the test is to ensure the control systems overspeed control loop controls the engine as required and prevents overspeed throughout the envelope. Engine overspeed incidents have resulted in structural failure of rotating components.

Criteria:
The engine overspeed control system shall maintain safe engine operation.

Standard:
Appendix D, paragraph 4.6.6.9.

Method of Compliance:
An engine shall be tested to demonstrate the engine overspeed control system IAW Appendix D, paragraph 4.6.6.9. The airworthiness substantiation shall include an Overspeed Control System Test Plan IAW DI-NDTI-80566, and Overspeed Control System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR P33.28		

7.2.7.3.10. Engine Control System Proof Pressure and Pressure Cycling

The purpose of the analyses and tests is to demonstrate the control system can withstand proof pressure testing and maximum pressure cycling and safely operate throughout its life cycle.

Criteria:
The engine components pressurized by fuel, oil or air shall safely operate under severe conditions.

Standard:
Appendix E, paragraph 5.5.
Appendix E, paragraph 5.5.2.
Appendix E, paragraph 5.5.3.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine components pressurized by fuel, oil or air shall demonstrate that they can safely withstand cycling between their minimum and maximum design operating pressures, after being proof tested, by testing IAW Appendix E, paragraphs 5.5., 5.5.2., and 5.5.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Engine Control System Pressure Cycling Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Engine Control System Pressure Cycling Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR P33		

7.2.7.3.11. Engine Control System Burst Pressure

The purpose of the test is to demonstrate the control system will not rupture when over pressurized. Analyses and tests which include burst pressure testing with posttest inspection verify that the component can safely withstand an over pressurization event at any time during its life cycle, without rupture.

Criteria:
The engine components pressurized by fuel, oil or air shall withstand over pressurization without rupture.

Standard:
Appendix E, paragraph 5.5.
Appendix E, paragraph 5.5.4.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine components pressurized by fuel, oil or air shall demonstrate that they will not rupture when over pressurized IAW Appendix E, paragraph 5.5. and 5.5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Engine Control System Burst Pressure Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Engine Control System Burst Pressure Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR P33		

7.2.7.3.12. Engine Control System Components Requirement

The purpose of these component tests is to ensure flight safety and preclude catastrophic failure, fire, or explosions during initial flight testing.

Criteria:
The engine control system components and accessories shall not be degraded after exposure to environments to ensure safe first flight.

Standard:
Appendix E, paragraph 5.2.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine control system components and accessories shall undergo the testing requirements defined in Appendix E, paragraph 5.2. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Engine Control System Flight AWR Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Engine Control System Flight AWR Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 23.1301 (23..2505 amdmt 64), 14CFR 25.1301, 14CFR 27.1301 14CFR 29.1301		

7.2.7.3.13. Data Bus Interfaces
The purpose of the requirement is to ensure all interfaces adhere to protocol specifications. The engine control system should be an integral part of the engine maintenance system and should be compatible with the aircraft data collection, ground support systems, and the maintenance support concept.

Criteria:
The engine electronic components with data bus communication interfaces shall properly operate to ensure safe operation of the aircraft.

Standard:
Appendix E, paragraph 5.6.4.6.
Appendix E, paragraph 5.10.

Method of Compliance:
Data bus communication interfaces shall be verified for compliance with protocol specifications IAW Appendix E, paragraph 5.6.4.6. The airworthiness substantiation shall include a Data Bus Interfaces Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Data Bus Interfaces Test Reports prepared IAW DI-NDTI-81897 or Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 23.1301 (23..2505 amdmt 64), 14CFR 25.1301, 14CFR 27.1301 14CFR 29.1301		

7.2.7.3.14. Crystal Oscillators

The purpose of the test is to ensure components with crystal oscillators meet performance requirements at all temperature extremes. There have been recent control system field events associated with crystal oscillators that require additional screening during development.

Criteria:

The engine electronic components with crystal oscillators shall properly function to ensure safe operation of the aircraft.

Standard:

Appendix E. paragraph 5.6.4.7.
Appendix E, paragraph 5.10.

Method of Compliance:

Components incorporating crystal oscillators shall be tested IAW Appendix E, paragraph 5.6.4.7. to demonstrate that they meet their performance specifications at all steady-state ambient temperatures. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Crystal Oscillator Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Crystal Oscillator Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33		

7.2.7.4. Control System Stability

The control system maintains both stable engine operation and response during all steady state and transient conditions and does not exhibit any unacceptable torsional modes when coupled to the airframe rotor system. Modulation of engine power from start-up through maximum power and shutdown by means of unrestricted throttle/collective movement must be linear.

Criteria:

Linear and non-linear torsional stability analyses of the combined engine and aircraft rotor system shall be performed prior to first flight. It shall be used to evaluate stability for large perturbations to the engine/rotor system.

Standard:
ADS-9, paragraph 4.2.
Appendix E, paragraph 5.8.4.

Method of Compliance:
The engine control system, coupled with an aircraft rotor system model, shall be analyzed IAW Appendix E, paragraph 5.8.4. The airworthiness substantiation shall include data presented IAW ADS-9, paragraph 4.2.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.28, 14CFR 23.1309 (23..2505 amdmt 64), 14CFR 25.1309, 14CFR 27.1309 14CFR 29.1309		

7.2.7.4.1. Control System Design
The purpose of this test is to demonstrate the fault detection, control unit switching and fault accommodation capability to assure smooth engine control transfer with no engine degradation.

Criteria:
Failure modes of the engine control system and supporting subsystems shall not cause controllability, stability, or handling quality effects.

Standard:
Appendix E, paragraph 5.8.
Appendix E, paragraph 5.8.2.
Appendix E, paragraph 5.10.

Method of Compliance:
The engine control system shall demonstrate that it can properly diagnose and safely accommodate single and multiple signal failures in a closed loop bench environment in accordance with Appendix E, paragraphs 5.8. .and 5.8.5. The airworthiness substantiation shall include a failure mode and effects analysis (FMEA) prepared IAW DI-MISC-80711, and IAW Appendix E, paragraph 5.10., a Control System Fault Accommodation Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Control System Fault Accommodation Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33.28		

7.2.7.5. Failure Modes/Criticality
Any failure of the engine controls and supporting subsystems results in a fail-operational or fail-safe condition.

7.2.7.5.1. Engine Control System Fail Safe Operation
This design requirement is to ensure that engine control system fault accommodation is addressed via the level of degradation (fail safe) and the identification of which system(s) is affected.

Criteria:
The engine control system design shall diagnose and safely accommodate simultaneously occurring signal and component failures.

Standard:
Appendix D, paragraph 3.3.6.7.
Appendix E, paragraph 5.8.
Appendix E, paragraph 5.8.2.
Appendix E, paragraph 5.10.

Method of Compliance:
The engine control system shall be designed to fail safe as specified in Appendix D, paragraph 3.3.6.7., and testing IAW Appendix E, paragraphs 5.8. and 5.8.2. The airworthiness substantiation (IAW Appendix E, paragraph 5.10) shall include an Engine Control System Common Mode Failure Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Engine Control System Common Mode Failure Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.5.2. Control System Power Interrupts.
The purpose of the design requirement and tests is to demonstrate the engine can operate safely and recover from power interrupts. Experience has shown that it is particularly difficult to design and incorporate compatible power supply systems due to variety of legacy electrical power quality and newer systems' sensitivity to power interrupts. System must be sufficiently sophisticated so that it does not require pilot attention during starting and operation.

Criteria:
The engine control system shall safely operate and recover from single, multiple and asymmetric power interrupts of varying duration.

Standard:
Appendix E, paragraph 5.8.

Appendix E, paragraph 5.8.3.
Appendix E, paragraph 5.10.

Method of Compliance:
The engine control system shall demonstrate tolerance to power interrupts in a closed loop bench environment IAW Appendix E, paragraphs 5.8. and 5.8.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10) shall include a Control System Power Interrupt Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Control System Power Interrupt Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.6. Engine Fuel System
The engine fuel system safely provides the required fuel supply to the combustor and fueldraulics subsystems under all required conditions.

7.2.7.6.1. Fuel System Tests
The purpose of the test is to demonstrate the engine fuel system's capability to provide sufficient fuel flow to the engine at all operating speeds and conditions to preclude engine flameouts, stalls and other fuel related failures.

Criteria:
The engine fuel pump shall provide necessary fuel flows, pressures and temperatures to satisfy the requirements of the engine under severe conditions.

Standard:
Appendix D, paragraph 4.9.1.13.

Method of Compliance:
The engine fuel system shall be tested prior to the completion of PFR testing IAW Appendix D, paragraph 4.9.1.13. The airworthiness substantiation shall include a Fuel System Test Plan IAW DI-NDTI-80566, and Fuel System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33.7., 33.35, 33.45, 33.49, 33.67		

7.2.7.6.2. Fuel Systems Highly Accelerated Life Test (HALT)
The purpose of HALT is to expose potential failure conditions during development. There have been problems with fuel system components that can be found during extensive testing and can be addressed prior to fielding.

Criteria:
The engine fuel system components and accessories shall properly operate throughout their life cycle.

Standard:
Appendix E, paragraph 5.9.
Appendix E, paragraph 5.9.1.
Appendix E, paragraph 5.9.2.
Appendix E, paragraph 5.10.

Method of Compliance:
Designated engine fuel system components shall undergo HALT for PFR IAW Appendix E, paragraph 5.9.1., and RDGT prior to fielding IAW Appendix E, paragraph 5.9.2. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Fuel Systems HALT/CERT Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, and a Fuel Systems HALT/CERT Report prepared IAW DI-NDTI-81897.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.6.3. Fuel Systems Simulated Operational Environment

The purpose of the SOT is to demonstrate acceptable IOC life for all fuel system components. SOTs are used to verify that the components can operate reliably throughout all the missions and preclude early failures that may occur in service.

Criteria:
The engine fuel system components shall operate satisfactorily when exposed to a simulated environment.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.3.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine fuel system components shall operate satisfactorily when exposed to simulated operational environments IAW Appendix E, paragraphs 5.1. and 5.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Fuel Systems SOT Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Fuel Systems SOT Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33.7., 33.35, 33.45, 33.49, 33.67		

7.2.7.6.4. Fuel Pumping System Test

The purpose of this test is to demonstrate the engine fuel pump's capability to provide sufficient fuel flow to the engine at all operating speeds and conditions to preclude engine flameouts, stalls and other fuel related failures.

Criteria:

The engine fuel pump shall provide fuel to ensure there are no engine flameouts, stalls and other fuel related failures.

Standard:

Appendix E, paragraph 5.6.5.
Appendix E, paragraph 5.10.

Method of Compliance:

The engine fuel pumping system shall demonstrate via test the ability to provide the necessary flows to operate the engine under all ambient pressure and temperature conditions, IAW Appendix E, paragraph 5.6.5. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Fuel Pumping System Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Fuel Pumping System Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR; 33.7., 33.67		

7.2.7.6.5. Fuel System Low-Lubricity Operational Test

The purpose of this test is to demonstrate that the components that rely on the fuel lubricity for self-lubrication can operate reliably throughout all the missions to preclude failures that may occur in service.

Criteria:

The engine fuel system components that rely on fuel for self-lubrication shall operate satisfactorily.

Standard:

Appendix E, paragraph 5.3.2.
Appendix E, paragraph 5.10.

Method of Compliance:
The fuel system components that require fuel for self-lubrication shall undergo a simulated mission operational test for at least 100 hours IAW Appendix E, paragraph 5.3.2. The airworthiness substantiation shall include a Fuel System Low Lubricity Operational Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Fuel System Low Lubricity Operational Test Report prepared IAW DI-NDTI-81897 or Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.6.6. Fuel System Components Environmental Testing

The purpose of this testing is to demonstrate that components will survive both real world and exaggerated environments while continuing to meet their individual performance requirements.

Criteria:
The engine fuel system components and accessories shall properly function during and after exposure to environmental effects.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.4.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine fuel system components shall meet their individual performance requirements when tested IAW Appendix E, paragraphs 5.1. and 5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Fuel System Components Environmental Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Fuel System Components Environmental Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.6.7. Lines, Fittings and Components

The purpose of the test is to demonstrate fuel system lines, fittings and other components have fire resistant/fireproof capability to ensure they do not contribute additional fire risk to the platform upon an event that ignites a fire.

Criteria:
The engine-mounted fuel lines, fittings and components shall not contribute to a fire risk.

Standard:
AC20-135
AS 1055E
AS 4273A
Appendix D, paragraph 3.3.6.1.
Appendix D, paragraph 3.3.6.7.
Appendix E, paragraph 5.5.5.
Appendix E, paragraph 5.10.

Method of Compliance:
Individual lines, fittings, components or assemblies shall be tested as specified in AC20-135, AS 1055E and AS 4273A IAW Appendix D, paragraphs 3.3.6.1., 3.3.6.7. and 4.5.2.5.5. as well as Appendix E, paragraph 5.5.5. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include Lines and Fittings/Components Fire Test Plans prepared IAW DI-NDTI-81895 & DI-RELI-80322, Lines and Fittings/Components Fire Test Reports prepared IAW DI-NDTI-81897 or Component Similarity Argument Reports prepared IAW DI-NDTI-81896 prior to PFR testing.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.7. Ignition System
The engine ignition system provides a safe and effective ignition source for the main combustor.

7.2.7.7.1. Ignition System HALT
The purpose of the HALT testing is to identify potential shortcomings of the ignition systems that can be addressed prior to fielding.

Criteria:
The engine ignition system components and accessories shall properly operate throughout their life cycle.

Standard:
Appendix E, paragraph 5.9.
Appendix E, paragraph 5.9.1.
Appendix E, paragraph 5.9.2.
Appendix E, paragraph 5.10.

Method of Compliance:
Designated engine ignition system components, IAW Appendix E, paragraph 5.9./Table VIII, shall undergo highly accelerated life testing (HALT) for PFR IAW Appendix E, paragraph 5.9.1., and RDGT prior to fielding IAW Appendix E, paragraph 5.9.2. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include Ignition System HALT/CERT Plans prepared IAW DI-NDTI-81895 & DI-RELI-80322, and Ignition System HALT/CERT Test Reports prepared IAW DI-NDTI-81897.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.7.2. Ignition System Simulated Operational Test (SOT)

The purpose of the SOT is to demonstrate acceptable IOC life for all ignition system components. Demonstration that the components can operate reliably throughout all the missions is needed so as to preclude early failures in service.

Criteria:

The engine ignition system components shall operate satisfactorily when exposed to a simulated environment.

Standard:

Appendix E, paragraph 5.1.
Appendix E, paragraph 5.3.
Appendix E, paragraph 5.10.

Method of Compliance:

Engine ignition system components shall operate satisfactorily when exposed to simulated operational environments IAW Appendix E, paragraphs 5.1. and 5.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Ignition System SOT Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, and an Ignition System SOT Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.7.3. Ignition System Performance

The purpose of the environmental testing is to ensure they will survive both real world and exaggerated environments while continuing to meet their individual performance requirements.

Criteria:

The engine ignition system components and accessories shall properly operate throughout the full range of environments.

Standard:

Appendix E, paragraph 5.1.
Appendix E, paragraph 5.4.
Appendix E, paragraph 5.10.

Method of Compliance:

Engine ignition system components shall meet their individual performance requirements when tested IAW Appendix E, paragraphs 5.1. and 5.4. The airworthiness substantiation

(IAW Appendix E, paragraph 5.10.) shall include an Ignition System Performance Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Ignition System Performance Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.7.4. Ignition System Components Fouling
The purpose of test is to demonstrate that the ignition system is capable of providing sufficient energy for starting and relighting the engine under all environmental and operating conditions without the need for extensive maintenance to replace fouled ignitors.

Criteria:
The engine ignition system shall operate satisfactorily during fouling conditions.

Standard:
Appendix E, paragraph 5.6.6.
Appendix E, paragraph 5.10.

Method of Compliance:
The engine ignition system components shall be functionally operated to demonstrate that the ignition system is capable of consistently starting the engine under fouling conditions, and tested as specified in Appendix E, paragraph 5.6.6. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Ignition System Components Fouling Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Ignition System Components Fouling Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.28, 33.75, 14CFR 23.1309 (23..2505 amdmt 64), 14CFR 25.1309, 14CFR 27.1309 14CFR 29.1309		

7.2.7.8. Engine Anti-Ice System
The engine anti-ice/de-ice system prevents damaging ice buildup or provides safe and non-damaging ice removal at all engine speeds/power levels and will not result in heat-induced damage to the engine's front frame structure. The engine anti-icing system, when required, shall prevent the accumulation of ice on any engine part including all

engine furnished shafts and housings which protrude into the inlet airstream while operating under the icing conditions specified in Appendix D. The total loss in performance IAW Appendix D shall include the effects of operation in the icing environment plus the effects of operation of the anti-icing system. The effect of anti-icing system operation in a non-icing environment shall be specified.

Criteria:
The engine anti-ice system shall prevent ice accumulation without engine instabilities, permanent damage, and excessive power loss

Standard:
Appendix D, paragraph 3.7.1.
Appendix D, paragraph 4.6.4.2
Appendix D, paragraph 4.6.3

Method of Compliance:
The Engine steady-state model is used to generate predictions of the power loss around the operating envelope. The actual performance loss will be measured in the Environmental Icing Test of Appendix D, paragraph 4.6.4.2 and the Altitude Test of Appendix D, paragraph 4.6.3. The deliverables for these have been specified herein.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.8.1. Engine Anti-Ice HALT
The purpose of HALT is to identify problems with anti-ice system components that can be found during extensive bench testing and can be addressed prior to fielding.

Criteria:
The engine anti-ice system components and accessories shall operate satisfactorily.

Standard:
Appendix E, paragraph 5.9.
Appendix E, paragraph 5.9.1.
Appendix E, paragraph 5.9.2.
Appendix E, paragraph 5.10.

Method of Compliance:
Designated engine anti-ice system components, IAW Appendix E, paragraph 5.9./Table VIII, shall undergo HALT for PFR IAW Appendix E, paragraph 5.9.1., and RDGT prior to fielding IAW Appendix E, paragraph 5.9.2. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include Engine Anti-Ice HALT/CERT Plans prepared IAW DI-NDTI-81895 & DI-RELI-80322, and an Engine Anti-Ice HALT/CERT Test Reports prepared IAW DI-NDTI-81897.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.8.2. Anti-Ice Simulated Operational Test (SOT)
The purpose of the SOT is to demonstrate acceptable IOC life for all anti-ice system components. SOTs are used to verify that the components can operate reliably throughout all the missions and preclude early failures that may occur in service.

Criteria:
The engine anti-ice system components shall operate satisfactorily when exposed to a simulated environment.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.3.
Appendix E, paragraph 5.10.

Method of Compliance:
Anti-ice system components shall operate satisfactorily when exposed to simulated operational environments IAW Appendix E, paragraphs 5.1. and 5.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Anti-Ice SOT Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Anti-Ice, SOT Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.8.3. Reserved.

7.2.7.8.4. Engine Anti-Ice System Performance
The purpose of environmental testing on components is to ensure they will survive both real world and exaggerated environments while continuing to meet their individual performance requirements.

Criteria:
The engine anti-ice system components and accessories shall operate satisfactorily throughout the full range of environments.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.4.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine anti-ice system components shall meet their individual performance requirements when tested IAW Appendix E, paragraphs 5.1. and 5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Engine Anti-Ice System Performance Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Engine Anti-Ice System Performance Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.9. Engine Cooling and Thermal Management

The engine cooling and thermal management systems safely remove excess heat from the engine and its subsystems and integrate with the aircraft thermal management system, if applicable

7.2.7.9.1. Heat Rejection Rate

The purpose of this analysis is to ensure the engine and sub-systems will perform satisfactorily in the thermal environment. The surface temperature and heat rejection must be controlled to ensure compatibility between the engine and the aircraft for safe and durable operation.

Criteria:
The engine cooling and thermal management systems shall remove excess heat from the engine and its subsystems to ensure proper system operation.

Standard:
Appendix D, paragraph 3.1.2.8.
Appendix D, paragraph 4.6.1.3.2.

Method of Compliance:
An analysis shall be performed that provides sufficient evidence that the engine and its subsystems shall function satisfactorily under the conditions specified in Appendix D, paragraph 3.1.2.8. Factors such as engine bay cooling flows, accessory pad loading, compressor bleed air conditions, anti-ice operation, oil system cooling requirements, engine skin temperature and radiation properties, and air and gas leakage from engine case flanges and split lines shall be taken into consideration in establishing engine heat rejection rates. The airworthiness substantiation shall include a Heat Rejection Analysis Report prepared IAW DI-MISC-80711, a Heat Rejection Test Plan IAW DI-NDTI-80566, and Heat Rejection Test Report IAW DI-NDTI-80809 prior to the initiation of the PFR testing.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.9.2. Engine Component Limiting Temperatures Analysis
Prior to the start of PFR an analysis shall be conducted to show that the engine components do not exceed their allowable temperature while mounted on the engine based of the requirements of Appendix D, paragraph 3.1.2.8.1

Criteria:
The analysis shall show component temperatures do not exceed their allowable temperatures.

Standard:
Appendix D, paragraph 3.1.2.8.1

Method of Compliance:
An Engine Component Limiting Temperatures Analysis shall be completed prior to PFR IAW Appendix D, paragraph 3.1.2.8.1. The airworthiness substantiation shall be an Engine Component Limiting Temperatures Analysis Report IAW DI- NDTI-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.9.3. Engine Component Limiting Test
The purpose of the limiting test is to demonstrate that components are capable of operating at design temperature limits. Engine cooling and thermal systems are designed to remove specified amount of heat to ensure that components are not exposed to temperatures beyond their design intent.

Criteria:
The engine components shall continue to operate when exposed to their limiting temperature.

Standard:
Appendix D, paragraph 3.1.2.8.1.
Appendix D, paragraph 4.6.4.9.

Method of Compliance:
The engine shall be subjected to an engine component limiting test to demonstrate compliance with Appendix D, paragraph 3.1.2.8.1. IAW Appendix D, paragraph 4.6.4.9. The airworthiness substantiation shall include an engine Component Limiting Test Plan IAW DI-NDTI-80566, and an Engine Component Limiting Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.9.4. Engine Thermal and Cooling Components

The purpose of environmental testing is to ensure components will survive both real world and exaggerated environments while continuing to meet their individual performance requirements.

Criteria:
The engine thermal and cooling system components and accessories shall properly operate throughout the full range of environments

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.4.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine thermal and cooling system components and accessories shall meet their individual performance requirements when tested in accordance with Appendix E, paragraphs 5.1. and 5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Engine Thermal and Cooling Components Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Engine Thermal and Cooling Components Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.10. Variable Geometry (Vg) System

The engine variable geometry systems provides proper variable guide vane positioning and must safely operate under all engine operating conditions.

7.2.7.10.1. Variable Geometry System Simulated Operational Test (SOT)

The purpose of the SOT is to demonstrate acceptable IOC life for all variable geometry system components. SOTs are used to verify that the components can operate reliably throughout all the missions and preclude early failures in service.

Criteria:
The engine variable geometry system components and accessories shall operate satisfactorily when exposed to a simulated environment.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.3.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine variable geometry system components shall operate satisfactorily when exposed to simulated operational environments IAW Appendix E, paragraphs 5.1. and 5.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Variable Geometry System SOT Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Variable Geometry SOT Test Report prepared IAW DI-NDTI-81897, or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.10.2. Variable Geometry System Performance

The purpose of environmental testing is to ensure components will survive both real world and exaggerated environments while continuing to meet their individual performance requirements.

Criteria:
The engine variable geometry system components and accessories shall properly function throughout the full range of environments.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.4.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine variable geometry system components shall meet their individual performance requirements when tested IAW Appendix E, paragraph 5.1. and 5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Variable Geometry System Performance Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Variable Geometry System Performance Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.11. Lubrication System

The engine lubrication system provides the engine with adequate lubrication and safely operates under all engine operating conditions. The lubrication system is free from excessive venting and any leakage does not support combustion.

7.2.7.11.1. Heat Rejection and Oil Cooling Capability

The purpose of this analysis and testing is to ensure proper heat balance in the engine system. The oil system must be able to properly lubricate and dissipate the engine heat,

oil wetted components can become coked from oil that sees excessively high temperatures.

Criteria:
The engine shall have adequate lubrication system heat rejection and cooling.

Standard:
Appendix D, paragraph 3.1.2.8.2.
Appendix D, paragraph 3.7.7.3.1.
Appendix D, paragraph 4.4.2.

Method of Compliance:
The engine heat rejection and cooling capability, including the oil system, will be obtained from engine having substantially the same parts list as the PFR endurance test engine. The analysis will be based on conditions throughout the environmental conditions and engine operating envelope and comply with the requirements of Appendix D, paragraph 3.1.2.8.2. and 3.7.7.3.1. The airworthiness substantiation shall include a heat rejection and surface temperature analysis report based on engine testing IAW Appendix D, paragraph 4.4.2. and DI-NDTI-80809. An oil flow and heat rejection analysis report demonstrating the heat balance analysis shall be prepared prior to the initiation of the qualification endurance test. The airworthiness substantiation shall include a Heat Rejection and Oil Cooling Capability Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14CFR 33.7., 33.39		

7.2.7.11.2. Oil Flow Interruption Test
The purpose of this test is to demonstrate the engine can operate satisfactorily during periods of high maneuver loads that may cause an oil interrupt without loss of engine power and sustain operation without any subsequent maintenance action.

Criteria:
The engine shall continue to operate during high maneuver loads with interrupted oil flow.

Standard:
Appendix D, paragraph 3.1.2.8.2.
Appendix D, paragraph 3.7.7.3.1.
Appendix D, paragraph 3.7.7.3.3.
Appendix D, paragraph 4.4.3.

Method of Compliance:
The engine heat rejection and cooling capability, including the oil system, will be obtained from engine having substantially the same parts list as the PFR endurance test engine. The analysis will be based on conditions throughout the environmental

conditions and engine operating envelope and comply with the requirements of Appendix D, paragraph 3.1.2.8.2. and 3.7.7.3.1. Testing shall be conducted IAW Appendix D, paragraph 4.4.3. The airworthiness substantiation shall include an oil flow Interruption Analysis Report prepared IAW DI-MISC-80711, an oil flow Interruption Test Plan IAW DI-NDTI-80566, and Oil Flow Interruption Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.11.3. Engine Loss of Oil Test

The purpose of this test is to demonstrate the engine can operate satisfactorily without oil for some extended period of time in order for the pilot to egress the hostile area, initiate shutdown or any other required action.

Criteria:

The engine shall continue to operate after loss of all oil supply to the engine bearings.

Standard:

Appendix D, paragraph 3.7.7.3.4.
Appendix D, paragraph 4.5.4.5.
Appendix D, paragraph 4.6.4.13.

Method of Compliance:

The engine oil system shall adequately lubricate the engine for not less than 6 minutes of operation at maximum continuous power after loss of all oil supply to the engine bearing sumps followed by 30 minutes of operation at maximum continuous power with lubrication restored IAW Appendix D, paragraph 3.7.7.3.4. An engine loss of oil test shall be completed IAW Appendix D, paragraph 4.5.4.5. Test shall be repeated IAW Appendix D, paragraph 4.6.4.13. if significant components have been changed from the PFR configuration. The airworthiness substantiation shall include an engine Loss of Oil Analysis Report prepared IAW DI-MISC-80711, an engine Loss of Oil Test Plan IAW DI-NDTI-80566, and an Engine Loss of Oil Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CDR 33.71		

7.2.7.11.4. Lubrication System Fire Test

The purpose of this test is to demonstrate the fire resistant/fireproof capability of the lubrication system lines, fittings, and components to ensure that they do not contribute additional fire risk to the platform upon an operational event that ignites a fire.

Criteria:

The engine lubrication system lines, fittings, and components shall not contribute to a fire risk.

Standard:
AC20-135
AS 1055E
AS 4273A
Appendix D, paragraph 3.3.6.1.
Appendix D, paragraph 3.3.6.7.
Appendix E, paragraph 5.5., 5.5.5. and 5.10.

Method of Compliance:
Individual lines, fittings, components or assemblies shall be tested as specified in AC20-135, AS 1055E and AS 4273A IAW Appendix D, paragraphs 3.3.6.1. and 3.3.6.7., as well as Appendix E, paragraphs 5.5. and 5.5.5. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Lubrication System Fire Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, a Lubrication System Fire Test Report IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896, prior to the initiation of the PFR testing.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.11.5. Lubrication System Pressure Test
The purpose of the test is to demonstrate that the lubrication system can withstand pressure cycling throughout the life cycle.

Criteria:
The engine mounted oil reservoir and mountings shall not have permanent deformation due to the stresses imposed by reservoir pressurization, engine vibration, and cycle stresses.

Standard:
Appendix D, paragraph 3.7.7.4.1.

Method of Compliance:
The engine mounted reservoir tank with filler cap installed shall be subjected to positive and negative differential pressures IAW Appendix D, paragraph 3.7.7.4.1. for a period of 30 minutes without any leakage or detrimental deformation. The airworthiness substantiation shall include a Lubrication System Pressure Test Plan IAW DI-NDTI-80566, and Lubrication System Pressure Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.71, 33.39		

7.2.7.11.6. Cyclic Fatigue, Proof Pressure and Associated Valve Tests

The purpose of this test is to demonstrate the engine lubrication system is capable of withstanding, without permanent deformation or fatigue damage, the stresses imposed by pressurization, engine vibration and cyclic stresses imposed by variation in ambient pressure.

Criteria:
The engine mounted oil reservoir and mountings shall not have permanent deformation or fatigue damage due to the stresses imposed by reservoir pressurization, engine vibration, and cycle stresses.

Standard:
Appendix E, paragraph 5.6.1.
Appendix E, paragraph 5.10.

Method of Compliance:
The engine, lubrication oil filler cap, fittings and oil tank shall have cyclic fatigue, proof pressure and associated valve tests IAW Appendix E, paragraph 5.6.1. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Cyclic Fatigue, Proof Pressure and Associated Valve Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, a Cyclic Fatigue, Proof Pressure and Associated Valve Test Report IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.71, 33.39		

7.2.7.11.7. Internal Oil Leakage

The purpose of this analysis is to evaluate the effects of internal oil leakage on engine performance. Oil leakage within the engine has caused engine fires, lack of proper bearing lubrication and coking within the bearing compartments.

Criteria:
The engine shall continue to operate satisfactorily with internal oil leakage.

Standard:
Appendix D, paragraph 3.7.7.3.2.

Method of Compliance:
The lubrication system shall be designed such that internal leakage does not adversely impact engine operation as specified in Appendix D, paragraph 3.7.7.3.2. The airworthiness substantiation shall include an Internal Oil Leakage Analysis Report prepared prior to the initiation of the PFR testing endurance test IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.39, 33.49, 33.87 , 33.71		

7.2.7.11.8. Engine Lubrication Simulated Operational Test (SOT)

The purpose of the SOT is to demonstrate acceptable IOC life for all lubrication system components. SOTs are used to verify that the components can operate reliably throughout all the missions and preclude early failures in service.

Criteria:

The engine lubrication system components shall operate satisfactorily when exposed to a simulated environment.

Standard:

Appendix E, paragraph 5.1.
Appendix E, paragraph 5.3.
Appendix E, paragraph 5.10.

Method of Compliance:

The engine lubrication system components shall operate satisfactorily when exposed to simulated operational environments IAW Appendix E, paragraph 5.1. and 5.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Engine Lubrication System SOT Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Engine Lubrication System SOT Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.11.9. Lubrication System Performance Test

The purpose of performance testing is to ensure that components will survive both real world and exaggerated environments while continuing to meet their individual performance requirements.

Criteria:

The engine lubrication system components shall properly operate throughout the full range of environments.

Standard:

Appendix E, paragraph 5.1.
Appendix E, paragraph 5.4.
Appendix E, paragraph 5.10.

Method of Compliance:
The engine lubrication components shall meet their individual performance requirements when tested IAW Appendix E, paragraphs 5.1. and 5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Lubrication System Performance Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Lubrication System Performance Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.12. Monitoring System
The propulsion monitoring system provides adequate warnings in a timely manner to reduce occurrences of in-flight shutdowns and power losses.

7.2.7.12.1. Monitoring System Components Simulated Operational Test (SOT)
The purpose of this testing is to demonstrate acceptable IOC life for all monitoring components. SOTs are used to verify that the components can operate reliably throughout all the missions and preclude early failures that may occur in service.

Criteria:
The engine monitoring system components shall operate satisfactorily when exposed to a simulated environment.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.3.
Appendix E, paragraph 5.10.

Method of Compliance:
The engine monitoring components shall operate satisfactorily when exposed to simulated operational environments IAW Appendix E, paragraphs 5.1. and 5.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Monitoring Components and Accessories Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Monitoring Components and Accessories Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33		

7.2.7.12.2. Monitoring System Performance
The purpose of this testing is to ensure monitoring system components will survive both real world and exaggerated environments while continuing to meet their individual performance requirements.

Criteria:
The engine monitoring system components shall meet all performance requirements throughout the full range of environments.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.4.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine monitoring system components shall meet their individual performance requirements when tested IAW Appendix E, paragraph 5.1. and 5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Monitoring System Performance Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Monitoring System Performance Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33		

7.2.7.13. Engine Bleed Air System
The engine bleed air system must be shown to provide the proper amount of air for all customer functions and safely operate under all engine operating conditions.

7.2.7.13.1. Bleed Air Systems
The purpose of this analysis/test is to ensure that bleed flow required for all aircraft functions, including anti-icing, remains viable during all portions of the mission. It is important that no power demand adjustment is required for bleed flow modulation.

Criteria:
The engine shall provide bleed air without degrading engine operation.

Standard:
Appendix D, paragraph 3.1.2.11., 4.5.1.2.2.1.

Method of Compliance:
Engine bleed air systems provide the proper amount of bleed air during ground and flight operation, under all atmospheric conditions and for all flight conditions in the aircraft operating envelope IAW Appendix D, paragraph 3.1.2.11. The airworthiness substantiation shall include a Compressor Bleed Air Systems Analysis Report prepared IAW DI-MISC-80711 prior to the initiation of the PFR endurance test.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.7., 33.73,33.66		

7.2.7.13.2. Customer Bleed Air

The purpose of this analysis/test is to ensure customer bleed air is not contaminated. Bleed air is normally used for cabin heat, air must be supplied with minimal contaminants to assure no possibility of a health hazard to the crew or interfere with their ability to perform the mission prior to initial flight testing.

Criteria:
The engine shall provide contaminant free bleed air extraction for safe operation of initial flight tests.

Standard:
Appendix D, paragraph 4.4.1.

Method of Compliance:
The engine customer bleed air shall be tested to proper pressure, temperature, air flow and contaminant level IAW Appendix D, paragraph 4.4.1. The airworthiness substantiation shall include a Customer Bleed Air Analysis Report prepared IAW DI-MISC-80711, a Customer Bleed Air Test Plan IAW DI-NDTI-80566, and Customer Bleed Air Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.13.3. Bleed Connection Loads

The purpose of this analysis and test is to demonstrate the capability of the bleed air ports to sustain operating loads during the engine life cycle.

Criteria:
The engine bleed hardware attachment loads, and maneuver loads shall not degrade bleed air engine connections.

Standard:
Appendix D, paragraph 3.1.2.11.1.
Appendix D, paragraph 4.6.1.
Appendix D, paragraph 4.6.6.6.6.

Method of Compliance:
The maximum bleed connection loads as specified in Appendix D, paragraph 3.1.2.11.1. shall be imposed on the engine endurance tests specified in Appendix D, paragraph 4.6.1. and 4.6.6.6.6. The airworthiness substantiation shall include a Bleed Connection Loads Analysis as part of the Strength and Life Analysis Report prepared IAW DI-NDTI-80809, a Bleed Connection Loads Test Plan IAW DI-NDTI-80566, and a Bleed Connection Loads Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.63, 33.83		

7.2.7.13.4. Customer Bleed Air

The purpose of this analysis is to ensure customer bleed air is not contaminated. Bleed air is normally used for cabin heat, air must be supplied with minimal contaminants to assure no possibility of a health hazard to the crew or interfere with their ability to perform the mission.

Criteria:

Engine customer bleed air shall not be contaminated.

Standard:

Appendix D, paragraph 4.6.1.2.3.
Appendix D, paragraph 3.1.2.11.3.

Method of Compliance:

Customer bleed air analysis shall be performed to prior to the start of the endurance test IAW Appendix D, paragraph 4.6.1.2.3. to ensure that contamination does not exceed levels specified in Appendix D, paragraph 3.1.2.11.3. The airworthiness substantiation shall include a Customer Bleed Air Test Plan IAW DI-NDTI-80566, and Customer Bleed Air Test Report IAW DI-NDTI-80809.

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.13.5. Bleed Air Systems Simulated Operational Test (SOT)

The purpose of the SOT is to demonstrate acceptable IOC life for all bleed air components. SOTs are used to verify that the components can operate reliably throughout all the missions and preclude early failures that may occur in service.

Criteria:

The engine bleed air system components shall operate satisfactorily when exposed to a simulated environment.

Standard:

Appendix E, paragraph 5.1.
Appendix E, paragraph 5.3.
Appendix E, paragraph 5.10.

Method of Compliance:

Engine bleed air system components shall operate satisfactorily when exposed to simulated operational environments IAW Appendix E, paragraph 5.1. and 5.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Bleed Air

Systems SOT Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Bleed Air Systems SOT Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33		

7.2.7.13.6. Bleed Air Components Performance Test

The purpose of the testing is to ensure bleed air components will survive both real world and exaggerated environments while continuing to meet their individual performance requirements.

Criteria:
The engine bleed air system components and accessories shall operate satisfactorily throughout the full range of environments.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.4.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine bleed air components shall meet their individual performance requirements when tested IAW Appendix E, paragraph 5.1. and 5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Bleed Air Components Performance Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Bleed Air Components Performance Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.84, 33.87, 33.89		

7.2.7.13.7. Bleed Air Pressure Tests

Criteria:
Reserved

Standard:
Reserved

Method of Compliance:
Engine bleed air systems shall be tested IAW Appendix E paragraphs 5.5.2. Proof Pressure, 5.5.3. Pressure Cycling, and 5.5.4. Burst Pressure.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.84, 33.87, 33.89		

7.2.7.14. Subsystem Rotating Components
High-energy controls and subsystem rotating components must be designed to be damage tolerant or have provisions for containment of failed parts. It must also be shown that changes in bearing thrust balance do not result in the bearing operating in failure prone regions of operation.

7.2.7.14.1. Overspeed and Containment Test
The purpose of the test is to verify the containment capability of components with high energy rotating elements in order to protect crew and equipment from impact damage upon component failure.

Criteria:
The engine control components and accessories shall have containment capability to ensure safe aircraft operation.

Standard:
Appendix E, paragraph 5.5.1.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine control components and accessories containing rotating elements shall be analyzed and tested IAW Appendix E, paragraph 5.5.1. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Overspeed and Containment Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Overspeed and Containment Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.94		

7.2.7.14.2. Reserved.

7.2.7.14.3. Reserved.

7.2.7.14.4. Alternator Test
The purpose of this analysis or test is to demonstrate the containment capability of engine driven alternators in order to protect crew and equipment from impact damage upon component failure.

Criteria:
The engine alternator shall have containment capability.

Standard:
Appendix E, paragraph 5.6.2.
Appendix E, paragraph 5.10.

Method of Compliance:
The engine alternator shall demonstrate via test (or analysis) that it is capable of safely containing a failure of its rotor componentry, IAW Appendix E, paragraph 5.6.2. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Alternator Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Alternator Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 20-128A		

7.2.7.15. Tubing/Plumbing and Externals
All engine mounted tubing, manifolds and clamps must be safely affixed and routed on the engine. All engine mounted components must be shown to be free from natural frequencies within the engine and aircraft operating ranges or that any such natural frequencies are sufficiently damped under maximum excitation levels in order that specified fatigue life is achieved. All pressure vessels, tubes and manifolds shall have design margin for their maximum operating conditions.

7.2.7.15.1. Reserved.

7.2.7.15.2. Heat Exchanger Proof and Cycling Pressure Test
The purpose of test is to verify that the components can safely operate during overpressurization events throughout their life cycle without rupture.

Criteria:
The engine mounted heat exchangers shall withstand overpressurization without rupture.

Standard:
Appendix E, paragraph 5.6.3.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine mounted heat exchangers shall be proof and cyclically pressure tested to demonstrate fatigue resistance, IAW Appendix E, paragraph 5.6.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Heat Exchanger Proof and Cycling Pressure Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Heat Exchanger Proof and Cycling Pressure Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.23, 33.21, 33.25, 33.64, 33.83		

7.2.7.15.3. Fire Test

The purpose of the test is to demonstrate that subsystem lines, fittings and components are fire resistant/fireproof to ensure those items do not contribute additional fire risk to the platform upon an event that ignites a fire.

Criteria:

The engine mounted lines, fittings and components shall not contribute to a fire risk.

Standard:

AC20-135
AS 1055E
AS 4273A
Appendix D, paragraph 3.3.6.1.
Appendix D, paragraph 3.3.6.7.
Appendix E, paragraph 5.5. and 5.5.5., and 5.10.

Method of Compliance:

Individual lines, fittings, components or assemblies shall be tested as specified in AC20-135, AS 1055E and AS 4273A IAW Appendix D, paragraphs 3.3.6.1. and 3.3.6.7., and Appendix E, paragraphs 5.5. and 5.5.5. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Fire Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, a Fire Test Report IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.16. Gearboxes, Power Takeoff

Engine mounted gearboxes must have design margin for their maximum operating conditions. It must be shown that failure of any gearbox mounted component (e.g., oil pumps, fuel pumps, starters, and generators) does not result in failure of the gearbox itself and failure of the engine power take-off (PTO) coupling assembly or driveshaft does not adversely affect safe operation of the aircraft.

7.2.7.16.1. Engine Gearbox Durability Endurance Test

The purpose of the endurance test is to demonstrate its durability while providing mechanical power to components required for engine and aircraft operation.

Criteria:

The engine drivetrain and external gearboxes shall be durable.

Standard:
Appendix D, paragraph 4.6.2.4.2.

Method of Compliance:
The engine drive train and associated gearboxes which drive engine components and customer accessories shall be subjected to a 300 hour endurance test IAW Appendix D, paragraph 4.6.2.4.2. The airworthiness substantiation shall include an engine Gearbox Durability Endurance Test Plan IAW DI-NDTI-80566, and an Engine Gearbox Durability Endurance Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.89, 33.83, 33.84, 33.87		

7.2.7.16.2. Engine Gearbox Operational Test
The purpose of the test is to demonstrate the gearboxes ability to transmit loads and successfully operate at all engine operating conditions throughout the flight envelope.

Criteria:
The engine drivetrain and associated gearboxes shall operate at all engine conditions.

Standard:
Appendix D, paragraph 3.1.2.7.
Appendix D, paragraph 4.3.4.4.
Appendix D, paragraph 4.5.1.3.
Appendix D, paragraph 4.6.1.3.

Method of Compliance:
The engine drive train and associated gearboxes which drive engine components and customer accessories shall be loaded to the rated loads and overhung moments as specified in Appendix D, paragraph 3.1.2.7. during the endurance tests IAW Appendix D, paragraph 4.5.1.3., 4.3.4.4. and 4.6.1.3. The airworthiness substantiation shall include an engine Gearbox Operational Test Plan IAW DI-NDTI-80566, and an Engine Gearbox Operational Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.89, 33.83, 33.84, 33.87		

7.2.7.17. Electrical Components and Harnesses
It must be shown that all engine mounted electrical components and cabling are safely affixed and routed on the engine, can safely operate in the lightning and electromagnetic effects environment of the aircraft, do not react to engine or aircraft induced vibratory

and acoustic excitations and electrical power is supplied to all safety critical engine systems under all flight conditions.

7.2.7.17.1. Reserved.

7.2.7.17.2. Engine Electrical Component HALT
The purpose of the HALT testing is to expose potential design deficiencies. There have been problems with engine electrical system components that can be found during extensive bench testing and can be addressed prior to fielding.

Criteria:
The engine electrical system components shall operate satisfactorily throughout their life cycle.

Standard:
Appendix E, paragraph 5.9.
Appendix E, paragraph 5.9.1.
Appendix E, paragraph 5.9.2.
Appendix E, paragraph 5.10.

Method of Compliance:
Designated engine electrical system components, IAW Appendix E, paragraph 5.9./Table VIII, shall undergo HALT for PFR IAW Appendix E, paragraph 5.9.1., and RDGT prior to fielding IAW Appendix E, paragraph 5.9.2. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include Engine Electrical Component HALT/CERT Plans prepared IAW DI-NDTI-81895 & DI-RELI-80322, and an Engine Electrical Component HALT/CERT Test Reports prepared IAW DI-NDTI-81897.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160				

7.2.7.17.3. Engine Electrical Component Simulated Operational Test (SOT)
The purpose of the SOT is to demonstrate acceptable IOC life for all electrical components. SOTs are used to verify that the components can operate reliably throughout all the missions and preclude early failures that may occur in service.

Criteria:
The engine electrical system components shall operate satisfactorily when exposed to a simulated environment.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.3.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine electrical system components shall operate satisfactorily when exposed to simulated operational environments IAW Appendix E, paragraph 5.1. and 5.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Engine Electrical Component SOT Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Engine Electrical Component SOT Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.89, 33.83, 33.84, 33.87, 33.69		

7.2.7.17.4. Explosive Atmosphere Test

The purpose of the test is to ensure that all electrical/electronic components are explosion proof, since an explosive atmosphere may exist near the component.

Criteria:
The engine subsystem components shall be capable of operation in an explosive atmosphere without incident.

Standard:
Appendix E, paragraph 5.4.9.
Appendix E, paragraph 5.10.

Method of Compliance:
All electrical components not hermetically sealed, or components with moving parts capable of creating a spark, shall be subjected to explosive atmosphere testing IAW Appendix E, paragraph 5.4.9. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Explosive Atmosphere Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, an Explosive Atmosphere Test Report IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896, prior to the initiation of the PFR testing.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160				

7.2.7.17.5. Electrical Component Vibration Tests

The purpose of the tests is to ensure that electrical components are designed to withstand transient vibrations induced by external forces and maintain adequate damping to prevent damage.

Criteria:
The engine components shall properly operate when exposed to vibration environments to ensure safe aircraft operation and mission effectiveness.

Standard:
Appendix E, paragraph 5.4.3.1.
Appendix E, paragraph 5.10.

Method of Compliance:
All components shall be subjected to vibration testing IAW Appendix E, paragraph 5.4.3.1. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Electrical Component Vibration Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Electrical Component Vibration Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896 prior to the initiation of the PFR testing.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.89, 33.83, 33.84,, 33.87, 33.69		

7.2.7.17.6. Electrical Component Electromagnetic Environmental Effects (E3) Test
The purpose of the testing is to demonstrate that the engine will operate satisfactorily in the E3 environment and the electromagnetic interface to the aircraft. Engine electrical components will be subjected to various electromagnetic environments from sources within the aircraft as well as those external which degrade engine performance.

Criteria:
The engine electrical and electronic equipment and subsystems shall not have emissions that could interfere with platform co-located equipment. The engine electronics shall meet their performance requirements when subjected to E3 and shall not be susceptible when exposed to an external electromagnetic environment.

Standard:
MIL-STD-461
RTCA/DO-160
Appendix D, paragraph 3.2.8.4.1.
Appendix D, paragraph 4.5.5.1.
Appendix D, paragraph 4.5.5.2.
Appendix E, paragraph 5.7.
Appendix E, paragraph 5.10.
Appendix I
Paragraph 13. of this document

Method of Compliance:
All engine electrical and electronic equipment and subsystems shall meet their performance requirements when subjected to the susceptibility, emission, electromagnetic pulse and lightning requirements of MIL-STD-461, RTCA/DO-160 and Appendix E, paragraph 5.7. The E3 tests shall be completed prior to PFR IAW Appendix D, paragraph 4.5.5.1 and AMACC Appendix E, paragraph 5.7. The airworthiness

substantiation shall include an EMI control plan and EMI/EMC test plan prepared prior to the initiation of the PFR testing IAW DI-EMCS-80199 and DI-EMCS-80201. A system analysis shall be prepared prior to PFR testing IAW DI-MISC-80711. Test reports shall be submitted IAW Appendix E, paragraph 5.10. and DI-EMCS-80200. In addition, E3 requirements are defined in paragraph 13. herein, and Appendix I.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.7.17.7. Electrical Power System Test

The purpose of the test is to demonstrate that after reaching ground idle conditions, the engine electrical power is uninterruptible and provides sufficient electrical power to sustain subsystems required for engine operation.

Criteria:

The engine electrical power system shall be compatible to the host aircraft's electrical power environment.

Standard:

Appendix D, paragraph 3.7.4.1.
Appendix E, paragraph 5.6.4.
Appendix E, paragraph 5.6.4.4.
Appendix E, paragraph 5.10.

Method of Compliance:

The engine electrical power system design shall meet the requirements of Appendix D, paragraph 3.7.4.1. and shall be tested IAW Appendix D, paragraphs 4.5.2.2.2. and 4.6.2.5.4. and IAW Appendix E, paragraphs 5.6.4. and 5.6.4.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Electrical Power System Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Electrical Power System Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.28, 3.37		

7.2.7.17.8. Electrical Components Fire Test

The purpose of the test is to demonstrate that electrical components are fire resistant/fireproof to the extent necessary to ensure those components do not fail such that engine control or shutdown capability is lost.

Criteria:

The engine electrical components shall not contribute to a safety risk during a fire event.

Standard:

AS 4273A
Appendix D, paragraph 3.3.6.7.
Appendix E, paragraph 5.5.
Appendix E, paragraph 5.5.5.
Appendix E, paragraph 5.10.

Method of Compliance:
Components or assemblies shall be tested IAW Appendix E, paragraphs 5.5. and 5.5.5. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Electrical Components Fire Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, an Electrical Components Fire Test Report IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896 prior to the initiation of the PFR testing.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.28, 33.37		

7.2.7.17.9. Electrical System Component Performance
The purpose of the testing is to ensure components will survive both real world and exaggerated environments while continuing to meet their individual performance requirements.

Criteria:
The engine electrical system components and accessories shall properly function throughout the full range of environments.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.4.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine electrical system components shall meet their individual performance requirements when tested IAW Appendix E, paragraph 5.1. and 5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Electrical System Component Performance Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Electrical System Component Performance Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.28, 33.37		

7.2.7.17.10. Airframe Power

The purpose of this analysis is to ensure engine electrical power is compatible with host aircraft capability. Air vehicle electrical alternate power may be required to ensure continued engine operation in the event of an engine electrical power system failure or interruption.

Criteria:
The engine electrical components that utilize airframe power shall be compatible with the aircraft electrical power system to ensure safe aircraft operation.

Standard:
Appendix E, paragraph 5.6.4.2.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine electrical components that utilize airframe power as either a primary or backup power source shall be analyzed to ensure maximum current draw does not exceed circuit breaker capacity IAW Appendix E, paragraph 5.6.4.2. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Electrical Power Analysis Report prepared IAW DI-NDTI-81897.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 23.1351 (Amdt. 23-64 23.2525 ASTM F3264-17); 14 CFR 25.1351; 14 CFR 27.1351; 14 CFR 29.1351.		

7.2.7.17.11. Electrical Component Short Circuit Protection

The purpose of the design requirement and testing is to ensure that electrical components will recover from temporary short circuit conditions and will not propagate failures to other interconnected components. Electrical insulation can become embrittled at low temperatures causing electrical shorts. Electrical shorts to ground can lead to system damage and engine system failure.

Criteria:
Engine electronic components shall recover from short-circuit conditions in the interconnecting cables or component connectors and shall not propagate damage to other components.

Standard:
Appendix E, paragraph 5.6.4.5.
Appendix E, paragraph 5.10.

Method of Compliance:
The engine electrical components shall meet the short circuit protection requirements specified in Appendix D, paragraph 3.7.4.9. when tested IAW Appendix E, paragraph 5.6.4. and 5.6.4.5. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Electrical Component Short Circuit Protection Analysis Report prepared IAW DI-MISC-80711, an Electrical Component Short Circuit Protection Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Electrical Component Short Circuit Protection Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160				

7.2.8. Propulsion Systems
The aircraft drivetrain, propulsion subsystems and engine to aircraft interfaces must provide for safe operation of the aircraft under all operating conditions and possible failure modes.

7.2.8.1. Engine Mounts
The purpose of this requirement is to demonstrate that the engine mounts are sufficiently strong for normal and safe operations throughout the specified service life.

Criteria:
The engine mounts shall secure and protect the engine under all operating conditions and failure modes.

Standard:
AMACC, paragraph 5.
Appendix F, paragraph 4.

Method of Compliance:
With respect to structures, the engine mounts shall meet the requirements of the AMACC, Paragraph 5. With respect to installed vibration, the engine installation shall meet the requirements of Appendix F, para 4. Vibration surveys and testing shall be completed IAW Appendix F, paragraph 4. The airworthiness substantiation shall include an engine Mount Design Report prepared IAW AMACC paragraph 5., an Engine Vibration Test Plan IAW DI-NDTI-80566, and an Engine Vibration Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 33.33, 33.43, 33.75		

7.2.8.2. Compartment Drainage

The purpose of this requirement is to demonstrate that the fluid drain system is compatible with the aircraft fluid collection system and prevents spillage or discharge of fluids during and after engine operation.

Criteria:
The aircraft propulsion system compartment drainage shall be compatible with the aircraft fluid collection system and prevents spillage or discharge of fluids.

Standard:
Appendix F, paragraph 2.3.
Appendix F, paragraph 12.

Method of Compliance:
The aircraft propulsion system compartment drainage capability shall be functionally demonstrated IAW Appendix F, paragraph 2.3. and paragraph 12. The airworthiness substantiation shall include a Compartment Drainage Test Plan IAW DI-NDTI-80566, and Compartment Drainage Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.3. Engine/Airframe Compatibility Testing

The purpose of this testing is to demonstrate the interface requirements between the engine and the airframe are met to assure safe operation of the platform throughout its operating envelope and mission set.

Criteria:
The engine and airframe shall be functionally compatible.

Standard:
Appendix F, paragraph 3.

Method of Compliance:
The engine and airframe meets their respective ICD requirements and satisfactory operation is demonstrated IAW Appendix F, paragraph 3. engine/airframe compatibility testing. The airworthiness substantiation shall include an Engine-Airframe Compatibility Test Plan IAW DI-NDTI-80566, and an Engine-Airframe Compatibility Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.4. Engine Performance and Operability

The purpose of this test is to demonstrate the aircraft's inlet systems effect on the engine's operability; including establishing the inlet distortion and environmental ingestion capability of the engine.

Criteria:
The engine air induction system shall function during all ground, flight, and environmental conditions without degrading the engine operation.

Standard:
Engine ICD
Appendix F, paragraph 6.

Method of Compliance:
All expected ground, flight, induced and natural environmental conditions (e.g., inlet ice accretion and separation, distortion, sand and dust ingestion, water ingestion, gas ingestion) do not adversely affect engine performance and operability, are in compliance with Engine ICD and demonstrated IAW Appendix F, paragraph 6. The airworthiness substantiation shall include an Inlet Design Analysis Report prepared IAW DI-MIS--80711, an Engine Performance and Operability Test Plan IAW DI-NDTI-80566, and an Engine Performance and Operability Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
SAE ARP 1420, 5686, 5687A, 5826A				

7.2.8.5. Engine Exhaust
The purpose of this test is to demonstrate engine exhaust interface with the aircraft, ground equipment and personnel. Engine exhaust swirl angles, pressure drop, and other performance parameters must be known to properly predict engine operation and performance as well as other equipment and personnel safety.

Criteria:
The engine direct exhaust gases shall not adversely affect the aircraft, personnel or degrade externally mounted equipment, fluid drains, air intakes, stores, rotor blades, or airframe structure.

Standard:
Engine ICD
Appendix F, paragraph 7.

Method of Compliance:
The engine exhaust maintains structural adequacy and meets the requirements of the Engine ICD and demonstrated IAW Appendix F, paragraph 7. The airworthiness substantiation shall include an Engine Exhaust Structural Analysis Report prepared IAW

DI-MISC-80711, an Engine Exhaust Test Plan IAW DI-NDTI-80566, and an Engine Exhaust Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.6. Nacelle Temperature Test

The purpose of this test is to demonstrate that adequate engine nacelle cooling exists. Engine bay cooling is designed to remove specified amount of heat to ensure that the engine mounted components are not exposed to temperatures beyond their design intent.

Criteria:
The engine bay/nacelle cooling and ventilation provisions shall properly extract heat to ensure proper component operating temperatures and safe aircraft operation.

Standard:
Appendix F, paragraph 5.

Method of Compliance:
Engine bay/nacelle cooling and ventilation provisions are adequate to maintain the temperatures of power plant components, engine fluids, other bay/nacelle equipment and structure within the temperature limits established for these components and fluids, underground and flight operating conditions, and after normal engine shutdown and demonstrated during testing IAW Appendix F, paragraph 5. The airworthiness substantiation shall include a Nacelle Analysis Report prepared IAW DI-MISC-80711, a Nacelle Temperature Test Plan IAW DI-NDTI-80566, and Nacelle Temperature Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7. Drivetrain

The drive system transmits power at the torque and speed required by the aircraft to all load absorbers and must be adequately evaluated for possible loads, torsional vibration and misalignments throughout the operating envelopes

7.2.8.7.1. Drive System

The purpose of the drive system is to transmit power at the torque and speed required by the aircraft to all load absorbers.

Criteria:
The drive system shall operate satisfactorily during all required loads.

Standard:
Appendix G, paragraph 4.1.
Appendix G, paragraph 4.2.
Appendix G, paragraph 5.1.
Appendix F, paragraph 8.

Method of Compliance:
The drive system shall meet the design requirements of Appendix G, paragraph 4.1. and 4.2. The airworthiness substantiation shall include Drive System analyses IAW Appendix G, paragraph 5.1. Drive Train Analysis Reports shall be prepared IAW DI-MISC-80711, Test Plans IAW DI-NDTI-80566, and Test Reports IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR, 27.917, 27.927, 14 CFR 29.917, 29.927.		

7.2.8.7.2. Safety Assessments and Reliability

The purpose of the failure mode and effects criticality analysis and safety/hazard assessment is to assess the predicted reliability and safety of the drive system.

Criteria:
The drive system shall be reliable and operate safely during all aircraft operations.

Standard:
Appendix G, paragraph 4.1.
Appendix G, paragraph 4.2.
Appendix G, paragraph 5.1.8.
Appendix G, paragraph 5.1.9.

Method of Compliance:
The drive system shall be designed and developed IAW Appendix G, paragraph 4.1., and 4.2. The airworthiness substantiation shall include Safety Assessments and Reliability Analysis Reports prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.3. Lubrication System

The purpose of this test is to demonstrate that the lubrication system of the drive system will survive real world environments and continue to meet its performance requirements throughout its operating envelope.

Criteria:
The drive lubrication system shall continue to operate during all operating environments.

Standard:
Appendix G, paragraph 4.1.2.4.
Appendix G, paragraph 4.1.2.9.
Appendix G, paragraph 4.2.9.6.
Appendix G paragraphs 4.2.9.1. - 4.2.9.5.
Appendix G, paragraph 4.2.9.7. - 4.2.9.11.
Appendix G, Paragraph 5.1.3.
Appendix G, paragraph 5.2.1.1. - 5.2.1.4.
Appendix G, paragraph 5.3.2.1.

Method of Compliance:
The drive lubrication system shall be designed and developed IAW Appendix G, paragraph 4.1.2.4., 4.1.2.9., 4.2.9.6. and 4.2.9.7. thru 4.2.9.11. and development and qualification testing completed IAW Appendix G, paragraph 5.1.3., 5.2.1.1. through 5.2.1.4. and 5.3.2.1. The airworthiness substantiation shall include a Lubrication System Test Plans IAW DI-NDTI-80566, and Lubrication System Test Reports IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.4. Loss of Lubrication
The purpose of this test is to demonstrate that the drive system will operate satisfactorily without oil for some extended period of time in order for the pilot to egress the hostile area, initiate shutdown or any other required action.

Criteria:
The drive system shall continue to operate after the loss of oil supply.

Standard:
Appendix G, paragraph 4.1.2.5.
Appendix G, para 5.3.2.5.3.
Appendix G, paragraph 5.3.3.6.

Method of Compliance:
The drive system loss of lubrication capability shall be designed and developed IAW Appendix G, paragraph 4.2.1.5. and qualification testing shall be completed IAW Appendix G, paragraph 5.3.2.5.3. and 5.3.3.6. The airworthiness substantiation shall include a Loss of Lubrication Test Plans IAW DI-NDTI-80566, and Loss of Lubrication Test Reports IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.5. Shafting

The purpose of the drive system shafting is to transmit power at the appropriate torque and speed for all allowed environments, loads, attitudes and misalignments. Steady state operation at a critical speed can quickly consumed high cycle fatigue life of components.

Criteria:
The drive system shafting shall continue to properly function during all operating conditions and environments.

Standard:
Appendix G, paragraph 4.1.2.1.
Appendix G, paragraph 4.2.10.
Appendix G, paragraph 5.3.2.3.
Appendix G, paragraph 5.3.2.3.6.

Method of Compliance:
The drive system shafting (including shafts, couplings and bearings) shall meet the requirements of Appendix G, paragraph 4.1.2.1. and 4.2.10. and qualification testing IAW Appendix G, paragraph 5.3.2.3. The airworthiness substantiation shall include a Drive Shaft Qualification Analysis Report prepared IAW DI-MISC-80711, a Drive Shaft Qualification Test Plan IAW DI-NDTI-80566, and Drive Shaft Qualification Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.6. Gears and Bearings

The purpose of design requirements and testing is to ensure gears and bearings will properly operate in their intended environment. Predictions of bearing performance and gear life have not been reliable, especially those components whose operating conditions exceed past experience or whose designs are unusual.

Criteria:
The drive system gears and bearings shall operate satisfactorily within intended environments to ensure safe flight.

Standard:
Appendix G, paragraph 4.1.2.2.
Appendix G, paragraph 4.1.2.3.
Appendix G, paragraph 4.2.10.4.
Appendix G, Paragraph 5.1.4.3.
Appendix G, paragraph 5.2.1.5.

Appendix G, paragraph 5.3.2.4.
Appendix G, paragraph 5.3.2.7.
Appendix G, paragraph 5.3.3.3.
Appendix G, paragraph 5.3.3.4.
Appendix G, paragraph 5.3.3.5.

Method of Compliance:
The drive system gears and bearings shall be designed and developed IAW Appendix G, paragraph 4.1.2.2., 4.1.2.3. and 4.2.10.4. and qualification testing shall be completed IAW Appendix G, paragraph 5.1.4.3., 5.2.1.5., 5.3.2.7., 5.3.3.4. and 5.3.3.5. The airworthiness substantiation shall include a Gears and Bearings Test Plans IAW DI-NDTI-80566, and Gears and Bearings Test Reports IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.7. Housings
The purpose of the design requirements and testing are to ensure the drive housings will operate when subject to all loads. Drive housing mounted accessories are subject to system mode vibrations, possible critical speeds in the operating envelope which could impart damaging loads into the housing.

Criteria:
The drive system housing shall continue to operate during all loads and environments to ensure safe flight.

Standard:
Appendix G, paragraph 4.2.6.
Appendix G, paragraph 5.2.1.5.3.3.
Appendix G, paragraph 5.3.2.8.
Appendix G, paragraph 5.3.3.3.
Appendix G, paragraph 5.3.3.5.

Method of Compliance:
The drive system housings shall be designed and developed IAW Appendix G, paragraph 4.2.6. and testing shall be completed IAW Appendix G, paragraph 5.2.1.5.3.3., 5.3.2.8,. 5.3.3.3. and 5.3.3.5. The airworthiness substantiation shall include Housing Qualification Test Plans IAW DI-NDTI-80566 and Housing Qualification Test Reports IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.8. Vibration and Torsional Stability

The purpose of this analysis and testing is to ensure the drive system is free from damaging vibration and dynamic response. Vibrations produced by drive system shafting, couplings and other components can transfer those vibrations to the main gearbox, causing premature failure of bearings and gears.

Criteria:
The drive system shall be free from damaging vibration and dynamic responses to ensure safe flight.

Standard:
Appendix G, paragraph 4.1.2.6.
Appendix G, paragraph 4.1.2.8.
Appendix G, paragraph 5.2.1.5.2.2.
Appendix G, paragraph 5.2.1.5.3.3.
Appendix G, paragraph 5.3.3.7.3.
Appendix G, paragraph 5.4.3.
Appendix G, paragraph 5.1.5.

Method of Compliance:
The drive system, from a destructive vibration standpoint, shall be designed and development IAW Appendix G, paragraph 4.1.2.6., 4.1.2.8. and 5.1.5. and testing completed IAW Appendix G, 5.2.1.5.2.2., 5.2.1.5.3.3., 5.3.3.7.3. and 5.4.3. The airworthiness substantiation shall include a Critical Speed Analysis Report prepared IAW DI-MISC-80711, a Vibration/Torsional Stability Test Plans IAW DI-NDTI-80566, and Vibration/Torsional Stability Test Reports IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.9. Clutches

The purpose of the design requirement and testing is to ensure the system can safely engage/disengage the drive system. Clutch failures can be catastrophic, allowing a sudden increase of torque transmitted to the drive system causing overtorque damage and possible failure.

Criteria:
The drive system clutch shall properly operate to ensure safe flight.

Standard:
Appendix G, paragraph 4.2.7.
Appendix G, paragraph 5.3.2.5.

Method of Compliance:
The drive system shall contain clutches designed and developed IAW Appendix G, paragraph 4.2.7. and testing shall be completed IAW Appendix G, paragraph 5.3.2.5.

The airworthiness substantiation shall include a Clutch Test Plans IAW DI-NDTI-80566, and Clutch Test Reports IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.10. Rotor Brake and Gust Lock

Rotor brake failures can be catastrophic, sudden engagements have caused overheat damage to the rotor brake with the risk of component failure as well as fire damage.

Criteria:
The drive system rotor brake and gust lock shall properly operate.

Standard:
Appendix G, paragraph 4.2.8.
Appendix G, paragraph 5.3.2.6.

Method of Compliance:
The drive system rotor brake and gust lock shall be designed IAW Appendix G, paragraph 4.2.8. and testing shall be completed IAW Appendix G, paragraph 5.3.2.6. The airworthiness substantiation shall include a Rotor Brake and Gust Lock Test Plan IAW DI-NDTI-80566, and Rotor Brake and Gust Lock Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.11. Debris and Condition Monitoring System

The purpose of this requirement is to ensure the drive system debris and condition monitoring system monitors and records parameters for safe platform operation, proper pilot notification and operational readiness improvements.

Criteria:
The drive system debris and condition monitoring systems shall properly operate.

Standard:
Appendix G, paragraph 4.2.9.5.1.
Appendix G, paragraph 5.3.2.1.2.

Method of Compliance:
The drive system debris and condition monitoring systems shall be designed and developed IAW Appendix G, paragraph 4.2.9.5.1. and testing shall be completed IAW Appendix G, paragraph 5.3.2.1.2. The airworthiness substantiation shall include a Debris and Condition Monitoring System Test Plan IAW DI-NDTI-80566, and Debris and Condition Monitoring System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.12. Environmental

The purpose of this testing on components is to ensure they will survive real world environments and continue to meet their individual performance requirements.

Criteria:

The drive system shall properly function throughout the full range of environments.

Standard:

Appendix G, paragraph 4.1.2.9.
Appendix G, Appendix A

Method of Compliance:

The drive system shall meet the environmental requirements of Appendix G, paragraph 4.1.2.9. and qualification testing completed IAW Appendix G, Appendix A. (Appendix G contains Appendix A). The airworthiness substantiation shall include an Environmental Test Plan IAW DI-NDTI-80566, and an Environmental Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.13. Drive System Stress Analysis

The purpose of this analyses for all drive system components is to verifying positive margins of safety at all design powers as well as a fatigue analysis of all components that substantiates unlimited life or a recommended retirement time.

Criteria:

The drivetrain system shall operate during and after external forces are induced and not degrade performance.

Standard:

Appendix G, paragraph 4.1.
Appendix G, paragraph 4.2.
Appendix G, paragraph 5.1.4.1.

Method of Compliance:

The drivetrain system shall meet the structural design requirements of Appendix G, paragraph 4.1. and 4.2., and analysis requirements of paragraph 5.1.4.1. The airworthiness substantiation shall include a Drive System Static and Fatigue Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.14. Drive System Fatigue Substantiation

The purpose of this analysis is to establish the safe life for all drive system components whose critical design loads are driven by aircraft flight/maneuvers and Ground-Air-Ground (GAG) cycles.

Criteria:
The drivetrain system shall properly operate during and after external forces are applied.

Standard:
Appendix G, paragraph 4.1.
Appendix G, paragraph 4.2.
Appendix G, paragraph 5.1.4.2.

Method of Compliance:
The drivetrain system shall meet the structural design requirements of Appendix G, paragraph 4.1. and 4.2., and analysis requirements of paragraph 5.1.4.2. The airworthiness substantiation shall include a Drive System Flight Load Fatigue Analysis and Fatigue Substantiation Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.15. Accessory System

The purpose of this analysis to ensure the accessories meet their design requirements for dynamic response and performance elements of individual accessory components and their mounting system while evaluating the drive system's performance.

Criteria:
The drivetrain accessory system shall properly function throughout environmental and operating conditions.

Standard:
Appendix G, paragraph 4.1.
Appendix G, paragraph 4.2.
Appendix G, paragraph 4.2.5.
Appendix G, paragraph 5.

Method of Compliance:
The drivetrain accessory system shall meet the design requirements of Appendix G, paragraph 4.2.5. The airworthiness substantiation shall include an Accessory System Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.16. System Performance

The purpose of the system performance test is to demonstrate the ability of the aircraft to successfully obtain its performance parameters as affected by the drive system's performance.

Criteria:
The drivetrain system shall properly function throughout the environmental and operating conditions of the aircraft.

Standard:
Aircraft System Specification
Appendix G, paragraph 4.1.
Appendix G, paragraph 4.2.
Appendix G, paragraph 5.1.10.

Method of Compliance:
The drivetrain system shall meet the system performance requirements of the Aircraft System Specification, Appendix G, paragraph 4.1. and 4.2., and analysis requirements of paragraph 5.1.10. The airworthiness substantiation shall include a System Performance and Margin Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.17. Generator Assembly

The purpose of the generator testing is to ensure it will survive real world environments and continue to meet its individual performance requirements.

Criteria:
The drivetrain system mounted generator assembly shall properly operate throughout the full range of environments.

Standard:
Appendix G, paragraph 4.1.
Appendix G, paragraph 4.2.
Appendix G, paragraph 5.3.2.2.

Method of Compliance:
The drivetrain system mounted generator assembly shall meet the requirements of Appendix G, paragraph 4.1. and paragraph 4.2. as well as the testing IAW Appendix G, paragraph 5.3.2.2. The airworthiness substantiation shall include a Generator Analysis Report prepared IAW DI-MISC-80711, a Generator Test Plan IAW DI-NDTI-80566, and Generator Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.18. First Flight Test

The purpose of the first flight testing is to ensure sufficient testing has been completed prior to First Flight to demonstrate the drive system's integrity and airworthiness.

Criteria:
The drive system shall operate satisfactorily during all initial flight-testing.

Standard:
Appendix G, paragraph 5.4.1.

Method of Compliance:
The drive system shall complete all analyses and testing IAW Appendix G, paragraph 5.4.1. prior to first flight. The airworthiness substantiation shall include Analysis Reports prepared IAW DI-MISC-80711, Test Plans IAW DI-NDTI-80566, and Test Reports IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.19. Qualification Bench Testing

The purpose of the bench testing is to verify that the components can operate reliably throughout all required missions and is needed to preclude failures that may occur in service. Bench tests to verify the design life shall be conducted on each transmission and gearbox configuration.

Criteria:
The drive system shall properly function during all environmental conditions to ensure safe vehicle operation.

Standard:
Appendix G, paragraph 5.3.3.3.
Appendix G, paragraph 5.3.3.4.
Appendix G, paragraph 5.3.3.5.

Method of Compliance:
The drive system shall complete all bench testing IAW Appendix G, paragraph 5.3.3.3. - 5.3.3.6. The airworthiness substantiation shall include a Test Plans IAW DI-NDTI-80566, and Test Reports IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.20. Flight Test

The purpose of the instrumented flight testing is to obtain the necessary loads to complete the fatigue life analysis of the drive system throughout the entire operating envelope.

Criteria:
The drive system life limited components shall be identified.

Standard:
Appendix G, paragraph 5.4.2.

Method of Compliance:
The drive system shall complete all flight testing IAW Appendix G, paragraph 5.4.2. prior to fielding. The airworthiness substantiation shall include a Drive System Flight Test Plan prepared IAW DI-NDTI-80566 and a Drive System Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.21. Torsional Stability Test

The purpose of the test is to ensure adequate stability margin exists in the fielded system and to verify and update the rotor model as necessary.

Criteria:
The drive system shall have positive stability margin.

Standard:
Appendix G, paragraph 5.1.2.
Appendix G, paragraph 5.4.3.

Method of Compliance:
The drive system shall complete torsional stability analysis and testing IAW Appendix G, paragraph 5.1.2. and 5.4.3. prior to fielding. The airworthiness substantiation shall include a Torsional Stability Analysis Report prepared IAW DI-MISC-80711, a Torsional Stability Test Plan prepared IAW DI-NDTI-80566 and a Torsional Stability Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.22. Drive System Temperature Survey

The purpose of the temperature survey is to determine that transmission/gearbox installations, including heat exchangers, provide satisfactory cooling throughout the flight envelope.

Criteria:
The drive system shall have adequate cooling capabilities for operations during high temperatures.

Standard:
Appendix G, paragraph 5.1.7.
Appendix G, paragraph 5.4.4.

Method of Compliance:
The drive system shall complete a drive system temperature analysis IAW Appendix G, paragraph 5.1.7. and a temperature survey IAW Appendix G, paragraph 5.4.4. prior to fielding. The airworthiness substantiation shall include a Thermal Analysis Report prepared IAW DI-MISC-80711, a Drive System Temperature Survey Test Plan prepared IAW DI-NDTI-80566 and a Drive System Temperature Survey Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.23. Ground Testing
The purpose of the ground testing is to expose all propulsion components to actual powers/loads as part of the integrated aircraft system before they are encountered on the flight test aircraft.

Criteria:
The drive system shall operate safely.

Standard:
Appendix G, 5.3.3.7.
Appendix G, paragraph 5.4.4.1.

Method of Compliance:
The drive system shall complete a ground testing IAW Appendix G, paragraph 5.3.3.7. and 5.4.4.1. prior to fielding. The airworthiness substantiation shall include Ground Test Plans prepared IAW DI-NDTI-80566 and Ground Test Reports prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.24. Flight Test
Various flight conditions shall be conducted to obtain transmission and gearbox temperature stabilization.

Criteria:

The drive system shall properly operate within acceptable temperature limits.

Standard:
Appendix G, paragraph 5.4.4.2.

Method of Compliance:
The drive system shall complete a flight testing IAW Appendix G, paragraph 5.4.4.2. prior to fielding. The airworthiness substantiation shall include a Flight Test Plan prepared IAW DI-NDTI-80566 and a Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.2.8.7.25. Drive System Performance Flight Test

The purpose of the flight testing is to substantiate the drive system performance / margin including the entire aircraft operating envelope as well as determining torque levels and available margin at all conditions evaluated.

Criteria:
The drive system shall properly operate within performance margins.

Standard:
Appendix G, paragraph 5.4.5.

Method of Compliance:
The drive system shall complete performance flight testing IAW Appendix G, paragraph 5.4.5. prior to fielding. The airworthiness substantiation shall include a Drive System Performance Flight Test Plan prepared IAW DI-NDTI-80566 and a Drive System Performance Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3. Auxiliary Power Unit (APU)

Any APU shall meet requirements in accordance with Appendix S. APU control system components shall meet requirements in Appendix E. The APU and associated components will operate safely within the flight and maneuver envelope and operational environment.

7.3.1. APU Noise Survey

The purpose of this test is to evaluate the capability of the APU and platform to meet the strength and durability requirements in the presence of the APU noise environment generated during APU operation. APU acoustic signature noise represents a health

hazard to personnel, an annoyance to civilian communities, and an observable that can be used to detect combat and search and rescue aircraft.

Criteria:
The APU shall operate such that the total APU noise is minimized.

Standard:
Appendix S, paragraph 3.2.5.6.
Appendix S, paragraph 4.6.4.9.

Method of Compliance:
An APU noise survey shall be conducted to substantiate the requirements of Appendix S, paragraph 3.2.5.6. and testing IAW Appendix S, paragraph 4.6.4.9. The airworthiness substantiation shall include an APU Noise Survey Analysis Report prepared IAW DI-MISC-80711, an APU Noise Survey Test Plan IAW DI-NDTI-80566, and APU Noise Survey Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.2. APU Smoke
The purpose of the APU smoke test is to demonstrate the APU does not emit visible smoke. Visible or detectable exhaust smoke trails or smoke puffs are observables and can be used to detect combat aircraft.

Criteria:
The APU shall not emit visible APU smoke at any power settings.

Standard:
Appendix S, paragraph 3.2.5.7.
Appendix S, paragraph 3.2.5.7.1.
Appendix S, paragraph 3.2.5.7.2.
Appendix S, paragraph 4.6.4.10.1.
Appendix S, paragraph 4.6.4.10.2.

Method of Compliance:
An APU exhaust smoke and invisible exhaust mass emissions test shall be completed to substantiate the requirements of Appendix S: APU, paragraphs 3.2.5.7., 3.2.5.7.1., 3.2.5.7.2. and testing IAW Appendix S, paragraph 4.6.4.10.1. and 4.6.4.10.2. The airworthiness substantiation shall include an APU Smoke Test Plan IAW DI-NDTI-80566 and an APU Smoke Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.3. APU Exhaust

An APU Exhaust Test shall be completed prior to the start of QT. The purpose of the APU exhaust test is to demonstrate system susceptibility and human safety requirements. Exhaust wake temperature and velocity profiles at operating conditions are measured to identify areas hazardous to personnel and equipment and provide data to ensure APU exhaust signature levels meet susceptibility requirements.

Criteria:
The APU exhaust wake shall be defined to prevent hazards to personnel and equipment.

Standard:
Appendix S, paragraph 3.7.9.1.1.
Appendix S, paragraph 3.7.9.2.
Appendix S, paragraph 3.7.9.2.1.
Appendix S, paragraph 4.6.4.11.

Method of Compliance:
An APU exhaust test shall be conducted to verify the requirements of Appendix S, paragraphs 3.7.9.2. and 3.7.9.2.1. An APU Exhaust Test shall be demonstrated IAW Appendix S, paragraph 4.6.4.11. The airworthiness substantiation shall include an APU Exhaust Test Plan IAW DI-NDTI-80566 and an APU Exhaust Test Report IAW DI-NDTI-80809. The APU shall be inspected to verify requirements of Appendix S, paragraph 3.7.9.1.1. and 3.7.9.2., and that APU dimensions are in accordance with an APU Interface Control Drawing and Installation Drawing.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.4. APU Performance

APU performance under various conditions and loads (i.e., altitude, Mach number, sea level, varying temperatures, bleed air extraction, power extraction, attitudes, power settings, etc.) as well as environmental conditions (icing, sand and dust, etc.) needs to be specified and measured to assess air vehicle performance under these conditions.

7.3.4.1. Installed Performance

The data for assessment of installed propulsion system performance meets the applicable specification requirements. This includes consideration of all installation effects imposed by the air vehicle, and all intended operational environments.

7.3.4.1.1. Performance Model

The purpose of the APU performance model is to provide a means of assessing performance without actual testing of APU hardware. APU performance information is of critical importance in the evaluation of the aircraft mission capability.

Criteria:
The APU power and fuel consumption shall be characterized.

Standard:
Appendix S, paragraph 3.2.1.
Appendix S, paragraph 3.2.1.1.
Appendix S, paragraph 3.2.1.2.
Appendix S, paragraph 3.2.1.2.1.
Appendix S, paragraph 3.2.1.2.2.
Appendix S, paragraph 3.2.1.4

Method of Compliance:
A steady state performance program shall be developed based on APU and component testing and as well as performance analysis in accordance with Appendix S, paragraph 3.2.1.2. and paragraph 3.2.1.2.1. using performance characteristics in accordance with Appendix S, paragraph 3.2.1. and rating tables in accordance with Appendix S, paragraph 3.2.1.1. .2. The program shall be a thermodynamic cycle simulation in which component identity is maintained; e.g., the compressor, turbine, and combustor must each be identifiable as entities in the model logic as required to obtain and maintain an accurate simulation. An APU transient program shall be developed in accordance with Appendix S, paragraph 3.2.1.2.2. Computer Program and Rating Tables shall be updated after the QT Altitude Test if the Deck and APU do not lapse within ±2% of each other. The lapse rates shall include Ng, shaft horsepower and Specific Fuel Consumption (SFC) independently with both ambient temperature and pressure altitude for all the rating table conditions. The airworthiness substantiation shall include a steady state performance computer program and an APU transient program, both in accordance with Appendix S, paragraph 3.2.1.2. Additionally, airworthiness substantiation of the performance programs shall be IAW Appendix S, paragraph 3.2.1.4. prepared IAW DI-MISC-80711 and updated prior to initiation of the Qualification endurance test.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.4.1.2. APU Performance Model Altitude Tests
The purpose of the APU performance model is to provide a means of assessing performance without actual testing of APU hardware. APU performance information is of critical importance in the evaluation of the aircraft mission capability.

Criteria:
The APU shall start and operate at altitude.

Standard:
Appendix S, paragraph 4.5.3.

Method of Compliance:
An APU, conforming to the same parts list and configuration as the endurance test APU, shall be subjected to altitude tests which consist of operation and air starting checks at several selected conditions within the APU operating envelope IAW Appendix S, paragraph 4.5.3. The airworthiness substantiation shall include an APU Altitude Analysis

Report prepared IAW DI-MISC-80711, an APU Altitude Test Plan IAW DI-NDTI-80566, and APU Altitude Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.4.1.3. Air Inlet Distortion Test

The purpose of the thermal distortion test is to evaluate the sensitivity of the APU to pressure and temperature changes. Early definition of the inlet distortion limits has proven to be necessary for successful integration of the APU into the aircraft and should be provided by the APU manufacturer as part of the tradeoffs that must be made during the design and development process.

Criteria:
The APU shall start and operate during and after APU inlet pressure and temperature changes.

Standard:
Appendix S, paragraph 3.1.2.10.3.
Appendix S, paragraph 4.5.3.
Appendix S, paragraph 4.6.3.

Method of Compliance:
An APU inlet distortion analysis shall be conducted to establish pressure and temperature distortion sensitivity in Appendix S, paragraph 3.1.2.10.3. The airworthiness substantiation shall include an Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 23.1091 (amdt. 23-64, 23.2435 ASTM F3264-17) 14 CFR 25.939, 25.1091; 14 CFR 27.939, 27.1091 14 CFR 29.939, 29.1091		

7.3.4.1.4. Altitude Tests

The purpose of the altitude test is to demonstrate the operation and air starting capability of the APU at altitude. Thorough testing of the APU around the envelope extremes in an altitude test facility has been a cost effective method of reducing the possibility of encountering APU problems during envelope expansion flight testing and deployment of the weapon system.

Criteria:
The APU shall start and operate at altitude.

Standard:
Appendix S, paragraph 3.2.5.1.3.
Appendix S, paragraph 4.4.7.
Appendix S, paragraphs 4.5.3., 4.5.3.1., 4.5.3.2., 4.5.3.2.1., 4.5.3.3.
Appendix S, paragraphs 4.6.3., 4.6.3.1., 4.6.3.2., 4.6.3.3.

Method of Compliance:
The APU shall be designed to meet altitude changes in accordance with Appendix S, paragraph 3.2.5.1.3. An APU, conforming to the same parts list and configuration as the endurance test APU, shall be subjected to altitude tests which consist of operation and air starting checks at several selected conditions within the APU operating envelope IAW Appendix S, paragraphs 4.4.7., 4.5.3., and 4.6.3. The airworthiness substantiation shall include an Altitude Analysis Report prepared IAW DI-MISC-80711, an Altitude Test Plan IAW DI-NDTI-80566, and Altitude Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.4.1.5. Disk Burst Test
An APU Disk Burst Test shall be completed prior to the start of QT. The purpose of the disk burst test is to demonstrate the disk burst margin to prevent the occurrence of a catastrophic failure. APUs are not designed to contain disks, so it is essential that the disk burst margin is well understood.

Criteria:
The APU shall have disk burst margin.

Standard:
Appendix S, paragraph 3.3.8.8.4.
Appendix S, paragraph 4.6.6.3.3.

Method of Compliance:
The APU disk burst requirements are defined in Appendix S, paragraph 3.3.8.8.4. and testing shall be completed IAW Appendix S, paragraph 4.6.6.3.3. The airworthiness substantiation shall include a Disk Burst Analysis Report prepared IAW DI-MISC-80711 for PFR and QT, a Disk Burst Test Plan IAW DI-NDTI-80566, and Disk Burst Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.4.1.6. Low and High Temperature Starting and Acceleration Test.
The purpose of this test is to ensure APU start and acceleration capability at low and high temperatures. Worldwide, all-weather operation and APU acceleration requires the use of specified fuels and oils under extreme hot and cold ambient temperature conditions.

Criteria:
The APU shall start, accelerate and operate during and after exposure to low and high temperatures.

Standard:
Appendix S, paragraphs 3.2.5.1.2., 3.2.1.5.5., 3.2.1.6.5., 3.2.5.1., 3.2.5.1.1., 3.7.4.3.2., 3.7.7.3., 3.7.8.2.
Appendix S, paragraph 4.3.5.6.
Appendix S, paragraphs 4.6.4.1., 4.6.1.3.2.

Method of Compliance:
The APU shall be designed to withstand environmental conditions of Appendix S, paragraph 3.2.5.1.2. An APU shall demonstrate low, high temperature starting and accelerating capability via testing IAW Appendix S, paragraph 4.6.4.1. The airworthiness substantiation shall include a Low and High Temperature Starting and Acceleration Analysis Report prepared IAW DI-MISC-80711, a Low and High Temperature Starting and Acceleration Test Plan IAW DI-NDTI-80566, and Low and High Temperature Starting and Acceleration Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.4.1.7. Environmental Icing
The purpose of the environmental icing test is to verify APU performance when operating in icing conditions prior to initial flight testing.

Criteria:
The APU shall start and operate during and after icing conditions.

Standard:
Appendix S, paragraph 3.2.5.2.
Appendix S, paragraph 4.6.4.2.

Method of Compliance:
The APU shall be designed to meet the environmental icing requirements of Appendix S, paragraph 3.2.5.2. and testing conducted IAW Appendix S, paragraph 4.6.4.2. The airworthiness substantiation shall include an Environmental Icing Test Plan IAW DI-NDTI-80566 and an Environmental Icing Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.4.1.8. Pressure Wash

The purpose of this test is to verify the APU meets performance requirements after exposure and removal of environmental contaminants such as salt water, sand and dust particles during maintenance operations. The APU must remain serviceable after spraying of a washing medium of a prescribed composition onto the APU to remove contaminants.

Criteria:

The APU shall start and operate after pressure wash is performed.

Standard:

Appendix S, paragraph 3.7.10.
Appendix E, paragraph 5.5.
Appendix E, paragraph 5.5.6.
Appendix E, paragraph 5.10.
Appendix S, paragraph 4.6.2.4.

Method of Compliance:

The APU and its control system components shall be designed and tested IAW Appendix E, paragraph 5.5.6. and Appendix S, paragraph 4.6.2.4.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10. and 5.5.6.) shall include an APU Pressure Wash Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an APU Pressure Wash Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.4.1.9. Humidity

The purpose of the humidity test is to determine the resistance of materiel to the effects of a warm, humid atmosphere.

Criteria:

The materiel shall perform IAW the APU specification before, during, and after exposure to Aggravated Cycle Humidity environment.

Standard:

Appendix S, paragraph 4.6.2.
Appendix E, paragraph 5.4.11.

Method of Compliance:
The materiel shall perform IAW the APU specification before, during, and after exposure to humidity environmental effects that occur over the lifecycle of the materiel. Compliance may be test, similarity analysis, analysis, demonstration, or a combination of methods listed with approval from the Using Service. Testing shall be IAW Appendix S, paragraph 4.6.2. and Appendix E, paragraph 5.4.11. The airworthiness substantiation shall include Humidity Test Plans IAW DI-NDTI-80566 and Humidity Test Procedures IAW DI-NDTI-80603 prior to testing. Humidity Test Reports shall be prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.4.2. Degraded Performance
Installed APU thrust or power is characterized in backup control mode, at field removal limits (if defined), and meets applicable specification requirements after bird, ice, water and sand ingestion.

7.3.4.2.1. Corrosion
The purpose of the corrosion requirement is to evaluate the susceptibility of the materials in the APU to corrosive attack. The air and gas path areas of the APU can be particularly susceptible to corrosive attack.

Criteria:
The APU shall start and operate after corrosion occurs.

Standard:
Appendix S, paragraph 3.2.5.4.
Appendix S, paragraph 3.3.1.1.4.
Appendix S, paragraph 4.6.4.3.

Method of Compliance:
The APU shall be designed to meet the corrosion requirements of Appendix S, paragraph 3.2.5.4. and 3.3.1.1.4. and complete the corrosion susceptibility test IAW Appendix S, paragraph 4.6.4.3. The airworthiness substantiation shall include a Corrosion Susceptibility Analysis Report prepared IAW DI-MISC-80711, a Corrosion Susceptibility Test Plan IAW DI-NDTI-80566, and Corrosion Susceptibility Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.4.2.2. Foreign Object Damage
The purpose of the FOD test is to demonstrate the APU has adequate tolerance to FOD. APUs frequently experience damage to compressor blades and other airfoils when

foreign or domestic objects enter the flow path. Blades insufficiently designed for FOD considerations have caused In Flight Shut Downs (IFSDs) and costly damage to the APU.

Criteria:
The APU shall start and operate after FOD ingestion to ensure safe flight.

Standard:
Appendix S, paragraph 3.2.5.5.2.
Appendix S, paragraph 4.6.4.5.

Method of Compliance:
The APU shall be designed to meet the requirements of foreign object damage tolerance per Appendix S, paragraph 3.2.5.5.2. and testing shall be conducted IAW Appendix S, paragraph 4.6.4.5. The airworthiness substantiation shall include a Foreign Object Damage Analysis Report prepared IAW DI-MISC-80711, a Foreign Object Damage Test Plan IAW DI-NDTI-80566, and Foreign Object Damage Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.4.2.3. Sand Ingestion

The purpose of the test is to demonstrate starting and operating capability of the APU after sand and dust ingestion. The operation of aircraft in sand and dust environments can result in serious erosion damage to APU parts as well as substantial blockage of turbine passages, resulting in significant performance loss.

Criteria:
The APU shall start and operate after and during sand and dust ingestion to ensure safe aircraft operation.

Standard:
Appendix S, paragraph 3.2.5.5.4.
Appendix S, paragraph 4.6.4.7.

Method of Compliance:
The APU shall be designed to meet the sand and dust ingestion requirements of Appendix S, paragraph 3.2.5.5.4. and testing conducted IAW Appendix S, paragraph 4.6.4.7. The airworthiness substantiation shall include a Sand and Dust Ingestion Analysis Report prepared IAW DI-MISC-80711, a Sand and Dust Ingestion Test Plan IAW DI-NDTI-80566, and Sand and Dust Ingestion Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.4.2.4. Atmospheric Liquid Water Ingestion

The purpose of the test is to evaluate the effects of water ingestion on APU system performance. Large amounts of water in the APU inlet affect APU performance resulting in resulting in stall, rotor speed rollback or combustor blowout.

Criteria:
The APU shall start and operate during and after atmospheric water ingestion.

Standard:
Appendix S, paragraph 3.2.5.5.5.
Appendix S, paragraph 4.6.4.8.

Method of Compliance:
The APU shall be designed to meet the atmospheric liquid water ingestion requirements of Appendix S, paragraph 3.2.5.5.5. and testing conducted IAW Appendix S, paragraph 4.6.4.8. The airworthiness substantiation shall include an Atmospheric Liquid Water Ingestion Test Plan IAW DI-NDTI-80566 and an Atmospheric Liquid Water Ingestion Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.4.2.5. Bird Ingestion

The purpose of the complete APU bird ingestion test is to demonstrate the APU meets the bird strike requirement including all interactive effects. APUs must be capable of ingesting birds encountered during missions without significant power loss, deterioration, or safety implications.

Criteria:
The APU shall operate after bird ingestion.

Standard:
Appendix S, paragraph 3.2.5.5.1. Appendix S, paragraph 4.6.4.4.

Method of Compliance:
The APU shall be designed to meet the bird ingestion requirements of Appendix S, paragraph 3.2.5.5.1. and testing conducted of Appendix S, paragraph 4.6.4.4. The airworthiness substantiation shall include an APU Bird Ingestion Test Plan IAW DI-NDTI-80566 and an APU Bird Ingestion Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.4.2.6. Hail and Ice Ingestion

The purpose of the hail and ice ingestion test is to demonstrate the structural capability to tolerate ingestion of environmentally generated ice (hailstones), ice shed from the aircraft, and APU inlet generated ice.

Criteria:
The APU shall start and operate during and after hail and ice ingestion.

Standard:
Appendix S, paragraph 3.2.5.5.3.
Appendix S, paragraph 4.6.4.6.

Method of Compliance:
The APU shall be designed to meet the hail and ice ingestion requirements of Appendix S, paragraph 3.2.5.5.3. and testing conducted of Appendix S, paragraph 4.6.4.6. The airworthiness substantiation shall include an APU Hail and Ice Ingestion Test Plan IAW DI-NDTI-80566, and an APU Hail and Ice Ingestion Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.5. APU Operability

7.3.5.1. Operability

is the APU's ability to start, accelerate and decelerate within prescribed limits without compressor stall, surge or flameout. It must be verified that the APU has a defined aerodynamic stability margin throughout the operating envelope, even with degraded APU factors, such that there is no loss of power or APU operation. Stability Margin positive stability margin exists at all flight conditions or that placards are documented in the flight manual.

7.3.5.1.1. Stability and Performance

The purpose of the stability and performance assessment is to ensure mechanical integrity, part durability and stable APU operation within all temperature and rotor speed limits during power transients.

Criteria:
The APU shall have positive stability margin.

Standard:
Appendix S, paragraph 3.2.1.6.5.
Appendix S, paragraph 3.2.1.6.7.
Appendix S, paragraph 4.5.3.
Appendix S, paragraph 4.6.3.

Method of Compliance:
The APU shall meet the stability and performance requirements IAW Appendix S, paragraph 3.2.1.6.7. and demonstrate those requirements during the Altitude test per Appendix S, paragraph 4.5.3. and 4.6.3. The airworthiness substantiation shall include a Stability and Operability Audit Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.5.1.2. Starting Torque and Speed
The purpose of the test is to ensure that the APU starts with the specified minimum starting torque characteristics to prevent field starting problems.

Criteria:
The APU shall start with minimum starting torque.

Standard:
Appendix S, paragraph 3.2.5.1.1.
Appendix S, paragraph 3.7.8.
Appendix S, paragraph 3.7.8.1.1.
Appendix S, paragraph 4.4.5.

Method of Compliance:
The APU shall meet the starting requirements IAW Appendix S, paragraphs 3.7.8. and 3.7.8.1.1. The APU shall be subjected to a test to demonstrate the starting torque and speed requirements IAW Appendix S, paragraph 4.4.5. The airworthiness substantiation shall include an APU Starting Torque and Speed Test Plan IAW DI-NDTI-80566 and an APU Starting Torque and Speed Test Report IAW DI- MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.5.1.3. Moment of Inertia of Rotating Parts
The purpose of the moment of inertia of rotating parts requirement is to provide data for use in design and evaluation of APU subsystems and overall APU design.

Criteria:
The APU model specification shall specify the maximum effective moment of inertia (slug-feet-squared) of the APU starter about three mutually perpendicular axes with the origin at the center of gravity.

Standard:
Appendix S, paragraph 3.7.8.1.2.

Method of Compliance:
The moment of inertia requirements of Appendix S, paragraph 3.7.8.1.2. shall be verified by reviewing the APU Model Specification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.5.1.4. Starting
The purpose of the starting requirement is to ensure the APU consistently starts under the conditions, limitations, and operating procedures throughout the entire operating envelope.

Criteria:
The APU shall start at specified temperature, altitudes, attitudes, airspeeds, and time frames IAW the APU specification or as provided by the Using Service.

Standard:
Appendix S, paragraph 3.7.8.2.
Appendix S, paragraph 3.7.8.2.1.
Appendix S, paragraphs 4.5.3., 4.6.3., 4.5.4.3., 4.6.6.5.

Method of Compliance:
Testing shall be accomplished to show that the starting system can meet all starting requirements IAW Appendix S, paragraphs 3.7.8.2. and 3.7.8.2.1. The Starting requirement shall be verified during Altitude and Attitude Tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.5.1.5. Starting Procedure
The purpose of the starting procedure requirement is to ensure that the established procedure for APU starts is simple to minimize false starts and excess burden to the operator.

Criteria:
The established starting procedure shall be simple and shall not require critical timing, within specified APU starting limits, and without adversely affecting the APU durability or structural.

Standard:
Appendix S, paragraph 3.7.8.3.
Appendix S, paragraphs 4.5.3., 4.6.3., 4.5.4.3., 4.6.6.5.

Method of Compliance:
The starting procedure requirements shall be accomplished IAW Appendix S, paragraph 3.7.8.3. The Starting Procedure requirement shall be verified during Altitude and Attitude Tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.5.1.6. Stopping
The purpose of the stopping requirement is to ensure that established procedure for APU stopping is simple, timely and does not negatively affect the integrity of the APU.

Criteria:
Upon receiving a signal from the air vehicle for stopping, the powerplant shall shut down by a single, rapid method in any operating condition.

Standard:
Appendix S, paragraph 3.2.1.6.3.
Appendix S, paragraphs 4.5.1.1.4., 4.6.1.1.4.

Method of Compliance:
APU shutdown, IAW Appendix S, paragraph 3.2.1.6.3., shall be accomplished per established procedures. The Stopping requirement IAW Appendix S, paragraph 4.6.1.1.4. shall be verified in an APU Test approved by the Using Service. A test plan and a test report shall be submitted IAW DI-NDTI-80566 and IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.5.1.7. Windmilling
The purpose of the windmilling requirement is to ensure the APU is capable of continuous windmilling without damage to the APU.

Criteria:
The APU shall be capable of continuous windmilling operation without damage to the APU, without excessive loss of lubricating oil, and without affecting capability of air restart and operating.

Standard:
Appendix S, paragraph 3.2.1.6.8.
Appendix S, paragraph 4.6.1.1.5.

Method of Compliance:
The windmilling requirements IAW Appendix S, paragraph 3.2.1.6.8. shall be substantiated by testing IAW Appendix S, paragraph 4.6.1.1.5. The Windmilling

requirement shall be verified in an APU Test approved by the Using Service. A test plan and a test report shall be submitted IAW DI-NDTI-80566 and IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.5.1.8. Starting Drive Train

The purpose of the starting drive train requirement is to ensure that the starting drive train is capable of meeting the starting torque and speed requirements within the times specified in the APU specification throughout the aircraft operational envelope.

Criteria:

The starting drive train shall meet APU torque acceptance capability as specified in the ICD or APU specification. If starting through a gearbox, failure of the air vehicle starting drivetrain shall not result in loss of remaining gearbox functions.

Standard:

Appendix S, paragraph 3.7.8.4.
Appendix S, paragraph 3.7.8.1.3.
Appendix S, paragraph 3.7.8.1.4.

Method of Compliance:

The starting drive train requirements IAW Appendix S, paragraph 3.7.8.4. shall be verified by analysis and test. A Starting Drive Train Analysis IAW DI-MISC-80711 shall be submitted. A test plan and a test report shall be submitted IAW DI-NDTI-80566 and IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.5.1.9. Primary Fuel

The purpose of the test is to ensure that the APU has stable operation throughout the operating envelope and that all significant APU performance limitations are identified when using designated primary fuels.

Criteria:

The APU shall start and operate when using a primary fuel.

Standard:

Appendix S, paragraph 3.7.3.2.1.
Appendix S, paragraph 4.5.3.
Appendix S, paragraph 4.6.3.
Appendix S, paragraph 4.6.4.1.

Method of Compliance:
The APU shall be meet the primary fuel requirements IAW Appendix S, paragraph 3.7.3.2.1. and demonstrate primary fuel capability. The primary fuel requirement shall be verified by test IAW Appendix S, paragraph 4.5.3., 4.6.3. and 4.6.4.1. The airworthiness substantiation shall include an Altitude Test Plan and a Low and High Temperature Starting and Acceleration Test Plan IAW DI-NDTI-80566 and an Altitude Test Report and a Low and High Temperature Starting and Acceleration Test Report IAW DI-NDTI-80809 shall be submitted.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.5.1.10. Restricted Fuel
The purpose of the test is to ensure that the APU has stable operation throughout the operating envelope and that all significant performance limitations are identified when using designated restricted fuels.

Criteria:
The APU shall start and operate when using a restricted fuel.

Standard:
Appendix S, paragraph 3.7.3.2.2. Appendix S, paragraph 4.5.3.
Appendix S, paragraph 4.6.3.

Method of Compliance:
The APU shall be meet the restricted fuel requirements IAW Appendix S, paragraph 3.7.3.2.2. and demonstrate restricted fuel capability. The restricted fuel requirement shall be verified by test IAW Appendix S, paragraph 4.5.3. and 4.6.3. The airworthiness substantiation shall include an Altitude Test Plan IAW DI-NDTI-80566 and an Altitude Test Report IAW DI-NDTI-80809 shall be submitted.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.5.1.11. Emergency Fuel
The purpose of the test is to ensure that the APU has stable operation throughout the operating envelope and that all significant performance limitations are identified when using designated emergency fuels.

Criteria:
The APU shall start and operate when using an emergency fuel.

Standard:
Appendix S, paragraph 3.7.3.2.3.
Appendix S, paragraph 4.6.5.

Method of Compliance:
The APU shall be meet the emergency fuel requirements IAW Appendix S, paragraph 3.7.3.2.3. and demonstrate emergency fuel capability IAW Appendix S, paragraph 4.6.5. The airworthiness substantiation shall include an Emergency Fuel Analysis Report prepared IAW DI-MISC-80711, an Emergency Fuel Test Plan IAW DI-NDTI-80566, and Emergency Fuel Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.5.2. Transient Operation
The APU must have adequate stability during throttle transients.

7.3.5.2.1. Power Transients
The purpose of the power transient assessment is to provide validation that the APU control system will provide adequate control of output shaft speed during power transients. The APU control has anticipators to improve transient response, to decrease overshoots, and to lower speed and performance droop.

Criteria:
The APU shall exhibit stable operation satisfactorily during power transients.

Standard:
Appendix S, paragraph 3.2.1.6. through 3.2.1.6.7.

Method of Compliance:
The APU shall meet the operating conditions IAW Appendix S, paragraph 3.2.1.6. through 3.2.1.6.7. The airworthiness substantiation shall include an APU Operating Characteristics Analysis Report substantiated with altitude test data and updated prior to the endurance portion of the qualification test prepared IAW DI- MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		FAA TSO C77b		

7.3.6. Physical Characteristics

7.3.6.1. Dry Mass of Complete APU
The purpose of the dry mass of complete APU requirement is to ensure the APU mass does not exceed the specification value.

Criteria:
The dry mass of the complete APU shall not exceed that specified in the model specification. Each qualification and production APU should be weighed, using the same procedure, to ensure consistency.

Standard:
Appendix S, paragraph 3.2.2.1.
Appendix S, paragraph 4.5.1.1.1.
Appendix S, paragraph 4.6.1.1.1.

Method of Compliance:
The mass requirements of Appendix S, paragraph 3.2.2.1. shall be verified by demonstration IAW Appendix S, paragraphs 4.5.1.1.1. and 4.6.1.1.1. A test plan and test report shall be submitted IAW DI-NDTI-80566 and DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.6.2. Mass of Residual Fluids

The purpose of the mass of residual fluids requirement is to ensure the APU mass does not exceed the specification value.

Criteria:
The mass of residual fluids remaining in the APU, gearbox, and off mounted components after operation and drainage, while the APU is in a horizontal attitude of the crankshaft or eccentric shaft relative to the level plane, shall be specified herein. The mass of operating fluids shall be specified in the model specification.

Standard:
Appendix S, paragraph 3.2.2.2.
Appendix S, paragraph 4.5.1.1.1.
Appendix S, paragraph 4.6.1.1.1.

Method of Compliance:
The mass requirements of Appendix S, paragraph 3.2.2.2. shall be verified by demonstration IAW Appendix S, paragraphs 4.5.1.1.1. and 4.6.1.1.1. A test plan and test report shall be submitted IAW DI-NDTI-80566 and DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.6.3. Bearings

The purpose of the bearings requirement is to ensure the bearing rings are positively prevented from rotation.

Criteria:
The bearing rings shall be positively prevented from rotation relative to the ring housing or shaft.

Standard:
Appendix S, paragraph 3.3.10.

Method of Compliance:
The bearings requirements of Appendix S, paragraph 3.3.10. shall be verified by inspection of physical hardware and review of the APU engineering and installation drawings.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7. APU Structures

7.3.7.1. Structure
Verify that the APU structure does not exhibit detrimental permanent set or deflect to the extent that operation or performance is impaired when operated to limit load conditions (singly or in combination) within the flight and ground envelope. Verify that the APU structure does not experience catastrophic failure under ultimate load conditions or combinations of ultimate loading.

7.3.7.1.1. External Forces and Mounts
The purpose of this analysis is to ensure APU components are designed to withstand the relatively infrequent, non-repetitive shocks, or transient vibrations induced by the external forces during flight maneuvers.

Criteria:
The APU shall operate after external forces are induced and not degrade performance to ensure safe aircraft operation

Standard:
Appendix S, paragraph 3.1.2.5.
Appendix S, paragraph 3.1.2.5.1.
Appendix S, paragraph 3.1.2.6. through Appendix S, paragraph 3.1.2.6.3.
Appendix S, Figure 1
Appendix S, paragraph 4.5.4.2.
Appendix S, paragraph 4.6.6.4.

Method of Compliance:
An analysis shall be performed that provides evidence that the APU shall function under the conditions specified in Appendix S, paragraph 3.1.2.5., 3.1.2.6. and Figure 1 (combined linear and angular effects) and that the APU shall withstand those conditions without permanent deformation and shall exhibit stable operation within normal operating

limits thereafter. Testing shall be conducted IAW Appendix S, paragraph 4.5.4.2. and 4.6.6.4. The airworthiness substantiation shall include an External Forces and Mounts Analysis Report prepared IAW DI-MISC-80711, an APU Static Load Test Plan IAW DI-NDTI-80566, and an APU Static Load Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.1.2. Gyroscopic Moment

An APU Gyroscopic Analysis shall be completed prior to the start of PFR. The purpose of this analysis is to demonstrate the APU's capability to withstand gyroscopic moments.

Criteria:

The APU shall operate after gyroscopic forces are applied.

Standard:

Appendix S, paragraph 3.1.2.5.1.
Appendix S, paragraph 4.6.6.8.

Method of Compliance:

An analysis shall be performed that provides sufficient evidence that the APU shall operate under the conditions specified in Appendix S, paragraphs 3.1.2.5.1. and 4.6.6.8. The airworthiness substantiation shall include an Analysis Report IAW DI-MISC-80711. APU gyroscopic moment loads may be introduced during the Engine Static Load Test, upon discussions with the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.1.3. Static, Attitude and Impact Load Test

The purpose of this test is to demonstrate adequate structural capability prior to initial flight testing. The forces induced by acceleration can cause permanent deformations and fractures that disable or destroy equipment, fasteners and mounting hardware.

Criteria:

The APU shall operate after static, attitude and impact loads are induced.

Standard:

Appendix S, paragraph 4.5.4.3.
Appendix S, paragraph 4.6.6.5.

Method of Compliance:

The APU of the endurance test configuration shall be subjected to an attitude IAW Appendix S, paragraphs 4.5.4.3. and 4.6.6.5. The airworthiness substantiation shall include an Attitude and Impact Load Test Analysis Report prepared IAW

DI-MIS-C-80711, an Attitude and Impact Load Test Plan IAW DI-NDTI-80566, and Attitude and Impact Load Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.1.4. APU Crash Load Test
The purpose of this test is to demonstrate structural capability prior to PFR. The forces from crash loads can cause catastrophic damage.

Criteria:
The APU shall not fail catastrophically after experiencing crash loads.

Standard:
Appendix S, paragraph 4.5.4.5.

Method of Compliance:
The APU Crash Load Test shall be completed prior to PFR IAW Appendix S, paragraph 4.5.4.5. The airworthiness substantiation shall include an APU Crash Load Test Plan IAW DI-NDTI-80566 and an APU Crash Load Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.1.5. Inlet and Exhaust Connections
The purpose of this test is to ensure that the maximum allowable loads specified for the static (1g) axial, shear and overhung moment do not adversely affect the operation or durability of the APU. The interfaces between the aircraft and the APU must be established and controlled to ensure compatibility.

Criteria:
The APU inlet, exhaust, fuels, drains and vents connection loads shall not degrade performance.

Standard:
Appendix S, paragraph 3.1.2.10.2.
Appendix S, paragraph 3.7.9.1.2.
Appendix S, paragraph 4.6.1.3.

Method of Compliance:
The APU's inlet, exhaust, fuel, drains and vents connections shall meet the conditions of Appendix S, paragraphs 3.7.3.1.3.2., 3.1.2.10.2., 3.1.2.13., 3.1.2.13.1., 3.1.2.13.2. and 3.7.9.1.2. The airworthiness substantiation (IAW Appendix S, paragraphs 4.5.1.3.1., 4.6.1.3., 4.6.1.3.1., 4.6.1.3.2., 4.6.1.5., and 4.6.1.6.) shall include an Inlet, Exhaust, Fuels, Drains and Vents Connections Analysis Report prepared IAW DI-MISC-80711, a

Test Plan IAW DI-NDTI-80566, and a Test Report IAW DI-NDTI-80809. The connections requirement shall also be verified by reviewing the APU configuration and envelope figure and model specification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.1.6. Bleed Air Connections

The purpose of this test is to demonstrate that loads from the bleed air connections do not affect the operation and durability of the APU. Bleed air may be required for various purposes including environmental control and anti-icing.

Criteria:

The APU bleed air connection loads shall not degrade performance.

Standard:

Appendix S, paragraph 3.1.2.11.
Appendix S, paragraph 3.1.2.11.1.
Appendix S, paragraph 3.1.2.11.2.
Appendix S, paragraphs 4.4.3., 4.5.1.3., 4.6.1.3., 4.6.1.5., and 4.6.1.6.

Method of Compliance:

The APU's bleed air connections shall meet the conditions of Appendix S, paragraphs 3.1.2.11., 3.1.2.11.1., and 3.1.2.11.2. The airworthiness substantiation (IAW Appendix S, paragraphs 4.4.3., 4.5.1.3., 4.6.1.3., 4.6.1.5., and 4.6.1.6.) shall include an Analysis Report IAW DI-MISC-80711, a Bleed Air Connection Test Plan IAW DI-NDTI-80566, and a Bleed Air Connection Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.1.7. APU Structure

The purpose of this design service life assessment is to ensure the desired levels of damage tolerance, durability, functional capability, operability, performance, reliability, and strength are attained.

Criteria:

The APU structure shall not experience nor exhibit failure.

Standard:

Appendix S, paragraph 3.3.8. Appendix S, paragraph 3.3.8.4.
Appendix S, paragraph 3.3.8.4.1.
Appendix S, paragraph 3.3.8.5.
Appendix S, paragraph 3.3.8.6.

Method of Compliance:
The APU shall meet or exceed the structural requirements in Appendix S, paragraph 3.3.8. Factors of safety applied to the design usage induced loads are IAW Appendix S, paragraph 3.3.8.4.1. Strength and life analysis is performed IAW Appendix S, paragraph 3.3.8.6. using material properties based on Appendix S, paragraph 3.3.8.5. Life predictions shall be determined for each potential failure mode to which the particular part is exposed, such as creep/stress rupture, corrosion, erosion, High Cycle Fatigue (HCF) and Low Cycle Fatigue (LCF). The airworthiness substantiation shall include a Strength and Life Analysis Report prepared IAW DI-MISC-80711 prior to the initiation of the PFR and updated prior to the Qualification test.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.1.8. Strength and Life Analysis
The APU shall meet or exceed the APU structural requirements. Factors of Safety applied to the design usage induced loads shall be included. Strength and life analysis shall be performed using specified material properties. Life predictions shall be determined for each potential failure mode to which the particular part is exposed, such as creep/stress rupture, corrosion, erosion, HCF, and LCF.

Criteria:
The analysis shall address the strength and life requirements.

Standard:
Appendix S, paragraph 3.3.8.1. through Appendix S, paragraph 3.3.8.10.1.
Appendix S, Addendum E

Method of Compliance:
The Strength and Life Analysis shall be completed prior to PFR IAW Appendix S, paragraph 3.3.8.1. through Appendix S, paragraph 3.3.8.10.1. and Appendix S, Addendum E. The airworthiness substantiation shall be the Strength and Life Report IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.1.9. Blade and Disk Contact
The purpose of the blade and disk contact requirement is to ensure that any contact with static parts during all phases of APU operation (to include surge and stall occurrences) shall not negatively impact APU capability.

Criteria:
The APU shall have positive stability margin.

Standard:
Appendix S, paragraph 3.3.8.4.2.
Appendix S, paragraph 3.3.8.4.

Method of Compliance: Appendix S, paragraph 3.3.8.6.
Blade and disk contact with any static parts of the APU during all phases of APU operation including surge and stall occurrences shall not adversely impact component capability per Appendix S, paragraph 3.3.8.4.2. The airworthiness substantiation shall include an APU Blade and Disk Contact Analysis IAW Appendix S, paragraph 3.3.8.6. and IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.1.10. Parts Classification

The purpose of the part classification requirement is to classify all powerplant parts for criticality to identify Critical Safety Items (CSIs) with associated critical characteristics, and Critical Application Items (CAIs).

Criteria:
The FMECA and a CSI/CAI summary shall be submitted to the Using Service for approval.

Standard:
MIL-STD-882
AMCOM Regulation 702-7
Appendix S, paragraph 3.3.8.1.1.
Appendix S, Table XVI

Method of Compliance:
All powerplant parts shall be classified for criticality per MIL-STD-882 and a Failure Modes and Effects and Criticality Analysis (FMECA) performed to identify Critical Safety Items (CSIs) and Critical Application Items (CAIs). The critical characteristics for all identified critical safety items shall be defined IAW AMCOM Regulation 702-7. The list of identified CSIs with their critical characteristics, and CAIs shall be submitted to the Using Service for approval. The FMECA and CSI/CAI shall be submitted IAW DI-SESS-81495 and DI-SAFT-81932.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.1.11. Vibration and Stress

The purpose of this test is to ensure the APU is free of detrimental resonances prior to initial flight testing. Lightweight, flexible structures which operate at elevated temperatures and high rotor speeds combine to make it impossible to design

aerodynamic surfaces (blades and vanes) with resonant frequencies beyond the operating range.

Criteria:
The APU shall be free of damaging vibration and dynamic response.

Standard:
Appendix S, paragraph 3.3.8.9.
Appendix S, paragraph 3.3.8.9.2.
Appendix S, paragraph 4.6.6.7.
Appendix S, paragraph 4.6.6.7.6.
Appendix S, paragraph 4.6.6.7.7.

Method of Compliance:
The APU shall be free of destructive vibration at all rotor speeds and load conditions IAW Appendix S, paragraph 3.3.8.9. and tested IAW Appendix S, paragraph 4.6.6.7., 4.6.6.7.6. and 4.6.6.7.7. Critical speeds shall be determined. Critical speeds shall meet or exceed the speed margins specified in Appendix S, paragraph 3.3.8.9.1. The airworthiness substantiation s hall include a Vibration and Stress Analysis Report prepared IAW DI-MISC-80711, a Vibration and Stress Test Plan IAW DI-NDTI-80566, and Vibration and Stress Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.1.12. Gear Resonance Test
An APU Gear Resonance Test shall be completed prior to the start of QT. The purpose of the test is to demonstrate the freedom from damaging resonance.

Criteria:
The APU shall be free from damaging resonance following the test.

Standard:
Appendix S, paragraph 3.3.8.9.
Appendix S, paragraph 4.6.6.12.

Method of Compliance:
The APU shall be free of destructive resonance damage during the test. The APU shall complete a Gear Resonance Test IAW Appendix S, paragraph 3.3.8.9. and tested IAW Appendix S, paragraph 4.6.6.12. The airworthiness substantiation shall include a Gear Resonance Analysis IAW DI-MISC-80711, Gear Resonance Test Plan IAW DI-NDTI-80566 and a Gear Resonance Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.1.13. Containment (Initial Flight Testing)

The purpose of this analysis is to determine that the APU has containment capability prior to initial flight testing. For safety of personnel and equipment, it is imperative to contain all blade failures.

Criteria:
The APU shall have containment capability.

Standard:
Appendix S, paragraph 3.3.8.8.1.

Method of Compliance:
An analysis shall be performed that provides sufficient evidence that the APU shall function under the conditions specified in Appendix S, paragraph 3.3.8.8.1. The analysis shall contain the methodology and relevant data points used in the determination. The airworthiness substantiation shall include a Containment Analysis as part of the Strength and Life Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.1.14. Containment Capability (Prior to Deployment)

The purpose of these tests and analyses is to demonstrate that the APU has adequate containment capability prior to deployment of the weapon system. For safety of personnel and equipment, it is imperative to contain all blade failures.

Criteria:
The APU shall have containment capability prior to weapon system deployment.

Standard:
Appendix S, paragraph 3.3.8.8.1.
Appendix S, paragraph 4.6.6.2.

Method of Compliance:
An APU or spin pit testing of rotor assemblies shall be conducted to demonstrate containment capability IAW Appendix S, paragraph 3.3.8.8.1. and 4.6.6.2. The airworthiness substantiation shall include an updated Containment Capability Analysis as part of the Strength and Life Report prepared IAW DI-MISC-80711, a Containment Capability Test Plan IAW DI-NDTI-80566, and a Containment Capability Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.1.15. Rotor Integrity
The purpose of the rotor integrity requirements are to evaluate the operational margin for rotor structural integrity while allowing continued use. The field often experiences overtemperature and overspeed events that may be pilot induced or a result of a material failure.

Criteria:
The APU rotors shall retain their structural integrity during overspeed (Section A of Appendix S, paragraph 3.3.8.8.2.) and overtemperature (Section B of Appendix S, paragraph 3.3.8.8.2.).

Standard:
Appendix S, paragraph 3.3.8.8.2.
Appendix S, paragraph 3.2.1.5.5.
Appendix S, paragraph 3.2.1.5.6.
Appendix S, paragraph 3.7.2.3.2.
Appendix S, paragraph 4.5.4.1.
Appendix S, paragraph 4.6.6.3.

Method of Compliance:
An analysis and subsequent APU testing shall be performed to demonstrate the APU rotors meets the integrity requirements of Appendix S, paragraph 3.3.8.8.2. The airworthiness substantiation (IAW Appendix S, paragraphs 4.5.4.1. and 4.6.6.3.) shall include a Rotor Integrity Analysis Report prepared IAW DI-MISC-80711, a Rotor Integrity Test Plan IAW DI-NDTI-80566, and Rotor Integrity Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.1.16. APU Overspeed Test (PFR)
The purpose of the overspeed test is to evaluate the overspeed capability of the APU prior to PFR to ensure margin, as approved by the Using Service, exists for the entire flight testing program.

Criteria:
The APU shall have adequate overspeed capability to ensure safe flight.

Standard:
Appendix S, paragraph 4.5.1.
Appendix S, paragraph 4.5.1.1.3.
Appendix S, paragraphs 4.5.1.5. and 4.5.1.6.

Method of Compliance:
An APU overspeed test shall be completed IAW Appendix S, paragraph 4.5.1.1.3. and 4.6.1.1.3. The airworthiness substantiation shall include an Overspeed Analysis Report

prepared IAW DI-MISC-80711, an Overspeed Test Plan IAW DI-NDTI-80566, and Overspeed Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.1.17. APU Overspeed Test (QT)
The purpose of the overspeed test is to evaluate the overspeed capability of the APU prior to QT to ensure margin, as approved by the Using Service, exists .

Criteria:
The APU shall have overspeed capability to ensure safe flight.

Standard:
Appendix S, paragraph 4.6.1.
Appendix S, paragraph 4.6.1.1.3.
Appendix S, paragraph 4.6.1.5. and 4.6.1.6.

Method of Compliance:
An APU overspeed test shall be completed IAW Appendix S, paragraph 4.6.1.1.3. The airworthiness substantiation shall include an Overspeed Analysis Report prepared IAW DI-MISC-80711, an Overspeed Test Plan IAW DI-NDTI-80566, and Overspeed Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.1.18. Overspeed Rotor Test (PFR)
An Overspeed Rotor Test shall be performed prior to PFR. The purpose of the overspeed rotor test is to ensure structural margin, as approved by the Using Service, exists between published speed limits and rotor speed capability. Past experience indicates that the APU can overspeed due to control system malfunctions or sudden loss of load.

Criteria:
The APU shall be capable of withstanding an overspeed event.

Standard:
Appendix S, paragraph 4.5.4.1.1.

Method of Compliance:
An APU overspeed test shall be completed for PR and Qualification IAW Appendix S, paragraph 4.5.4.1.1. The airworthiness substantiation shall include an Overspeed Analysis Report prepared IAW DI-MISC-80711, an Overspeed Rotor Test Plan IAW DI-NDTI-80566, and Overspeed Rotor Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.1.19. Overspeed Rotor Test (QT)
An Overspeed Rotor Test shall be performed prior to QT. The purpose of the overspeed rotor test is to ensure structural margin, as approved by the Using Service, exists between published speed limits and rotor speed capability. Past experience indicates that the APU can overspeed due to control system malfunctions or sudden loss of load.

Criteria:
The APU shall be capable of withstanding an overspeed event.

Standard:
Appendix S, paragraph 4.6.6.3.1.

Method of Compliance:
An APU overspeed test shall be completed prior to PFR IAW Appendix S, paragraph 4.6.6.3.1. The airworthiness substantiation shall include an Overspeed Analysis Report prepared IAW DI-MISC-80711, an Overspeed Rotor Test Plan IAW DI-NDTI-80566, and Overspeed Rotor Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.1.20. Overtemperature
An Overtemperature Test shall be performed prior to PFR. The purpose of the overtemperature analysis and test is to evaluate the overtemperature capability of the APU prior to initial flight testing. Overtemperature events are likely during developmental flight testing.

Criteria:
The APU shall have an overtemperature capability.

Standard:
Appendix S, paragraph 4.5.4.1.1.
Appendix S, paragraph 4.5.4.1.2.

Method of Compliance:
An APU overtemperature test shall be completed prior to PFR IAW Appendix S, paragraph 4.5.4.1.2. and 4.6.6.3.2. The airworthiness substantiation shall include an Overtemperature Analysis Report prepared IAW DI-MISC-80711, an Overtemperature Test Plan IAW DI-NDTI-80566, and Overtemperature Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.1.21. Overtemperature Test (QT)
An Overtemperature Test shall be performed prior to QT. The purpose of the overtemperature analysis and test is to evaluate the overtemperature capability of the APU prior to initial flight testing. Overtemperature events are likely during developmental flight testing.

Criteria:
The APU shall have an overtemperature capability.

Standard:
Appendix S, paragraph 4.6.6.3.1.
Appendix S, paragraph 4.6.6.3.2.

Method of Compliance:
An APU overtemperature test shall be completed prior to QT IAW Appendix S, paragraph 4.6.6.3.2. The airworthiness substantiation shall include an Overtemperature Analysis Report prepared IAW DI-MISC-80711, an Overtemperature Test Plan IAW DI-NDTI-80566, and Overtemperature Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.1.22. Blade Failure
The purpose of the analysis and tests is to demonstrate that the APU possesses structural integrity after blade loss so that a catastrophic failure will not occur following the loss of 4/3 blades or the load resulting from the loss of one full blade and the resulting secondary damage.

Criteria:
The APU shall not experience a catastrophic failure following a blade loss.

Standard:
Appendix S, paragraph 3.3.8.8.3.
Appendix S, paragraph 4.6.6.2.

Method of Compliance:
An analysis shall be performed to demonstrate the APU blade out capability meets the requirements of Appendix S, paragraph 3.3.8.8.3. The airworthiness substantiation shall include a Blade Failure Analysis Report prepared IAWDI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.1.23. APU Low Cycle Fatigue (LCF) Life Analysis .
Prior to the start of Preliminary Flight Rating, a Low Cycle Fatigue Life Analysis shall be created based on the requirements specified herein.

Criteria:
The APU shall not experience a low cycle fatigue failure.

Standard:
Appendix S, paragraph 3.3.8.3.

Method of Compliance:
An APU LCF Life Analysis shall be completed prior to PFR IAW Appendix S, paragraph 3.3.8.3. The airworthiness substantiation shall be included in the Strength and Life Report IAW DI-NDTI-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.1.24. APU 1875 Low Cycle Fatigue Test (PFR)
The purpose of the LCF test is to demonstrate that rotating parts that are subjected to mechanical and thermal stresses during APU operation have sufficient LCF capability prior to PFR. Low cycle fatigue is the damage generated in a material by cyclic load reversals, which cause repeated plastic deformation.

Criteria:
The APU shall not experience a low cycle fatigue failure.

Standard:
Appendix S, paragraph 3.3.8.3.
Appendix S, paragraph 4.5.4.7.

Method of Compliance:
Prior to PFR, perform an APU LCF Test showing compliance with Appendix S, paragraph 3.3.8.3. and shall be conducted IAW Appendix S, paragraph 4.5.4.7. The airworthiness substantiation shall include an APU LCF Analysis IAW DI-MISC-80711, an APU LCF Test Plan IAW DI-NDTI-80566, and an APU LCF Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.1.25. APU 3750 Low Cycle Fatigue Test (QT)

The purpose of the LCF test is to demonstrate that rotating parts that are subjected to mechanical and thermal stresses during APU operation have sufficient LCF capability prior to QT. Low cycle fatigue is the damage generated in a material by cyclic load reversals, which cause repeated plastic deformation.

Criteria:
The APU shall not experience a low cycle fatigue failure.

Standard:
Appendix S, paragraph 3.3.8.3. Appendix S, paragraph 4.6.6.1.2.

Method of Compliance:
APU low cycle fatigue tests showing compliance with Appendix S, paragraph 3.3.8.3. shall be conducted IAW Appendix S, paragraph 4.6.6.1.2. The airworthiness substantiation shall include a Low Cycle Fatigue Analysis Report prepared IAW DI-MISC-80711, an APU Low Cycle Fatigue Tests Plan IAW DI-NDTI-80566, and an APU Low Cycle Fatigue Tests Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.1.26. APU Low Cycle Fatigue Test (LCF) Component Test

The purpose of the LCF test is to demonstrate that rotating parts that are subjected to mechanical and thermal stresses during APU operation have sufficient LCF capability prior to initial flight testing. Low cycle fatigue is the damage generated in a material by cyclic load reversals, which cause repeated plastic deformation.

Criteria:
The APU shall not experience a low cycle fatigue failure.

Standard:
Appendix S, paragraph 3.3.8.3.
Appendix S, paragraph 4.6.6.1.1.

Method of Compliance:
APU low cycle fatigue tests showing compliance with Appendix S, paragraph 3.3.8.3. shall be conducted IAW Appendix S, paragraph 4.6.6.1.1. The airworthiness substantiation shall include a Low Cycle Fatigue Analysis Report prepared IAW DI-MISC-80711, an APU Low Cycle Fatigue Test Plan IAW DI-NDTI-80566, and an APU Low Cycle Fatigue Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.1.27. APU High Cycle Fatigue Test (HCF) Tests

The purpose of the HCF test is to demonstrate that rotating parts that are subjected to mechanical and thermal stresses during APU operation have sufficient HCF capability prior to initial flight testing. HCF life requirement is to ensure that combination of mean and alternating stresses will not preclude an APU component from reaching its design service life limit.

Criteria:
The APU shall not experience a high cycle fatigue failure.

Standard:
Appendix S, paragraph 3.3.8.2.
Appendix S, paragraph 3.2.5.5.2.
Appendix S, paragraph 3.3.8.9.2.
Appendix S, paragraph 4.6.6.7.

Method of Compliance:
APU high cycle fatigue tests showing compliance with Appendix S, paragraph 3.3.8.2. shall be conducted IAW Appendix S, paragraph 4.6.6.7. The airworthiness substantiation shall include a High Cycle Fatigue Analysis Report prepared IAW DI-MISC- 80711, an APU High Cycle Fatigue Test Plan IAW DI-NDTI-80566, and an APU High Cycle Fatigue Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.1.28. Creep

The purpose of the creep requirement is to demonstrate that APU components and accessories do not exhibit creep throughout the operational envelope and design service life which would result in material contact or imminent failure.

Criteria:
APU components and accessories shall not creep so that operation is impaired throughout the design service life. Part creep shall not affect disassembly and reassembly of the APU or new part replacement at overhaul throughout its design life.

Standard:
Appendix S, paragraph 3.3.8.7.
Appendix S, paragraph 3.3.8.1.
Appendix S, paragraph 3.3.8.5.
Appendix S, paragraph 3.3.8.6.
Appendix S, paragraph 3.3.8.6.1.

Method of Compliance:
A creep analysis showing compliance with Appendix S, paragraph 3.3.8.7. shall be conducted IAW Appendix S, paragraphs 3.3.8.1., 3.3.8.5., 3.3.8.6., and 3.3.8.6.1. The airworthiness substantiation shall include a Creep Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.1.29. APU Mass Moment of Inertia

The purpose of the mass moment of inertia of APU requirement is to provide data for use in design and evaluation of aircraft subsystems, and overall aircraft design.

Criteria:
The APU Model Specification shall specify the maximum effective mass moment of inertia (slug-feet squared) of the complete dry engine core about three mutually perpendicular axes with the origin at the center of gravity.

Standard:
Appendix S, paragraph 3.1.2.4.

Method of Compliance:
The mass moment of inertia requirements of Appendix S, paragraph 3.1.2.4. shall be verified by analysis and demonstration. An analysis report shall be submitted IAW DI-MISC-80711. A demonstration shall be verified and approved by the Using Service. The APU specification shall also be reviewed to ensure the Mass MOI is present.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.1.30. Power Absorber Characteristics

The purpose of the power absorber characteristics requirement is to characterize the components' ability to absorb and dampen impact energy or shocks at powerplant interfaces.

Criteria:
The allowable range of characteristics of a shaft power absorber at the power absorber to powerplant interface shall be IAW the ICD.

Standard:
Appendix S, paragraph 3.1.2.14.
Appendix S, paragraph 3.1.2.14.1.
Appendix S, paragraph 3.1.2.14.4.
Appendix S, paragraph 4.6.6.10.
Appendix S, paragraph 4.5.1.
Appendix S, paragraphs 4.5.1.5. and 4.5.1.6.

Appendix S, paragraph 4.5.3.
Appendix S, paragraph 4.5.4.7.
Appendix S, paragraph 4.6.1.
Appendix S, paragraphs 4.6.1.5. and 4.6.1.6.
Appendix S, paragraph 4.6.3.
Appendix S, paragraph 4.6.6.1.

Method of Compliance:
The power absorber characteristics requirements of Appendix S, paragraphs 3.1.2.14., 3.1.2.14.1., 3.1.2.14.4., 4.6.6.10., 4.5.1., 4.5.3., 4.5.4.7., 4.6.1., 4.6.3., and 4.6.6.1. shall be included in test plan(s) when a power absorber is utilized. The Using Service may request substantiating analysis for the power absorber characteristics.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.1.31. Calibrations and Recalibrations
The purpose of the calibration and recalibration requirements are to establish baseline characteristics before and after APU operation.

Criteria:
The APU shall have calibration and recalibration capabilities to meet the requirements of Appendix S, paragraphs 4.6.1.2. through 4.6.1.2.3. and Appendix S, paragraphs 4.6.1.4. through 4.6.1.4.3.

Standard:
Appendix S, paragraphs 4.6.1.2. through 4.6.1.2.3.
Appendix S, paragraphs 4.6.1.4. through 4.6.1.4.3.
Appendix E, paragraph 5.1.2.

Method of Compliance:
The APU calibration and recalibration requirements of Appendix S, paragraphs 4.6.1.2. through 4.6.1.2.3., Appendix S, paragraphs 4.6.1.4. through 4.6.1.4.3., and Appendix E, paragraph 5.1.2. shall be verified by testing. A test plan and test report shall be submitted IAW DI-NDTI-80566 and DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.2. Durability
It must be shown that the APU has positive durability margins over the defined operational interval and duty cycle to preclude adverse safety, economic, or operational effects.

7.3.7.2.1. Damage Tolerance PFR

The purpose of the damage tolerance assessment is to ensure a level of durability prior to initial flight testing with defects resulting from material, manufacturing, and service-induced anomalies IAW Appendix S, 3.3.8.10. Complete failure of test APUs has occurred in past development programs due to undetected damage growth.

Criteria:
The APU shall be durable.

Standard:
Appendix S, paragraph 3.3.8.10.
Appendix S, paragraph 3.3.8.10.1.

Method of Compliance:
Fracture safety and mission critical APU parts shall be damage tolerant in accordance with Appendix S, paragraph 3.3.8.10. The damage tolerance requirement shall be verified by analysis. An analysis report shall be provided IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.2.2. Structural Life PFR (Analysis)

The purpose of the structural life analysis is to ensure the design usage is not less severe than the specified duty cycle.

Criteria:
The APU and all components thereof shall be designed for a minimum life of 6000 hours. Bearing B1 life shall be a minimum of 6000 hours.

Standard:
Appendix S, paragraph 3.3.8.1.

Method of Compliance:
The APU Structural Life Analysis shall verify the APU and all APU components meets design lives IAW Appendix S, paragraph 3.3.8.1. The airworthiness substantiation shall be an APU Design Life Analysis Report IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.2.3. Durability PFR (Testing)

The purpose of the durability PFR testing is to ensure that cracking or other structural or material degradation which could result in functional impairment or excessive in-service maintenance problems does not occur during the design service life.

Criteria:
Perform the Composite Test IAW the requirements outlined in Appendix S, paragraphs 4.5.1. through 4.5.1.6.

Standard:
Appendix S, paragraphs 4.5.1. through 4.5.1.6.

Method of Compliance:
The airworthiness substantiation shall include an APU Composite Testing Plan IAW DI-NDTI-80566 and an APU Composite Testing Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.2.4. Durability Qualification

The purpose of the durability qualification testing is to ensure that cracking or other structural or material degradation which could result in functional impairment or excessive in-service maintenance problems does not occur during the design service life.

Criteria:
The APU shall function with positive durability margins to preclude adverse safety, economic or operational effects.

Standard:
Appendix S, paragraph 4.6.1. through 4.6.1.6.

Method of Compliance:
The APU Composite Test shall be successfully completed IAW Appendix S, paragraph 4.6.1. for Qualification. The airworthiness substantiation shall include an APU Composite Test Plan IAW DI-NDTI-80566 and an APU Composite Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.2.5. Main Shaft, Seals, and Bearing Mechanical Tests

Prior to the start of PFR, the APU main shaft, seals, and bearings shall be subjected to mechanical testing.

Criteria:
The test ensures the APU and APU component designs operate at design conditions for temperature, heat generation, and amount of slip. It also ensures that components do not exhibit oil coking, premature failure modes, or abnormal wear.

Standard:
Appendix S, paragraph 4.5.4.6.

Method of Compliance:
The Main Shaft, Seals, and Bearings Mechanical Tests shall be completed prior to PFR IAW Appendix S, paragraph 4.5.4.6. A test plan and test report shall be submitted IAW DI-NDTI-80566 and IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.2.6. Main Shaft Bearing Assurance Tests

Prior to the start of QT, a Main Shaft Bearing Assurance Test shall be conducted to demonstrate the endurance of the APU's main shaft bearings.

Criteria:
The APU shall be capable of demonstrating compliance to the bearing assurance testing requirements.

Standard:
Appendix S, paragraph 4.6.6.11.

Method of Compliance:
The APU shall complete a Main Shaft Bearings Assurance Test IAW Appendix S, paragraph 4.6.6.11. A test plan and test report shall be submitted IAW DI-NDTI-80566 and IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.2.7. Operating Limits

The purpose of operating limits is to provide and demonstrate the APU operating characteristics and limits for the operator to know the full range of APU capabilities.

Criteria:
The APU shall function with positive durability margins as installed in the aircraft.

Standard:
Appendix S, paragraph 3.2.1.5. through 3.2.1.5.12.

Method of Compliance:
All APU steady state and transient operating limits (maximum, minimum) shall be specified per Appendix S, paragraphs 3.2.1.5. through 3.2.1.5.12. The specified limits shall be predicated on the most critical tolerances of the APU. The airworthiness substantiation shall include an APU operating limitation report, including turbine

temperature correlation studies prepared prior to the initiation of the PFR IAW DI-MISC-80711 and updated with revised operational limits and correlation studies prior to the initiation of the Qualification test. Operating limits shall also be verified by review of the APU Specification with approval of the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.2.8. Output Shaft Static Torque Test

The purpose of the test is to demonstrate that the output shaft can safely operate within prescribed limits to ensure safe operation during initial flight testing. Past experience indicates that the engine output shaft torque can increase because of a malfunction or other anomaly.

Criteria:

The APU output shaft system shall not exhibit detrimental permanent set or deflection to the extent that operation or performance is impaired.

Standard:

Appendix S, paragraph 4.5.2.2.1.
Appendix S, paragraph 4.6.2.4.2.

Method of Compliance:

The APU output shaft system shall be subjected to testing at the maximum allowable output torque IAW Appendix S, paragraphs 4.5.2.2.1. and 4.6.2.4.2. A test plan and test report shall be submitted IAW DI-NDTI-80566 and IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.2.9. APU Temperature Limits

Prior to the start of PFR and QT, an analysis shall be conducted to identify the APU temperature limits.

Criteria:

The analysis shall provide correlation studies of the APU temperature limits. The APU shall operate within the specified temperature limits.

Standard:

Appendix S, paragraph 3.2.1.5.5.

Method of Compliance:

An APU Temperature Limits Analysis shall be completed prior to PFR and QT IAW Appendix S, paragraph 3.2.1.5.5. An analysis report shall be submitted IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.2.10. Vibration Limits
The purpose of the vibration limits requirement is to ensure the APU and APU components are designed to operate at specified vibration limits.

Criteria:
The vibration limits analysis shall provide its maximum permissible APU vibration limits (overall velocity limits [true RMS]) at each sensor location on the APU.

Standard:
Appendix S, paragraph 3.2.1.5.10.

Method of Compliance:
An APU Vibration Limits Analysis shall be completed prior to PFR IAW Appendix S, paragraph 3.2.1.5.10. An analysis report shall be submitted IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.2.11. Vibration and Dynamic Response (Analysis)
The purpose of the analysis is to demonstrate if the APU is free of damaging dynamic response. Absence of damaging vibration and dynamic response is essential to maintain the desired mechanical and structural integrity of the APU prior to initial flight tests.

Criteria:
The APU shall be free of damaging vibration and dynamic response.

Standard:
Appendix S, paragraph 3.3.8.9.
Appendix S, paragraph 3.3.8.9.1.
Appendix S, paragraph 3.3.8.9.2.

Method of Compliance:
The APU design shall comply with the requirements of Appendix S, paragraphs 3.3.8.9., 3.3.8.9.1., and 3.3.8.9.2. An analysis report shall be submitted IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.2.12. Vibration and Dynamic Response PFR

The purpose of the survey is to demonstrate the APU is free of damaging dynamic response. Absence of damaging vibration and dynamic response is essential to maintain the desired mechanical and structural integrity of the APU prior to initial flight tests.

Criteria:
The APU shall be free of damaging vibration and dynamic response.

Standard:
Appendix S, paragraph 3.3.8.9.
Appendix S, paragraph 3.2.1.5.10.
Appendix S, paragraph 4.4.4.

Method of Compliance:
The APU design shall comply with the requirements of Appendix S, paragraph 3.3.8.9. and 3.2.1.5.10. A vibration survey shall be completed IAW Appendix S, paragraph 4.4.4. A test plan and test report shall be submitted IAW DI-NDTI-80566 and IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.2.13. Vibration and Stress Tests

The purpose of the vibration and stress tests is to demonstrate the APU‘s capability to resist destructive vibrations. Instrumented APU tests are necessary to verify the dynamic response of the total APU system due to system analysis and modeling challenges.

Criteria:
The APU shall be capable to resist destructive vibrations and dynamic response.

Standard:
Appendix S, paragraph 4.6.4.12. Appendix S, paragraph 3.3.8.9.2.
Appendix S, paragraph 3.2.1.6.6.
Appendix S, paragraph 3.2.1.5.5.
Appendix S, paragraph 3.2.5.8.

Method of Compliance:
The APU shall complete vibration tests IAW Appendix S, paragraph 4.6.4.12. The airworthiness substantiation shall include a Vibration and Stress Analysis Report prepared IAW DI-MISC-80711, a Vibration Test Plan IAW DI-NDTI-80566, and Vibration Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.3. Material Characterization

The materials used in the APU need to be fully characterized using minimal allowables that are established considering statistical variability, the expected environments, fabrication processes, repair techniques, and quality assurance procedures. Verify that conditions and properties for material repairs satisfy design requirements.

7.3.7.3.1. Material and Processes

The purpose of the analysis is to ensure the materials and processes used during the design and manufacture of the APU will meet all specification requirements.

Criteria:
The APU materials, coatings and processes shall be corrosion and NBC resistant.

Standard:
Appendix S, paragraph 3.3.1.1. through 3.3.1.1.5.

Method of Compliance:
The materials, adhesives, sealants, elastomeric materials, o-rings, and corrosion protection used in the APU shall meet the requirements of Appendix S, paragraphs 3.3.1.1. through 3.3.1.1.5. The airworthiness substantiation shall include an analysis report of any APU manufacturer's documents that are used for materials and processes submitted prior to the initiation of the PFR IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.3.2. External Surfaces

The purpose of the external surfaces requirement is to ensure the APU and APU components are designed to resist collection and buildup of dirt, sand, and liquids.

Criteria:
The external surfaces of the APU and APU components shall be designed to not collect dirt, sand, and liquids.

Standard:
Appendix S, paragraph 3.2.7.
Appendix E. paragraph 5.4.13.

Method of Compliance:
The external surfaces of the APU shall meet the requirements of Appendix S, paragraph 3.2.7. A test plan and test report shall be submitted IAW DI-NDTI-80566 and IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.3.3. Fasteners

The purpose of the fasteners requirement is to ensure the suitability and fasteners in locations where loss of the fastener could affect safety of flight or ability to control the APU.

Criteria:
A self-retaining, secondary means of retention, feature shall be used at points where loss of the fastener could affect safety of flight or ability to control the engine. Cotter pins, safety wire, or safety cable shall not be used to secure aforementioned fasteners.

Standard:
Appendix S, paragraph 3.3.1.2. through 3.3.1.2.6.

Method of Compliance:
The fastener requirements of Appendix S, paragraphs 3.3.1.2. through 3.3.1.2.6. shall be verified by inspection and analysis. An analysis report shall be submitted IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.4. Nameplate and Product Marking

The purpose of the marking/identification requirement is to provide positive designation, identification, tracking and management for engineering configuration control.

Criteria:
A plan for serialization and marking shall be defined. All Critical Safety Items (CSI) shall be serialized and marked.

Standard:
AMCOM Regulation 702-7
Appendix S, paragraph 3.3.3. through 3.3.3.5.

Method of Compliance:
All CSIs, and depot repairable CSIs shall be marked and identified. Data format shall be IAW MIL-STD-130. The airworthiness substantiation shall include a Marking and Identification Plan developed IAW AMCOM Regulation 702-7 and Appendix S, paragraphs 3.3.3. through 3.3.3.5. Proposed solutions to Nameplate and Product Marking requirements shall be submitted IAW DI-MGMT-81803 and are subject to approval by the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.5. Transportability

The purpose of the transportability requirement is to ensure the materiel systems are designed, engineered, and constructed to preclude environmental or mechanical damage during handling or transportation. Transportability approval is required prior to engineering and manufacturing development as we as prior to production and fielding.

Criteria:
The APU shall be designed for movement on, and be compatible with, standard aircraft maintenance trailers. Features shall be provided to permit installation on and use of static and mobile ground equipment, as approved by the Using Service.

Standard:
AR 70-47
Appendix S, paragraph 3.2.6.
Appendix S, paragraph 3.2.6.1.

Method of Compliance:
The transportability requirements of Appendix S, paragraphs 3.2.6. and 3.2.6.1. shall be verified by analysis and demonstration. The analysis shall include all information necessary for the handling and transportation of the propulsion system components e.g., blocking, slinging, lifting, and tiedown detail and procedures to assure safe handling. An analysis report shall be submitted IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.6. Design Service Life

The APU is designed such that pertinent environmental variables and all sources of repeated loads are considered and these considerations are included in the development of the design duty cycle.

7.3.7.6.1. Interchangeability

The purpose of the interchangeability requirement is to ensure that parts with the same part number are interchangeable to reduce logistic support requirements, minimize maintenance and repair problems, and assure that APU performance and operability are not compromised.

Criteria:
The APU components and individual parts shall be functionally and dimensionally interchangeable and replaceable with each other with respect to installation and performance.

Standard:
Appendix S, paragraph 3.3.5.

Method of Compliance:
The interchangeability requirements of the APU shall meet the requirements of Appendix S, paragraph 3.3.5. The airworthiness substantiation shall include an analysis report of any matched or selected fit parts as well as any module replacement limits prepared prior to the initiation of the PFR IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.7.7. Life Management
Inspection intervals and life-limited components must be identified in the technical manuals and a process to track life consumption must be operational and current.

7.3.7.7.1. Monitoring System
The purpose of the monitoring system requirement is to ensure the accuracy of information used to determine operation, maintenance and life limits. The APU monitoring system monitors and records parameters for safe platform operation, operational readiness improvements, and life limit updates.

Criteria:
The APU monitoring system shall monitor and calculate lives for life limited parts.

Standard:
Appendix S, paragraph 3.1.4. through 3.1.4.4.
Appendix S, paragraph 3.7.4.4.
Appendix S, paragraph 3.7.6.1.1.
Appendix S, paragraph 3.7.6.1.2.
Appendix S, paragraph 4.6.2.6.
Appendix S, 4.5.1.3.1.
Appendix S, 4.6.1.3.1.

Method of Compliance:
The APU condition monitoring system shall demonstrate compliance with Appendix S, paragraphs 3.1.4. through 3.1.4.4., 3.7.4.4., 3.7.6.1.1., and 3.7.6.1.2. An analysis report (IAW Appendix S, paragraphs 4.5.1.3.1., 4.6.1.3.1. and 4.6.2.6.) shall be submitted IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.7.7.2. APU Condition Monitoring
The purpose of condition monitoring requirement is to provide information to permit safe APU operation within the established limits.

Criteria:
The APU components shall monitor critical parameters to ensure operation within established limits.

Standard:
Appendix S, paragraph 3.7.6.2.
Appendix S, paragraph 3.7.6.3.
Appendix S, paragraph 3.7.6.4.
Appendix S, paragraph 3.7.6.5.
Appendix S, paragraph 3.7.6.6.
Appendix S, paragraph 3.7.6.7.
Appendix S, paragraph 3.7.6.7.1.

Method of Compliance:
The APU condition monitoring system shall demonstrate compliance with Appendix S, paragraphs 3.7.6.2., 3.7.6.3., 3.7.6.4., 3.7.6.5., 3.7.6.6., 3.7.6.7., and 3.7.6.7.1. An analysis report shall be submitted IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8. APU Subsystems
All APU parts and components which are APU manufacturer provided that are required for APU operation are considered subsystem. These often include the APU control system, fuel, lubrication, anti-icing and other necessary components.

7.3.8.1. APU Control System
The APU control system maintains safe APU operation under all required conditions.

7.3.8.1.1. APU Component Tests
The purpose of the APU component tests is to qualify APU components for a PFR and QT.

Criteria:
The APU components shall operate within the operating limitations and environmental conditions specified in the APU Specification.

Standard:
Appendix S, paragraph 4.5.2.
Appendix S, paragraph 4.5.2.2.
Appendix S, paragraph 4.6.2.
Appendix S, paragraph 4.6.2.1.
Appendix S, paragraph 4.6.2.2.
Appendix S, Table XVII-A
Appendix S, Table XVII-B
Appendix E, Section 5

Method of Compliance:
The APU components shall be verified by testing and analysis IAW Appendix S, paragraphs 4.5.2., 4.5.2.2., 4.6.2., 4.6.2.1., 4.6.2.2., Table XVII-A, and Table XVII-B and Appendix E, Section 5. Analysis reports, test plans, and test reports shall be submitted IAW DI-MISC-80711, IAW DI-NDTI-80566, and IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.1.2. Software
The purpose of the software verification is to ensure software functions as intended. Due to its increased complexity, amount of code and airworthiness implication, software verification and qualification is necessary.

Criteria:
The APU software shall properly function to ensure safe APU operation.

Standard:
Appendix E, paragraph 5.8.1.
Appendix S, paragraph 3.7.2.3.6.
Appendix S, paragraph 4.5.2.6.
Appendix S, paragraph 4.6.2.5.

Method of Compliance:
The APU software shall be designed, developed and tested IAW RTCA/DO-178C and RTCA/DO-254, Appendix E, paragraph 5.8.1., and Appendix S, paragraph 4.6.2.5. (and all subparagraphs). The System Safety Assessment shall be performed to determine the Design Assurance Level (DAL) and be approved by the Using Service. The airworthiness substantiation shall include documentation IAW paragraph 15.0., software airworthiness.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.1.3. APU Control System Highly Accelerated Life Testing (HALT)
The purpose of HALT is to identify potential shortcoming of the control system that can be found during extensive bench testing and can be addressed prior to fielding.

Criteria:
The APU control system components and accessories shall properly operate throughout their life cycle.

Standard:
Appendix E, paragraph 5.9.
Appendix E, paragraph 5.9.1.

Appendix E, paragraph 5.9.2.
Appendix E, paragraph 5.10.
Appendix E, Table VIII
Appendix S, paragraph 4.5.2.5.

Method of Compliance:
APU control system components shall be tested IAW Appendix S, paragraph 4.5.2.5. Designated APU control system components shall be designed to meet reliability growth goals and tested IAW Appendix E, paragraph 5.9./Table VIII and undergo highly accelerated life testing (HALT) for PFR IAW Appendix E, paragraph 5.9.1., and Reliability Development and Growth Testing (RDGT) prior to fielding IAW Appendix E, paragraph 5.9.2. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include APU Control System HALT/CERT Plans prepared IAW DI-NDTI-81895 & DI-RELI-80322, and APU Control System HALT/CERT Reports prepared IAW DI-NDTI-81897.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.1.4. APU Control System SOT
The purpose of the SOT is to demonstrate the IOC life, as approved by the Using Service, for all control system components. SOTs are used to verify that the components can operate reliably throughout all the missions and preclude early failures that may occur in service.

Criteria:
The APU control system components and accessories shall operate IAW the requirements, as approved by the Using Service, throughout their life cycle.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.3.
Appendix E, paragraph 5.10.

Method of Compliance:
Engine control system components and accessories shall operate when exposed to simulated operational environments IAW Appendix E, paragraphs 5.1. and 5.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an APU Control System SOT Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an APU Control System SOT Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.1.5. APU Control System Environmental Performance

The purpose of component environmental testing is to ensure components will survive both real world and exaggerated environments while continuing to meet their individual performance requirements.

Criteria:
The APU control system components and accessories shall function throughout their environmental life cycle to ensure safe flight.

Standard:
Appendix S, paragraph 3.7.2.2.
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.4.
Appendix E, paragraph 5.10.

Method of Compliance:
APU control system components and accessories shall meet their individual performance requirements (Appendix S, paragraph 3.7.2.2.) when tested IAW Appendix E, , paragraphs 5.1. and 5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an APU Control System Environmental Performance Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an APU Control System Environmental Performance Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.1.6. APU Control System Proof Pressure and Pressure Cycling

The purpose of the analyses and tests is to demonstrate the control system can withstand the maximum pressure cycling and safely operate throughout its life cycle.

Criteria:
The APU components pressurized by fuel, oil or air shall safely operate under severe conditions.

Standard:
Appendix E, paragraph 5.5.
Appendix E, paragraph 5.5.2.
Appendix E, paragraph 5.5.3.
Appendix E, paragraph 5.10.

Method of Compliance:
APU components pressurized by fuel, oil or air shall demonstrate that they can safely withstand cycling between their minimum and maximum design operating pressures, after being proof tested, by testing IAW Appendix E, paragraphs 5.5., 5.5.2., and 5.5.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an

APU Control System Pressure Cycling Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an APU Control System Pressure Cycling Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.1.7. APU Control System Burst Pressure

The purpose of the test is to demonstrate the control system will not rupture when overpressurized. Analyses and tests which include burst pressure testing with posttest inspection verify that the components can safely withstand an overpressurization event at any time during its life cycle without rupture.

Criteria:

The APU components pressurized by fuel, oil or air shall withstand overpressurization without rupture.

Standard:

Appendix E, paragraph 5.5.
Appendix E, paragraph 5.5.4.
Appendix E, paragraph 5.10.

Method of Compliance:

APU components pressurized by fuel, oil or air shall demonstrate that they will not rupture when overpressurized IAW Appendix E, paragraph 5.5. and 5.5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an APU Control System Burst Pressure Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an APU Control System Burst Pressure Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.1.8. Data Bus Interfaces

The purpose of the requirement is to ensure all interfaces adhere to protocol specifications. The APU control system should be an integral part of the APU maintenance system and should be compatible with the aircraft data collection, ground support systems, and the maintenance support concept.

Criteria:

The APU electronic components with data bus communication interfaces shall properly operate to ensure safe operation of the aircraft.

Standard:
Appendix E, paragraph 5.6.4.6.
Appendix E, paragraph 5.10.

Method of Compliance:
Data bus communication interfaces shall be verified for compliance with protocol specifications IAW Appendix E, paragraph 5.6.4.6. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Data Bus Interfaces Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Data Bus Interfaces Test Report prepared IAW DI-NDTI-81897 or Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.1.9. APU Crystal Oscillators

The purpose of the test is to ensure components with crystal oscillators meet performance requirements at all temperature extremes. There have been recent control system field events associated with crystal oscillators that require additional screening during development.

Criteria:
The APU electronic components with crystal oscillators shall properly function to ensure safe operation of the aircraft.

Standard:
Appendix E, paragraph 5.6.4.7.
Appendix E, paragraph 5.10.

Method of Compliance:
Components incorporating crystal oscillators shall be tested IAW Appendix E, paragraph 5.6.4. 7 to verify that they meet their performance specifications at all steady-state ambient temperatures. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Crystal Oscillator Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Crystal Oscillator Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.1.10. APU Control System Adjustment

The APU control system will be accessible for removal and replacement, without necessitating removal or displacement of any other component, unless otherwise approved by the using service. The purpose of the control system adjustment

requirement is to ensure that all APU calibration is performed in a controlled environment.

Criteria:
APU line replaceable units shall be removed and replaced without removal or displacement of other components. The APU control system shall not be field adjustable. The APU control system shall enable operation throughout the entire operating envelope without external adjustment.

Standard:
Appendix S, paragraph 3.7.2.3.
Appendix S, paragraph 3.7.2.3.1.

Method of Compliance:
The requirements of Appendix S, paragraphs 3.7.2.3. and 3.7.2.3.1. shall be verified by demonstration. A test plan and test report shall be submitted IAW DI-NDTI-80566 and IAW DI-NDT-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.1.11. APU Control System Reprogramming

The purpose of the APU control system reprogramming requirement is to ensure vetted, tested, and approved updates can be made in the field.

Criteria:
The APU control system shall be designed to all software changes to be made in the field without the need to remove the unit from the APU or airframe. Unauthorized reprogramming shall be prevented.

Standard:
Appendix S, paragraph 3.7.2.3.5.

Method of Compliance:
The requirements of Appendix S, paragraph 3.7.2.3.5. shall be verified by demonstration. A test plan and test report shall be submitted IAW DI-NDTI-80566 and IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.1.12. APU Control System Impact Test

The purpose of the impact test will demonstrate the ability of APU control system components, mounted in a crew compartment, or near a system or other component

critical to occupant safety, to withstand crash safety forces without becoming detached from their mounts.

Criteria:
The APU external components and accessories shall not present a safety risk to crew members during a hard/uncontrolled landing.

Standard:
Appendix E, paragraph 5.4.5.
Appendix E, paragraph 5.10.

Method of Compliance:
APU control components located in a crew compartment, or near a system or other component critical to occupant safety shall be subjected to an impact test IAW Appendix E, paragraph 5.4.5. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Test Report prepared IAW DI-NDTI-81897 or Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.1.13. APU Control System PMA Short to Ground
The purpose of the PMA short to ground assessment is to ensure that control system components operate when exposed to shorts associated with the PMA. Electrical shorts to ground can lead to propagated control system damage and an APU system failure.

Criteria:
The APU control system components shall function during a PMA electrical short to ground.

Standard:
Appendix E, paragraph 5.6.4.1. Appendix E, paragraph 5.10.

Method of Compliance:
APU control system components which are powered directly by the APU PMA shall operate and/or not be damaged during and after exposure to shorts to ground of any one phase. Analysis and/or testing shall be IAW Appendix E, paragraph 5.6.4.1. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.1.14. Overtemperature Control System
The purpose of the test is to ensure that the control system's overtemperature control loop controls the APU as required and prevents overtemperature during starting and operation.

Criteria:
The APU overtemperature control system shall maintain safe APU operation.

Standard:
Appendix S, paragraph 3.7.2.3.3.1.
Appendix S, paragraph 3.7.2.3.3.2.
Appendix S, paragraph 4.6.6.9.

Method of Compliance:
The APU shall be designed to meet the overtemperature requirements of Appendix S, paragraphs 3.7.2.3.3.1. and 3.7.2.3.3.2. An APU shall be tested to demonstrate the APU overtemperature control system IAW Appendix S, paragraph 4.6.6.9. The airworthiness substantiation shall include an Overtemperature Control System Test Plan IAW DI-NDTI-80566, and Overtemperature Control System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.1.15. Overspeed Control System
The purpose of the test is to ensure the control systems overspeed control loop controls the APU as required and prevents overspeed throughout the envelope. APU overspeed incidents have resulted in structural failure of rotating components.

Criteria:
The APU overspeed control system shall maintain safe APU operation.

Standard:
Appendix S, paragraph 3.7.2.3.2.1.
Appendix S, paragraph 3.7.2.3.2.2.
Appendix S, paragraph 4.6.6.10.

Method of Compliance:
The APU shall be designed to meet the overspeed requirements of Appendix S, paragraphs 3.7.2.3.2.1. and 3.7.2.3.2.2. An APU shall be tested to demonstrate the APU overspeed control system IAW Appendix S, paragraph 4.6.6.10. The airworthiness substantiation shall include an Overspeed Control System Test Plan IAW DI-NDTI-80566, and Overspeed Control System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.1.16. Control Signals
The purpose of the control signals is to ensure the APU control system can provide the required input and output signals.

Criteria:
The APU shall provide for input signals from external sources, as required, and shall also provide for output signals for use external to the APU as specified.

Standard:
Appendix S, paragraph 3.7.2.1.

Method of Compliance:
The control signal requirements of Appendix S, paragraphs 3.7.2.1. shall be verified by analysis. An Analysis Report IAW DI-MISC-80711 shall be submitted and approved by the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.2. APU Control System Stability
The control system maintains both stable APU operation and response during all steady state and transient conditions. Modulation of APU power from start-up through maximum power and shutdown by means of unrestricted throttle/collective movement must be linear.

7.3.8.2.1. APU Control System Design Fault Detection and Accommodation
The purpose of this test is to demonstrate the fault detection, control unit switching and fault accommodation capability to assure smooth APU control transfer with no APU degradation.

Criteria:
The APU control system design shall diagnose and safely accommodate signal and component failures.

Standard:
Appendix E, paragraph 5.8.
Appendix E, paragraph 5.8.5.
Appendix E, paragraph 5.10.

Method of Compliance:
The APU control system shall demonstrate that it can diagnose and safely accommodate single and multiple signal failures in a closed loop bench environment in accordance with Appendix E, paragraphs 5.8. and 5.8.5. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an APU Control System Fault Accommodation Test

Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an APU Control System Fault Accommodation Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.3. APU Failure Modes/Criticality
Any failure of the APU controls and supporting subsystems results in a fail-safe condition.

7.3.8.3.1. APU Control System Fail Safe Operation
This design requirement is to ensure that APU Control system fault accommodation is addressed via the level of degradation (fail safe) and the identification of which system(s) is affected.

Criteria:
The APU control system design shall diagnose and safely accommodate simultaneously occurring signal and component failures.

Standard:
Appendix S, paragraph 3.3.6.6.
Appendix S, paragraph 3.7.2.2.1.
Appendix E, paragraph 5.8. Appendix E, paragraph 5.8.2. Appendix E, paragraph 5.10.

Method of Compliance:
The APU control system shall be designed to fail safe as specified in Appendix S, paragraphs 3.3.6.6. and 3.7.2.2.1. and tested IAW Appendix E .2. , paragraphs 5.8. and 5.8.2. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an APU Control System Common Mode Failure Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an APU Control System Common Mode Failure Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.3.2. Backup Control
The purpose of the backup control requirement is to demonstrate APU performance and stability during transfer from the primary control.

Criteria:
Transfer from the primary system to the backup control shall be automatic at any power setting without APU performance instability or change to the control system input.

Standard:
Appendix S, paragraph 3.7.2.2.2.
Appendix E, paragraph 5.6.4.2.
Appendix E, paragraph 5.6.4.4.
Appendix E, paragraph 5.10.

Method of Compliance:
The requirements of Appendix S, paragraph 3.7.2.2.2. shall be verified by analysis and tests. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall be IAW Appendix E, paragraphs 5.6.4.2. and 5.6.4.4. and include an Analysis IAW DI-MISC-80711, a Test Plan IAW DI-NDTI-80566, and a Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.4. APU Fuel System
The APU fuel system safely provides the required fuel supply to the combustor and fuel subsystems under all required conditions.

7.3.8.4.1. Fuel System Fire Tests
The purpose of the test is to demonstrate fuel system lines, fittings and other components have fire resistant/fireproof capability to ensure they do not contribute additional fire risk to the platform upon an event that ignites an APU fire.

Criteria:
The APU fuel lines, fittings and components shall not contribute to a fire risk.

Standard:
AC20-135
AS 1055E
AS 4273A
Appendix S, paragraph 3.3.6.1.
Appendix S, paragraph 3.3.6.6.
Appendix E, paragraph 5.5.5.
Appendix E, paragraph 5.10.

Method of Compliance:
The APU individual lines, fittings, components or assemblies shall be tested as specified in AC20-135, AS 1055E and AS 4273A IAW Appendix S, paragraphs 3.3.6.1. and 3.3.6.6. and Appendix E, paragraph 5.5.5. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include Test Plans prepared IAW DI-NDTI-81895 & DI-RELI-80322, Test Reports prepared IAW DI-NDTI-81897 or Component Similarity Argument Reports prepared IAW DI-NDTI-81896 prior to PFR.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.4.2. APU Fuel Systems Simulated Operational Test (SOT)

The purpose of the SOT is to demonstrate IOC life for all fuel system components. SOTs are used to verify that the components can operate reliably throughout all the missions and preclude early failures that may occur in service.

Criteria:

The APU fuel control system components and accessories shall operate when exposed to a simulated environment.

Standard:

Appendix E, paragraph 5.1.
Appendix E, paragraph 5.3.
Appendix E, paragraph 5.10.
Appendix S, paragraph 4.6.2.2.
Appendix S, Table XVII-B

Method of Compliance:

APU fuel system components and accessories shall operate satisfactorily when exposed to simulated operational environments and test IAW Appendix E, paragraphs 5.1. and 5.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Fuel Systems SOT Plan IAW DI-NDTI-81895, a Fuel Systems SOT Report IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.4.3. APU Fuel Pumping System Test

The purpose of this test is to demonstrate APU fuel pump's capability to provide sufficient fuel flow to the APU at all operating speeds and conditions to preclude APU flameouts, stalls and other fuel related failures.

Criteria:

The APU fuel pump shall provide fuel to ensure there are no APU flameouts, stalls and other fuel related failures.

Standard:

Appendix S, paragraph 3.7.3.1.3.1.
Appendix S, paragraph 3.7.3.1.3.3.
Appendix S, paragraph 3.7.3.3.3.
Appendix S, paragraph 3.7.3.3.4.
Appendix E, paragraph 5.6.5.
Appendix E, paragraph 5.10.

Method of Compliance:
The APU fuel pumping system shall demonstrate via test the ability to provide the necessary flows to operate the APU under all ambient pressure and temperature conditions, IAW Appendix S, paragraph 3.7.3.1.3.3. and to meet the fuel system performance requirements IAW Appendix S, paragraphs 3.7.3.3.3. and 3.7.3.3.4. The APU Fuel Pump shall be tested IAW Appendix E, paragraph 5.6.5. and subparagraphs. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.4.4. APU Fuel System Components Environmental Testing
The purpose of this testing is to demonstrate that components will survive both real world and exaggerated environments while continuing to meet their individual performance requirements.

Criteria:
The APU fuel system components and accessories shall function during and after exposure to environmental effects.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.4.
Appendix E, paragraph 5.10.

Method of Compliance:
APU fuel system components shall meet their individual performance requirements when tested IAW Appendix E, paragraphs 5.1. and 5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Fuel System Components Environmental Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Fuel System Components Environmental Test Report prepared IAW DI-MISC-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.4.5. Fuel Flow Limit
The purpose of the fuel flow limit requirement is to ensure the APU fuel flow is within the maximum limits as specified in the APU model specification.

Criteria:
The APU fuel flow shall measure within the limits established in the APU model specification.

Standard:
Appendix S, paragraph 3.7.3.1.2.
Appendix S, paragraph 4.5.3.
Appendix S, paragraph 4.6.3.

Method of Compliance:
The requirements of Appendix S, paragraph 3.7.3.1.2. shall be verified by tests. The airworthiness substantiation shall be verified by the Performance Computer Program with substantiation provided in the Altitude Test Report (reference Appendix S, paragraph 4.5.3. and 4.6.3.). The fuel flow limit requirement shall also be verified by reviewing the APU model specification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.4.6. Fuel Contamination
The purpose of the fuel contamination requirement is to ensure fuel wetted components can tolerate contaminated fuel as per the specified limits.

Criteria:
The APU shall operate with fuel contamination as per specified limits without performance degradation or mechanical damage resulting in loss of service life.

Standard:
Appendix S, paragraph 3.7.3.3.2.
Appendix S, paragraph 3.7.3.3.6.
Appendix E, paragraph 5.3.4.
Appendix E, paragraph 5.10.

Method of Compliance:
The requirements of Appendix S, paragraph 3.7.3.3.2. shall be verified by test IAW Appendix E, paragraph 5.3.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Test Plan IAW DI-NDTI-81895 & DI-RELI-80322 and a Test Report IAW DI-NDTI-81897.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.4.7. APU Fuel System Cavitation Endurance and Low Temperature Operation
The purpose of the fuel system cavitation endurance and low temperature operation requirement is to ensure the fuel system pumping elements will resist deterioration from cavitation.

Criteria:
The APU fuel pumping system shall resist deterioration from cavitation.

Standard:
Appendix E, paragraph 5.3.
Appendix E, paragraph 5.3.7.
Appendix E, paragraph 5.10.
Appendix S, paragraph 4.6.2.2.

Method of Compliance:
The requirements shall be verified by test. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Test Plan IAW DI-NDTI-81895 & DI-RELI-80322 and a Test Report IAW DI-NDTI-81897 shall be submitted and approved by the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.4.8. Fuel Pump Priming
The purpose of the fuel pump priming requirement is to ensure the capability of on-engine fuel pumps to self-prime.

Criteria:
The fuel pump shall be self-priming IAW the air vehicle specification.

Standard:
Appendix S, paragraph 3.7.3.3.4.1.
Appendix E, paragraph 5.6.5.2.

Method of Compliance:
The requirements of Appendix S, paragraph 3.7.3.3.4.1. shall be verified by tests IAW Appendix E, paragraph 5.6.5.2. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Test Plan IAW DI-NDTI-81895 & DI-RELI-80322 and a Test Report IAW DI-NDTI-81897 shall be submitted and approved by the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.4.9. Fuel System Bubble Ingestion
The purpose of the fuel system bubble ingestion requirement is to demonstrate that the APU fuel system shall be capable of continuously ingesting slugging flow at its inlet without performance degradation throughout the APU operating envelope.

Criteria:
A test shall be conducted to demonstrate that the APU fuel pumping system is capable of continuously ingesting slugging flow presented at the APU fuel inlet, without discharge flow interruption.

Standard:
SAE ARP 4028
Appendix E, paragraph 5.6.5.3.
Appendix E, paragraph 5.10.
Appendix S, paragraph 3.7.3.3.5.

Method of Compliance:
Each APU fuel system shall be tested in accordance with Appendix E, paragraph 5.6.5.3. to verify fuel system bubble ingestion capability. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Test Plan IAW DI-NDTI-81895 & DI-RELI-80322 and a Test Report IAW DI-NDTI-81897 shall be submitted and approved by the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.4.10. Fuel Filter
The purpose of the fuel filter is to protect or limit the effects of contamination on the APU.

Criteria:
The filter shall have capacity to permit a cumulative fuel flow to maintain continuous APU operation with contaminated fuel without being cleaned.

Standard:
ISO 12103-1
ISO 11171
ISO 4406
ARP 1827D
Appendix S, paragraph 3.7.3.4.
Appendix S, paragraph 4.6.9.

Method of Compliance:
The requirements of Appendix S, paragraph 3.7.3.4. shall be tested in accordance with Appendix S, paragraph 4.6.9. and SAE ARP 1827D. The airworthiness substantiation shall include a Test Plan IAW DI-NDTI-80566 and a Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.4.11. Fuel System Calibration Limits
The purpose of the fuel system calibration limits requirement is to define the limits when using MIL-PRF-7024, Type II test fluid.

Criteria:
The APU fuel system shall have calibration limits defined when using specified test fluid.

Standard:
Appendix S, paragraph 3.7.3.3.1.

Method of Compliance:
The requirements of Appendix S, paragraph 3.7.3.3.1. shall be verified by test. A Test Plan IAW DI-NDTI-80566 and a Test Report IAW DI-NDTI-80809 shall be submitted and approved by the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.5. APU Ignition System
The APU ignition system provides a safe and effective ignition source for the main combustor.

7.3.8.5.1. APU Ignition System Simulated Operational Test (SOT)
The purpose of the SOT test is to demonstrate IOC life, as approved by the Using Service, for all ignition system components. Demonstration that the components can operate reliably throughout all the missions is needed to preclude early failures in service.

Criteria:
The APU ignition system components and accessories shall operate when exposed to a simulated environment.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.3.
Appendix E, paragraph 5.10.
Appendix S, paragraph 4.6.2.2.
Appendix S, Table XVII-B

Method of Compliance:
APU ignition system components and accessories shall operate when exposed to simulated operational environments IAW Appendix E, paragraphs 5.1. and 5.3. The

airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an APU Ignition System SOT Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an APU Ignition System SOT Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.5.2. APU Ignition System Performance

The purpose of the environmental testing is to ensure the ignition system will function and survive both real world and exaggerated environments while continuing to meet their individual performance requirements.

Criteria:

The APU ignition system components and accessories shall operate throughout the full range of environments.

Standard:

Appendix E, paragraph 5.1.
Appendix E, paragraph 5.4.
Appendix E, paragraph 5.10.
Appendix S, paragraph 3.7.5.1.
Appendix S, paragraph 3.7.5.2.

Method of Compliance:

APU ignition system components shall meet their individual performance requirements when tested IAW Appendix E, paragraphs 5.1. and 5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Ignition System Performance Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Ignition System Performance Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.5.3. APU Ignition System Components Fouling

The purpose of the test is to demonstrate that the ignition system is capable of providing sufficient energy for starting and relighting under all environmental and operating conditions without the need for extensive maintenance to replace fouled ignitors.

Criteria:

The APU ignition system shall start the APU under fouling conditions.

Standard:

Appendix S, paragraph 3.7.5.3.1.

Appendix S, paragraph 3.7.5.3.2.
Appendix E, paragraph 5.6.6.
Appendix E, paragraph 5.10.

Method of Compliance:
The APU ignition system components shall be functionally operated to demonstrate that the ignition system is capable of consistently starts the APU under fouling conditions, and tested as specified in Appendix E, paragraph 5.6.6. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Ignition System Components Fouling Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an Ignition System Components Fouling Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.6. APU Anti-Ice System (if used)
The APU anti-ice/de-ice system prevents damaging ice buildup or provides safe and non-damaging ice removal at all APU speeds/power levels and will not result in heat-induced damage to the APU's front frame structure.

7.3.8.6.1. APU Anti-Ice Simulated Operational Test (SOT)
The purpose of the SOT is to demonstrate IOC life, as approved by the Using Service, for all anti-ice system components. SOTs are used to verify that the components can operate reliably throughout all the missions and preclude early failures that may occur in service.

Criteria:
The APU anti-ice system components and accessories shall operate when exposed to a simulated environment.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.3.
Appendix E, paragraph 5.10.
Appendix S, paragraph 4.6.2.2.
Appendix S, Table XVII-B

Method of Compliance:
APU anti-ice system components and accessories shall operate when exposed to simulated operational environments IAW Appendix E, paragraphs 5.1. and 5.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an APU Anti-Ice SOT Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an APU Anti-Ice SOT Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.6.2. APU Anti-Ice System Performance

The purpose of environmental testing on components is to ensure they will survive both real world and exaggerated environments while continuing to meet their individual performance requirements.

Criteria:
The APU anti-ice system shall operate throughout the full range of environments.

Standard:
Appendix S, paragraph 3.2.5.2.
Appendix S, paragraph 3.7.1. through 3.7.1.2.
Appendix S, paragraph 4.6.3.

Method of Compliance:
The APU anti-ice system performance shall demonstrate that the anti-ice system is capable of consistently keeping the APU free of ice accretion under adverse environmental conditions, and tested as specified in Appendix S, paragraphs 3.2.5.2. and 3.7.1. through 3.7.1.2. The airworthiness substantiation shall include a Test Plan IAW DI-NDTI-80566 and a Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.6.3. APU Anti-Ice Components

Criteria:
The APU anti-ice system components and accessories shall properly operate throughout the full range of environments.

Standard:
Appendix S, paragraph 4.6.2.3.
Appendix E, paragraph 5.1. and 5.4.

Method of Compliance:
APU anti-ice system components shall meet their individual performance requirements when tested IAW Appendix E, paragraphs 5.1. and 5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.6.4. Accessory Drive
The purpose of the accessory drive requirement is to ensure the APU drive train and external gearboxes are durable and will withstand specified loads.

Criteria:
The APU drive train and external gearboxes shall be capable of withstanding the specified loads for the specified time.

Standard:
Appendix S, paragraph 3.1.2.7.
Appendix S, paragraph 4.5.1.3.1.
Appendix S, paragraph 4.6.2.4.1.
Appendix S, paragraph 4.6.1.3.

Method of Compliance:
The APU's accessory drive shall meet the conditions of Appendix S, paragraphs 4.5.1.3.1., 4.6.2.4.1. and 4.6.1.3. The airworthiness substantiation shall include a Test Plan IAW DI-NDTI-80566 and a Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.7. APU Cooling and Thermal Management
The APU cooling and thermal management systems safely remove excess heat from the APU and its subsystems and integrate with the air vehicle thermal management system, if applicable.

7.3.8.7.1. APU Heat Rejection Rate
The purpose of this analysis is to ensure the APU and sub-systems will perform in the thermal environment. The surface temperature and heat rejection must be controlled to ensure compatibility between the APU and the aircraft for safe and durable operation.

Criteria:
The APU cooling and thermal management systems shall remove excess heat from the APU and its subsystems to ensure system operation.

Standard:
Appendix S, paragraph 3.1.2.8.
Appendix S, paragraph 3.1.2.8.3.
Appendix S, paragraph 4.4.1.

Method of Compliance:
An analysis shall be performed that provides sufficient evidence that the APU and its subsystems, including the oil system, shall function under the conditions specified in Appendix S, paragraph 3.1.2.8. Factors such as APU bay cooling flows, accessory pad loading, compressor bleed air conditions, anti-ice operation, oil system cooling requirements, skin temperature and radiation properties, and air and gas leakage from case flanges and split lines shall be taken into consideration in establishing APU heat rejection rates. The airworthiness substantiation shall include a Heat Rejection Rate Analysis Report prepared IAW DI-MISC-80711, a Heat Rejection Rate Test Plan IAW DI-NDTI-80566, and Heat Rejection Rate Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.7.2. APU Component Limiting Test
The purpose of the limiting test is to demonstrate that components are capable of operating at design temperature limits. APU cooling and thermal systems are designed to remove specified amount of heat to ensure that components are not exposed to temperatures beyond their design intent.

Criteria:
The APU components shall continue to operate when exposed to their limiting temperature.

Standard:
Appendix S, paragraph 3.1.2.8.1.
Appendix S, paragraph 4.5.4.8.
Appendix S, paragraph 4.6.4.13.

Method of Compliance:
The APU shall be subjected to an analysis and APU component limiting test to demonstrate compliance with Appendix S, paragraph 3.1.2.8.1. IAW Appendix S, paragraph 4.5.4.8. and 4.6.4.13. The airworthiness substantiation shall include an Analysis Report IAW DI-MISC-80711, a Test Plan IAW DI-NDTI-80566 and a Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.8. APU Lubrication System
The purpose of these tests is to ensure the APU lubrication system safely operates under all APU operating conditions, the lubrication system is free from excessive discharge at the breather and that the lubrication system and bearing compartments do not support combustion.

7.3.8.8.1. APU Oil Flow Interruption Test

The purpose of this test is to demonstrate the APU can operate during periods of high maneuver loads that may cause an oil interrupt without loss of APU power and sustain operation without any subsequent maintenance action.

Criteria:
The APU shall continue to operate during high maneuver loads with interrupted oil flow.

Standard:
Appendix S, paragraph 3.7.7.3.3.
Appendix S, paragraph 4.4.2.

Method of Compliance:
The Oil Flow Interruption requirement shall be verified by test. A Test Plan IAW DI-NDTI-80566 and a Test Report IAW DI-NDTI-80809 shall be submitted.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.8.2. Heat Rejection and Oil Cooling Capability

The purpose of this analysis and testing is to ensure heat balance in the APU system. The oil system must be able to lubricate and dissipate the APU heat, oil wetted components can become coked from oil that sees excessively high temperatures.

Criteria:
The APU shall have lubrication system heat rejection and cooling to ensure that the lubrication system stays within specified temperature limits throughout the complete operating envelope.

Standard:
Appendix S, paragraph 3.7.7.2.
Appendix S, paragraph 3.7.7.2.1.
Appendix S, paragraph 3.7.7.3.1.

Method of Compliance:
The APU heat rejection and cooling capability, including the oil system, will be obtained from APU having substantially the same parts list as the PFR endurance test engine. The analysis will be based on the environmental conditions and APU operating envelope and comply with the requirements of Appendix S, paragraph 3.7.7.3.1. The airworthiness substantiation shall include a test plan and test report based on APU testing IAW Appendix S, paragraph 3.7.7.3.1., DI-NDTI-80566, and DI-NDTI-80809. An analysis report demonstrating the heat balance shall be prepared prior to the initiation of the qualification endurance test. The airworthiness substantiation shall include an Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.8.3. APU Lubrication System Fire Test

The purpose of this test is to demonstrate the fire resistant/fireproof capability of the lubrication system lines, fittings, and components to ensure that they do not contribute additional fire risk to the platform upon an event that ignites a fire.

Criteria:

The APU lubrication system lines, fittings, and components shall not contribute to a fire risk.

Standard:

AC20-135
AS 1055E
AS 4273A
Appendix E, paragraph 5.5., 5.5.5. and 5.10.
Appendix S, paragraph 3.3.6.1.
Appendix S, paragraph 3.3.6.6.

Method of Compliance:

Individual lubrication lines, fittings, components or assemblies shall be tested as specified in AC20-135, AS 1055E and AS 4273A IAW Appendix E, paragraphs 5.5. and 5.5.5. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an APU Lubrication System Fire Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, an APU Lubrication System Fire Test Report IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896, prior to the initiation of the PFR.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.8.4. APU Loss of Oil Test

An APU Loss of Oil Test shall be completed prior to PFR. If significant components have changed from the PFR configuration Loss of Oil Test, a repeat Loss of Oil Test shall be completed prior to QT (up to the Using Service’s discretion). The purpose of this test is to demonstrate the APU can operate without oil for some extended period of time in order for the pilot to egress the hostile area, initiate shutdown or any other required action.

Criteria:

The APU shall continue to operate after loss of all oil supply to the APU bearings.

Standard:

Appendix S, paragraph 3.7.7.3.4.
Appendix S, paragraph 4.5.4.4.
Appendix S, paragraph 4.6.6.6.

Method of Compliance:
The APU oil system shall lubricate the APU and meet the lubrication system requirements IAW Appendix S, paragraph 3.7.7.3.4. and Appendix S, paragraphs 4.5.4.4. and 4.6.6.6. The Loss of Oil requirement shall be verified by test. A test plan and test report shall be submitted IAW DI- NDTI-80566 and DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.8.5. APU Lubrication System Pressure Test
The purpose of the test is to demonstrate that the lubrication system can withstand pressure cycling , without permanent deformation or fatigue damage, of the stresses imposed by pressurization, APU vibration and cyclic stresses imposed by variation in ambient pressure throughout the life cycle.

Criteria:
The APU mounted oil reservoir and mountings shall not have permanent deformation due to the stresses imposed by reservoir pressurization, APU vibration, and cycle stresses.

Standard:
Appendix S, paragraph 3.3.6.1.
Appendix S, paragraph 3.7.7.1.
Appendix S, paragraph 3.7.7.4.1.
Appendix S, paragraph 3.7.7.4.1.1. through Appendix S, paragraph 3.7.7.4.7.
Appendix E, paragraph 5.4.3.
Appendix E, paragraph 5.6.1.
Appendix E, paragraph 5.10.

Method of Compliance:
The APU mounted reservoir tank with filler cap installed, fittings, pressure valves, and oil tank shall be subjected to positive and negative differential pressures, cyclic fatigue, proof pressure and associated valve tests IAW Appendix S, paragraph 3.7.7.4.1. through 3.7.7.4.7. and Appendix E, paragraph 5.6.1. The airworthiness substantiation (IAW Appendix E, paragraph 5.10) shall include a Test Plan IAW DI-NDTI-81895 & DI-REL-80322 and a Test Report IAW DI-NDTI-81897, or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.8.6. APU Internal Oil Leakage
The purpose of this analysis is to evaluate the effects of internal oil leakage on APU performance. Oil leakage within the APU has caused APU fires, lack of bearing lubrication and coking within the bearing compartments.

Criteria:
Operation of the APU with internal oil leakage shall not cause oil discharge from the APU upon subsequent starting after shutdown, adversely affect oil supply determination, cause contamination of compressed air, cause residual fires in the APU after shutdown, cause deposits, or produce visible smoke.

Standard:
Appendix S, paragraph 3.7.7.3.2.

Method of Compliance:
The lubrication system shall be designed such that internal leakage does not adversely impact APU operation as specified in Appendix S, paragraph 3.7.7.3.2. The airworthiness substantiation shall include an Internal Oil Leakage Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.8.7. APU Lubrication Components Simulated Operational Test (SOT).
The purpose of the SOT is to demonstrate IOC life, as approved by the Using Service, for all lubrication system components and accessories. SOTs are used to verify that the components can operate reliably throughout all the missions and preclude early failures in service.

Criteria:
The APU lubrication system components and accessories shall operate when exposed to a simulated environment.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.3.
Appendix E, paragraph 5.10.
Appendix S, paragraph 4.6.2.2.
Appendix S, Table XVII-B

Method of Compliance:
The APU lubrication components and accessories shall operate satisfactorily when exposed to simulated operational environments IAW Appendix E, paragraphs 5.1. and 5.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an APU Lubrication System SOT Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an

APU Lubrication SOT Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.8.8. Lubrication System Performance Test
The purpose of performance testing is to ensure that components will survive both real world and exaggerated environments while continuing to meet their individual performance requirements.

Criteria:
The APU lubrication system components and accessories shall operate throughout the full range of environments.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.4.
Appendix E, paragraph 5.10.
Appendix S, paragraph 3.7.7.
Appendix S, paragraph 3.7.7.3.

Method of Compliance:
The APU lubrication components and accessories shall meet their individual performance requirements when tested IAW Appendix E, paragraphs 5.1. and 5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.9. APU Bleed Air System
The APU bleed air system must be shown to provide the proper amount of air for all customer functions and safely operate under all APU operating conditions.

7.3.8.9.1. APU Bleed Air Systems
The purpose of this analysis is to ensure that bleed flow required for all aircraft functions, including anti-icing, remains viable during all portions of the mission. It is important that no power demand adjustment is required for bleed flow modulation.

Criteria:
The APU shall provide bleed air without degrading APU operation.

Standard:
Appendix S, paragraph 3.1.2.11.

Method of Compliance:
APU bleed air systems provide the proper amount of bleed air during ground and flight operation, under all atmospheric conditions and for all flight conditions in the air vehicle operating envelope IAW Appendix S, paragraph 3.1.2.11. The airworthiness substantiation shall include an APU Bleed Air Systems Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.9.2. APU Customer Bleed Air

The purpose of this analysis and test is to ensure customer bleed air is not contaminated and the pressure, temperature, and flow are IAW APU specification. Bleed air is normally used for cabin heat, air must be supplied with minimal contaminants to assure no possibility of a health hazard to the crew or interfere with their ability to perform the mission prior to initial flight testing.

Criteria:
The APU shall provide contaminant free bleed air extraction for safe operation of initial flight tests. The APU shall provide bleed air without degrading APU operation while providing customer bleed air to specified requirements.

Standard:
Appendix S, paragraph 3.1.2.11.
Appendix S, paragraph 3.1.2.11.3.
Appendix S, paragraph 4.4.3.
Appendix S, paragraph 4.5.1.2.3.1.
Appendix S, paragraph 4.6.1.2.3.1.

Method of Compliance:
The APU customer bleed air shall be tested to proper pressure, temperature, air flow and contaminant level IAW Appendix S, paragraphs 3.1.2.11. and 3.1.2.11.3. and tested per Appendix S, paragraphs 4.4.3., 4.5.1.2.3.1., and 4.6.1.2.3.1. The airworthiness substantiation shall include an APU Customer Bleed Air Analysis Report prepared IAW DI-MISC-80711, an APU Customer Bleed Air Test Plan IAW DI-NDTI-80566, and an APU Customer Bleed Air Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.9.3. APU Bleed Connection Loads

Criteria:
The purpose of this analysis and test is to demonstrate the capability of the bleed air ports to sustain operating loads during the APU life cycle.

The APU bleed hardware attachment loads and maneuver loads shall not degrade bleed air APU connections.

Standard:
Appendix S, paragraph 3.1.2.11.1. Appendix S, paragraphs 4.5.1., 4.6.1.
Appendix S, paragraphs 4.5.1.5., 4.5.1.6.
Appendix S, paragraphs 4.6.1.5., 4.6.1.6.

Method of Compliance:
The maximum bleed connection loads as specified in Appendix S, paragraph 3.1.2.11.1. shall be imposed on the APU Combined Test 4.6.1. The airworthiness substantiation shall include documentation of the maximum bleed connection loads used in the APU Composite Test IAW Appendix S, paragraph 4.5.1. and 4.6.1. and DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.9.4. APU Bleed Air Systems Simulated Operational Test (SOT)
The purpose of the SOT is to demonstrate life, as approved by the Using Service, for all bleed air components. SOTs are used to verify that the components can operate reliably throughout all the missions and preclude early failures that may occur in service.

Criteria:
The APU bleed air system components and accessories shall operate when exposed to a simulated environment.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.3.
Appendix E, paragraph 5.10.
Appendix S, paragraph 4.6.2.2.
Appendix S, Table XVII-B

Method of Compliance:
APU bleed air system components and accessories shall operate satisfactorily when exposed to simulated operational environments IAW Appendix E, paragraphs 5.1. and 5.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an APU Bleed Air Systems SOT Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an APU Bleed Air Systems SOT Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.9.5. APU Bleed Air Components Performance Test

The purpose of the testing is to ensure bleed air components will survive real world environments and continue to meet their individual performance requirements.

Criteria:
The APU bleed air system components and accessories shall operate satisfactorily throughout the full range of environments.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.4.
Appendix E, paragraph 5.10.

Method of Compliance:
APU bleed air components shall meet their individual performance requirements when tested IAW Appendix E, paragraph 5.1. and 5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an APU Bleed Air Components Performance Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an APU Bleed Air Components Performance Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.9.6. APU Bleed Air Components Pressure Tests

The purpose of the testing is to ensure bleed air components will survive pressures and pressure cycles during the lifecycle and continue to meet their individual performance requirements.

Criteria:
The APU bleed air system components and accessories shall operate throughout the full range of pressures.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.5.2.
Appendix E, paragraph 5.5.3.
Appendix E, paragraph 5.5.4.
Appendix E, paragraph 5.10.

Method of Compliance:
APU bleed air components shall meet their individual performance requirements when tested IAW Appendix E, paragraph 5.1., 5.5.2., 5.5.3., and 5.5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.9.7. Air Inlet Design and Dimensions
The purpose of the air inlet design and dimensions requirement is to ensure the interface dimensions are specified.

Criteria:
The air inlet shall interface with the aircraft.

Standard:
Appendix S, paragraph 3.1.2.10.1.

Method of Compliance:
The air inlet design and dimensions shall be verified by inspecting the as-built hardware to ensure the inlet conforms to the ICD and installation drawing.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.9.8. Air Inlet Screen
The purpose of the air inlet screen requirement is to prevent the ingestion of FOD into the APU.

Criteria:
The air inlet shall protect the APU from FOD damage.

Standard:
Appendix S, paragraph 3.1.2.10.4.

Method of Compliance:
The air inlet screen shall be verified by inspecting the as-built hardware to ensure the screen conforms to the APU specification and engineering drawing.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.9.9. Inlet Particle Separator/Inlet Barrier Filter (IPS/IBF)
The purpose of the IPS/IBF requirement is to ensure the IPS/IBF is removable and does not adversely affect performance.

Criteria:
The IPS/IBF shall be removable and no adverse impact to performance.

Standard:
Appendix S, paragraph 3.2.1.
Appendix S, paragraph 3.1.2.10.5.

Method of Compliance:
The IPS/IBF requirement shall be verified by demonstration to show the IPS/IBF is removable. The IPS/IBF requirement shall be verified by analysis IAW Appendix S, paragraph 3.2.1. and submitted to the Using Service IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.9.10. Surge Control Bleed Valve(s)
The purpose of the surge control bleed valve(s) requirement is to protect the APU from surge and regulate bleed air IAW the APU specification.

Criteria:
The surge control bleed valves shall protect against surge and nonconforming bleed air flow.

Standard:
Appendix S, paragraph 3.1.2.11.4.
Appendix S, paragraph 4.5.2., 4.5.2.5., 4.6.2.2., 4.6.2.3., 4.6.2.4.

Method of Compliance:
The surge control bleed valve(s) requirement shall be verified by analysis and test. An analysis (IAW Appendix S, paragraphs 4.5.2., 4.5.2.5., 4.6.2.2., 4.6.2.3., and 4.6.2.4.) shall be submitted IAW DI-MISC-80711. A test plan and test report shall be verified IAW DI-NDTI-80566 and IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.10. APU Subsystem Rotating Components
High-energy controls and subsystem rotating components must be designed to be damage tolerant or have provisions for containment of failed parts. It must also be shown that changes in bearing thrust balance do not result in the bearing operating in failure prone regions of operation.

7.3.8.10.1. APU Overspeed and Containment Test

The purpose of the analysis and tests is to verify the capability of components with high energy rotating elements in order to protect crew and equipment from impact damage upon component failure.

Criteria:
The APU control components and accessories shall have containment capability.

Standard:
Appendix E, paragraph 5.5.1.
Appendix E, paragraph 5.10.

Method of Compliance:
APU control components and accessories containing rotating elements shall be analyzed and tested IAW Appendix E, paragraph 5.5.1. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an APU Overspeed and Containment Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an APU Overspeed and Containment Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.10.2. Alternator Test

The purpose of this analysis or test is to demonstrate the containment capability of APU driven alternators in order to protect crew and equipment from impact damage upon component failure.

Criteria:
The APU alternator shall have containment capability.

Standard:
Appendix E, paragraph 5.6.2.
Appendix E, paragraph 5.10.

Method of Compliance:
The APU alternator shall demonstrate via test (or analysis) that it is capable of safely containing a failure of its rotor componentry, IAW Appendix E, paragraph 5.6.2. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Test Report prepared IAW DI-NDT--81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-8189.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.11. APU Tubing/Plumbing and Externals

All APU mounted tubing, manifolds and clamps must be safely affixed and routed on the APU. All APU mounted components must be shown to be free from natural frequencies within the APU and air vehicle operating ranges or that any such natural frequencies are sufficiently damped under maximum excitation levels in order that specified fatigue life is achieved. All pressure vessels, tubes and manifolds shall have design margin for their maximum operating conditions.

7.3.8.11.1. Reserved.

7.3.8.11.2. APU Heat Exchanger Cycling and Proof Pressure Test

The purpose of analysis and tests is to verify that the components can safely operate during over pressurization events throughout their life cycle without rupture. Proof pressure, flow, pressure, and temperature cycling test shall be performed.

Criteria:
The APU mounted heat exchangers shall withstand over pressurization without rupture.

Standard:
Appendix E, paragraph 5.6.3.
Appendix E, paragraph 5.10.

Method of Compliance:
APU mounted heat exchangers shall be cyclically pressure tested followed by the proof pressure test to demonstrate fatigue , IAW Appendix E, paragraph 5.6.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an APU Heat Exchanger Proof and Cycling Pressure Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an APU Heat Exchanger Proof and Cycling Pressure Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.11.3. Flammable Fluid Systems

The purpose of the test is to demonstrate that subsystem lines, fittings and components are fire resistant/fireproof to ensure those items do not contribute additional fire risk to the platform upon an event that ignites a fire.

Criteria:
The APU mounted lines, fittings and components shall not contribute to a fire risk.

Standard:
AC20-135
AS 1055E

AS 4273A
Appendix S, paragraph 3.3.6.1.
Appendix S, paragraph 4.5.2.
Appendix S, paragraph 4.6.2.
Appendix E, paragraphs 5.5., 5.5.5. and 5.10.

Method of Compliance:
Individual lines, fittings, components or assemblies shall be tested as specified in AC20-135, AS 1055E and AS 4273A IAW Appendix S, paragraph 3.3.6.1., and Appendix E, paragraphs 5.5. and 5.5.5. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, a Test Report IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.11.4. Fire Prevention
The purpose of the fire prevention requirement is to identify locations where APU surface temperatures are sufficient to ignite flammable fluids.

Criteria:
The APU specification shall specifically identify locations where APU surface temperatures are sufficient to ignite flammable fluids and specify if a fire shield is required.

Standard:
Appendix S, paragraph 3.3.6.1.1.

Method of Compliance:
The fire prevention requirement shall be verified by reviewing the APU specification, ICD, engineering drawings, and installation drawings.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.11.5. APU Control System Safety
The purpose of the control system safety requirement is to have a safe control system.

Criteria:
The APU control system shall operate safely.

Standard:
Appendix S, paragraph 3.3.6.6.

Method of Compliance:
The APU control system safety requirement shall be verified by analysis. An analysis shall be submitted IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.11.6. Fluid Leakage
The purpose of the fluid leakage requirement is to ensure there is no leakage from any part of the APU except through provided drains.

Criteria:
The APU shall not leak except through the drains provided for this purpose.

Standard:
Appendix S, paragraph 3.3.6.3.

Method of Compliance:
The APU fluid leakage requirement shall be verified by analysis. An analysis shall be submitted IAW DI-MISC-80711, The APU fluid leakage requirement shall also be verified by reviewing the APU specification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.11.7. Air and Gas Leakage
The purpose of the air and gas leakage requirement is to ensure there is no safety hazard or aircraft damage attributed to air or gas leakage.

Criteria:
There shall be no air and gas leakage of USTI temperature and/or concentrated impingement to present a safety hazard or affect installation requirements.

Standard:
Appendix S, paragraph 3.1.2.9.

Method of Compliance:
The air and gas leakage requirement shall be verified by analysis. An analysis shall be submitted IAW DI-MISC-80711, The APU air and gas leakage requirement shall also be verified by reviewing the APU specification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.11.8. Purging of Combustible Fluids

The purpose of the purging of combustible fluids requirement is to provide provisions to prevent accumulation of fluids in the APU.

Criteria:
The APU shall not accumulate combustible fluids.

Standard:
Appendix S, paragraph 3.3.6.4.

Method of Compliance:
The purging of combustible fluids requirement shall be verified by analysis. An analysis shall be submitted IAW DI-MISC-80711, The APU fluid leakage requirement shall also be verified by reviewing the APU specification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.11.9. Ground Safety

The purpose of the ground safety requirement is to provide warning notices for hazards.

Criteria:
The APU warning notices shall be established.

Standard:
Appendix S, paragraph 3.3.6.5.

Method of Compliance:
The APU ground safety requirement shall be verified by reviewing engineering drawings.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.11.10. Air Intake Design for Fire Prevention

The purpose of the air intake design is to preclude fire.

Criteria:
The APU air intake design provisions for fireproofing and flammable fluid avoidance.

Standard:
Appendix S, paragraph 3.1.2.10.6.
Appendix S, paragraph 3.1.2.10.7.

Method of Compliance:
The APU design drawings and the as-built hardware shall be inspected for compliance.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.12. APU Electrical Components and Harnesses

It must be shown that all APU mounted electrical components and cabling are safely affixed and routed on the APU, can safely operate in the lightning and electromagnetic effects environment of the air vehicle, do not react to APU or air vehicle induced vibratory and acoustic excitations and electrical power is supplied to all safety critical APU systems under all flight conditions.

7.3.8.12.1. APU Electrical Component Simulated Operational Test (SOT)

The purpose of the SOT is to demonstrate acceptable IOC life, as approve by the Using Service, for all electrical components. SOTs are used to verify that the components can operate reliably throughout all the missions and preclude early failures that may occur in service.

Criteria:

The APU electrical system components and accessories shall operate satisfactorily when exposed to a simulated environment.

Standard:

Appendix E, paragraph 5.1.
Appendix E, paragraph 5.3.
Appendix E, paragraph 5.10.
Appendix S, paragraph 4.6.2.2.
Appendix S, Table XVII-B

Method of Compliance:

APU electrical system components and accessories shall operate when exposed to simulated operational environments IAW Appendix E, paragraphs 5.1. and 5.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an APU Electrical Component SOT Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an APU Electrical Component SOT Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		TSO C77b		

7.3.8.12.2. APU Explosive Atmosphere Test

The purpose of the tests is to ensure that all electrical/electronic components are explosion proof, since an explosive atmosphere may exist near the component.

Criteria:

The APU subsystem components shall be capable of operation in an explosive atmosphere without incident.

Standard:
Appendix E, paragraph 5.4.9.
Appendix E, paragraph 5.10.
Appendix S, paragraph 3.3.6.2.

Method of Compliance:
All electrical components not hermetically sealed, or components with moving parts capable of creating a spark, shall meet the requirements of Appendix E, paragraph 5.4.9. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Explosive Atmosphere Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, an Explosive Atmosphere Test Report IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896, prior to the initiation of the PFR.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160		TSO C77b. APU Electrical System Component Performance		

7.3.8.12.3. APU Electrical Component E3 Test
The purpose of the testing is to demonstrate that the APU will operate in the E3 environment and the electromagnetic interface to the aircraft. APU electrical components will be subjected to various electromagnetic environments from sources within the aircraft as well as those external which degrade APU performance.

Criteria:
The APU electrical and electronic equipment and subsystems shall not have emissions that could interfere with platform co-located equipment. The APU electronics shall not be susceptible when exposed to an external electromagnetic environment.

Standard:
MIL-STD-461
RTCA/DO-160
Appendix E, paragraph 5.7.
Appendix E, paragraph 5.10.
Appendix I
Paragraph 13. of this document
Paragraph 20.1. of this document
Appendix S, paragraphs 3.3.2. through 3.3.2.3.
Appendix S, paragraph 4.5.1.1.2.
Appendix S, paragraph 4.6.1.1.2.
Appendix S, paragraph 4.6.7.

Method of Compliance:
All APU electrical and electronic equipment and subsystems shall meet their performance requirements when subjected to the susceptibility, emission, electromagnetic pulse and lightning requirements of MIL-STD-461, RTCA/DO-160 and Appendix E, paragraph 5.7., and Appendix S, paragraphs 4.5.1.1.2., 4.6.1.1.2. and 4.6.7. The airworthiness substantiation shall include an EMI control plan and EMI/EMC test plan prepared prior to the initiation of the PFR IAW DI-EMCS-80199 and DI-EMCS-80201. A system analysis shall be prepared prior to PFR IAW DI-MISC-80711. Test reports shall be submitted IAW Appendix E, paragraph 5.10. and DI-EMCS-80200. In addition, E3 requirements are defined in paragraph 13. herein, and Appendix I.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.12.4. High Altitude Electromagnetic Pulse (HEMP)
The purpose of EMP/HEMP testing is to determine how flight critical subsystems and equipment respond to exposure to an EMP/HEMP.

Criteria:
The APU electronics items shall survive, remain safe, and meet their operational performance requirements when exposed to the EMP/HEMP environment.

Standard:
MIL-STD-2169
MIL-STD-464, paragraph 5.6.
Appendix S, paragraph 3.3.2.4.
Appendix E, paragraph 5.7.2.

Method of Compliance:
If specified by the procuring authority, the APU, and its associated electronic components, shall meet its operational performance requirements when exposed to the EMP/HEMP environment of MIL-STD-464, paragraph 5.6.

This environment is classified and is defined in MIL-STD-2169. EIDs defined as having a safety function shall have a minimum of 16.5. dB safety margin. EIDs defined as having a reliability function shall have a minimum of 6 dB safety margin.

The item under test shall be production representative. Compliance shall be verified by test and/or analysis. The airworthiness substantiation shall include an EMP Test Plan and Procedure Report IAW DI-EMCS-81541 and an EMP Test Report IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.12.5. Initial Nuclear Radiation (INR)
The purpose of the Initial Nuclear Radiation (INR) requirement is to ensure APU survivability when subject to INR. The system (aircraft level) specification shall be reviewed to determine applicability of this requirement.

Criteria:
All APU electrical and electronic equipment and subsystems shall enter a fail fixed mode, if normal operation cannot be maintained when subjected to INR.

Standard:
Appendix S, paragraph 3.3.2.5.
Appendix S, paragraph 3.3.4.

Method of Compliance:
The requirements of Appendix S, paragraphs 3.3.2.5. and 3.3.4. shall be verified by tests. A Test Plan IAW DI-NDTI-80566 and a Test Report IAW DI-NDTI-80809 shall be submitted.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.12.6. Cyber Attacks
The purpose of the cybersecurity requirement is to provide a means to ensure airworthiness, or the ability of the APU to safely attain, sustain, and complete flight under adversary offensive cyber operations.

Criteria:
The APU and APU control system preliminary design shall implement best practices to mitigate potential cyber-attacks. Any cybersecurity vulnerability gaps within the system software shall be identified and classified.

Standard:
NIST SP 800-53 Rev 4
DoDI 8510.01
AMACC Section 20.1. Cybersecurity
Appendix S, paragraph 3.3.2.6.
Appendix S, paragraph 4.6.7.1.

Method of Compliance:
The requirements of Appendix S, paragraph 3.3.2.6. shall be verified by analysis, demonstrations, and tests IAW Appendix S paragraph 4.6.7.1. The airworthiness substantiation shall include standards, tools, and methods used to meet the identified cybersecurity requirements in Section 20 of the AMACC. Substantiation shall also include a Software Vulnerability Assessment IAW DI-MISC-80711 and prepared IAW NIST SP 800 161 and DFARS 252.239 7018. This assessment shall include a Program Protection Implementation Plan (PPIP). As a part of the PPIP, the process shall

document the evaluation of supplied software/firmware and reuse software/firmware (both initial acquisitions and updates) for vulnerability implications according to Government supplied criteria. This applies to both software development environment infrastructure software/tools and to deliverable software firmware. Any cybersecurity vulnerability gaps identified shall be classified.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.12.7. APU Electrical System Component Performance

The purpose of the testing is to ensure components will survive both real world and exaggerated environments while continuing to meet their individual performance requirements.

Criteria:

The APU electrical system components and accessories shall function throughout the full range of environments.

Standard:

Appendix E, paragraph 5.1.
Appendix E, paragraph 5.4.
Appendix E, paragraph 5.10.

Method of Compliance:

APU electrical system components shall meet their individual performance requirements when tested IAW Appendix E, paragraphs 5.1. and 5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an APU Electrical System Component Performance Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an APU Electrical System Component Performance Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896, prepared prior to the initiation of the APU QT.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.12.8. APU Electrical Power/Loads Analysis

The purpose of this analysis is to ensure APU electrical power does not exceed the maximum current draw from the aircraft.

Criteria:

The APU electrical components that utilize airframe power shall not exceed the maximum current draw from the aircraft electrical power system to ensure safe aircraft operation.

Standard:
Appendix E, paragraph 5.6.4.2.
Appendix E, paragraph 5.10.
Appendix S, paragraph 4.5.2.3.

Method of Compliance:
APU electrical components that utilize airframe power as either a primary or backup power source shall be analyzed to ensure maximum current draw does not exceed circuit breaker capacity IAW Appendix E, paragraph 5.6.4.2. and Appendix S, paragraph 4.5.2.3. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an APU Airframe Power Analysis Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.12.9. APU Electrical Component Short Circuit Protection
The purpose of the design requirement and testing is to ensure that electrical components will recover from temporary short circuit conditions and will not propagate failures to other interconnected components. Electrical insulation can become embrittled at low temperatures causing electrical shorts. Electrical shorts to ground can lead to system damage and APU system failure.

Criteria:
APU electronic components shall operate safely when subjected to short-circuit conditions in the interconnecting cables or component connectors.

Standard:
Appendix E, paragraph 5.6.4.5.
Appendix E, paragraph 5.10.
Appendix S, paragraphs 3.7.4.9. through 3.7.4.9.3.

Method of Compliance:
The APU electrical components shall meet the short circuit protection requirements specified in Appendix S, paragraph 3.7.4.9. through 3.7.4.9.3. when tested IAW Appendix E, paragraph 5.6.4.5. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an APU Electrical Component Short Circuit Protection Analysis Report prepared IAW DI-NTDI-80711, an APU Electrical Component Short Circuit Protection Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an APU Electrical Component Short Circuit Protection Test Report prepared IAW DI-NDTI-81897 or a Component Similarity A0072gument Report prepared IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.12.10. APU Electrical System Components

The APU electrical system components that utilize airframe power as either a primary or backup power source need to be compatible with standard platform electrical characteristics as defined by the relevant version of MIL-STD-704.

Criteria:

The APU electrical power system shall be compatible with the host aircraft's electrical power environment.

Standard:

Appendix S, paragraph 3.7.4.1.
Appendix S, paragraph 4.5.2.2.
Appendix S, paragraphs 4.5.2.2.2. through 4.5.2.2.2.2.3.
Appendix E, paragraph 5.6.4.
Appendix E, paragraph 5.6.4.4.
Appendix E, paragraph 5.10.

Method of Compliance:

Appendix S, paragraphs 4.5.2.2.2. through 4.5.2.2.2.2.3. and IAW Appendix E, paragraph 5.6.4. and 5.6.4.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an APU Electrical Power System Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, an APU Electrical Power System Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI- 81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.12.11. Generator/Alternator

The purpose of the generator testing is to ensure it will survive real world environments and continue to meet its individual performance requirements.

Criteria:

The generator shall meet the power requirements throughout the operating envelope of the generator.

Standard:

Appendix S, paragraph 3.7.4.1.1.

Method of Compliance:

The requirements of Appendix S, paragraph 3.7.4.1.1. shall be verified by analysis, demonstrations, and tests. The airworthiness substantiation shall include an Analysis IAW DI-MISC-80711, a Test Plan IAW DI-NDTI-80566, and a Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.12.12. Alternate Electrical Power

The purpose of the alternate electrical power requirement is to ensure the APU will automatically switch to an external power source and retain normal operation.

Criteria:
The APU shall continue operating after switching to alternate power.

Standard:
Appendix S, paragraph 3.7.4.2.

Method of Compliance:
The requirements of Appendix S, paragraph 3.7.4.2. shall be verified by analysis, demonstrations, and tests. The airworthiness substantiation shall include an Analysis IAW DI-MISC-80711, a Test Plan IAW DI-NDTI-80566, and a Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.12.13. Electrical Connectors and Cables

The purpose of the electrical connectors and cables requirements is to ensure the manufacturing and fabrication workmanship meets military and aerospace industry standards.

Criteria:
The electrical connectors and cables shall adhere to aerospace industry standards and manufacturing workmanship.

Standard:
Appendix S, paragraph 3.7.4.3.2.

Method of Compliance:
The requirements of Appendix S, paragraph 3.7.4.3.2. shall be verified by reviewing engineering drawings for adherence to military and aerospace industry standards. This requirement shall also be verified by demonstration by connecting and disconnecting connectors under the conditions specified.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.12.14. External Electrical Power
The purpose of the external electrical power requirements is to ensure that external APU electrical equipment utilizes specified power.

Criteria:
The APU electrical equipment normally utilizing external power shall operate with 28 VDC.

Standard:
Appendix S, paragraph 3.7.4.3.1.

Method of Compliance:
The requirements of Appendix S, paragraph 3.7.4.3.1. shall be verified analysis and test. An analysis report IAW DI-MISC-80711, a Test Plan IAW DI-NDTI-80566, and a Test Report IAW DI-NDTI-80809 shall be submitted. The requirements shall also be verified by reviewing the installation drawings.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.12.15. Digital Communication Signal Interface
The purpose of the digital communication signal interface requirements is to ensure the data format and timing requirements are identified and controlled using an ICD.

Criteria:
The digital communication signal interface shall be specified in an ICD.

Standard:
Appendix S, paragraph 3.7.4.3.3.

Method of Compliance:
The requirements of Appendix S, paragraph 3.7.4.3.3. shall be verified by reviewing the Interface Control Document (ICD).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.12.16. Electrical Bonding
The purpose of the electrical bonding requirement is to protect equipment and personnel from shock hazards.

Criteria:
The electrical bonding shall preclude electrical shock hazards.

Standard:
Appendix S, paragraph 3.7.4.5.
Appendix S, paragraph 4.6.8.1.

Method of Compliance:
The requirements of Appendix S, paragraph 3.7.4.5. shall be verified by analysis and test IAW Appendix S, paragraph 4.6.8.1. and MIL-STD-464D (Section 5.11.). An analysis report IAW DI-MISC-80711, a Test Plan IAW DI-NDTI-80566, and a Test Report IAW DI-NDTI-80809 shall be submitted. The requirements shall also be verified by reviewing the ICD, installation drawings, and engineering drawings for bonding provisions.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.12.17. Ground Isolation
The purpose of the ground isolation requirement is to ensure the APU to aircraft interface is not used as a power or signal return.

Criteria:
The ground isolation shall not require aircraft structure to be used as a power return. The ground isolation shall not provide a sneak path onto signal returns.

Standard:
Appendix S, paragraph 3.7.4.6.
Appendix S, paragraph 4.6.8.2.

Method of Compliance:
The requirements of Appendix S, paragraph 3.7.4.6. shall be verified by analysis and test IAW Appendix S, paragraph 4.6.8.2. An analysis report IAW DI-MISC-80711, a Test Plan IAW DI-NDTI-80566, and a Test Report IAW DI-NDTI-80809 shall be submitted. The requirements shall also be verified by reviewing the ICD, installation drawings, and engineering drawings for grounding provisions.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.12.18. Potting Compounds
The purpose of the potting compounds requirement is to preclude potting materials in repairable components, unless otherwise approved by the Using Service.

Criteria:
The potting compounds shall not be used in repairable components.

Standard:
Appendix S, paragraph 3.7.4.7.

Method of Compliance:
The requirements of Appendix S, paragraph 3.7.4.7. shall be verified by reviewing engineering drawings to ensure no potting materials are used in repairable components.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.8.12.19. Airframe Load Impedance
The purpose of the airframe load impedance requirement is to prevent damage to the APU from electrical exceedances.

Criteria:
The airframe load impedance shall prevent damage to the APU from electrical exceedances.

Standard:
Appendix E, paragraph 5.8.5.
Appendix S, paragraph 3.7.4.8.
Appendix S, paragraph 4.6.8.3.

Method of Compliance:
The requirements of Appendix S, paragraph 3.7.4.8. shall be verified by analysis and test IAW Appendix S, paragraph 4.6.8.3. and Appendix E, paragraph 5.8.5. For digital data links, the control system shall meet the electrical impedance requirements of the data link specification. An analysis report IAW DI-MISC-80711, a Test Plan IAW DI-NDTI-80566, and a Test Report IAW DI-NDTI-80809 shall be submitted.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.9. APU Air Vehicle Integration
The air vehicle drivetrain, propulsion subsystems and APU to air vehicle interfaces must provide for safe operation of the air vehicle under all operating conditions and possible failure modes.

7.3.9.1. APU Mounts
The purpose of this requirement is to demonstrate that the APU mounts are sufficiently strong for normal and safe operations throughout the specified service life.

Criteria:
The APU mounts shall secure and protect the APU under all operating conditions and failure modes.

Standard:
Appendix F, paragraph 4.

Method of Compliance:
The APU mounts meet the requirements of Appendix F, paragraph 4. and vibration surveys and testing completed IAW Appendix F, paragraph 4. The airworthiness substantiation shall include an APU Mounts Analysis Report prepared IAW DI-MISC-80711, an APU Mounts Test Plan IAW DI-NDTI-80566, and APU Mounts Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.9.2. APU Compartment Drainage

The purpose of this requirement is to demonstrate that the fluid drain system is compatible with the aircraft fluid collection system and prevents spillage or discharge of fluids during and after APU operation.

Criteria:
The aircraft propulsion system compartment drainage shall be compatible with the aircraft fluid collection system and prevents spillage or discharge of fluids.

Standard:
Appendix F, paragraph 2.3.
Appendix F, paragraph 12.

Method of Compliance:
The air vehicle propulsion system compartment drainage capability shall be functionally demonstrated IAW Appendix F, paragraph 2.3. and paragraph 12. The airworthiness substantiation shall include a Compartment Drainage Design Report prepared IAW DI-MISC-80711, an engine Compartment Drainage Test Plan IAW DI-NDTI-80566, and an Engine Compartment Drainage Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.9.3. APU/Airframe Compatibility Testing

The purpose of this testing is to demonstrate the interface requirements between the APU, and the airframe are met to ensure safe operation of the platform throughout its operating envelope and mission set.

Criteria:
The APU and airframe shall be functionally compatible.

Standard:
Appendix F, paragraph 3.

Method of Compliance:
The APU and airframe meets their respective ICD requirements and satisfactory operation is demonstrated IAW Appendix F, paragraph 3. APU/airframe compatibility testing. The airworthiness substantiation shall include an APU/Airframe Compatibility Analysis Report prepared IAW DI-MISC-80711, an APU/Airframe Compatibility Test Plan IAW DI-NDTI-80566, and APU/Airframe Compatibility Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.9.4. APU Performance and Operability

The purpose of this test is to demonstrate the aircraft's inlet systems effect on the APU's operability; including establishing the inlet distortion and environmental ingestion capability of the APU.

Criteria:
The APU air induction system shall function during all ground, flight, and environmental conditions without degrading the APU operation.

Standard:
APU ICD
Appendix F, paragraph 6.

Method of Compliance:
All expected ground, flight, induced and natural environmental conditions (e.g., inlet ice accretion and separation, distortion, sand and dust ingestion, water ingestion, gas ingestion) do not adversely affect APU performance and operability, are in compliance with APU ICD and demonstrated IAW Appendix F, paragraph 6. The airworthiness substantiation shall include an APU Performance and Operability Analysis Report prepared IAW DI-MISC-80711, an APU Performance and Operability Test Plan IAW DI-NDTI80566, and APU Performance and Operability Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.9.5. APU Exhaust

The purpose of this test is to demonstrate APU exhaust interface with the aircraft, ground equipment and personnel. APU exhaust swirl angles, pressure drop, and other performance parameters must be known to properly predict APU operation and performance as well as other equipment and personnel safety.

Criteria:
The APU direct exhaust gases shall not adversely affect the aircraft, personnel or degrade externally mounted equipment, fluid drains, air intakes, stores, rotor blades, or airframe structure.

Standard:
APU ICD
Appendix F, paragraph 7.

Method of Compliance:
The APU exhaust maintains structural integrity and meets the requirements of the APU ICD and demonstrated IAW Appendix F, paragraph 7. The airworthiness substantiation shall include an APU Exhaust Analysis Report prepared IAW DI-MISC-80711, an APU Exhaust Test Plan IAW DI-NDTI-80566, and APU Exhaust Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.9.6. APU Nacelle Temperature Test
The purpose of this test is to demonstrate that adequate APU nacelle cooling exists. APU bay cooling is designed to remove specified amount of heat to ensure that the APU mounted components are not exposed to temperatures beyond their design intent.

Criteria:
The APU Bay/nacelle cooling and ventilation provisions shall extract heat to ensure proper component operating temperatures and safe aircraft operation.

Standard:
Appendix F, paragraph 5.

Method of Compliance:
APU bay/nacelle cooling and ventilation provisions are adequate to maintain the temperatures of power plant components, fluids, other bay/nacelle equipment and structure within the temperature limits established for these components and fluids, underground and flight operating conditions, and after normal APU shutdown and demonstrated during testing IAW Appendix F, paragraph 5. The airworthiness substantiation shall include a Nacelle Temperature Analysis Report prepared IAW DIMISC-80711, a Nacelle Temperature Test Plan IAW DI-NDTI-80566, and Nacelle Temperature Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.9.7. Helicopter Drive System Torsional Stability

The purpose of helicopter drive system torsional stability requirement is to ensure the APU drive systems and connected drive systems are compatible, if applicable.

Criteria:
The helicopter drive system shall have positive torsional stability margin, as approved by the Using Service.

Standard:
Appendix S, paragraph 4.5.2.4.
Appendix E
ARP 704

Method of Compliance:
A torsional stability analysis of the helicopter drive system shall be conducted. The airworthiness substantiation shall include an Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.10. Design Control

7.3.10.1. Changes in Design, Vendors, or Fabrication Process

The purpose of the changes in design, vendors, or fabrication process requirement is to verify traceability for APU components and ensure that manufacturing planning and quality controls are being implemented and documented.

Criteria:
Parts, components, assemblies affected by changes in design, vendors, or fabrication process shall be documented.

Standard:
Appendix S, paragraph 3.3.9.4.1.
Appendix S, paragraph 3.3.9.4.2.

Method of Compliance:
Refer to the Statement of Work.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.10.2. Assembly of Components and Parts

The purpose of the assembly of components and parts requirement is to ensure the APU components are designed to take into account replaceability, serviceability, and (Murphy proof) interchangeability.

Criteria:

Components that are not structurally and functionally interchangeable with other parts on the same powerplant shall not be physically interchangeable (Murphy Proof). Parts and components shall be designed such that it is impossible to install them incorrectly. Connections located in close proximity to each other shall be made physically non-interchangeable. Each connection provided for powerplant instrumentation necessary to ensure operation of the powerplant shall be marked to identify it with its corresponding instrument IAW the ICD.

Standard:

Appendix S, paragraph 3.3.9.3.

Method of Compliance:

The assembly of components and parts requirement of Appendix S, paragraph 3.3.9.3. shall be substantiated by review of engineering and installation drawings. The requirement shall also be verified by demonstrating assembly of components and parts.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.10.3. Maintenance

The purpose of the maintenance requirements is to ensure the APU, APU subsystems, and APU components are integrated to take into account designing for modularity, inspection, serviceability, accessibility, replaceability, standard hardware, and wear limits without degrading performance, effectiveness, or reliability.

Criteria:

The as-built APU shall be capable of modular components, borescope inspection, service and accessibility, and use of standard tools.

Standard:

Appendix S, paragraph 3.2.4.
Appendix S, paragraphs 3.5.1. through 3.5.1.4.
Appendix S, paragraph 3.7.4.4.
Appendix S, paragraph 4.4.6.

Method of Compliance:

This requirement shall be verified by demonstration.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.10.3.1. Repair Procedures and Wear Limits
The purpose of the repair procedures and wear limits requirement is to provide instruction for continued airworthiness.

Criteria:
Criteria are instructions for continued airworthiness.

Standard:
Appendix S, paragraphs 3.5.1.5.
AMACC Section 16.2.

Method of Compliance:
This requirement shall be verified by submitting documentation per AMACC Section 16.2. Technical data shall be provided to support the Interactive Electronic Technical Manual (IETM) for the APU and the Depot Maintenance Work Requirement (DMWR) for the APU.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.10.4. Parts List
The purpose of the parts list requirement is to freeze the APU configuration undergoing qualification. The parts list for the APU configuration that successfully completes the PFR and QT verifications shall be the approved parts list for the respective APU model.

Criteria:
The parts list for the APU, including software version, that successfully completes the designated APU milestone verifications shall constitute the approved parts list.

Standard:
Appendix S, paragraph 3.3.9.2.

Method of Compliance:
The parts list shall be provided IAW DI-MISC-80711, which shall include hardware and software configuration. A bill of materials shall be provided prior to PFR and QT Testing IAW DI-ILSS-81169.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.10.5. Standardization

The purpose of the standardization requirement is to ensure uniformity and compatibility for APU components and configurations.

Criteria:
Standardization principles, standard parts, materials, processes, tools, subsystems, and components shall be used to the maximum extent possible without compromise in design, performance, operability, or economic life of the APU.

Standard:
Appendix S, paragraph 3.3.9.1.

Method of Compliance:
The standardization requirement IAW Appendix S, paragraph 3.3.9.1. shall be substantiated by reviewing engineering drawings to ensure standardization is applied.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.11. Manner of Testing and Reporting

The purpose of the Manner of Testing and Reporting requirements is to standardize the processes for testing, including but not limited to test surveillance, test configuration, test apparatus, test conditions, data, test reports.

Criteria:
The APU tests shall be IAW Appendix S, paragraphs 4.3. through 4.3.6.2.

Standard:
Appendix S, paragraphs 4.3. through 4.3.6.2.

Method of Compliance:
These requirements shall be verified by test plans and test reports approved by the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.12. Quality Verification

The purpose of the Quality Verification requirements section is to ensure the Using Service is provided the necessary documentation and test results when procuring an APU.

Criteria:
APU quality verifications shall include acquiring data, analyses, testing, and/or inspections subject to approval by the Using Service.

Standard:
Appendix S, paragraph 3.8.1.
Appendix S, paragraph 4.4.
Appendix S, paragraph 3.8.2.
Appendix S, paragraph 4.5.
Appendix S, paragraph 3.8.3.
Appendix S, paragraph 4.6.

Method of Compliance:
The APU Quality Verifications shall be IAW Appendix S, paragraphs 3.8.1. through 3.8.3.
The APU Quality Verifications shall be provided IAW DI-NDTI-80603 (Procedure) and DI-QCIC-81891 (Data Sheets) and approved at the discretion of the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.13. Acceptance Test
The purpose of the Acceptance Test requirements section is to ensure the Using Service is provided the necessary documentation and test results when procuring an APU.

Criteria:
Each APU submitted for delivery to the Using Service shall have an acceptance test conducted.

Standard:
Appendix S, paragraph 3.8.4.
Appendix S, paragraphs 4.7. through 4.7.7.

Method of Compliance:
The APU Acceptance Tests shall be IAW Appendix S, paragraphs 4.7. through 4.7.7.
The APU Acceptance Tests shall be provided IAW DI-NDTI-80603 (Procedure) and DI-QCIC-81891 (Data Sheets) and approved at the discretion of the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.3.14. Reserved

7.4. Reciprocating Engine
The engine and associated components will operate safely within the flight and maneuver envelope and operational environment.

7.4.1. Design and Construction
The engine and associated components shall be designed following an open system approach where feasible.

7.4.1.1. Item and Interface Definition

The engine configuration and interface definition shall be defined by the Using Service. A typical engine configuration consists of a compression ignition heavy fuel engine connected by extension shafting and a supporting structure to a single reduction gear assembly having a single propeller shaft offset from the engine. However, other engine configurations are supported.

7.4.1.1.1. Interface and Installation

The purpose of the interface and installation requirement is to ensure all interfaces adhere to aircraft specifications.

Criteria:
The Engine ICD shall define all mechanical, electrical, software, and dynamic interface requirements necessary to safely install and operate the engine in an air vehicle.

Standard:
Appendix U, paragraph 3.1.1.1.
Appendix U, paragraph 3.1.1.1.1.
Appendix U, paragraph 4.3.2.1.1.
Appendix U, paragraph 4.4.1.1.

Method of Compliance:
The interface and installation requirements of Appendix U, paragraph 3.1.1.1., 3.1.1.1.1., 4.3.2.1.1. and 4.4.1.1. shall be substantiated by documentation, inspection and demonstration.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.1.2. Interface Loads

The purpose of the interface loads requirement is to ensure the actual interface loads are within analytical values.

Criteria:
The maximum allowable loads for all parts that interface with the air vehicle shall be as shown in the Engine ICD.

Standard:
Appendix U, paragraph 3.1.1.3.
Appendix U, paragraph 4.4.1.3.

Method of Compliance:
The interface loads requirements of Appendix U, paragraph 3.1.1.3. shall be verified by analysis. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.1.3. and include an Interface Loads Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.1.3. Installation Hardware
The purpose of the installation hardware requirement is to ensure all propulsion system components are capable of being installed in the intended platform aircraft (i.e., drop in configurations).

Criteria:
The propulsion system shall be capable of installation in any air vehicle configuration to include multi-engine air vehicles with different engine locations.

Standard:
Appendix U, paragraph 3.1.1.2.
Appendix U, paragraph 4.4.1.2.

Method of Compliance:
The installation hardware requirements of Appendix U, paragraph 3.1.1.2. shall be substantiated by inspection and demonstration.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.1.4. External Forces and Mounts
The purpose of this analysis is to ensure engine components are designed to withstand the relatively infrequent, non-repetitive shocks, or transient vibrations induced by the external forces during flight maneuvers.

Criteria:
The engine shall operate after external forces are induced and not degrade performance.

Standard:
Appendix U, paragraph 3.1.1.4.1.
Appendix U, paragraph 3.1.1.4.2.
Appendix U, paragraph 4.4.1.4.1.
Appendix U, paragraph 4.4.1.4.2.

Method of Compliance:
The installation hardware requirements of Appendix U, paragraphs 3.1.1.4.1. and 3.1.1.4.2. shall be substantiated by analysis and test. An analysis shall be performed that provides sufficient evidence that the engine shall function satisfactorily under the conditions specified in Appendix U, paragraph 3.1.1.4.1. and 3.1.1.4.2., and that the engine shall withstand those conditions without permanent deformation and shall operate satisfactorily thereafter. The airworthiness substantiation shall include an External Forces and Mounts Analysis IAW DI-MISC-80711, an External Forces and Mounts Test

Plan IAW DI-NDTI-80566, and an External Forces and Mounts Test Report IAW DI-NDTI-80809 prior to the initiation of the PFR.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.1.5. Engine Stiffness

The purpose of the engine stiffness requirement is to ensure the engine is tolerant of external loads and moments without distortion.

Criteria:

The estimated stiffness of the engine in resisting loads and moments shall be IAW the ICD.

Standard:

Appendix U, paragraph 3.1.1.4.3.
Appendix U, paragraph 4.4.1.4.3.

Method of Compliance:

The engine stiffness requirements of Appendix U, paragraph 3.1.1.4.3. shall be verified by analysis. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.1.4.3. and include an Engine Stiffness Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.1.6. Power Command Signal

The purpose of the power command signal requirement is to define the commanded power (% max power) for operational ratings and signals.

Criteria:

The commanded power (% max power) for operational ratings and signals shall be IAW the ICD. Engine power response shall be continuous from Idle to Maximum power.

Standard:

Appendix U, paragraph 3.1.1.5.1.
Appendix U, paragraph 4.4.1.5.1.

Method of Compliance:

The power command signal requirements of Appendix U, paragraph 3.1.1.5.1. shall be verified by analysis and test. The power command signal requirements of Appendix U, paragraph 3.1.1.5.1. shall be conducted IAW Appendix U, paragraph 4.4.1.5.1. The airworthiness substantiation shall include a Power Commanded Signal Analysis IAW DI-MISC-80711, Power Commanded Signal Test Plan IAW DI-NDTI-80566, and a Power Commanded Signal Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.1.7. Emergency Engine Shutdown

The purpose of the emergency engine shutdown requirement is to demonstrate rapid shut down of the engine to preclude a runaway engine which may result in catastrophic damage to the aircraft or injury to personnel.

Criteria:

There shall be a means to allow the operator to rapidly shut off the engine to preclude a runaway engine (i.e. ECU shutdown or air intake shut-off).

Standard:

Appendix U, paragraph 3.1.1.5.4.
Appendix U, paragraph 4.4.1.5.4.

Method of Compliance:

An emergency engine shutdown demonstration, analysis and test shall be conducted IAW Appendix U, paragraph 4.4.1.5.4. The airworthiness substantiation shall include an Engine Emergency Shutdown Analysis IAW DI-MISC-80711, Engine Emergency Shutdown Test Plan IAW DI-NDTI-80566, and an Engine Emergency Shutdown Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.1.8. Lever Torque

The purpose of the lever torque requirement is to provide operational criteria for the mechanical commanded power interface for systems with mechanical power levers.

Criteria:

For systems with mechanical interfaces, the levers shall not move with the engine operating unless external force is applied and shall be free of abrupt changes in actuating torque throughout the levers operational range.

Standard:

Appendix U, paragraph 3.1.1.5.5.
Appendix U, paragraph 4.4.1.5.5.

Method of Compliance:

The lever torque requirements of Appendix U, paragraph 3.1.1.5.5. shall be substantiated by analysis and test conducted IAW Appendix U, paragraph 4.4.1.5.5. The airworthiness substantiation shall include a Lever Torque Analysis IAW DI-MISC-80711, Lever Torque Test Plan IAW DI-NDTI-80566, and a Lever Torque Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.1.9. Subsystem Interfaces

The purpose of the subsystem interfaces requirement is to ensure all interfaces adhere to aircraft specifications. The engine control system should be an integral part of the engine maintenance system and should be compatible with the aircraft data collection, ground support systems, and the maintenance support concept.

Criteria:

The engine electronic components with data bus communication interfaces shall properly operate to ensure safe operation of the aircraft.

Standard:

Appendix E, paragraph 5.10.
Appendix U, paragraph 5.6.4.6.
Appendix U, paragraph 3.1.1.6.
Appendix U, paragraph 4.4.1.6.

Method of Compliance:

Data bus communication interfaces shall be verified for compliance with aircraft specifications IAW Appendix E, paragraph 5.6.4.6. The airworthiness substantiation shall include a Data Bus Interfaces Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, a Data Bus Interfaces Test Reports IAW DI-NDTI-81897 or Component Similarity Argument Report IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.1.10. Lines and Fittings

The purpose of the lines and fittings requirement is to ensure fluid filled (i.e., fuel, lubricant, hydraulic fluid, etc.) system lines and fittings withstand normal maintenance installation and disassembly as required without leaking or failing.

Criteria:

The engine-mounted fluid filled lines, fittings and components shall not contribute to a leak or fail under normal maintenance procedures.

Standard:

Appendix U, paragraph 3.1.1.7.
Appendix U, paragraph 4.4.1.7.

Method of Compliance:

The lines and fittings requirements of Appendix U, paragraph 3.1.1.7. shall be conducted IAW Appendix U, paragraph 4.4.1.7. The airworthiness substantiation shall include a

demonstration, a Lines and Fittings Analysis IAW DI-MISC-80711, Lines and Fittings Test Plan IAW DI-NDTI-80566, and a Lines and Fittings Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.1.11. Drains and Fluid Collection Devices

The purpose of the drains and fluid collection devices requirement is to ensure the fluid drain system is compatible with the aircraft fluid collection system and prevents spillage or discharge of fluids during and after engine operation.

Criteria:

Fluid drains, drain characteristics, and collection requirements shall be shown in the ICD. Drains shall function statically and throughout the operating envelope.

Standard:

Appendix U, paragraph 3.1.1.8.
Appendix U, paragraph 4.4.1.8.

Method of Compliance:

The drains and fluid collection devices requirements of Appendix U, paragraph 3.1.1.8. shall be verified by analysis. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.1.8. and include a Drain and Fluid Collection Devices Analysis IAW DI-MISC-80711. During engine endurance and altitude testing, the source and amount of fluid drainage should be verified. Consideration should be given to simulating the drain actual pressure in the test cell to ensure the drains will work properly during flight.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.1.12. Power Absorber Characteristics

The purpose of the power absorber characteristics requirement is to characterize the component’s ability to absorb and dampen impact energy or shocks at powerplant interfaces.

Criteria:

The allowable range of characteristics of a shaft power absorber at the power absorber to powerplant interface shall be IAW the ICD.

Standard:

Appendix U, paragraph 3.1.1.9.
Appendix U, paragraph 4.4.1.9.

Method of Compliance:
The power absorber characteristics requirements of Appendix U, paragraph 3.1.1.9. and 4.4.1.9. shall be verified by diagram inspection, analysis and tests. The airworthiness substantiation shall include a Power Absorber Characterization Analysis IAW DI-MISC-80711, a Power Absorber Characterization Test Plan I AW DI-NDTI-80566, and a Power Absorber Characterization Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.1.13. Power Takeoff (PTO)
The purpose of the Power Takeoff (PTO) requirement is to ensure the PTO is functionally and dimensionally replaceable with respect to installation and performance.

Criteria:
When PTO pads and drives are provided for driving aircraft accessories, the ratings, clearance envelopes, dimensions, and other pertinent information shall be as shown in the ICD.

Standard:
Appendix U, paragraph 3.1.1.10.
Appendix U, paragraph 4.4.1.10.

Method of Compliance:
The Power Takeoff requirements of Appendix U, paragraph 3.1.1.10. and 4.4.1.10. shall be verified by demonstration of clearance envelopes, drawing review for dimension validation, a demonstration of accessibility, and capability tests of the PTO. The airworthiness substantiation shall include a PTO Capability Test Plan IAW DI-NDTI-80566, and a PTO Capability Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.1.14. Starting Drivetrain
The purpose of the starting drivetrain requirement is to ensure that the starting drivetrain can meet the starting torque and speed requirements within the times specified in the ICD throughout the aircraft operational envelope.

Criteria:
The starter drivetrain shall meet engine torque acceptance capability as specified in the ICD. If starting through a gearbox, failure of the air vehicle starting drivetrain shall not result in loss of remaining gearbox functions.

Standard:
Appendix U, paragraph 3.1.1.11.
Appendix U, paragraph 4.4.1.11.

Method of Compliance:
The starting drivetrain requirements IAW Appendix U, paragraph 3.1.1.11. shall be substantiated by analysis and testing. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.1.11. and include a Starting Drivetrain Analysis IAW DI-MISC-80711, a Starting Drivetrain Test Plan IAW DI-NDTI-80566, and a Starting Drivetrain Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.1.15. Starting Torque and Speed

The purpose of the test is to ensure that the engine starts with the specified minimum starting torque and speed characteristics, as defined by the EMS, to prevent field starting problems.

Criteria:
The engine shall start with minimum starting torque and speed.

Standard:
Appendix U, paragraph 3.1.1.11.1.
Appendix U, paragraph 4.4.1.11.1.

Method of Compliance:
The starting torque and speed requirements shall be subjected to a test to demonstrate the starting torque and speed requirements IAW Appendix U, paragraph 3.1.1.11.1. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.1.11.1. and include an Engine Starting Torque and Speed Test Plan IAW DI-NDTI-80566, and an Engine Starting Torque and Speed Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.1.16. Exhaust System Interface

The purpose of the exhaust system interface requirement is to demonstrate the exhaust interface with the aircraft. The exhaust pressure drop, and other performance parameters, must be known to properly predict engine operation and performance.

Criteria:
The interface of the engine with the air vehicle shall allow the engine to perform as required IAW the aircraft and engine ICD(s) and the aircraft specification.

Standard:
Appendix U, paragraph 3.1.1.14.
Appendix U, paragraph 4.4.1.14.

Method of Compliance:
The requirements of Appendix U, paragraph 3.1.1.14. shall be verified by demonstration and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.1.14. and include a Exhaust System Interface Test Plan IAW DI-NDTI-80566, and Exhaust System Interface Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.1.17. Compatibility – Engine and Air Vehicle

The purpose of this testing is to demonstrate the interface requirements between the engine and the airframe are met to assure safe operation of the platform throughout its operating envelope and mission set.

Criteria:
The engine and airframe shall be functionally compatible.

Standard:
Appendix F, paragraph 3.
Appendix U, paragraph 3.1.1.14.
Appendix U, paragraph 4.4.1.14.

Method of Compliance:
The engine and airframe meet their respective ICD requirements and satisfactory operation is demonstrated IAW Appendix F, paragraph 3. engine/airframe compatibility testing. The airworthiness substantiation shall include by demonstration, an Engine-Airframe Compatibility Test Plan IAW DI-NDTI-80566, and an Engine-Airframe Compatibility Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.1.18. Control System and Engine Accessory Components

Control system components, powerplant accessory components, and other functional subsystems of the powerplant, which are classified as an LRU (line replaceable unit), require qualification testing separate from the powerplant. These components and subsystems shall be identified.

Criteria:
Line Replaceable Unit (LRU) components and subsystems shall be identified.

Standard:
Appendix U, paragraph 3.1.1.15.
Appendix U, paragraph 4.4.1.15.

Method of Compliance:
The requirements of Appendix U, paragraph 3.1.1.15. shall be verified by inspection. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.1.15. and include Line Replaceable Unit Component List IAW DI-SAFT-81932 which shall be verified by inspection.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.1.19. Instructions for Continued Airworthiness

The purpose of the Instructions for Continuing Airworthiness (ICA) is to provide information to ensure the aircraft and subsystems are operated, modified, repaired, overhauled, and maintained in accordance with the approved design and are kept compliant with said design.

Criteria:
All installation, operation and maintenance instructions necessary to maintain airworthiness shall be defined in the ICA.

Standard:
MIL-STD-40051-1
MIL-STD-40051-2
DI-TMSS-81676
Appendix U, paragraph 3.1.1.16.
Appendix U, paragraph 4.4.1.16.

Method of Compliance:
The requirement of Appendix U, paragraph 3.1.1.16. shall be substantiated by the submittal of, at a minimum, the supplied information cited in Appendix U, paragraph 4.4.1.16. The airworthiness substantiation shall provide Technical Data essential for the instructions for continuing airworthiness of the aircraft, engine, ground control/support components, major dynamic and flight control components IAW MIL-STD-40051-1 and MIL-STD-40051-2. The technical data shall be prepared IAW DI-TMSS-81676.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.2. Physical Characteristics

7.4.1.2.1. Dry Weight of Complete Propulsion System

The purpose of the dry weight of complete propulsion system requirement is to ensure the propulsion system weight does not exceed the specification value.

Criteria:

The dry weight of the complete propulsion system shall not exceed that specified in the Engine Model Specification (EMS). Each qualification and production propulsion system should be weighed, using the same procedure, to ensure consistency.

Standard:

Appendix U, paragraph 3.1.2.1.
Appendix U, paragraph 4.4.2.1.

Method of Compliance:

The weight requirements of Appendix U, paragraph 3.1.2.1. shall be verified by demonstration. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.2.1. and include a Propulsion Physical Characteristics Summary Report IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.2.2. Weight of Residual Fluids

The purpose of the weight of residual fluids requirement is to ensure the propulsion system weight does not exceed the specification value.

Criteria:

The weight of residual fluids remaining in the engine, gearbox, and off mounted components after operation and drainage, while the engine is in a horizontal attitude of the crankshaft or eccentric shaft relative to the level plane, shall be specified herein. The weight of operating fluids shall also be specified in the model specification.

Standard:

Appendix U, paragraph 3.1.2.2.
Appendix U, paragraph 4.4.2.2.

Method of Compliance:

The weight requirements of Appendix U, paragraph 3.1.2.2. shall be verified by demonstration. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.2.2. and include a Propulsion Physical Characteristics Summary Report IAW DI-MISC-80711. These values shall be verified or modified prior to any Qualification Test.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.2.3. Wet Weight of Complete Propulsion System
The purpose of the wet weight of complete propulsion system requirement is to ensure the propulsion system weight does not exceed the specification value.

Criteria:
The wet weight of the complete propulsion system shall not exceed that specified in the model specification. Each qualification and production propulsion system should be weighed, using the same procedure, to ensure consistency.

Standard:
Appendix U, paragraph 3.1.2.3.
Appendix U, paragraph 4.4.2.3.

Method of Compliance:
The weight requirements of Appendix U, paragraph 3.1.2.3. shall be verified by demonstration. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.2.3. and include a Propulsion Physical Characteristics Summary Report IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.2.4. Weight of Additional Equipment
The purpose of the weight of additional equipment requirement is to ensure the propulsion system weight of additional propulsion system equipment does not exceed the specification value.

Criteria:
The weights of items which are not components of the engine or gearbox, but which are furnished with it shall be listed in the EMS.

Standard:
Appendix U, paragraph 3.1.2.4.
Appendix U, paragraph 4.4.2.4.

Method of Compliance:
The weight requirements of Appendix U, paragraph 3.1.2.4. shall be verified by demonstration. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.2.4. and include a Propulsion Physical Characteristics Summary Report IAW DI-MISC-80711. These items shall not be included in the dry weight of the engine or gearbox.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.2.5. Mass Moment of Inertia of Complete Engine
The purpose of the mass moment of inertia of complete engine requirement is to provide data for use in design and evaluation of aircraft subsystems, and overall aircraft design.

Criteria:
The Engine Model Specification (EMS) shall specify the maximum effective mass moment of inertial (slug-feet squared) of the complete dry engine core about three mutually perpendicular axes with the origin at the center of gravity.

Standard:
Appendix U, paragraph 3.1.2.5.
Appendix U, paragraph 4.4.2.5.

Method of Compliance:
The mass moment of inertia requirements of Appendix U, paragraph 3.1.2.5. shall be verified by analysis. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.2.4. and include a Propulsion Physical Characteristics Summary Report IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.3. Materials, Processes and Parts
The purpose of the analysis is to ensure the materials and processes used during the design and manufacture of the engine will meet all specification requirements.

Criteria:
The materials, coatings and processes used in the design and manufacture of the complete propulsion system shall be chosen, applied, and utilized such that they meet the specified requirements.

Standard:
Appendix U, paragraph 3.1.3.
Appendix U, paragraph 3.1.3.1.
Appendix U, paragraph 3.1.3.2.
Appendix U, paragraph 3.1.3.3.
Appendix U, paragraph 3.1.3.4.
Appendix U, paragraph 4.4.3.

Method of Compliance:
The materials, adhesives, and sealants used in the propulsion system shall meet the requirements of Appendix U, paragraph 3.1.3., 3.1.3.1., 3.1.3.2., 3.1.3.3. and 3.1.3.4. The airworthiness substantiation shall include a Material and Process Analysis IAW DI-MISC-80711, Material and Process Test Plan IAW DI-NDTI-80566, and a Material and Process Test Report IAW DI-NDTI-80809. The Material and Process Analysis report

may include any engine manufacturer's documents that are used for materials and processes.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.3.1. Cylinder Wall Coatings

The purpose of the cylinder wall coatings requirement is to ensure the suitability and durability of the cylinder wall coating used in the engine.

Criteria:

The suitability and durability of the cylinder wall coating used in the engine shall be based on minimum material capability, based on -3σ values.

Standard:

Appendix U, paragraph 3.1.3.3.
Appendix U, paragraph 4.4.3.3.

Method of Compliance:

The cylinder wall coatings requirements of Appendix U, paragraph 3.1.3.3. shall be conducted IAW Appendix U, paragraph 4.4.3.3. The airworthiness substantiation shall include a Cylinder Wall Coatings Analysis IAW DI-MISC-80711, Cylinder Wall Coatings Test Plan IAW DI-NDTI-80566, and a Cylinder Wall Coatings Test Report IAW DI-NDTI-80809

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.4. Fasteners

The purpose of the fasteners requirement is to ensure the suitability and locations where loss of the fastener could affect safety of flight or ability to control the engine.

Criteria:

A self-retaining, secondary means of retention, feature shall be used at points where loss of the fastener could affect safety of flight or ability to control the engine. Cotter pins, safety wire, or safety cable shall not be used to secure aforementioned fasteners.

Standard:

Appendix U, paragraph 3.1.4.
Appendix U, paragraph 4.4.4.

Method of Compliance:

The fastener requirements of Appendix U, paragraph 3.1.4. shall be verified by inspection and analysis. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.4. and include a Fasteners Assessment IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.5. Nameplate and Product Marking

The purpose of the marking/identification requirement is to provide positive designation, identification, tracking and management for engineering configuration control.

Criteria:

A plan for serialization and marking shall be defined. All Critical Safety Items (CSI) shall be serialized and marked.

Standard:

AMCOM Regulation 702-7
MIL-STD-130
Appendix U, paragraph 3.1.5.
Appendix U, paragraph 4.4.5.
Appendix U, paragraph 4.4.5.1.
Appendix U, paragraph 4.4.5.2.

Method of Compliance:

All CSIs, and depot repairable CAIs shall be marked and identified. Locations and methods of markings must be IAW drawings, technical data packages, contract quality assurance provisions, or through other contract requirements/clauses. Data format shall be IAW MIL-STD-130. All CSIs require individual serialization or identification by lot number for traceability. Serial number requirements may be identified on drawings in the technical data packages IAW MIL-STD-31000, and in contract quality assurance provisions, or through other contract requirements/clauses. An internal system for assigning serial numbers shall be developed. Serialization shall occur so that any individualized inspection/process that involves a critical characteristic is traceable to a specific serial number. All serial numbers approved for issue or provided by the Government shall be accounted for; this includes material scrapped during manufacturing (if item/product serialization has been assigned prior to final marking). Serial numbers used in this program shall not be used on any other part with the same basic part number (i.e., only a dash number or revision letter difference) manufactured by that contractor. The airworthiness substantiation shall include a Marking and Identification Plan developed IAW AMCOM Regulation 702-7, Appendix B, and MIL-STD-130 and prepared IAW DI-MISC-80508."

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.6. Transportability

The purpose of the transportability requirement is to ensure that materiel systems are designed, engineered, and constructed to preclude environmental or mechanical

damage during handling or transportation. Transportability approval is required prior to engineering and manufacturing development as well as prior to production and fielding.

Criteria:
The engine shall be designed for movement on, and be compatible with, standard aircraft maintenance trailers. Features shall be provided to permit installation on and use of appropriate static and mobile ground equipment.

Standard:
AR 70-47
Appendix U, paragraph 3.1.6.
Appendix U, paragraph 4.4.6.

Method of Compliance:
The transportability requirements of Appendix U, paragraph 3.1.6. shall be verified by analysis and demonstration. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.6. and include a Transportability Engineering Analysis IAW DI-MISC-80711. The analysis shall include all information necessary for the handling and transportation of the propulsion system components (e.g., blocking, bracing, slinging, lifting, and tiedown detail and procedures to assure safe handling; procedures to disassemble, load, restrain, and offload materiel; environmental preservation, etc.)

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.7. Interchangeability
The purpose of the interchangeability requirement is to ensure that parts with the same part number are interchangeable to reduce logistic support requirements, minimize maintenance and repair problems, and assure that engine performance and operability are not compromised.

Criteria:
The engine components and individual parts shall be functionally and dimensionally interchangeable and replaceable with each other with respect to installation and performance.

Standard:
Appendix U, paragraph 3.1.7.
Appendix U, paragraph 4.4.7.

Method of Compliance:
The interchangeability requirement shall meet the requirements of Appendix U, paragraph 3.1.7. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.7. and include an Interchangeability Analysis Report IAW DI-MISC-80711 of any matched or selected fit parts as well as any module replacement limits prepared prior to the initiation of the PFR.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.8. Safety

7.4.1.8.1. Flammable Fluids Systems

The purpose of the flammable fluids systems requirement is to demonstrate fluid filled (i.e., fuel, lubricant, hydraulic fluid, etc.) system lines, fittings and other components have fire resistant/fireproof capability to ensure they do not contribute additional fire risk to the platform upon an event that ignites a fire.

Criteria:
The engine-mounted fluid filled lines, fittings and components shall not contribute to a fire risk.

Standard:
AC20-135
AS 1055E
AS 4273A
Appendix E, paragraph 5.5.5.
Appendix E, paragraph 5-10.
Appendix U, paragraph 3.1.8.1.
Appendix U, paragraph 4.4.8.1.

Method of Compliance:
The flammable fluids systems requirement shall meet the requirements of Appendix U, paragraph 3.1.8.1. Individual lines, fittings, components or assemblies shall be tested as specified in AC20-135, AS 1055E and AS 4273A IAW Appendix U, paragraphs 3.1.8.1., as well as Appendix E, paragraph 5.5.5. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Flammable Fluid Systems Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Flammable Fluid Systems Test Report IAW DI-NDI-81897 or Component Similarity Argument Reports IAW DI-NDTI-81896 prior to PFR.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.8.2. Fire Prevention

The purpose of the fire prevention requirement is to ensure propulsion system components surface temperatures which can ignite flammable fluids are identified in the EMS.

Criteria:
Components with surface area temperatures sufficient to ignite flammable fluid shall be specifically identified in the EMS. If a fire shield is required, it shall be identified in the EMS.

Standard:
Appendix U, paragraph 3.1.8.2.
Appendix U, paragraph 4.4.8.2.

Method of Compliance:
The fire prevention requirement shall meet the requirements of Appendix U, paragraph 3.1.8.2. An analysis shall be performed to annotate propulsion system component surface areas in which temperatures may be sufficient to ignite flammable fluids used for operation or maintenance of the aircraft. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.8.2. and include a Fire Prevention Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.8.3. Explosion Proof
The purpose of the explosion proof requirement is to ensure that all electrical/electronic components are explosion proof since an explosive atmosphere may exist near the component.

Criteria:
The engine subsystem components shall be capable of operation in an explosive atmosphere without incident.

Standard:
Appendix E, paragraph 5.4.9.
Appendix E, paragraph 5.10.
Appendix U, paragraph 3.1.8.3.
Appendix U, paragraph 4.4.8.3.

Method of Compliance:
The explosion proof requirement shall meet the requirements of Appendix U, paragraph 3.1.8.3. All electrical components not hermetically sealed, or components with moving parts capable of creating a spark, shall be subjected to explosive atmosphere testing IAW Appendix E, paragraph 5.4.9. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Explosive Atmosphere Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, an Explosive Atmosphere Test Report IAW DI-NDTI-81897 or a Component Similarity Argument Report IAW DI-NDTI-81896, prior to the initiation of the PFR.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.8.4. Combustible Fluid Drains
The purpose of the combustible fluid drains requirement is to ensure that all areas where combustible fluids may collect can be cleared to preclude a safety hazard.

Criteria:
Provisions shall be made for clearing all vent areas and other pockets or compartments where combustible fluids may collect during or subsequent to operation of the engine.

Standard:
Appendix U, paragraph 3.1.8.4.
Appendix U, paragraph 4.4.8.4.

Method of Compliance:
The combustible fluid drain requirements shall meet the requirements of Appendix U, paragraph 3.1.8.3. and shall be verified by analysis, inspection and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.8.4. and include a Combustible Fuld Drain Analysis IAW DI-MISC-80711. The test should be performed as part of the attitude test (reference Appendix U, paragraph 3.2.2.2.; Appendix U, paragraph 4.5.2.2.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.8.5. Air and Gas Leakage
The purpose of the air and gas leakage requirement is to ensure there is no safety hazard or aircraft damage attributed to air or gas leakage.

Criteria:
There shall be no air and gas leakage of sufficient temperature and concentrated impingement to present a safety hazard, affect installation requirements, or adversely affect engine nacelle equipment.

Standard:
Appendix U, paragraph 3.1.8.5.
Appendix U, paragraph 4.4.8.5.

Method of Compliance:
The air and gas leakage requirement shall meet the requirements of Appendix U, paragraph 3.1.8.5. and shall be verified by analysis. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.8.5. and include a Air and Gas Leakage Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.8.6. Inlet Airflow Distortion

The purpose of the inlet airflow distortion requirement is to demonstrate the aircraft's inlet systems effect on the engine's operability, including establishing the inlet distortion and environmental ingestion capability of the engine. Early definition of the inlet distortion limits have proven to be necessary for successful integration of the engine into the aircraft and should be provided by the engine manufacturer as part of the tradeoffs that must be made during the design and development process.

Criteria:

The engine air induction system shall function during all ground, flight, and environmental conditions without degrading the engine performance or operation (i.e., turbocharger stall; turbocharger surge, flameout, etc.).

Standard:

Engine ICD
Appendix U, paragraph 3.1.8.6.
Appendix U, paragraph 4.4.8.6.

Method of Compliance:

The air and inlet airflow distortion requirement shall meet the requirements of Appendix U, paragraph 3.1.8.6. and shall be verified by analysis and tests. The air inlet shall not adversely affect engine performance or operability. The requirements shall be accomplished with a propulsion system compliant with the Engine ICD. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.8.6. and include an Inlet Design Analysis Report IAW DI-MISC-80711, an Engine Performance and Operability Test Plan IAW DI-NDTI-80566, and an Engine Performance and Operability Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.8.7. Pressure and Temperature Rate of Change

The purpose of the pressure and temperature rate of change requirement is to evaluate the sensitivity of the engine to pressure and temperature changes during weapon deployment.

Criteria:

For aircraft that will be used for missile deployment, the engine shall withstand the specified rate-of-change of pressure and temperature, separately or in combination without performance degradation (e.g., stall, flameout, etc.) or mechanical damage.

Standard:
Appendix U, paragraph 3.1.8.7.
Appendix U, paragraph 4.4.8.7.

Method of Compliance:
The pressure and temperature rate of change requirement shall meet the requirements of Appendix U, paragraph 3.1.8.7. and shall be verified by analysis and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.8.7. and include a Pressure and Temperature Rate of Change Analysis IAW DI-MISC-80711, a Pressure and Temperature Rate of Change Test Plan IAW DI-NDTI-80566, and a Pressure and Temperature Rate of Change Test Report IAW DI-NDTI-81897.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.8.8. Ground Safety

The purpose of the ground safety requirement is to ensure warning notices are provided where applicable to preclude safety hazards to aircraft maintainers.

Criteria:
Warning notices shall be provided, where applicable, for high voltage systems and sources, radioactive devices, explosive devices, high powered optical sources, and high temperature components.

Standard:
Appendix U, paragraph 3.1.8.8.
Appendix U, paragraph 4.4.8.8.

Method of Compliance:
The ground safety requirement shall meet the requirements of Appendix U, paragraph 3.1.8.8. and shall be verified by analysis and inspection. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.8.8. and include a Ground Safety Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.8.9. Exhaust Outlet

The purpose of the exhaust outlet requirement is to verify human safety requirements. Exhaust temperature and velocity profiles at operating conditions are measured to identify areas hazardous to personnel and equipment and provide data to ensure engine exhaust signature levels meet susceptibility requirements.

Criteria:
The exhaust system shall direct exhaust gases to the atmosphere clear of personnel, externally mounted equipment, fluid drains, air intakes, stores, and airframe structure.

Standard:
Appendix U, paragraph 3.1.8.9.
Appendix U, paragraph 4.4.8.9.

Method of Compliance:
The exhaust outlet requirement shall meet the requirements of Appendix U, paragraph 3.1.8.9. and shall be verified by analysis. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.8.p. and include a Exhaust Outlet Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.8.10. Fire Protection
The purpose of the fire protection requirement is to demonstrate the propulsion system is designed to have fire resistant/fireproof capability.

Criteria:
The propulsion system is designed to minimize the probability of the occurrence and spread of fire during normal operation and failure conditions as well as minimize the hazardous effects in the event of a fire.

Standard:
Appendix U, paragraph 3.1.8.10.
Appendix U, paragraph 4.4.8.10.

Method of Compliance:
The fire protection requirements IAW Appendix U, paragraph 3.1.8.10. shall be substantiated by analysis and testing IAW Appendix U, paragraph 4.4.8.10. and include a Fire Protection Analysis IAW DI-MISC-80711, a Fire Protection Test Plan IAW DI-NDT--80566, and a Fire Protection Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.9. Design Control

7.4.1.9.1. Parts List
The purpose of the parts list requirement is to freeze the propulsion system configuration undergoing qualification. The parts list for the propulsion system configuration that

successfully completes the PFR and QT verifications shall be the approved parts list for the respective engine model.

Criteria:
The parts list for the propulsion system, including software version, that successfully completes the designated engine milestone verifications shall constitute the approved parts list.

Standard:
Appendix U, paragraph 3.1.9.1.
Appendix U, paragraph 4.4.9.1.

Method of Compliance:
The parts list requirement IAW Appendix U, paragraph 3.1.9.1. shall be substantiated by inspection and a Parts List IAW Appendix U, paragraph 4.4.9.1. and include a Parts List IAW DI-MISC-80711, which shall include hardware and software configuration.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.9.2. Assembly of Components and Parts
The purpose of the assembly of components and parts requirement is to ensure the propulsion system components are designed to consider replaceability, serviceability, and (Murphy proof) interchangeability.

Criteria:
Components that are not structurally and functionally interchangeable with other parts on the same powerplant shall not be physically interchangeable (Murphy Proof). Parts and components shall be designed such that it is impossible to install them incorrectly. Connections located in close proximity to each other shall be made physically non-interchangeable. Each connection provided for powerplant instrumentation necessary to ensure operation of the powerplant shall be marked to identify it with its corresponding instrument IAW the ICD.

Standard:
Appendix U, paragraph 3.1.9.2.
Appendix U, paragraph 4.4.9.2.

Method of Compliance:
The assembly of components and parts requirement of Appendix U, paragraph 3.1.9.2. shall be substantiated by inspection and demonstration. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.9.2.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.9.3. Changes in Vendors or Fabrication Processes

The purpose of the changes in vendors or fabrication processes requirement is to verify traceability for propulsion components and ensure that manufacturing planning and quality controls are being implemented and documented properly.

Criteria:
Parts, components, and assemblies affected by changes in vendors or fabrication process shall be documented.

Standard:
Appendix U, paragraph 3.1.9.3.
Appendix U, paragraph 4.4.9.3.

Method of Compliance:
The requirements of Appendix U, paragraph 3.1.9.3. shall be substantiated by inspection, documentation and testing IAW Appendix U, paragraph 4.4.9.3. as deemed appropriate by the Using Authority. Substantiation IAW Appendix U, paragraph 4.4.9.3. shall include a Vendor and Fabrication Summary IAW DI-NDTI-81896. A Vendor and Fabrication Test Plan IAW DI-NDTI-80566, and a Vendor and Fabrication Test Report IAW DI-NDTI-80809 may be requested at the Using Authority discretion if testing is deemed necessary.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.9.4. Standardization

The purpose of the standardization requirement is to ensure uniformity and compatibility for propulsion system components and configurations.

Criteria:
Standardization principles, standard parts, materials, processes, tools, subsystems, and components shall be used to the maximum extent possible without compromise in design, performance, operability, or economic life of the engine.

Standard:
Appendix U, paragraph 3.1.9.4.
Appendix U, paragraph 4.4.9.4.

Method of Compliance:
The standardization requirement IAW Appendix U, paragraph 3.1.9.4. shall be substantiated by documentation, inspection and demonstration. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.9.4.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.1.10. Preservation and Storage.
The purpose of the preservation and storage requirement is to ensure materials are protected from harm, damage, pilferage or destruction by environmental factors with the intent of extending their serviceable life.

Criteria:
The propulsion system shall have a storage life as defined by the Engine Model Specification (EMS) and approved by the Using Service. Upon removal from storage, the propulsion system shall be readily returned to an operational status.

Standard:
Appendix U, paragraph 3.1.10.
Appendix U, paragraph 4.4.10.

Method of Compliance:
The preservation and storage requirement of Appendix U, paragraph 3.1.10. shall be substantiated by inspection and analysis. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.4.10. and include a Preservation and Storage Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.2. Performance and Operability
Engine performance under various conditions and loads (i.e., altitude, sea level, varying temperatures, power extraction, attitudes, power settings, etc.) as well as environmental conditions (icing, sand and dust, etc.) needs to be specified and measured to assess aircraft performance under these conditions.

Operability is the engine’s ability to start, accelerate and decelerate within prescribed limits without flameout. It must be verified that the engine has adequate combustion stability throughout the operating envelope, even with degraded engine factors, such that there is no loss of power or engine operation.

7.4.2.1. Performance Characteristics
The minimum engine performance characteristics (the poorest performing engine that would be submitted for acceptance) shall be based on specified criteria.

7.4.2.1.1. Engine Ratings and Operating Limitations
The purpose of the engine ratings and operating limitations requirement is to establish engine commanded power ratings for safe operation of the engine.

Criteria:
Engine ratings and operating limitations are established by the Original Equipment Manufacturer (OEM) and shall be included in the Engine Model Specification (EMS).

Standard:
Appendix U, paragraph 3.2.1.1.
Appendix U, paragraph 3.2.1.5.
Appendix U, paragraph 4.5.1.1.

Method of Compliance:
The engine ratings and operating limitations requirement of Appendix U, paragraph 3.2.1.1. shall be substantiated by analysis and tests. Engine ratings and operating limitations are established by the OEM and shall be included in the Engine Model Specification (EMS). The airworthiness substantiation shall be IAW Appendix U, paragraph 4.5.1.1. and shall be verified in parallel with the Performance Computer Program (reference Appendix U, paragraph 3.2.1.5.) by analysis, engine altitude tests and air vehicle performance tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.2.1.2. Steady-State Performance Model
The purpose of the engine performance model is to provide a means of assessing performance without actual testing of engine hardware. Engine performance information is of critical importance in the evaluation of the aircraft mission capability.

Criteria:
Engine power and fuel consumption shall be characterized.

Standard:
Appendix U, paragraph 3.2.1.2.
Appendix U, paragraph 3.2.1.4.
Appendix U, paragraph 3.2.1.5.
Appendix U, paragraph 3.2.1.6.
Appendix U, paragraph 4.5.1.2.
Appendix U, paragraph 4.5.1.4.
Appendix U, paragraph 4.5.1.5.

Method of Compliance:
A steady state performance program shall be developed based on engine and component testing and as well as performance analysis in accordance with Appendix U, para 3.2.1.2. and paragraph 3.2.1.4. The program shall be a thermodynamic cycle simulation in which major component identity is maintained; e.g., the ambient air inlet temperature, manifold air inlet temperature/pressure, turbocharger turbine outlet temperature, etc. must each be identifiable as entities in the model logic as required to obtain and maintain an accurate simulation. Computer Program and Rating Tables shall

be updated after the Qualification Test (QT) Altitude Test if the Deck and engine do not lapse within ±2% of each other. The lapse rates shall include engine speed, output brake horsepower and SFC lapse independently with both ambient temperature and pressure altitude for all the rating table conditions. The airworthiness substantiation shall include a steady state performance computer program in accordance with Appendix U, paragraph 3.2.1.5. Additionally, airworthiness substantiation of the performance programs shall be IAW Appendix U, paragraph 4.5.1.5. prepared IAW DI-MISC-80711 and updated prior to initiation of the Qualification endurance test.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.2.1.3. Performance Ratings

The purpose of the performance ratings requirement is to provide a ensure that rated engine performance data from the Engine Steady State Performance Program do not lapse the Altitude Test data by more than 2%.

Criteria:

The maximum brake specific fuel consumption requirements and the maximum engine speed requirements in the performance rating tables shall be at the corresponding minimum output shaft power specified in the performance rating tables.

Standard:

Appendix U, paragraph 3.2.1.3.
Appendix U, paragraph 4.5.1.3.

Method of Compliance:

The performance ratings requirement of Appendix U, paragraph 3.2.1.3. shall be substantiated by analysis and tests. Engine performance ratings shall be included in the Engine Model Specification (EMS). The airworthiness substantiation shall be IAW Appendix U, paragraph 4.5.1.3. and shall be verified in parallel with the Engine Performance Presentation and Performance Computer Program (reference Appendix U, paragraph 3.2.1.4., 3.2.1.5. and 3.2.1.6.; Appendix U, paragraph 4.5.1.4., 4.5.1.5. and 4.5.1.6.) by analysis, engine altitude tests and air vehicle performance tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.2.2. Operating Characteristics and Limits

The purpose of operating characteristic and limits requirement is to provide and demonstrate the engine operating characteristics and limits for the operator to know the full range of engine capabilities.

Criteria:

The engine shall function with positive durability margins as installed in the aircraft.

Standard:
Appendix U, paragraph 3.2.2.
Appendix U, paragraph 4.5.2.

Method of Compliance:
All engine steady state and transient operating limits (maximum, minimum) shall be specified per Appendix U, paragraph 3.2.2. The specified limits shall be predicated on the most critical tolerances of the engine. The airworthiness substantiation shall include an Engine Operating Limitation Analysis IAW DI-MISC-80711, an Engine Operating Limitation Test Plan IAW DI-NDTI-80566, and an Engine Operating Limitation Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.2.2.1. Operating Envelope

The purpose of this test is to ensure engine start and acceleration capability at low and high temperatures. Worldwide, all-weather operation and engine acceleration requires the use of specified fuels and oils under extreme hot and cold ambient temperature conditions.

Criteria:
The engine shall start, accelerate, and operate during and after exposure to low and high temperatures.

Standard:
Appendix U, paragraph 3.2.2.1.
Appendix U, paragraph 4.5.2.1.

Method of Compliance:
An engine shall demonstrate low, high temperature starting and accelerating capability via testing IAW Appendix U, paragraph 3.2.2.1. and paragraph 4.5.2.1. The airworthiness substantiation shall include a Low and High Temperature Starting and Acceleration Test Plan IAW DI-NDTI-80566, and Low and High Temperature Starting and Acceleration Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.2.2.2. Altitude Tests

The purpose of the attitude test is to demonstrate the engine systems can successfully operate at anticipated attitudes during initial flight testing. Extended flight operation at certain weapon system attitudes has resulted in oil system malfunctions, such as oil starvation, bearing sump flooding, gearbox flooding, oil foaming problems, and seal leaks.

Criteria:
The engine shall be capable of operating at specified attitudes.

Standard:
Appendix U, paragraph 3.2.2.2.
Appendix U, paragraph 4.5.2.2.

Method of Compliance:
The engine shall be subjected to an attitude test to demonstrate satisfactorily operation IAW Appendix U, paragraph 3.2.2.2. and paragraph 4.5.2.2. The airworthiness substantiation shall include an Engine Attitude Analysis IAW DI-MISC-80711, an Engine Attitude Test Plan IAW DI-NDTI-80566, and an Engine Attitude Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.2.2.3. Starting

The purpose of this test is to ensure the engine makes successful ground and air starts under the conditions, limitations and operating procedures throughout the altitude starting envelope of the aircraft, including extreme low and high temperatures of the aircraft operating envelope.

Criteria:
The engine shall start at specified ambient temperatures, altitudes and airspeeds, and time frame IAW the air vehicle specification or as provided by the Using Service.

Standard:
Appendix U, paragraph 3.2.2.3.
Appendix U, paragraph 4.5.2.3.

Method of Compliance:
Testing shall be accomplished to show that the starting system can meet all starting requirements IAW Appendix U, paragraph 3.2.2.3. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.5.2.3., and include a Starting Analysis IAW DI-MISC-80711, a Starting Test Plan IAW DI-NDTI-80566, and a Starting Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.2.2.3.1. Ground

The purpose of the ground start requirement is to expose the propulsion system to actual powers/loads as part of the integrated aircraft system and verify start capability before flight test.

Criteria:
Ground starts shall be demonstrated to be accomplished at temperature extremes without any damage to the system.

Standard:
Appendix U, paragraph 3.2.2.3.1.
Appendix U, paragraph 4.5.2.3.1.

Method of Compliance:
The ground starting requirements Appendix U, paragraph 3.2.2.3.1. and Appendix U, paragraph 4.5.2.3.1. shall be accomplished prior to PFR. The airworthiness substantiation shall include a Ground Start Analysis IAW DI-MISC-80711, a Ground Start Test Plan IAW DI-NDTI-80566, and a Ground Start Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.2.2.3.2. Air Starts

The purpose of the air start requirement is to expose the propulsion system to actual powers/loads as part of the integrated aircraft system and verify start capability during flight.

Criteria:
The engine shall start at altitudes and airspeeds IAW the EMS.

Standard:
Appendix U, paragraph 3.2.2.3.2.
Appendix U, paragraph 4.5.2.3.2.

Method of Compliance:
The air starting requirements shall be accomplished IAW Appendix U, paragraph 3.2.2.3.2. and Appendix U, paragraph 4.5.2.3.2. The airworthiness substantiation shall include an Air Start Analysis IAW DI-MISC-80711, an Air Start Test Plan IAW DI-NDTI-80566, and an Air Start Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.2.2.3.3. Starting Limits

The purpose of the starting limits requirement is to ensure the EMS starting requirements are within tested limits.

Criteria:
The starting altitude and ambient temperature limitations for starting shall be IAW the EMS.

Standard:
Appendix U, paragraph 3.2.2.3.3.
Appendix U, paragraph 4.5.2.3.3.

Method of Compliance:
Tests shall be conducted at a test facility that can simulate exact conditions for starting. Testing shall be conducted using the worst-case fuel and oil combination. The airworthiness substantiation shall include a Starting Limits Analysis IAW DI-MISC-80711, a Starting Limits Test Plan IAW DI-NDTI-80566, and a Starting Limits Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.2.2.3.4. Starting Procedure

The purpose of the starting procedure requirement is to ensure that established procedure for engine starts is simple to minimize false starts and burden to the operator.

Criteria:
The established starting procedure shall be simple and shall not require critical timing, within specified engine starting limits and without adversely affecting the engine durability or structural integrity.

Standard:
Appendix U, paragraph 3.2.2.3.4.
Appendix U, paragraph 4.5.2.3.4.

Method of Compliance:
The starting procedure requirements shall be accomplished IAW Appendix U, paragraph 3.2.2.3.4. The airworthiness substantiation shall include a Starting Procedure Test Plan IAW DI-NDTI-80566, and a Starting Procedure Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.2.2.4. Stopping

The purpose of the stopping requirement is to ensure that established procedure for engine stopping is simple, timely and does not negatively affect the integrity of the propulsion system.

Criteria:
Upon receiving a signal from the air vehicle for stopping, the powerplant shall shut down by a single, rapid method in any operating condition.

Standard:
Appendix U, paragraph 3.2.2.4.
Appendix U, paragraph 4.5.2.4.

Method of Compliance:
Propulsion system shutdown, IAW Appendix U, paragraph 3.2.2.4., shall be accomplished per established procedures. The airworthiness substantiation IAW Appendix U, paragraph 4.5.2.4. shall include a Propulsion System Shutdown Analysis IAW DI-MISC-80711, a IAW Propulsion System Shutdown Test Plan IAW DI-NDTI-80566, and a Propulsion System Shutdown Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.2.2.5. Low Power Conditions

7.4.2.2.5.1. Idle Thrust or Power (Ground or Flight Idle)
The purpose of the idle thrust or power (ground or flight idle) requirement is to establish the minimum self-sustaining idle power ratings for ground operations and flight.

Criteria:
Idle shall be the minimum self-sustaining condition of the engine and shall be set by the “idle power” command.

Standard:
Appendix U, paragraph 3.2.2.5.1.
Appendix U, paragraph 4.5.2.5.1.

Method of Compliance:
The idle thrust or power (ground or flight idle) requirements of Appendix U, paragraph 3.3.2.2.5.1. shall be verified by analysis and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.5.2.5.1. and shall include a Ground and Flight Idle Analysis IAW DI-MISC-80711 to assure the ground and flight idle ratings are consistent with aircraft performance requirements. The Analysis shall be verified during the Performance Computer Program test with substantiation provided in the Altitude Test Report (reference Appendix U, paragraph 4.14.1.2.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.2.2.6. Stability and Performance
The purpose of the stability and performance assessment is to ensure that positive stability margin exists at all flight conditions or that placards are documented in the flight manual.

Criteria:
The engine shall have positive stability to protect against flameouts and knock during rapid throttle transients or load changes.

Standard:
Appendix U, paragraph 3.2.2.6.
Appendix U, paragraph 4.5.2.6.
Appendix U, paragraph 4.5.2.2.6.1.
Appendix U, paragraph 4.5.2.2.6.2.

Method of Compliance:
The engine stability and performance assessment shall be IAW Appendix U, paragraph 3.2.2.6. and paragraph 4.5.2.6., and verified during the Altitude test per Appendix U, paragraph 4.14.1.2. The airworthiness substantiation shall include a Stability Audit IAW DI-MISC-80711 and verified with substantiation provided in the Altitude Test Report (reference Appendix U, paragraph 4.14.1.2.), a Ground and Flight Test Plan IAW DI-NDTI-80566 and a Ground and Flight Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.2.2.7. Transients
The engine must have adequate stability during throttle transients.

Criteria:
The engine shall perform any power transient throughout all operating conditions and the operating envelope of the engine while meeting the specified requirements. Power requests in any sequence and at any rate, including the effects of PTO demands, shall not result in exceeding any engine operating limit, result in unstable operation of the engine, or cause any mechanical damage.

Standard:
Appendix U, paragraph 3.2.2.7.
Appendix U, paragraph 3.2.2.7.1.
Appendix U, paragraph 4.5.2.7.
Appendix U, paragraph 4.5.2.7.1.

Method of Compliance:
The transient and over/undershoot requirements of Appendix U, paragraph 3.2.2.7. and 3.2.2.7.1. shall be verified by analysis and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.5.2.7. and 4.5.2.7.1. and shall include a Transient Analysis IAW DI-MISC-80711 to assure the engine transient performance is consistent with aircraft performance requirements. Transient verification shall be included as part of the altitude test with substantiating included in the Altitude Test Report (reference Appendix U, paragraph 4.14.1.2.). Power, temperature, engine speeds, fuel flow, and

other such pertinent parameters shall be recorded during each transient. Testing or analysis shall be performed for all control modes.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.2.2.8. Surface Temperature and Heat Rejection

The purpose of this requirement is to ensure the engine and associated subsystems will perform satisfactorily in the thermal environment. The surface temperature and heat rejection must be controlled to ensure compatibility between the propulsion system and the aircraft for safe and durable operation.

Criteria:

The propulsion system cooling and thermal management systems shall remove excess heat from the engine and associated subsystems to ensure proper system operation.

Standard:

Appendix U, paragraph 3.2.2.13.
Appendix U, paragraph 4.5.2.13.

Method of Compliance:

An analysis and testing shall be performed that provides sufficient evidence that the engine and its associated subsystems function satisfactorily under the conditions specified in Appendix U, paragraph 3.2.2.13. and Appendix U, paragraph 4.5.2.13. Such factors as engine bay cooling flows, accessory pad loading, coolant and oil systems cooling requirements, skin temperature, radiation properties, etc. shall be taken into consideration in establishing propulsion system heat rejection rates. The airworthiness substantiation shall include a Heat Rejection Rate Analysis Report IAW DI-MISC-80711, a Heat Rejection Rate Test Plan IAW DI-NDTI-80566, and a Heat Rejection Rate Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.2.2.8.1. Control System and Engine Accessory Components

The purpose of this testing is to demonstrate that the mounted and off-mounted engine components do not exceed their allowable temperatures when surrounded by still air under worst case conditions.

Criteria:

The mounted and off-mounted engine components shall operate as required when surrounded by worse case ambient air temperatures as specified in the EMS and ICD.

Standard:

Appendix U, paragraph 3.2.2.13.1.

Appendix U, paragraph 4.5.2.13.1.

Method of Compliance:
The requirements of Appendix U, paragraph 3.2.2.13.1. shall be verified by analyses and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.5.2.13.1. and include a Control and Accessory Limiting Temperature Analysis IAW DI-MISC-80711. The analysis shall be verified using a thermal survey to substantiate temperatures, coolant flow rates, heat transfer coefficients, etc. This thermal survey shall be conducted in the installed configuration. The thermal survey plan and report shall be provided in a Control and Accessory Limiting Temperature Test Plan IAW DI-NDTI-80566, and a Control and Accessory Limiting Temperature Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.2.2.9. Cooling Fluid Flow and Heat Rejection
The purpose of this requirement is to ensure the performance of the propulsion system cooling fluids.

Criteria:
The performance of the cooling fluid systems (e.g., glycol coolant, fuel, oil, etc.) and associated cooling provisions and cooling requirements shall be substantiated.

Standard:
Appendix U, paragraph 3.2.2.14.
Appendix U, paragraph 4.5.2.14.

Method of Compliance:
The requirements of Appendix U, paragraph 3.2.2.14. and Appendix U, paragraph 4.5.2.14. shall be verified by analyses and tests. The airworthiness substantiation shall include a Cooling Fluid Flow and Heat Rejection Analysis IAW DI-MISC-80711. The analysis shall be verified using a thermal survey to substantiate temperatures, coolant flow rates, heat transfer coefficients, etc. This thermal survey shall be conducted in the installed configuration. The thermal survey plan and report shall be provided in a Cooling Fluid Flow and Heat Rejection Test Plan IAW DI-NDTI-80566, and a Cooling Fluid Flow and Heat Rejection Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.3. Environmental Conditions
Environmental conditions and operating envelope of the engine includes all extremes and limits such as externally applied loads, attitudes, and environmental extremes

independently and concurrently in all combinations within the scope of the engine specification.

7.4.3.1. Atmospheric Conditions

7.4.3.1.1. Humidity

The purpose of the humidity test is to determine the resistance of materiel to the effects of a warm, humid atmosphere.

Criteria:
The materiel shall perform IAW the equipment specification before, during, and after exposure to Aggravated Cycle Humidity environment.

Standard:
MIL-STD-810, Method 507
Appendix U, paragraph 3.3.1.1.
Appendix U, paragraph 4.6.1.1.

Method of Compliance:
The materiel shall perform IAW the equipment / platform specification before, during, and after exposure to Humidity environmental effects that occur over the life cycle of the materiel. Compliance may be by test, similarity analysis, analysis, demonstration, or a combination of methods. Testing shall be IAW MIL-STD-810, Method 507, procedure II (Aggravated Cycle). The airworthiness substantiation shall include Humidity Test Plans IAW DI-NDTI-80566 and Humidity Test Procedures IAW DI-NDTI-80603 prior to testing. Humidity Test Reports shall be prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.3.1.2. Fungus

The purpose of the fungus test is to assess the susceptibility of materials to fungal growth. The primary objectives of the fungus test are to determine:

a. If the materials or the assembled combination of same, will support fungal growth, and where possible, identify dominant species present.

b. How rapidly fungus will grow on the materiel.

c. How fungus may affect the materiel, its mission, and its safety for use following the growth of fungus on the materiel.

d. If the materiel can be stored effectively in a field environment.

e. If there are simple cleaning processes.

Criteria:
The materiel shall perform IAW the equipment specification before and after exposure to Fungus environment.

Standard:
MIL-STD-810, Method 508
Appendix U, paragraph 3.3.1.2.
Appendix U, paragraph 4.6.1.2.

Method of Compliance:
The materiel shall perform IAW the equipment / platform specification before and after exposure to fungal environmental effects that occur over the life cycle of the materiel. Compliance may be by test, similarity analysis, analysis, demonstration, or a combination of methods. Testing shall be IAW MIL-STD-810, Method 508. Coupon testing is allowed. The airworthiness substantiation shall include Fungus Test Plans IAW DI-NDTI-80566 and Fungus Test Procedures IAW DI-NDTI-80603 prior to testing. Fungus Test Reports shall be prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.3.1.3. Corrosive Atmosphere
The purpose of the corrosion requirement is to ensure the propulsion system can operate and perform to specification during and after exposure to a corrosive environment.

Criteria:
The propulsion system shall perform IAW the equipment specification before and after exposure to a corrosive environment.

Standard:
Appendix U, paragraph 3.3.1.3.
Appendix U, paragraph 4.6.1.3.

Method of Compliance:
The propulsion system shall perform IAW the equipment / platform specification before and after exposure to a corrosive environment that occur over the life cycle of the materiel. Compliance may be by analysis, inspection, demonstration, or test, or a combination of methods. Testing shall be IAW Appendix U, paragraphs 3.3.1.3. and 4.6.1.3. Coupon testing is allowed where applicable. The airworthiness substantiation shall include Corrosive Atmosphere Test Plans IAW DI-NDTI-80566 and Corrosive Atmosphere Test Procedures IAW DI-NDTI-80603 prior to testing. Corrosive Atmosphere Test Reports shall be prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.3.1.4. Environmental Icing
The purpose of the environmental icing test is to verify engine performance when operating in icing conditions prior to initial flight testing.

Criteria:
The engine shall start and operate during and after icing conditions.

Standard:
Appendix U, paragraph 3.3.1.4.
Appendix U, paragraph 4.6.1.4.

Method of Compliance:
The engine shall be designed to meet the engine environmental icing requirements of Appendix U, paragraph 3.3.1.4. and paragraph 4.6.1.4. The airworthiness substantiation shall include an engine Environmental Icing Test Plan IAW DI-NDTI-80566, and an Engine Environmental Icing Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.3.2. Ingestion Capability
The purpose of the test is to demonstrate starting and operating capability of the engine under all expected ground, flight, and environmental (including ice, fluid, foreign object, sand, and dust, as applicable) conditions without adversely affecting propulsion system operation or resulting in damage.

Criteria:
The engine shall start and operate after and during exposure to environmental contaminants (including ice, fluid, foreign object, sand, and dust, as applicable).

Standard:
Appendix U, paragraph 3.3.2.
Appendix U, paragraph 4.6.2.

Method of Compliance:
The engine shall be designed to meet the ingestion capability requirements of Appendix U, paragraph 3.3.2. and paragraph 4.6.2. The airworthiness substantiation shall include a Engine Ingestion Capability Analysis IAW DI-MISC-80711, a Engine Ingestion Capability Test Plan IAW DI-NDTI-80566, and ad Engine Ingestion Capability Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.3.2.1. Air Filter

The purpose of the air filter requirement is to ensure the engine is protected against foreign material particles in the induction air supply.

Criteria:

Each air filter must be capable of withstanding the effects of environmental conditions, fluids and solvents which it is expected to be exposed in service and maintenance, and have a design feature to prevent migration of filter media.

Standard:

Appendix U, paragraph 3.1.8.6.1.
Appendix U, paragraph 4.6.2.1.

Method of Compliance:

The requirements of Appendix U, paragraph 3.1.8.6.1. shall be verified by analyses and tests. The airworthiness substantiation shall include an Air Filter Analysis IAW DI-MISC-80711, an Air Filter Test Plan IAW DI-NDTI-80566, and an Air Filter Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.3.3. Electromagnetic Environmental Effects (E3)

All propulsion system electrical and electronic equipment and subsystems shall meet their performance requirements when subjected to the electromagnetic environmental effects of ADS-37A-PRF for flight critical systems, including Table I, Parts A and B (at full field strength); EMC, EMV, EMP, HERO, HERF, HERP, and control of static electricity.

7.4.3.3.1. Electrical Components E3 Test

The purpose of the testing is to demonstrate that the engine will operate satisfactorily in the E3 environment and the electromagnetic interface to the aircraft. Engine electrical components will be subjected to various electromagnetic environments from sources within the aircraft as well as those external which degrade engine performance.

Criteria:

The engine electrical and electronic equipment and subsystems shall not have emissions that could interfere with platform co-located equipment. The engine electronics shall not be susceptible when exposed to an external electromagnetic environment.

Standard:

MIL-STD-461
RTCA/DO-160
Appendix E, paragraph 5.7.
Appendix E, paragraph 5.10.
Appendix I

AMACC Section 13 Electromagnetic Environmental Effects (E3)
Appendix U, paragraph 3.3.3.1.
Appendix U, paragraph 3.3.3.2.
Appendix U, paragraph 3.3.3.3.
Appendix U, paragraph 3.3.3.4.
Appendix U, paragraph 4.6.3.1.
Appendix U, paragraph 4.6.3.2.
Appendix U, paragraph 4.6.3.3.
Appendix U, paragraph 4.6.3.4.

Method of Compliance:
All engine electrical and electronic equipment and subsystems shall meet their performance requirements when subjected to the susceptibility, emission, electromagnetic pulse and lightning requirements of MIL-STD-461, RTCA/DO-160 and Appendix E, paragraph 5.7. The airworthiness substantiation shall include an EMI Control Plan and EMI/EMC Test Plan prepared prior to the initiation of the PFRT IAW DI-EMCS-80199 and DI-EMCS-80201. An EMI/EMC System Analysis shall be prepared prior to PFRT IAW DI-MISC-80711. EMI/EMC Test Reports shall be submitted IAW Appendix E, paragraph 5.10. and DI-EMCS-80200. In addition, E3 requirements are defined in paragraph 13 herein, and Appendix I.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.3.3.2. High Altitude Electromagnetic Pulse (HEMP)
The purpose of EMP/HEMP testing is to determine how flight critical subsystems and equipment respond to exposure to an EMP.

Criteria:
The aircraft electronics and ordnance items shall survive, remain safe, and meet their operational performance requirements when exposed to the EMP/HEMP environment.

Standard:
MIL-STD-2169
MIL-STD-464, paragraph 5.6.
Appendix U, paragraph 3.3.3.5.
Appendix U, paragraph 4.6.3.5.

Method of Compliance:
If specified by the procuring authority, the platform, and its associated electronic components and ordnance items, shall meet its operational performance requirements when exposed to the EMP/HEMP environment of MIL-STD-464, paragraph 5.6.

This environment is classified and is defined in MIL-STD-2169. EIDs defined as having a safety function shall have a minimum of 16.5. dB safety margin. EIDs defined as having a reliability function shall have a minimum of 6 dB safety margin.

The item under test, to include ordnance system electronics, shall be production representative. Compliance shall be verified by test and/or analysis. The airworthiness substantiation shall include an EMP Test Plan and Procedure Report IAW DI-EMCS-81541, and an EMP Test Report IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.3.3.3. Initial Nuclear Radiation (INR)
The purpose of the Initial Nuclear Radiation (INR) requirement is to ensure propulsion system survivability when subject to INR.

Criteria:
All engine electrical and electronic equipment and subsystems shall enter a fail fixed mode if normal operation cannot be maintained when subjected to initial nuclear radiation (INR).

Standard:
Appendix U, paragraph 3.3.3.6.
Appendix U, paragraph 4.6.3.6.

Method of Compliance:
The requirements of Appendix U, paragraph 3.3.3.6. shall be verified by tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.6.3.6. and include a Initial Nuclear Radiation (INR) Test Plan IAW DI-NDTI-80566, and a Initial Nuclear Radiation (INR) Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.3.4. External Contamination
The purpose of the external contamination requirement is to ensure no contaminants may accumulate on propulsion system external surfaces without access to flush them away.

Criteria:
The design of components shall not allow contaminants to be trapped in external surfaces or around seals without the ability to run off or be flushed away.

Standard:
Appendix U, paragraph 3.3.4.
Appendix U, paragraph 4.6.4.

Method of Compliance:
The external contamination requirements of Appendix U, paragraph 3.3.4. shall be substantiated by inspection and demonstration.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4. Integrity
For the purpose of this section, integrity refers to the ability of a component, structure or asset to operate at optimum level under the pressure of a load, including the weight of the asset itself. The asset needs to sustain without drastically breaking and/or deforming, whilst still being able to perform its intended use.

7.4.4.1. Structural Integrity

7.4.4.1.1. Design Service Life
The engine is designed such that pertinent environmental variables, and all sources of repeated loads are considered, and these considerations are included in the development of the design duty cycle.

Criteria:
The engine and all associated components shall have a minimum design service life 2000 hours or as specified by the Using Service.

Standard:
Appendix U, paragraph 3.4.1.1.
Appendix U, paragraph 3.4.1.6.10.
Appendix U, paragraph 4.7.1.1.

Method of Compliance:
The requirements of Appendix U, paragraph 3.4.1.1. and 3.4.1.6.10. shall be verified by analysis, inspections and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.7.1.1. and include analysis results included in the Strength and Life Analysis IAW DI-MISC-80711.

The durability tests cited in Appendix U, paragraph 3.4.1.5. shall be used to demonstrate the durability and reliability, and to characterize the wear points and patterns of the powerplant. Test results shall contribute to establishment of the initial service life limit for the major propulsion assemblies under test.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4.1.1.1. Expendables Design Service Life

The purpose of the Expendables Design Service Life requirement is to ensure any expendables (i.e., air filter, oil filter, fuel filter, etc.) shall meet minimum maintenance-free operating requirements.

Criteria:
The design service life without replacement of all expendable parts and components shall be equal to, or greater than, the minimum maintenance-free operating period.

Standard:
Appendix U, paragraph 3.4.1.1.1.
Appendix U, paragraph 4.7.1.1.1.

Method of Compliance:
The requirements of Appendix U, paragraph 3.4.1.1.1. shall be verified by analysis, inspections and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.7.1.1.1. and include an Expendables Service Life Analysis IAW DI-MISC-80711, an Expendables Service Life Test Plan IAW DI-NDTI-80566, and an Expendables Service Life Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4.1.1.2. Bearing Design Service Life

The purpose of the Expendables Design Service Life requirement is to ensure propulsion system bearings can meet their design service life under actual operating conditions.

Criteria:
Rolling element bearings shall have an L1 contact fatigue life IAW applicable ABMA standards no less than the design service life of the engine.

Standard:
Appendix U, paragraph 3.4.1.1.2.
Appendix U, paragraph 3.4.1.6.9.
Appendix U, paragraph 4.7.1.1.2.
Appendix U, paragraph 4.7.1.6.9.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.4.1.1.2. and 3.4.1.6.9. shall be verified by analysis and tests. The airworthiness substantiation shall be IAW Appendix U, paragraphs 4.7.1.1.2. and 4.7.1.6.9., and include a Bearing Life and Loads Analysis Report IAW DI-MISC-80711. This report shall be submitted to provide detail and summary of how the bearing life is calculated. The report shall also include the bearing reaction loads from KISSsoft. The inputs and outputs of the KISSsoft analysis shall be included in an Appendix to this report. The results of the engine endurance test shall be used to verify the Bearing Life and Loads Analysis Report.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4.1.2. Design Usage

The purpose of the design-usage-requirement is to characterize details related to the intensity, duration, and frequency of occurrence of various environmental conditions experienced by the structure in accordance with the aircraft system specification. Detailed characterization of the design usage environment supports design, analysis, and testing program activities. Environmental conditions may be natural or induced and include conditions related to temperature, altitude, precipitation, humidity, chemical, abrasive, vibratory, and corrosive environments.

Criteria:

The powerplant shall be capable of withstanding the design usage IAW the air vehicle specification or by the Using Service.

Standard:

MIL-STD-3063
Appendix U, paragraph 3.4.1.2.
Appendix U, paragraph 4.7.1.2.

Method of Compliance:

The airworthiness substantiation shall include a Design Usage Environment Spectra analysis for the propulsion system IAW the requirements of the Aircraft System Specification. Environments covered in the spectra shall include at a minimum exposure to rain, sand, corrosion, temperature, moisture absorption, ice, and snow. Unless otherwise specified in the Aircraft System Specification or Engine Model Specification (EMS), the airworthiness substantiation may leverage simplified analysis based on environmental extremes that envelop the design-usage-environment spectra, with appropriate documentation in the structural design criteria. The design usage environment spectra and associated environmental extremes shall be updated IAW section 5.4.1. of MIL-STD-3063. When not incorporated into the structural design criteria, the airworthiness substantiation shall include a Design Usage Environment Spectra Analysis Report IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4.1.2.1. Externally Applied Forces

The purpose of this test is to demonstrate that adequate structural capability prior to deployment of the weapon system. The forces induced by acceleration can cause permanent deformations and fractures that disable or destroy equipment, fasteners and mounting hardware.

Criteria:
The propulsion system shall operate safely with externally applied forces prior to weapon deployment.

Standard:
Appendix U, paragraph 3.4.1.2.1.
Appendix U, paragraph 4.7.1.2.1.

Method of Compliance:
The propulsion system cases and mounts of the endurance test engine configuration shall be subjected to a static test to verify the requirements of Appendix U, paragraph 3.4.1.2.1. A static rig test shall be conducted to demonstrate the capability of the propulsion system and its supports to withstand maximum externally applied forces without permanent deformation of any component and 1.5 times those forces without failure of any component. In this test, maximum thrust loads, acceleration loads, torque and reaction loads will be applied separately and then in combination. Stress and deflection data will be obtained at critical locations as determined by analysis. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.7.1.2.1. and include a Static Load Analysis Report IAW DI-MISC-80711, a Static Load Test Plan IAW DI-NDTI-80566, and a Static Load Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4.1.3. Material Characterization
The purpose of the material characterization requirement is to ensure the materials and processes used during the design and manufacture of the propulsion system will meet all specification requirements.

Criteria:
The materials used in the propulsion system shall be fully characterized using minimal allowables that are established considering statistical variability, the expected environments, fabrication processes, repair techniques, and quality assurance procedures.

Standard:
Appendix U, paragraph 3.4.1.3.
Appendix U, paragraph 4.7.1.3.

Method of Compliance:
The requirements of Appendix U, paragraph 3.4.1.3. shall be verified by documentation, analysis and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.7.1.3. and include a Material Characterization Analysis Report which may include any manufacturer's documents that are used for materials and processes used throughout the propulsion system IAW DI-MISC-80711. Additionally, a Material Characterization

Test Plan IAW DI-NDTI-80566 and a Material Characterization Test Report IAW DI-NDTI-80809 shall be submitted at the discretion of the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4.1.4. Part Classification

The purpose of the part classification requirement is to classify all powerplant parts for criticality to identify Critical Safety Items (CSIs) with associated critical characteristics, and Critical Application Items (CAIs).

Criteria:

The FMECA and a CSI/CAI summary shall be submitted to the Using Service for approval.

Standard:

MIL-STD-882
AMCOM Regulation 702-7
Appendix U, paragraph 3.4.1.4.
Appendix U, paragraph 4.7.1.4.

Method of Compliance:

All powerplant parts shall be classified for criticality per MIL-STD-882 and a Failure Modes and Effects and Criticality Analysis (FMECA) performed to identify Critical Safety Items (CSIs) and Critical Application Items (CAIs). The critical characteristics for all identified critical safety items shall be defined IAW AMCOM Regulation 702-7. The list of identified CSIs with their critical characteristics, and CAIs shall be submitted to the Using Service for approval.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4.1.5. Durability

7.4.4.1.5.1. Low Cycle Fatigue Life

The purpose of the LCF life requirement is to ensure that generalized cracking will not occur prior to reaching the required design service life. Prediction of LCF life requires testing for increased confidence in predicted life limit.

Criteria:

Engine parts shall have minimum Low Cycle Fatigue (LCF) lives not shorter than the design service life.

Standard:

14 CFR Part 35

MIL-P-26366A
Appendix U, paragraph 3.4.1.5.1.
Appendix U, paragraph 3.4.1.5.1.1.
Appendix U, paragraph 3.4.1.5.2.
Appendix U, paragraph 4.7.1.5.1.
Appendix U, paragraph 4.7.1.5.1.1.
Appendix U, paragraph 4.7.1.5.1.2.

Method of Compliance:
LCF life prediction shall be based on an allowable fatigue curve calculated from mean life to crack initiation reduced by a reliability factor of three standard deviations based on applicable material scatter and shall account for stress concentrations as applicable to the design. The airworthiness substantiation shall include a Low Cycle Fatigue Life Analysis IAW DI-MISC-80711. The analysis shall be substantiated by a Low Cycle Fatigue Life Test Plan IAW DI-NDTI-80566, and a Low Cycle Fatigue Life Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4.1.5.2. High Cycle Fatigue Life
The purpose of the HCF life requirement is to ensure that combination of mean and alternating stresses will not preclude an engine component from reaching its design service life limit.

Criteria:
Engine parts shall not fail when subject to the maximum attainable combined steady state and vibratory stresses. Parts subjected to LCF loads in addition to HCF loads shall be designed considering the effect of LCF damage on the material HCF life.

Standard:
Appendix U, paragraph 3.4.1.5.2.
Appendix U, paragraph 4.7.1.5.2.
Method of Compliance:
Analyses shall be performed for all components subject to HCF to demonstrate HCF capability. The airworthiness substantiation shall include a High Cycle Fatigue Life Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4.1.5.3. Creep
The purpose of the creep requirement is to demonstrate that engine components and accessories do not exhibit creep throughout the operational envelope and design service life which would result in material contact or imminent failure.

Criteria:
Engine components and accessories shall not creep so that operation is impaired throughout the design service life. Part creep shall not affect disassembly and reassembly of the engine or new part replacement at overhaul throughout its design life.

Standard:
Appendix U, paragraph 3.4.1.5.3.
Appendix U, paragraph 4.7.1.5.3.

Method of Compliance:
A creep analysis and test showing compliance with Appendix U, paragraph 3.4.1.5.3. shall be conducted IAW Appendix U, paragraph 4.7.1.5.3. The airworthiness substantiation shall include a Creep Analysis IAW DI-MISC-80711, a Creep Test Plan IAW DI-NDTI-80566, and a Creep Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4.1.6. Strength
The purpose of the strength requirement is to ensure that engine components and accessories can withstand maximum stresses when subject to limiting loads.

Criteria:
The engine shall meet all design requirements after exposure to limit loads, and not exhibit detrimental permanent set or deflect to the extent that operation or performance is impaired when operated to limit load conditions.

Standard:
Appendix U, paragraph 3.4.1.6.
Appendix U, paragraph 4.7.1.6.

Method of Compliance:
A strength analysis showing compliance with Appendix U, paragraph 3.4.1.6. shall be conducted IAW Appendix U, paragraph 4.7.1.6. The airworthiness substantiation shall include a Strength and Life Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4.1.6.1. Factors of Safety
The purpose of the factors of safety requirement is to ensure the required load factors are applied to design usage induced load types to establish limit and ultimate conditions for all engine and accessory components.

Criteria:
The limit and ultimate conditions for the load types cited in Appendix U, paragraph 3.4.1.6.1. shall be applied to establish limit and ultimate conditions for all engine parts and accessories.

Standard:
Appendix U, paragraph 3.4.1.6.1.
Appendix U, paragraph 4.7.1.6.1.

Method of Compliance:
A factor of safety analysis showing compliance with Appendix U, paragraph 3.4.1.6.1. shall be conducted IAW Appendix U, paragraph 4.7.1.6.1. The airworthiness substantiation shall include a Factors of Strength Analysis which shall be included in the Strength Analysis (reference Appendix U, paragraph 3.4.1.6.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4.1.6.2. Containment
The purpose of this analysis is to determine that the engine has adequate containment capability to preclude fire and catastrophic damage to engine external systems or air vehicle systems, and preclude injury to personnel.

Criteria:
The engine shall have containment capability.

Standard:
Appendix U, paragraph 3.4.1.6.3.
Appendix U, paragraph 4.7.1.6.3.

Method of Compliance:
An analysis shall be performed that provides sufficient evidence that the engine shall function satisfactorily under the conditions specified in Appendix U, paragraph 3.4.1.6.3. The analysis shall contain the methodology and relevant data points used in the determination. The airworthiness substantiation shall include a Containment Analysis IAW DI-MISC-80711, a Containment Test Plan IAW DI-NDTI-80566, and a Containment Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4.1.6.3. Overspeed and Overtemperature
The purpose of the overspeed and overtemperature requirement is to evaluate the overspeed and overtemperature capability of the engine to ensure adequate margin exists.

Criteria:
The engine shall be capable of withstanding overspeed and overtemperature events.

Standard:
Appendix U, paragraph 3.4.1.6.5.
Appendix U, paragraph 4.7.1.6.5.

Method of Compliance:
For the overspeed test, all components shall be subjected to the engine operation outlined in Appendix U, paragraph 3.4.1.6.5. Upon successful completion of the overspeed test, the same engine shall be operated at the overtemperature conditions specified in Appendix U, paragraph 3.4.1.6.5. Following each test, parts and assemblies shall be within the allowable dimensional limits and there shall be no evidence of imminent failure. The airworthiness substantiation shall include an Engine Overspeed and Overtemperature Analysis IAW DI-MISC-80711, an Engine Overspeed and Overtemperature Test Plan IAW DI-NDTI-80566, and an Engine Overspeed and Overtemperature System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4.1.6.4. Engine Cooling
The engine cooling and thermal management systems safely remove excess heat from the engine and its subsystems and integrate with the aircraft thermal management system, if applicable.

Criteria:
Engine design and constructions shall provide the necessary cooling under worst case conditions in which the air vehicle is intended to operate. A thermal analysis and test shall be performed to determine margin of safety from thermal runaway or damage leading to an engine inflight shutdown under worst case operating conditions.

Standard:
Appendix U, paragraph 3.4.1.6.6.
Appendix U, paragraph 4.7.1.6.6.

Method of Compliance:
The requirements of Appendix U, paragraph 3.4.1.6.6. shall be verified by analysis and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.7.1.6.6. and include a Engine Cooling Analysis IAW DI-MISC-80711, a Engine Cooling Test Plan IAW DI-NDTI-80566, and a Engine Cooling Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4.1.7. Damage Tolerance

The purpose of the damage tolerance requirement is to establish inspection intervals and procedures necessary to ensure structural integrity in accordance with the fatigue and fracture methodologies. The choice of airworthiness substantiation via damage tolerance must include considerations for fleet maintenance strategies IAW the Aircraft System Specification and should include considerations for cost and schedule in the decision to substantiate via damage tolerance versus other fatigue methodologies.

Criteria:
The propulsion system structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063
Appendix U, paragraph 3.4.1.7.
Appendix U, paragraph 3.4.1.7.1.
Appendix U, paragraph 3.4.1.7.2.
Appendix U, paragraph 4.7.1.7.
Appendix U, paragraph 4.7.1.7.1.
Appendix U, paragraph 4.7.1.7.2.

Method of Compliance:
The airworthiness substantiation shall include damage tolerance substantiation of inspection intervals and procedures IAW Appendix U, paragraph 3.4.1.7. (using section 5.4.3.1. of MIL-STD-3063 as guidance) and IAW the requirements of the Aircraft System Specification. The damage tolerance substantiation shall be IAW Appendix U, paragraph 4.7.1.7., 4.7.1.7.1. and 4.7.1.7.2., and the fatigue and fracture methodologies and shall be based on the damage tolerance analysis. The airworthiness substantiation shall include a Damage Tolerance Substantiation Report IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4.1.8. Vibration and Dynamic Response

The purpose of this test is to ensure the engine is free of detrimental resonances throughout its operational range prior to initial flight testing.

Criteria:
The engine shall be free of damaging vibration and dynamic response.

Standard:
Appendix U, paragraph 3.4.1.8.
Appendix U, paragraph 3.4.1.8.1.
Appendix U, paragraph 4.7.1.8.
Appendix U, paragraph 4.7.1.8.1.

Method of Compliance:
Dynamic models shall be developed for major engine parts and components IAW Appendix U, paragraph 3.4.1.8. Critical speeds shall be determined and shall meet or exceed the speed margins specified in Appendix U, paragraph 3.4.8.1.1. Vibration test conducted per Appendix U, paragraphs 4.7.1.8. and 4.7.1.8.1. The airworthiness substantiation shall include an Engine Vibration and Stress Analysis Report IAW DI-MISC-80711, an Engine Vibration and Stress Test Plan IAW DI-NDTI-80566, and an Engine Vibration and Stress Test Report IAW DI-NDTI-80809; to be updated prior to Qualification Test.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4.1.8.1. Critical Speeds
The purpose of the critical speed requirement is to ensure the propulsion system is free of resonance conditions at all shaft rotational speeds that would cause the propulsion system to not to meet all the requirements of the specification.

Criteria:
The propulsion system shall be free from damaging vibration and dynamic responses that may result in premature failure or loss of component life. Steady state operation at critical speeds can quickly consume high cycle fatigue life of components.

Standard:
Appendix U, paragraph 3.4.1.8.2.
Appendix U, paragraph 4.7.1.8.2.

Method of Compliance:
The requirements of Appendix U, paragraph 3.4.1.8.2. shall be verified by analysis and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.7.1.8.2. and include a Critical Speed Analysis Report IAW DI-MISC-80711. The results of the critical speed analysis shall be verified as part of the Vibration and Dynamic Response requirement (reference Appendix U, paragraph 3.4.1.8.2.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.4.2. Software Integrity
The purpose of the software integrity requirement is to ensure software is developed and functions as intended. Due to its increased complexity, amount of code and airworthiness implication, software verification and qualification is necessary.

Criteria:
The software shall be developed, verified, and validated IAW the most stringent software level of DO-178 determined for the application IAW ARP 4754.

Standard:
ARP 4754
DO-178
Appendix U, paragraph 3.4.4.
Appendix U, paragraph 4.7.4.

Method of Compliance:
The requirements of Appendix U, paragraph 3.4.4. shall be verified by inspection, demonstration, analysis and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.7.4. and include a Safety Analysis Report prepared IAW DI-MISC-80711 and documentation IAW paragraph 15.0, Software Airworthiness.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.5. Reliability and Maintainability
The as-designed engine reliability and maintainability shall be capable of meeting air vehicle availability goals for the mission mix profile as allocated from the air vehicle specification.

7.4.5.1. Maintainability
The purpose of the maintainability requirements is to ensure the propulsion system, subsystems, and components are integrated to consider accessibility, replaceability, serviceability, and (Murphy proof) interchangeability without degrading performance, effectiveness, or reliability.

Criteria:
The as-designed engine reliability and maintainability shall be capable of meeting air vehicle availability goals for the mission mix profile as allocated from the air vehicle specification.

Standard:
Appendix U, paragraph 3.5.
Appendix U, paragraph 3.5.2.
Appendix U, paragraph 3.5.2.1.
Appendix U, paragraph 3.5.2.2.
Appendix U, paragraph 3.5.2.3.
Appendix U, paragraph 3.5.3.
Appendix U, paragraph 4.8.
Appendix U, paragraph 4.8.2.
Appendix U, paragraph 4.8.2.1.
Appendix U, paragraph 4.8.2.2.
Appendix U, paragraph 4.8.2.3.
Appendix U, paragraph 4.8.3.

Method of Compliance:
A Maintenance Service Analysis IAW DI-MISC-80711 shall be provided to establish man-hours to perform maintenance, inspection intervals and criteria, and repair of serviceable propulsion system assemblies and/or sub-components. This analysis shall also include establish component accessibility and tool requirements for the maintenance procedures cited in the analysis report. This analysis shall be verified by demonstration. Testing shall be required at the discretion of the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.6. Survivability
The propulsion system shall have the ability to remain mission capable during and after a natural or man-made disturbance.

7.4.6.1. Susceptibility

7.4.6.1.1. Noise
The purpose of the noise requirement is to verify human safety requirements. Engine acoustic signature noise represents a health hazard to personnel, an annoyance to civilian communities, and an observable that can be used to detect combat and search and rescue aircraft.

Criteria:
The powerplant (including the propeller) shall operate such that the total powerplant noise is minimized.

Standard:
Appendix U, paragraph 3.6.1.1.
Appendix U, paragraph 4.9.1.1.

Method of Compliance:
An engine noise survey shall be conducted to substantiate the requirements of Appendix U, paragraph 3.6.1.1. IAW Appendix U, paragraph 4.9.1.1. The airworthiness substantiation shall include an Engine Noise Analysis IAW DI-MISC-80711, an Engine Noise Test Plan IAW DI-NDTI-80566, and an Engine Noise Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.6.1.2. Exhaust/IR Signature
The purpose of the engine exhaust/IR requirement is to ensure engine temperatures do not exceed engine component limits (i.e., turbocharger) which may deteriorate

component life, and ensure exhaust signature levels meet susceptibility requirements IAW the aircraft specification.

Criteria:
The engine shall not exceed the exhaust temperature levels IAW the air vehicle specification while meeting the specification requirements at any point during the engine life.

Standard:
Appendix U, paragraph 3.6.1.2.
Appendix U, paragraph 4.9.1.2.

Method of Compliance:
An engine exhaust test shall be conducted to verify the requirements of Appendix U, paragraph 3.6.2.1. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.9.1.2. and include an Engine Exhaust Test Plan IAW DI-NDTI-80566 and an Engine Exhaust Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.6.1.3. Engine Smoke
The purpose of the engine smoke test is to demonstrate the engine does not emit visible smoke. Visible or detectable exhaust smoke trails or smoke puffs are observables and can be used to detect combat aircraft.

Criteria:
The engine shall not emit visible engine smoke at any power settings.

Standard:
ARP 1179
Appendix U, paragraph 3.6.1.3.
Appendix U, paragraph 4.9.1.3.

Method of Compliance:
An engine exhaust smoke and invisible exhaust mass emissions test shall be completed to substantiate the requirements of Appendix U, paragraph 3.6.1.3. IAW Appendix U, paragraph 4.9.1.3. The airworthiness substantiation shall an Engine Exhaust Gas Emission Test Plan IAW DI-NDTI-80566, and Engine Exhaust Gas Emission Test Plan IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.6.1.4. Gaseous Emissions

The purpose of the engine gaseous emissions requirement is to demonstrate the engine does not emit invisible exhaust mass emissions.

Criteria:
The engine shall not produce byproduct exhaust emissions greater than the levels specified by the procuring activity when using any primary or alternate fuel.

Standard:
40 CFR 89 Subpart E
Appendix U, paragraph 3.6.1.4.
Appendix U, paragraph 4.9.1.4.

Method of Compliance:
The requirements of Appendix U, paragraph 3.6.1.4. shall be verified by analysis and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.9.1.4. and include a Engine Exhaust Gas Emission Test Plan IAW DI-NDTI-80566, and a Engine Exhaust Gas Emission Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.6.2. Vulnerability

7.4.6.2.1. Cybersecurity

The purpose of the cybersecurity requirements is to provide a means to ensure airworthiness, or the ability of the propulsion system to safely attain, sustain and complete flight under adversary offensive cyber operations.

Criteria:
The powerplant and control system preliminary design shall implement best practices to mitigate potential cyber-attack. Any cybersecurity vulnerability gaps within the system software shall be identified and classified.

Standard:
NIST SP 800-53 Rev 4
DoDI 8510.01
AMACC Section 20.1. Cybersecurity
Appendix U, paragraph 3.6.2.1.
Appendix U, paragraph 4.9.2.1.

Method of Compliance:
The requirements of Appendix U, paragraph 3.6.2.1. and 4.9.2.1. shall be verified by analysis, demonstrations, and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.9.2.1. and include standards, tools, and methods used to meet the identified cybersecurity requirements in paragraph 20 of the AMACC. Substantiation

shall also include a Software Vulnerability Assessment IAW DI-MISC-80711 and prepared IAW NIST SP 800 161 and DFARS 252.239 7018. This assessment shall include a Program Protection Implementation Plan (PPIP). As a part of the Program Protection Implementation Plan (PPIP), the process shall document the evaluation of supplied software/firmware and reuse software/firmware (both initial acquisitions and updates) for vulnerability implications according to Government supplied criteria. This applies to both software development environment infrastructure software/tools and to deliverable software firmware. Any cybersecurity vulnerability gaps identified shall be classified.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.6.2.2. Chemical and Biological Agent Effects

The purpose of chemical and biological agent effects requirement is to ensure propulsion system performance and operability during and after hazardous chemical and biological exposure.

Criteria:

The propulsion system shall survive contamination from chemical and biological agents, and decontamination without losing mission capability.

Standard:

Appendix U, paragraph 3.6.2.3.
Appendix U, paragraph 4.9.2.3.

Method of Compliance:

The requirements of Appendix U, paragraph 3.6.2.3. shall be verified by analysis, demonstration, and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.9.2.3. and include a Chemical and Biological Agent Effects Analysis IAW DI-MISC-80711, a Chemical and Biological Agent Effects Test Plan IAW DI-NDTI-80566, and a Chemical and Biological Agent Test Report Effects IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7. Subsystems

Equipment that is installed as an integral part of an aircraft system that, if inoperable or removed, will prevent the aircraft from flying or make it unsafe.

7.4.7.1. Control System

The purpose of the control system requirement is to ensure automatic control of the propulsion system in order to meet all specification requirements throughout the environmental conditions and operating envelope of the propulsion system.

Criteria:
The engine control system components and accessories shall maintain safe engine operation under all required conditions throughout their mission cycle.

Standard:
RTCA/DO-178
RTCA/DO-254
AMACC 15.0 (Software Airworthiness) and its subsections
Appendix E, paragraph 5.8.
Appendix E, paragraph 5.8.1.
Appendix E, paragraph 5.8.2.
Appendix E, paragraph 5.8.3.
Appendix E, paragraph 5.8.4.
Appendix E, paragraph 5.8.5.
Appendix U, paragraph 3.7.2.
Appendix U, paragraph 4.10.2.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.2. shall be verified by analysis, demonstration, and test. The airworthiness substantiation shall be IAW Appendix E, paragraph 5.8., 5.8.1. through 5.8.5. and Appendix U, paragraph 4.10.2.

Substantiation shall include:

a. Engine Control System: Engine Control System Analysis IAW DI-MISC-80711 and prepared IAW RTCA/DO-178, RTCA/DO-254; Engine Control System Test Plan IAW DI-NDTI-80566 and prepared IAW RTCA/DO-178, RTCA/DO-254; Engine Control System Test Report IAW DI-NDTI-80809; Software Standard Practices.

b. Common-mode Multiple Signal Failure: Common-mode Multiple Signal Failure Test Plan IAW DI-NDTI-80566; Common-mode Multiple Signal Failure Test Report IAW DI-NDTI-80809.

c. Complex Power Interrupts: Complex Power Interrupts Test Plan IAW DI-NDTI-80566; Complex Power Interrupts Test Report IAW DI-NDTI-80809.

d. Aircraft Drive System Torsional Stability: A Linear and Non-linear Torsional Stability Analyses IAW DI-MISC-80711 of the combined engine and aircraft propeller/or rotor system shall be performed prior to first flight, or whenever any engine or aircraft system component which may affect torsional stability is modified.

e. Fault Injection: Fault Injection Test Plan IAW DI-NDTI-80566; Fault Injection Test Report IAW DI-NDTI-8080.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.1.1. Control System Performance
The purpose of the control system performance requirement is to demonstrate the design capability of the engine controls.

Criteria:
The control system shall provide engine power response and prevent exceedance of thermodynamic and mechanical limits when subjected to unrestricted power demand, and shall self-detect and accommodate failures during and after detected malfunction/failure.

Standard:
MIL-STD-704
MIL-HDBK-704
MIL-STD-1553
ARINC 429
Appendix E, paragraph 5.6.4.
Appendix E, paragraph 5.6.4.1.
Appendix E, paragraph 5.6.4.2.
Appendix E, paragraph 5.6.4.3.
Appendix E, paragraph 5.6.4.4.
Appendix E, paragraph 5.6.4.5.
Appendix E, paragraph 5.6.4.6.
Appendix E, paragraph 5.6.4.7.
Appendix U, paragraph 3.7.2.1.
Appendix U, paragraph 4.10.2.1.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.2.1. shall be verified by analysis and tests. The airworthiness substantiation shall be IAW Appendix E, paragraph 5.6.4., 5.6.4.1. through 5.6.4.7. and Appendix U, paragraph 4.10.2.1.

Substantiation shall include:

a. Failure Mode Effects and Criticality Analysis (FMECA) IAW DI-MISC-80711.

b. PMA-Induced Damage: A PMA Neutral Short-to-Ground Analysis IAW DI-MISC-80711; a PMA Neutral Short-to-Ground Test Plan IAW DI-NDTI-80566, and a PMA Neutral Short-to-Ground Test Report IAW DI-NDTI-80809.

c. Electrical Loads Analysis (reference Appendix E, paragraph 5.6.4.): A Load Measurements Test Plan IAW DI-NDTI-80566, a Load Measurements Test Report IAW DI-NDTI-80809. The Load Measurements Test shall be performed IAW MIL-HDBK-704, LDC101. At the discretion of the Using Service, an analysis by the supplier may be accepted in lieu of test, in which case the supplier shall submit an analysis conforming to the requirements of Appendix E, paragraph 5.10.4.3.

d. Overheat: A Engine Control Overheat Test Plan IAW DI-NDTI-80566 and a Engine Control Overheat Test Report IAW DI-NDTI-80809.

e. Power Compatibility: A Power Compatibility Test Plan IAW DI-NDTI-80566, a Power Compatibility Test Report IAW DI-NDTI-80809, a Short Circuit Protection Test Plan IAW DI-NDTI-80566, and a Short Circuit Protection Test Report IAW DI-NDTI-80809.

f. Data Bus Specification Compliance Analysis: A Data Bus Interfaces Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, Data Bus Interfaces Test Reports IAW DI-NDTI-81897 or a Component Similarity Argument Report IAW DI-NDTI-81896.

g. Crystal Oscillator: A Crystal Oscillator Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, a Crystal Oscillator Test Report IAW DI-NDTI-81897 or a Component Similarity Argument Report IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.1.1.1. Backup Control
The purpose of the backup control requirement is to demonstrate engine performance and stability during transfer from the primary control.

Criteria:
Transfer from the primary system to the backup control and back to the primary system shall be automatic at any power setting without engine performance instability or change to the control system input.

Standard:
Appendix U, paragraph 3.7.2.1.1.
Appendix U, paragraph 4.10.2.1.1.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.2.1.1. shall be verified by analysis and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.2.1.1. and include a Backup Control System Performance Analysis IAW DI-MISC-80711, a Backup Control Performance Test Plan IAW DI-NDTI-80566, and a Backup Control Performance Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.1.1.2. Control System Adjustment
The purpose of the control system adjustment requirement is to ensure that all engine calibration is performed in a controlled environment.

Criteria:
No field adjustment of the control system shall be required to enable operation throughout the entire operating envelope.

Standard:
Appendix U, paragraph 3.7.2.2.
Appendix U, paragraph 4.10.2.2.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.2.2. shall be verified by demonstration.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.1.2. Overspeed and Overtemperature Protection System

The purpose of the overspeed protection system requirement is to demonstrate the capability of the engine overspeed control system and take corrective action to prevent propulsion system limits from being exceeded.

Criteria:
The engine control system shall detect, store, and report all engine overspeed and overtemperature conditions.

Standard:
Appendix U, paragraph 3.7.2.3.
Appendix U, paragraph 4.10.2.3.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.2.3. shall be verified by tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.2.3. and include an Overspeed Control System Test Plan IAW DI-NDTI-80566, a Overspeed Control System Test Report IAW DI-NDTI-80809, a Overtemperature Control System Test Plan IAW DI-NDTI-80566, and a Overtemperature Control System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.1.3. Control System Safety

The objective of the Control System Safety requirement is to develop a Fault Tree Analysis (FTA) to recognize hazards that may occur, documenting their unwanted consequences and analyzing their potential causes. Using the data detailed in the FTA, a functional Hazard Analysis (FHA) is to be developed to identify the consequence of failure for those hazards identified.

Criteria:
All system-level functions for consequence of failure shall be defined in a System-Level FHA. All hazards shall be identified and described in a FTA based on the FHA.

Standard:
SAE ARP 4761
MIL-STD-882E
Appendix U, paragraph 3.7.2.4.
Appendix U, paragraph 4.10.2.4.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.2.4. shall be verified by analyses, demonstrations, and tests. A FTA shall be prepared based on the FHA for catastrophic and critical vehicle events. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.2.4. and include FTA IAW DI-MISC-80711 and prepared IAW and prepared IAW SAE ARP 4761, and a FHA)IAW DI-MISC-80711. The failure rate data in support of the FTA shall be sourced from a functional level FMECA (reference Appendix E, paragraph 5.6.4.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.2. Fuel System

7.4.7.2.1. Fuels
The purpose of the fuels requirement is to verify that the engine operates to all engine performance parameters when using designated fuels.

Criteria:
The engine shall start and function and meet engine performance parameters throughout its complete environmental and operating envelope for all steady-state and transient operation when using designated fuels.

Standard:
Appendix U, paragraph 3.7.3.1.
Appendix U, paragraph 4.10.3.1.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.3.1. shall be verified by tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.3.1. and verified during Engine Calibration (reference Appendix U, paragraph 4.3.5.1.2.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.2.2. Fuel System Performance

7.4.7.2.2.1. Fuel Contamination

The purpose of the fuel contamination requirement is to ensure fuel wetted components downstream from the fuel filter can tolerate contaminated fuel as per the specified limits.

Criteria:
The engine shall tolerate fuel contamination as per specified limits without performance degradation or mechanical damage resulting in loss of service life.

Standard:
Appendix U, paragraph 3.7.3.2.1.
Appendix U, paragraph 4.10.3.2.1.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.2.3.1. shall be verified by analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.2.3.1. and include a Fuel Contamination Analysis IAW DI-MISC-80711, a Fuel Contamination Test Plan IAW DI-NDTI-80566, and a Fuel Contamination Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.2.2.2. Fuel System Depressed Fuel Inlet Performance Test

The purpose of the fuel system depressed fuel inlet performance test requirement is to demonstrate the engine fuel system's capability to provide sufficient fuel flow to the engine at all operating speeds and conditions to preclude engine flameouts, stalls and other fuel related failures.

7.4.7.2.2.2.1. Net Positive Suction Pressure (NPSP) Test

The purpose of the Net Positive Suction Pressure (NPSP) test requirement is to determine the aircraft engine fuel pumps resistance to cavitation.

Criteria:
The fuel pump shall supply the required amount of fuel at the required pressures for engine operation throughout its operating envelope for fuel inlet temperatures and pressures within specified limits, without cavitation or performance degradation.

Standard:
SAE ARP4024
Appendix E, paragraph 5.6.5.4.
Appendix U, paragraph 3.7.3.2.3.
Appendix U, paragraph 4.10.3.2.3.1.

Method of Compliance:
The engine fuel system shall be tested in accordance with SAE ARP4024 and Appendix E, paragraph 5.6.5.1. to determine the NPSP capability of each. The results from this testing shall be analyzed to determine if the overall engine fuel system meets the NPSP capability specified in 3.7.3.2.3. The airworthiness substantiation shall include a Net Positive Suction Pressure (NPSP) Test Plan IAW DI-NDTI-80566, and a Net Positive Suction Pressure (NPSP) Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.2.2.2.2. Vapor Volume to Liquid Volume (V/L) Test

The purpose of the Vapor Volume to Liquid Volume (V/L) test requirement is to demonstrate that the engine fuel pumping system is capable of continuously ingesting fuel with a vapor-to-liquid ratio as specified in the EMS or component specification.

Criteria:
The engine fuel system shall meet or exceed the specified V/L capability requirements.

Standard:
SAE ARP4024
Appendix E, paragraph 5.6.5.1.
Appendix U, paragraph 3.7.3.2.3.
Appendix U, paragraph 4.10.3.2.3.2.

Method of Compliance:
Each engine fuel system shall be tested in accordance with Appendix E, paragraph 5.6.5.1. to verify Vapor Volume to Liquid Volume (V/L) capability. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.3.2.3.2. and include a Vapor Volume to Liquid Volume (V/L) Test Plan IAW DI-NDTI-80566, and a Vapor Volume to Liquid Volume (V/L) Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.2.2.3. Fuel System Bubble Ingestion

The purpose of the Fuel System Bubble Ingestion requirement is to demonstrate that the engine fuel system shall be capable of continuously ingesting slugging flow at its inlet without performance degradation throughout the engine operating envelope.

Criteria:
A test shall be conducted to demonstrate that the engine fuel pumping system is capable of continuously ingesting slugging flow presented at the engine fuel inlet, without discharge flow interruption.

Standard:
SAE ARP4028
Appendix E, paragraph 5.6.5.3.
Appendix U, paragraph 3.7.3.2.4.
Appendix U, paragraph 4.10.3.2.4.

Method of Compliance:
Each engine fuel system shall be tested in accordance with Appendix E, paragraph 5.6.5.3. to verify fuel system bubble ingestion capability. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.3.2.4. and include a Fuel Bubble Ingestion Test Plan IAW DI-NDTI-80566, and a Fuel Bubble Ingestion Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.2.2.4. Fuel Pump Priming

The purpose of the fuel pump priming requirement is to ensure the capability of on-engine fuel pumps to self prime.

Criteria:
The fuel pump shall be self-priming IAW the air vehicle specification.

Standard:
Appendix U, paragraph 3.7.3.2.5.
Appendix U, paragraph 4.10.3.2.5.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.3.2.5. shall be verified by tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.3.2.5. and include a Fuel Pump Priming Test Plan IAW DI-NDTI-80566, and a Fuel Pump Priming Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.2.2.5. Fuel Lubricity

The purpose of this test is to demonstrate that the components that rely on the fuel lubricity for self-lubrication can operate reliably throughout all the missions to preclude failures that may occur in service.

Criteria:
The engine fuel system components that rely on fuel for self-lubrication shall operate satisfactorily. For Compression Ignition engines, the engine shall operate without loss or

reduction of performance when using fuel with a lubricity value equivalent to a 0.030-0.035 inch (0.75-0.90mm) wear scar diameter as defined by ASTM D5001.

Standard:
Appendix E, paragraph 5.10.
Appendix E, paragraph 5.3.2.
Appendix U, paragraph 3.7.3.2.6.
Appendix U, paragraph 4.10.3.2.6.

Method of Compliance:
The fuel system components that require fuel for self-lubrication shall undergo a simulated mission operational test for at least 100 hours IAW Appendix E, paragraph 5.3.2. The airworthiness substantiation shall include a Fuel System Low Lubricity Operational Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, a Fuel System Low Lubricity Operational Test Report IAW DI-NDTI-81897 or Component Similarity Argument Report IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.2.2.6. Fuel System Performance with Water Saturated

The purpose of the fuel system performance with water saturated fuel requirement is to demonstrate that the engine fuel system can remove water from the fuel to maintain the fuel at or below the specified water saturation limit to prelude damage to fuel system components and assure performance and operability requirements are maintained.

Criteria:
The engine fuel filter/water separator assembly system shall be capable of sustained operation throughout its flow and pressure range with both a free water/fuel mix and water saturated fuel.

Standard:
Appendix U, paragraph 3.7.3.2.7.
Appendix U, paragraph 4.10.3.2.7.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.3.2.7. shall be verified by tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.3.2.7. and include a Water Saturated Fuel Analysis IAW DI-MISC-80711, a Water Saturated Fuel Test Plan IAW DI-NDTI-80566, and a Water Saturated Fuel Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.2.2.7. Fuel Flow Limit

The purpose of the fuel flow limit requirement is to ensure the engine fuel flow is within the maximum and minimum limits as specified in the engine model specification.

Criteria:
The engine fuel flow shall measure within the limits established in the engine model specification.

Standard:
Appendix U, paragraph 3.7.3.2.9.
Appendix U, paragraph 4.10.3.2.9.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.3.2.9. shall be verified by tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.3.2.9. and verified during the Performance Computer Program test with substantiation provided in the Altitude Test Report (reference Appendix U, paragraph 4.14.1.2.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.2.2.8. Fuel Return Temperature

The purpose of the fuel return temperature requirement is to ensure the fuel temperature rise from recirculation does not exceed thermal limits as per the engine model specification (EMS) across all operating conditions and the operational envelope.

Criteria:
Fuel temperature rise from recirculation shall not exceed thermal limits across all operating conditions and the operational envelope.

Standard:
Appendix U, paragraph 3.7.3.2.10.
Appendix U, paragraph 4.10.3.2.10.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.3.2.10. shall be verified by tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.3.2.10. and conducted prior to first flight on an aircraft conforming to the same parts list and configuration as the endurance test engine during ground testing (Appendix U, paragraph 3.2.2.3.1.). Testing shall be conducted under worst-case operating conditions.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.2.3. Fuel System Components

The purpose of the fuel system component requirement is to demonstrate that components will survive throughout the full range of environments while continuing to meet their individual performance requirements.

Criteria:
The engine fuel system components and accessories shall properly function during and after exposure to environmental effects.

Standard:
Appendix E, paragraph 5.10.
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.4.
Appendix U, paragraph 3.7.3.3.
Appendix U, paragraph 4.10.3.3.

Method of Compliance:
Engine fuel system components shall meet their individual performance requirements when tested IAW Appendix E, paragraphs 5.1. and 5.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Fuel System Components Environmental Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, a Fuel System Components Environmental Test Report IAW DI-NDTI-81897 or a Component Similarity Argument Report IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.2.3.1. Fuel System Valves

The purpose of the fuel system valves requirement is to ensure that the installation of fuel system valves do not impart damaging loads to fuel system lines and fittings, and are installed so that gravity and vibration do not component performance or life.

Criteria:
Each valve and fuel system control shall be supported so that loads resulting from its operation or from accelerated flight conditions are not transmitted to the lines connected to the valve, and shall be installed so that gravity and vibration will not affect the selected position.

Standard:
Appendix U, paragraph 3.7.3.3.1.
Appendix U, paragraph 4.10.3.3.1.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.3.3.1. shall be verified by analysis and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.3.3.1. and include a Fuel System Valves Analysis IAW DI-MISC-80711, a Fuel System Valves

Test Plan IAW DI-NDTI-80566, and a Fuel System Valves Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.2.3.2. Fuel Filter

The purpose of the fuel filter requirement is to demonstrate the engines' ability to meet performance specification with a worse case contaminated fuel filter throughout the filters designated service life interval.

Criteria:

The filter shall have sufficient capacity to permit a cumulative fuel flow to maintain continuous engine operation at maximum continuous rated power at sea level with contaminated fuel without being cleaned.

Standard:

ISO 12103-1
ISO 11171
ISO 4406
Appendix U, paragraph 3.7.3.3.2.
Appendix U, paragraph 4.10.3.3.2.

Method of Compliance:

The requirements of Appendix U, paragraph 3.7.3.3.2. shall be verified by demonstration and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.3.3.2. and include a Fuel Filter Test Plan IAW DI-NDTI-80566, and a Fuel Filter Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.2.3.3. Fuel System Drains

The purpose of the fuel system drains requirement is to ensure provisions are incorporated for safe defueling of the aircraft to prevent hazardous conditions.

Criteria:

The aircraft shall have a minimum of one fuel system drain per tank, and one fuel system drain per engine to allow for fuel pre-flight sample inspection, and removal of sediment and water in sumps. The sump drains shall also allow for entire fuel system drainage with the air vehicle in its normal ground attitude.

Standard:

Appendix U, paragraph 3.7.3.3.3.
Appendix U, paragraph 4.10.3.3.3.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.3.3.3. shall be verified by demonstration, inspection, and analysis. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.3.3.3. and include a Fuel System Drain Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.2.3.4. Fuel Pump
The purpose of the fuel pump requirement is to demonstrate the engine fuel pump's capability to provide sufficient fuel flow to the engine at all operating speeds and conditions to preclude engine flameouts, stalls and other fuel related failures.

Criteria:
The engine fuel pump shall provide necessary fuel flows, pressures and temperatures to satisfy the requirements of the engine under severe conditions.

Standard:
Appendix U, paragraph 3.7.3.3.4.
Appendix U, paragraph 4.10.3.3.4.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.3.3.4. shall be verified by analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.3.3.4. The engine fuel pump shall be tested with the engines fuel system prior to the completion of PFR testing. The airworthiness substantiation shall include a Fuel System Test Analysis IAW DI-MISC-80711, Fuel System Test Plan IAW DI-NDTI-80566, and Fuel System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	*DoD/MIL Docs*	*FAA/EASA*	*Def-Stan 970*	*STANAG*

7.4.7.3. Electrical System

7.4.7.3.1. Electrical Power
The engine shall provide uninterruptable electrical power IAW the ICD. Engine equipment shall be capable of accepting externally supplied air vehicle electrical power for engine starting.

Criteria:
The engine electrical power system shall be compatible to the host aircraft's electrical power environment.

Standard:
Appendix E, paragraph 5.6.4.
Appendix E, paragraph 5.6.4.4.
Appendix E, paragraph 5.10.
Appendix U, paragraph 3.7.4.1.
Appendix U, paragraph 4.10.4.1.

Method of Compliance:
The engine electrical power system design shall meet the requirements of Appendix U, paragraph 3.7.4.1. and shall be tested Appendix U, paragraph 4.10.4.1. and IAW Appendix E, paragraphs 5.6.4. and 5.6.4.4. The airworthiness substantiation (IAW Appendix E, paragraph 5.10) shall include an Electrical Power System Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, an Electrical Power System Test Report IAW DI-NDTI-81897 or a Component Similarity Argument Report IAW DI-NDTI-81896.

Additional Information

Comm Docs	*DoD/MIL Docs*	*FAA/EASA*	*Def-Stan 970*	*STANAG*

7.4.7.3.1.1. Generator
The purpose of the generator requirement is to ensure it will survive throughout the full range of environments and continue to meet its individual performance requirements.

Criteria:
The generator shall meet the power requirement, as per the Using Authority, throughout the operating envelope of the generator.

Standard:
Appendix U, paragraph 3.7.4.1.1.
Appendix U, paragraph 4.10.4.1.1.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.4.1.1. shall be verified by analyses, demonstrations, and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.4.1.1. and shall include a Generator Analysis IAW DI-MISC-80711, a Generator Test Plan IAW DI-NDTI-80566, and Generator Test Report IAW DI-NDTI-80809.

a. In addition to other tests required by this standard, the following shall be conducted qualify electrical generators and their installation:

(1) Overspeed: The generator shall be tested per the overspeed requirement of Appendix U, paragraph 3.4.1.6.5., with no electrical load. At the completion of the test there shall be no evidence of mechanical or electrical damage or impending failure.

(2) Containment: A containment analysis or test shall verify the generator case provides radial containment of rotating components at the generator peak transient

operating speed. The generator shall be tested at the maximum transient generator speed in a manner to cause a mechanical failure of the generator system. All damage shall be contained within the generator housing.

(3) Bearing Life: An analysis shall be performed to verify that generator shaft bearings have a minimum B10 life of 4500 hours. Any auxiliary bearings shall be capable of preventing rotor / stator rub at full electrical load for a minimum of 10-hours in the event of main generator bearing failure.

(4) Structural Analysis: A stress analysis of the accessory gearbox housing, generator case, and attachment hardware shall be performed to ensure all aircraft structural design requirements are met under flight and crash loads. An analysis of gears and bearings in the accessory gear train shall be conducted to verify all component design requirements are met.

(5) Shaft Shear Section: The generator drive shaft design shall include a shear section to limit the torque transmitted from the generator to the gearbox drive pad. Shear of generator shaft shall occur prior to causing any damage to accessory gear train. When the shaft shear section breaks, all rotating parts of the generator shall be disconnected from the drive pad.

(6) Load test: The generator shall be operated at a speed corresponding to the percent of the minimum and maximum allowable propeller speed under full rated electrical load for one hour. During this test, the generator shall be subjected to the maximum component limiting temperature. At the completion of the test there shall be no evidence of mechanical or electrical damage or impending failure.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.3.2. Electrical Connectors and Cables

The purpose of the electrical connectors and cables requirement is to ensure that at cold atmospheric temperatures the electrical cables will flex to prevent damage to connectors and corresponding hardware during normal maintenance procedures.

Criteria:

Electrical cables shall flex at cold atmospheric temperatures to prevent damage to connectors and corresponding hardware during maintenance.

Standard:

Appendix U, paragraph 3.7.4.3.
Appendix U, paragraph 4.5.2.3.1.
Appendix U, paragraph 4.10.4.3.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.4.3. shall be verified by analyses, demonstrations, and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.4.3. and verified as part of the Cold Soak Test (reference Appendix U, paragraph 4.5.2.3.1.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.3.3. Electrical Bonding

The purpose of the electrical bonding requirement is to ensure that all electrical and electronic components on the propulsion system shall have clearly defined electrical bonding interfaces that shall be identified in the design documentation, including drawings.

Criteria:
The propulsion system shall have a clearly defined electrical bonding interfaces with the air vehicle as identified in the ICD.

Standard:
MIL-STD-464D, paragraph 5.11.
Appendix U, paragraph 3.7.4.4.
Appendix U, paragraph 4.10.4.4.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.4.4. shall be verified by demonstration, inspection. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.4.4. and include identification of the electrical bonding interfaces in the Installation Control Document (ICD).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.3.4. Ground Isolation

The purpose of the ground isolation requirement is to ensure the propulsion system does not use the air vehicle structure for power or signal return.

Criteria:
The propulsion system to air vehicle interfaces shall not use vehicle structure for electrical grounding.

Standard:
Appendix U, paragraph 3.7.4.5.
Appendix U, paragraph 4.10.4.5.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.4.5. shall be verified by inspection and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.4.5. and include a Ground Isolation Test Plan IAW DI-NDTI-80566, and a Ground Isolation Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.3.5. Potting Compound

The purpose of the potting compound requirement is to ensure potting compounds are necessary, and if so that they are suitable for the application and do not impose damage to the connecting hardware due to higher mechanical loads, or allow contamination which may lead to electronic failure (i.e., water ingress).

Criteria:
The use of potting compounds shall not be permitted except where specifically approved by the Using Service.

Standard:
Appendix U, paragraph 3.7.4.6.
Appendix U, paragraph 4.10.4.6.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.4.6. shall be verified by inspection and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.4.6.. Verification should be conducted on the engine endurance test that has the greatest number of thermal cycles to demonstrate the ability of the potting compound to resist cracking. (reference Appendix U, paragraph 4.14.1.1.1.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.3.6. Wiring Faults

The purpose of the wiring fault requirement is to ensure that the engine control system does not experience permanent damage or disruption or loss of function after an electrical wiring short circuit.

Criteria:
The electronic engine control system shall maintain normal operation during and after experiencing any wiring fault.

Standard:
Appendix U, paragraph 3.7.4.7.
Appendix U, paragraph 3.7.4.7.1.

Appendix U, paragraph 3.7.4.7.2.
Appendix U, paragraph 3.7.4.7.3.
Appendix U, paragraph 4.10.4.7.
Appendix U, paragraph 4.10.4.7.1.
Appendix U, paragraph 4.10.4.7.2.
Appendix U, paragraph 4.10.4.7.3.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.4.7.2. and 3.7.4.7.3. shall be verified by test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.7.2. and 4.10.7.2. and include a Wiring Faults Test Plan IAW DI-NDTI-80566, and a Wiring Faults Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.4. Ignition and Combustion Energy Assist Systems

7.4.7.4.1. Combustion Energy Assist Systems
The purpose of the combustion energy assist system requirement is to ensure performance and durability of combustion energy assist components or systems.

Criteria:
Combustion Energy Assist System components (e.g. glow plugs or other devices to preheat the combustion chamber, manifold intake air heaters, etc.) shall provide the appropriate level of heat required to warm the cylinders. Any failure of a combustion energy assist system component shall not cause damage to the engine.

Standard:
Appendix U, paragraph 3.7.5.1.
Appendix U, paragraph 4.10.5.1.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.5.1. shall be verified by analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.5.1. and include a Combustion Energy Assist Systems Analysis IAW DI-MISC-80711. The Analysis shall be verified during the Performance Computer Program test with substantiation provided in the Altitude Test Report (reference Appendix U, paragraph 4.14.1.2.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.4.1.1. Spark Plug

The purpose of the spark plug requirement is to ensure spark plug performance and inclusion of the spark plug specification parameters to the Engine Model Specification (EMS).

Criteria:
The spark plug used shall have quality to withstand at highly fluctuating temperature and pressure in the combustion chamber. The parameters for the spark plug shall be included in the EMS.

Standard:
Appendix U, paragraph 3.7.5.2.
Appendix U, paragraph 4.10.5.2.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.5.2. shall be verified by analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.5.2. and include a Spark Plug Analysis IAW DI-MISC-80711. The Analysis shall be verified with substantiation provided in the Altitude Test Report (reference Appendix U, paragraph 4.14.1.2.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.4.1.2. Ignition System
The purpose of the ignition system requirement is to ensure reliability of the electronic ignition system.

Criteria:
Each engine must be equipped with an ignition system for starting the engine on the ground and in flight. An electric ignition system shall have redundant (at least two) igniters and independent electric circuits.

Standard:
Appendix U, paragraph 3.7.5.3.
Appendix U, paragraph 4.10.5.3.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.5.3. shall be verified by inspection and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.5.3. and shall be verified with substantiation provided in the Altitude Test Report (reference Appendix U, paragraph 4.14.1.2.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.5. Engine Health Monitoring System (EHMS)

The purpose of the Engine Health Monitoring System (EHMS) requirement is to ensure the propulsion system has the capability to perform advanced trending, monitoring, and prognostic functions relative to the engine performance.

Criteria:

The propulsion system shall incorporate equipment as required to monitor engine performance, electrical and mechanical condition. The EHMS shall be able to interface and transfer data to a ground station for data review, trending, and interrogation. The failure of the EHMS shall not cause a failure of any other mission or safety critical system.

Standard:

Appendix U, paragraph 3.7.6.
Appendix U, paragraph 4.10.6.

Method of Compliance:

The requirements of Appendix U, paragraph 3.7.6. shall be verified by analysis, demonstrations, and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.6. and include a Engine Health Monitoring System (EHMS) System Analysis IAW DI-MISC-80711, a Engine Health Monitoring System (EHMS) System Test Plan IAW DI-NDTI-80566, and a Engine Health Monitoring System (EHMS) System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.5.1. Engine and Component Life Usage Tracking

The purpose of the engine and component life usage tracking requirement is to ensure the accuracy of information used to determine operation, maintenance and life limits. The engine monitoring system monitors and records parameters for safe platform operation, operational readiness improvements, and life limit updates.

Criteria:

The engine monitoring system shall monitor and calculate lives for life limited parts.

Standard:

Appendix U, paragraph 3.7.6.1.
Appendix U, paragraph 4.10.6.1.

Method of Compliance:

The requirements of Appendix U, paragraph 3.7.6.1. shall be verified by analysis, demonstrations, and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.6.1. and include a Monitoring System Performance Analysis IAW DI-MISC-80711, a Monitoring System Performance Test Plan IAW DI-NDTI-80566, and

Monitoring System Performance Test Report IAW DI-NDTI-80809. Any algorithms used as part of this functionality shall be submitted for approval by the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.5.2. Fault Detection/Isolation

The purpose of the Fault Detection/Isolation requirement is to ensure that the Engine Health Monitoring System (EHMS) has the capability to output a comprehensive suite of internal and Line Replaceable Unit (LRU) built in tests fault codes to facilitate the detection and isolation of faults.

Criteria:

The EHMS shall have the capability to accomplish failure detection and failure isolation to the LRU without the assistance of support equipment at the organizational level. The propulsion system health monitoring system shall be located for convenient readout by ground maintenance personnel.

Standard:

Appendix U, paragraph 3.7.6.2.
Appendix U, paragraph 4.10.6.2.

Method of Compliance:

The requirements of Appendix U, paragraph 3.7.6.2. shall be verified by modeling, inspection, analysis, and Built-in-Test (BIT) test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.6.1. with analysis and testing performed as part of the Engine Health Monitoring System (EHMS) substantiation effort (reference Appendix U, paragraph 3.7.6.). Any algorithms used as part of this functionality shall be submitted for approval by the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.5.3. Performance Monitoring/Trending

The purpose of the performance monitoring/trending requirement is for the EHMS to measure the engine’s capability relative to the specified performance.

Criteria:

The EHMS shall incorporate an engine model that provides a metric of the engine’s capability relative to the specified performance.

Standard:

Appendix U, paragraph 3.2.1.5.
Appendix U, paragraph 3.7.6.3.
Appendix U, paragraph 4.10.6.3.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.6.3. shall be verified by inspection, demonstration and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.6.3. and shall be verified in parallel with the Engine Performance Presentation and Performance Computer Program (reference Appendix U, paragraph 3.2.1.5.) by analysis, engine altitude tests and air vehicle performance tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.5.4. Onboard Engine Diagnostic Functions
The purpose of the onboard engine diagnostic functions requirement is for the EHMS to monitor engine parameters to detect early failure symptoms and performance degradation, permit fault isolation, and provide long-term failure trending information.

Criteria:
The EHMS shall incorporate on-board engine diagnostic capability.

Standard:
Appendix U, paragraph 3.2.1.5.
Appendix U, paragraph 3.7.6.4.
Appendix U, paragraph 4.10.6.4.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.6.4. shall be verified by modeling, demonstration, analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.6.4. and shall be verified in parallel with the Performance Computer Program (reference Appendix U, paragraph 3.2.1.5.) by analysis, engine altitude tests and air vehicle performance tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.5.5. Oil Condition and Fluid Monitoring
The purpose of the oil condition and fluid monitoring requirement is to state the fluid condition monitoring sensors that shall be used by the EHMS.

Criteria:
The oil and fuel sensors shall be monitored by the EHMS.

Standard:
Appendix U, paragraph 3.2.1.5.
Appendix U, paragraph 3.7.6.5.
Appendix U, paragraph 4.10.6.5.

Appendix U, paragraph 4.14.1.2.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.6.5. shall be verified by inspection, demonstration and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.6.3. and shall be verified in parallel with the Engine Performance Presentation and Performance Computer Program (reference Appendix U, paragraph 3.2.1.5.) by analysis, engine altitude tests (reference Appendix U, paragraph 4.14.1.2.) and air vehicle performance tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.6. Lubrication System
The lubrication system of the engine shall function properly throughout all environmental conditions in the operating envelope of the engine, including all flight maneuver forces and attitudes which the air vehicle is required to perform. These requirements shall be met at any oil level greater than that which is defined as “unusable.”

7.4.7.6.1. Lubrication Oil
The purpose of the lubrication oil requirement is to verify that the engine operates to all engine performance parameters when using designated lubricants.

Criteria:
The engine shall start, function and meet engine performance parameters throughout its complete environmental and operating envelope for all steady-state and transient operation when using designated lubricants.

Standard:
Appendix U, paragraph 3.7.8.1.
Appendix U, paragraph 4.5.2.3.1.
Appendix U, paragraph 4.10.8.1.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.8.1. shall be verified by analysis and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.8.1. and include a Lubrication Analysis IAW DI-MISC-80711, a Lubrication Test Plan IAW DI-NDTI-80566, and a Lubrication Test Report IAW DI-NDTI-80809. A Cold Soak Test (reference Appendix U, paragraph 4.5.2.3.1.) shall also be used as verification of this requirement.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.6.1.1. Oil Pressure and Temperature Limits
The operating oil pressure and temperature limits shall be listed in the EMS.

Criteria:
The maximum and minimum operating oil pressure limits and the maximum transient and maximum allowable steady state oil temperature limits shall be listed in the EMS, including during starting and initial operation.

Standard:
Appendix U, paragraph 3.2.1.5.
Appendix U, paragraph 3.7.8.1.1.
Appendix U, paragraph 4.10.8.1.1.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.8.1.1. shall be verified by analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.8.1.1. and include a Oil Pressure and Temperature Limits Analysis IAW DI-MISC-80711, and shall be verified in parallel with the Performance Computer Program (reference Appendix U, paragraph 3.2.1.5.) by analysis, engine altitude tests and air vehicle performance tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.6.1.2. Oil Consumption Limits
The purpose of the oil consumption limits requirement is to characterize the oil consumption limits, and operating oil pressure for incorporation into the EMS.

Criteria:
The oil consumption limits, including all forms of oil loss, shall be determined by the contractor and presented in the EMS.

Standard:
Appendix U, paragraph 3.7.8.1.2.
Appendix U, paragraph 4.3.4.1.1.
Appendix U, paragraph 4.5.2.2.
Appendix U, paragraph 4.10.8.1.2.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.8.1.2. shall be verified by analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.8.1.2. and include a Oil Consumption Limits Analysis IAW DI-MISC-80711, a Oil Consumption Limits Test Plan IAW DI-NDTI-80566, and a Oil Consumption Limits Test Report IAW DI-NDTI-80809. Testing shall use the test condition of Appendix U, paragraph 4.3.4.1.1., and assume the worst-case attitude condition of Appendix U, paragraph 4.5.2.2.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.6.2. Lubrication System Components and Features

The purpose of the lubrication system components and features requirement is to ensure performance and safety of the lubrication system components or systems.

Criteria:

The lubrication system components and systems shall meet performance standards and ensure safe operation.

Standard:

Appendix U, paragraph 3.6.1.3.
Appendix U, paragraph 3.7.8.2.
Appendix U, paragraph 4.10.8.2.

Method of Compliance:

The requirements of Appendix U, paragraphs 3.7.8.2. shall be verified by analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.8.2. and include a Lubrication System Components and Features Analysis IAW DI-MISC-80711, a Lubrication System Components and Features Test Plan IAW DI-NDTI-80566, and a Lubrication System Components and Features Test Report IAW DI-NDTI-80809. Additional verification of this requirement may be presented in engine altitude tests and air vehicle performance tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.6.2.1. Oil Reservoir

The purpose of the oil reservoir requirement is to ensure that the oil reservoir has the required capacity and can withstand pressure cycling throughout the life cycle.

Criteria:

The total enclosed capacity of the oil reservoir, usable oil volume, gulping oil volume, unusable oil volume, and expansion space shall be IAW the EMS.

Standard:

Appendix E, paragraph 5.6.1.
Appendix U, paragraph 3.7.8.2.1.
Appendix U, paragraph 4.10.8.2.1.

Method of Compliance:

The requirements of Appendix U, paragraphs 3.7.8.2.1. shall be verified by analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.8.2.1. and include a Oil Reservoir Capacity and Pressure Analysis IAW DI-MISC-80711.

Additionally, the oil reservoir tank with filler cap installed shall be subjected to positive and negative differential pressures IAW Appendix E, paragraph 5.6.1. Additional airworthiness substantiation shall include a Lubrication System Pressure Test Plan IAW DI-NDTI-80566, and Lubrication System Pressure Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.6.2.1.1. Oil Reservoir External Features

The purpose of the oil reservoir external features requirement is to demonstrate that the oil reservoir has external features to monitor oil level and to features for maintenance servicing.

Criteria:

The oil reservoir shall contain external features necessary to determine the oil level and to service and drain the reservoir.

Standard:

Appendix U, paragraph 3.7.8.2.1.1.
Appendix U, paragraph 4.10.8.2.1.1.

Method of Compliance:

The requirements of Appendix U, paragraphs 3.7.8.2.1.1. shall be verified by demonstration, inspection and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.8.2.1.1. and include a Oil Reservoir External Features Test Plan IAW DI-NDTI-80566, and a Oil Reservoir External Features Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.6.2.2. Oil Drains

The purpose of the oil drains requirement is to demonstrate that the oil drains are at the optimum location for oil sampling and servicing, and designed to preclude accidental opening during routine maintenance or when exposed to severe vibration.

Criteria:

Drain ports shall be provided at low points in the oil system for draining the engine oil while the engine is in attitudes IAW the ICD. The oil drain shall be constructed to prevent accidental opening during routine maintenance operations or during severe engine vibration cycles.

Standard:

Appendix U, paragraph 3.7.8.2.2.
Appendix U, paragraph 4.10.8.2.2.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.8.2.2. shall be verified by inspection and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.8.2.2. and include a Oil Drains Summary Report IAW DI-MISC-80711 to summarize the inspection and testing conducted to verify this requirement. Verification shall be accomplished on endurance and attitude test engines.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.6.2.3. Oil Filters
The purpose of the oil filters requirement is to demonstrate the serviceability of the oil filter and demonstrate the engine's ability meet performance specification with a worse case contaminated oil filter throughout the filters designated service life interval.

Criteria:
The oil filter shall be serviceable and have sufficient capacity and safe-guards to permit a cumulative oil flow to specified engine performance with contaminated oil. The oil filter assembly shall incorporate a pressure relief bypass (with indication) to ensure engine performance in the event of a clogged oil filter.

Standard:
MIL-DTL-8815/31
Appendix U, paragraph 3.7.8.2.3.
Appendix U, paragraph 4.10.8.2.3.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.8.2.3. shall be verified by analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.8.2.3. and include an Oil Filters Analysis IAW DI-MISC-80711, an Oil Filters Test Plan IAW DI-NDTI-80566, and an Oil Filters Test Report IAW DI-NDTI-80809. Oil filter performance shall be verified by bench test prior to engine test. Engine filter elements shall be inspected during engine tests to ensure that the oil filter configuration, filtration capacity, and servicing features are per the specification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.6.2.4. Oil Coolers
The purpose of oil coolers requirement is to verify that the oil cooler is serviceable and can safely operate throughout its operational envelope and life cycle without failure due to mechanical loads.

Criteria:
The oil cooler and its supporting structures shall be serviceable and able to withstand mechanical loads encountered throughout the operating envelope. The oil cooler shall incorporate a pressure bypass and be designed to facilitate internal cleaning and inspection.

Standard:
Appendix U, paragraph 3.7.8.2.5.
Appendix U, paragraph 4.10.8.2.5.
Appendix U, paragraph 4.15.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.8.2.5. shall be verified by analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.8.2.5. and include a Oil Coolers Analysis IAW DI-MISC-80711. Testing shall be in accordance with Appendix U, paragraph 4.15.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.7. Exhaust Nozzle System

The purpose of exhaust nozzle system requirement is to ensure any failure of the exhaust nozzle system does not result in damage to the air vehicle.

Criteria:
Any exhaust nozzle system failure shall not cause damage to the air vehicle.

Standard:
Appendix U, paragraph 3.7.10.
Appendix U, paragraph 4.10.10.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.10. shall be verified by analysis. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.10. and include a Exhaust Nozzle System Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.8. Power Augmentation System

The purpose of power augmentation system requirement is to ensure any transitioning to and from augmented power does not result in damage or performance degradation to the engine.

Criteria:
If applicable, power augmenter operation shall be provided to the propulsion system throughout the entire operating envelope. Transition from non-augmented to augmented operation shall be free of large, abrupt power changes, and shall not cause a loss of engine operability.

Standard:
Appendix U, paragraph 3.7.11.
Appendix U, paragraph 4.10.11.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.11. shall be verified by analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.11. and include a Power Augmentation System Analysis IAW DI-MISC-80711 and shall be verified in parallel with the Performance Computer Program (reference Appendix U, paragraph 3.2.1.5.) by analysis, engine altitude tests and air vehicle performance tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.9. Propeller System
The requirements of this section produces the documentation to substantiate a propeller for use on the designated host aircraft. If a commercially available propeller is selected for the aircraft configuration, the Federal Aviation Administration (FAA) propeller airworthiness certification and continued compliance documentation may be submitted and will be considered by the Using Authority as substantiation for propeller qualification.

7.4.7.9.1. Propeller System Performance
The purpose of propeller system performance requirement is to ensure the propeller system functions IAW the air vehicle specification over the operational envelope and in all environmental conditions.

Criteria:
The propeller system shall function continuously under flight conditions IAW the air vehicle specification in all environmental conditions.

Standard:
FAA 14 CFR 35
Appendix U, paragraph 3.7.15.1.
Appendix U, paragraph 3.7.15.1.1.
Appendix U, paragraph 3.7.15.1.2.
Appendix U, paragraph 3.7.15.1.3.
Appendix U, paragraph 4.10.15.1.
Appendix U, paragraph 4.10.15.1.1.
Appendix U, paragraph 4.10.15.1.2.
Appendix U, paragraph 4.10.15.1.3.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.15.1., 3.7.15.1.1., 3.7.15.1.2. and 3.7.15.1.3. shall be verified by demonstrations, analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.15.1., 4.10.15.1.1., 4.10.15.1.2. and 4.10.15.1.3. and include a Propeller System Performance Analysis IAW DI-MISC-80711, a Propeller System Performance Test Plan IAW DI-NDTI-80566, and a Propeller System Performance Test Report IAW DI-NDTI-80809.

If the performer wishes to utilize an FAA commercially certified propeller with type certification IAW 14 CFR Part 25, data shall be prepared IAW DI-SAFT-80901C. Manuals for commercial derivative aircraft and/or propellers shall be delivered IAW DI-TMSS-80067.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.9.2. Propeller Integrity
The purpose of propeller integrity requirement is to ensure the propeller meets design and construction requirements to ensure operational margin for structural integrity while allowing continued use.

Criteria:
The propeller shall meet the design and construction requirements of FAR Part 35, subpart B, and test requirements of FAR Part 35, subpart C.

Standard:
FAR part 35 subpart B
FAR part 35 subpart C
Appendix U, paragraph 3.7.15.2.
Appendix U, paragraph 4.10.15.2.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.15.2. shall be verified by analysis and test. The airworthiness substantiation shall be IAW the FAR part 35 subpart C and Appendix U, paragraph 4.10.15.2. and include a Propeller Integrity Analysis IAW DI-MISC-80711, a Propeller Integrity Test Plan IAW DI-NDTI-80566, and a Propeller Integrity Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.9.3. Propeller System Components and Features

The propeller system components and features requirements are to ensure the propeller has no features or characteristics that make it unsafe for the uses for which qualification is requested.

Criteria:
The propeller system shall perform safely for the environmental conditions and the operating envelope of the air vehicle.

Standard:
Appendix U, paragraph 3.7.15.3.
Appendix U, paragraph 4.10.15.3.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.15.3. shall be verified by analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.15.3. and include a Propeller System Component Analysis IAW DI-MISC-80711, a Propeller System Component Test Plan IAW DI-NDTI-80566, Propeller System Component Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.9.3.1. Propeller Control System

The purpose of the propeller control system requirement is to verify that all required pitch and feathering control functions performs as specified throughout all environmental conditions and operating envelope of the air vehicle.

Criteria:
The propeller control system shall perform all pitch and feathering control functions required herein during steady-state and transition between modes throughout all environmental conditions and the operating envelope of the air vehicle.

Standard:
Appendix U, paragraph 3.7.15.3.1.
Appendix U, paragraph 4.10.15.3.1.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.15.3.1. shall be verified by demonstration, analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.15.3.1. and include a Propeller Control System Analysis IAW DI-MISC-80711, a Propeller Control System Test Plan IAW DI-NDTI-80566, Propeller Control System Test Report IAW DI-NDTI-80809; and a Compliance Summary Report - Governor and Propeller System IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.9.3.2. Hydraulic System

The purpose of the hydraulic system requirements is to ensure the hydraulic system and components function as specified throughout all environmental conditions and operating envelope of the air vehicle.

Criteria:

The hydraulic system and components shall function throughout all environmental conditions and the operating envelope of the air vehicle.

Standard:

MIL-PRF-87527
MIL-PRF-83282
Appendix U, paragraph 3.4.1.2.
Appendix U, paragraph 3.7.15.3.2.
Appendix U, paragraph 4.10.15.3.3.

Method of Compliance:

The requirements of Appendix U, paragraphs 3.7.15.3.2. shall be verified by demonstration, analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.15.3.2. and include a Propeller Hydraulic System of the air vehicle. Analysis IAW DI-MISC-80711, a Propeller Hydraulic System Test Plan IAW DI-NDTI-80566, and a Propeller Hydraulic System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.9.3.2.1. Hydraulic System Entrapped Air

The purpose of the hydraulic system entrapped air requirement is to ensure entrapped air in the hydraulic system does not result in loss of system pressure or degradation of system performance.

Criteria:

Entrapped air shall not cause sustained loss of system pressure or degradation of system performance.

Standard:

Appendix U, paragraph 3.7.15.3.2.1.
Appendix U, paragraph 4.10.15.3.2.1.

Method of Compliance:

The requirements of Appendix U, paragraph 3.7.15.3.2.1. shall be verified by demonstration and test. The airworthiness substantiation shall be IAW Appendix U,

paragraph 4.10.15.3.2.3. and include a Hydraulic System Entrapped Air Test Plan IAW DI-NDTI-80566, and a Propeller Hydraulic System Entrapped Air Test Report IAW DI-NDTI-80809 and shall also be verified during air vehicle performance tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.9.3.2.2. Hydraulic Fluid Filters

The purpose of the hydraulic fluid filters requirement is to demonstrate the serviceability of the hydraulic filter, and demonstrate the propulsion system's ability meet performance specification with a worse case contaminated hydraulic filter throughout the filters designated service life interval.

Criteria:

The hydraulic fluid filter shall be serviceable and have sufficient capacity and safe-guards to permit a cumulative oil flow to specified hydraulic system performance with contaminated fluid. The filter assembly shall incorporate a pressure relief bypass (with indication) to ensure system performance in the event of a clogged oil filter.

Standard:

Appendix U, paragraph 3.7.15.3.2.2.
Appendix U, paragraph 4.10.15.3.2.2.

Method of Compliance:

The requirements of Appendix U, paragraph 3.7.15.3.2.2. shall be verified by analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.15.3.2.2. and include a Hydraulic Fluid Filters Analysis IAW DI-MISC-80711, a Hydraulic Fluid Filters Test Plan IAW DI-NDTI-80566, and a Hydraulic Fluid Filters Test Report IAW DI-NDTI-80809. Hydraulic filter performance shall be verified by bench test prior to system level testing. Hydraulic filter elements shall be inspected during system level tests to ensure that the hydraulic filter configuration, filtration capacity, and servicing features are per the specification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.9.3.3. Propeller Anti-ice/De-ice System

The purpose of the propeller anti-ice/de-ice system requirement is to demonstrate capability to prevent structural ice from forming on propeller components which may lead to imbalance or loss of power.

Criteria:

The propeller system shall incorporate an ice control system for the blades, cuffs, and spinner. The propeller shall operate under icing conditions IAW the air vehicle specification.

Standard:
Air Vehicle Specification
Appendix U, paragraph 3.7.15.3.3.
Appendix U, paragraph 4.10.15.3.3.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.15.3.3. shall be verified by analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.15.3.3. and include a Propeller Anti-ice/De-ice System Analysis IAW DI-MISC-80711, a Propeller Anti-ice/De-ice System Test Plan IAW DI-NDTI-80566, and a Propeller Anti-ice/De-ice System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.9.3.4. Blade Cuffs

The purpose of the blade cuff requirement is to ensure performance, function and fit of blade cuffs.

Criteria:
If applicable, blade cuffs shall be attached to provide corrosion protection without causing chafing to the propeller.

Standard:
Air Vehicle Specification
Appendix U, paragraph 3.7.15.3.4.
Appendix U, paragraph 4.10.15.3.4.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.15.3.4. shall be verified by demonstration and analysis. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.15.3.4. and include a Propeller Blade Cuff Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.9.3.5. Spinner

The purpose of the spinner requirement is to ensure performance, function and fit of the propeller spinner.

Criteria:
The spinner shall provide an airflow compatible with engine and airframe requirements. The spinner shall provide access for inspection and servicing of the applicable propeller mechanisms. The spinner shall retain its form under all operating conditions and when subjected to normal handling during maintenance.

Standard:
Air Vehicle Specification
Appendix U, paragraph 3.7.15.3.5.
Appendix U, paragraph 4.10.15.3.5.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.15.3.5. shall be verified by demonstration and analysis. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.15.3.5. and include a Propeller Spinner Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.9.3.6. Paint/Marking

The purpose of the paint/marking requirement is to ensure safety to ground crew by marking each propeller so that the disc is conspicuous under normal daylight ground conditions.

Criteria:
Each propeller shall be marked so that the disc is conspicuous under normal daylight ground conditions.

Standard:
Appendix U, paragraph 3.7.15.3.6.
Appendix U, paragraph 4.10.15.3.6.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.15.3.6. shall be IAW Appendix U, paragraph 4.10.15.3.6. and verified by inspection.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.10. Gearbox

The purpose of the gearbox requirement is to ensure the gearbox will transmit power from the engine all load absorbers (i.e., accessories, propeller, etc.) without damaging resonances at all operational speeds, and will meet all specified performance requirements.

Criteria:
Engine mounted gearboxes must have design margin for their maximum operating conditions. It must be shown that failure of any gearbox mounted component does not result in failure of the gearbox itself or adversely affect safe operation of the aircraft.

Standard:
Appendix U, paragraph 3.7.16.
Appendix U, paragraph 4.10.16.
Appendix U, paragraph 4.10.16.1.
Appendix U, paragraph 4.10.16.2.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.16. shall be verified by analyses and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.16. and include a Gearbox Analysis IAW DI-MISC-80711, a Gearbox Stress and Fatigue Analysis IAW DI-MISC-80711, a Gearbox Overstress Test Plan IAW DI-NDTI-80566, a Gearbox Overstress Test Report IAW DI-NDTI-80809; a Gear Tooth Bending Fatigue Test Plan IAW DI-NDTI-80566; and a Gear Tooth Bending Fatigue Test Report IAW DI-NDTI-80809. The gearbox shall also be subjected to the engine tests IAW Appendix U, paragraph 4.14.1. (including all sub-paragraphs).

a. The gearbox analysis shall include, but be limited to the following categories/subject matter:

(1) Lubrication System:

(2) Material: Suitability, Material Properties

(3) Methods: Factors of Safety

(4) Oil Filter Life: Expendables Design Service Life

(5) Lubrication System Integrity: Internal Passages and Hoses, Oil Lines and Fittings,

(6) Operating Limitations,

(7) Lubrication System: Attitude Analysis, Oil Filter Bypass Flow Rate and Indication

(8) Oil System – General: Usable Oil Quantity, Oil System Loads, Oil Compatibility

(9) Propeller Hydraulic Components: Static Seal and Plugs Integrity, Plug Integrity of

(10) Propeller Control Oil Passages

b. Gears and Shafts:

(1) Material: Suitability, Material Properties

(2) Methods, Calculate and summarize the Kv Velocity Factor, Load Distribution Factors,

(3) Safety Factors, Spline Analysis

(4) Gears and Shafts: Case Deflections in Gear Analysis, Gear and Shaft Critical Speeds

c. Gear Modal Plots: Modal Analysis

(1) Shaft Analysis: Shaft Fatigue Analysis

(2) Loads: Gear and Shaft Stress Analysis

d. Bearings:

(1) Bearing Type Selection: Bearing internal clearance at all operating conditions

(2) Methods: Bearing Life Calculations, Bearing Dynamic Capacity

(3) Loads: Bearing Loads, Gyroscopic Loads,

(4) Life: Bearing Life Calculations

e. Housing:

(1) Materials: Suitability, Material properties

(2) Loads: Static Design Loads, Maneuver Loads

(3) Stress/Fatigue: Rainflow Analysis, Compressive mean stress, Mean/Alternating Load

(4) Combinations, Thermal and LCF Evaluation

(5) Methods: Model Correlation; Fatigue Scale Factors

(6) Accessory Attachment Mounting Loads and Shear Sections: Accessory Attachments

(7) Accessory Mounting Pads

(8) Life: Initial Service Life Limit

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.11. Cooling System

The purpose of the cooling system requirement is to ensure aircraft integrated cooling and thermal management systems safely remove excess heat from the engine and its subsystems.

Criteria:
The cooling system, when integrated in the host aircraft, shall maintain the temperatures of engine components and engine fluids within the established limits under all environmental conditions and operating envelope of the engine.

Standard:
Engine Model Specification (EMS)
Installation Control Document (ICD)
Appendix U, paragraph 3.7.17.
Appendix U, paragraph 4.10.17.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.17. shall be verified by analyses and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.17. and include a Cooling System Analysis IAW DI-MISC-80711, a Cooling System Test Plan IAW DI-NDTI-80566, and a Cooling System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.11.1. Coolant
The purpose of the coolant requirement is to verify that the integrated propulsion system operates to all engine performance parameters when using designated coolant.

Criteria:
The integrated propulsion system shall meet all engine performance parameters throughout its complete environmental and operating envelope for all steady-state and transient operation when using designated coolant.

Standard:
Engine Model Specification (EMS)
Appendix U, paragraph 3.7.17.1.
Appendix U, paragraph 4.10.17.1.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.17.1. shall be verified by analyses and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.17.1. The airworthiness substantiation shall be included in the Cooling System Analysis and Coolant System Test Report (reference Appendix U, paragraph 4.10.17.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.11.2. Cooling System Components and Features

The purpose of the cooling system components and features requirement is to ensure performance and safety of the cooling system components or systems.

Criteria:
The cooling system components and systems shall meet performance standards and ensure safe operation.

Standard:
Appendix U, paragraph 3.7.17.2.
Appendix U, paragraph 4.10.17.2.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.17.2. shall be verified by demonstration, analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.17.2. and include a Cooling System Components and Features Analysis IAW DI-MISC-80711, a Cooling System Components and Features Test Plan IAW DI-NDTI-80566, and a Cooling System Components and Features Test Report IAW DI-NDTI-80809. Additional verification of this requirement may be presented in engine altitude tests and air vehicle performance tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.11.2.1. Coolant Tank

The purpose of the coolant tank requirement is to ensure that the coolant tank has the required capacity and can withstand pressure cycling throughout the life cycle.

Criteria:
The total enclosed capacity of the coolant tank, usable coolant volume, unusable coolant volume, and expansion space shall be IAW the EMS.

Standard:
Engine Model Specification (EMS)
Appendix E, paragraph 5.6.1.
Appendix U, paragraph 3.7.17.2.1.
Appendix U, paragraph 4.10.17.2.1.

Method of Compliance:
The requirements of Appendix U, paragraphs 3.7.17.2.1. shall be verified by analysis and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.17.2.1. and include a Coolant Tank Capacity and Pressure Analysis IAW DI-MISC-80711. Additionally, the complete coolant tank assembly shall be subjected to positive and negative differential pressures IAW Appendix E, paragraph 5.6.1. Additional airworthiness substantiation shall include a Coolant System Pressure Test Plan IAW DI-NDTI-80566, and Coolant System Pressure Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.11.2.2. Radiator
The purpose of the radiator requirement is to verify that the component can safely withstand all vibration, inertia, thermal and coolant pressure loads throughout the aircraft operational envelope and life cycle without rupture.

Criteria:
Each coolant radiator shall withstand all vibration, inertia, thermal, and coolant pressure loads encountered through the entire operating envelope and life cycle without rupture.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.6.3.
Appendix E, paragraph 5.10.
Appendix U, paragraph 3.7.17.2.2.
Appendix U, paragraph 4.10.17.2.2.
Appendix U, paragraph 4.15.

Method of Compliance:
The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Radiator Proof and Cycling Pressure Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Radiator Proof and Cycling Pressure Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896. Airworthiness substantiation shall also include a Radiator Vibration Test Plan IAW DI-NDTI-80566 and a Radiator Vibration Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.12. Turbocharger System
The turbocharger rotor assembly shall remain within functional dimensions during and after exposure to an overspeed malfunction.

The turbocharger rotating assembly shall not exhibit imbalance or damage under overspeed malfunction conditions.

The turbocharger mount shall withstand all loads encountered in the operating envelope. The turbocharger mount shall prevent the transmittal of harmful vibration to and from the turbocharger.

7.4.7.12.1. Turbocharger Performance
The purpose of this requirement is to verify turbocharger meets the applicable specification performance requirements under various operating conditions (i.e., sea

level, altitude, power settings, etc.). This includes consideration of all installation effects imposed by the air vehicle, and all intended operational environments.

Criteria:
The turbocharger shall meet its individual performance requirements in all environmental conditions throughout the flight envelope.

Standard:
Appendix U, paragraph 3.7.18.1.
Appendix U, paragraph 4.10.18.1.

Method of Compliance:
A turbocharger, conforming to the same parts list and configuration as the endurance test engine, shall be subjected to altitude tests which consist of operation at several selected conditions within the engine operating envelope. The airworthiness substantiation shall include a Turbocharger Performance Analysis IAW DI-MISC-80711, a Turbocharger Performance Test Plan IAW DI-NDTI-80566, and a Turbocharger Performance Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.12.2. Turbocharger System Integrity

7.4.7.12.2.1. Turbocharger Rotor Strength (Overspeed)
The purpose of the turbocharger rotor strength (overspeed) requirement is to ensure adequate margin for the most critically stressed turbocharger rotor components for the entire aircraft flight envelope.

Criteria:
Analysis and testing shall show the turbocharger has adequate overspeed capability to ensure safe flight. Testing shall demonstrate parts and assemblies to be within the allowable dimensional limits with no evidence of imminent failure.

Standard:
Appendix U, paragraph 3.7.18.2.1.
Appendix U, paragraph 4.10.18.2.1.

Method of Compliance:
A turbocharger overspeed test shall be completed IAW Appendix U, paragraph 4.10.18.2.1. The airworthiness substantiation shall include a Turbocharger Overspeed Analysis IAW DI-MISC-80711, a Turbocharger Overspeed Test Plan IAW DI-NDTI-80566, and a Turbocharger Overspeed Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.12.2.2. Turbocharger Low Cycle Fatigue
The purpose of the LCF test is to demonstrate that turbocharger rotating parts that are subjected to mechanical and thermal stresses during engine operation have sufficient LCF capability. Low cycle fatigue is the damage generated in a material by cyclic load reversals, which cause repeated plastic deformation.

Criteria:
The turbocharger shall not experience a low cycle fatigue failure.

Standard:
Appendix U, paragraph 3.4.1.5.1.
Appendix U, paragraph 3.7.18.2.2.
Appendix U, paragraph 4.10.18.2.2.

Method of Compliance:
Turbocharger low cycle fatigue test showing compliance with Appendix U, paragraph 3.7.18.2.2. shall be conducted IAW Appendix U, paragraph 4.10.18.2.2. The airworthiness substantiation shall include a Turbocharger Low Cycle Fatigue Test Plan IAW DI-NDTI-80566, and a Turbocharger Low Cycle Fatigue Test Report IAW DI-NDTI-80809 (Reference Appendix U, paragraph 3.4.1.5.1.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.12.2.3. Turbocharger High Cycle Fatigue
The purpose of the HCF test is to demonstrate that turbocharger compressor, turbine and cases are free of detrimental resonance frequencies and vibration amplitudes in the turbocharger speed/altitude operating ranges.

Criteria:
Analysis and testing shall show the maximum vibration response be no greater than 70% of the -3σ material capabilities.

Standard:
Appendix U, paragraph 3.4.1.5.2.
Appendix U, paragraph 3.7.18.2.3.
Appendix U, paragraph 4.10.18.2.3.

Method of Compliance:
A turbocharger high cycle fatigue test showing compliance with Appendix U, paragraph 3.7.18.2.3. shall be conducted for PFR IAW Appendix U, paragraph 4.10.18.2.3. The airworthiness substantiation shall include a Turbocharger High Cycle Fatigue Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.12.2.4. Turbocharger Creep
The purpose of the turbocharger creep requirement is to demonstrate that turbocharger rotating components do not exhibit creep throughout the operational envelope and service life which would result in material contact or imminent failure.

Criteria:
The turbocharger rotating parts shall not exhibit material creep to the extent that operation is impaired for the operating envelope and the design service life.

Standard:
Appendix U, paragraph 3.7.18.2.4.
Appendix U, paragraph 4.10.18.2.4.

Method of Compliance:
A turbocharger creep analysis and test showing compliance with Appendix U, paragraph 3.7.18.2.4. shall be conducted for PFR IAW Appendix U, paragraph 4.10.18.2.4. The airworthiness substantiation shall include a Turbocharger Creep Analysis IAW DI-MISC-80711, a Turbocharger Creep Test Plan IAW DI-NDTI-80566, and a Turbocharger Creep Test Report IAW DI-NDTI-80809 (reference Appendix U, paragraph 3.4.1.5.3.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.12.2.5. Turbocharger Critical Speeds
The purpose of the turbocharger critical speed requirement is to ensure that turbocharger rotating components are fee of damaging resonances at all operational speeds.

Criteria:
Turbocharger analysis and testing shall demonstrate that any critical speed below the maximum operating speed will be traversed without causing any detrimental effects. Any critical speed within the operation range shall not produce stresses above the endurance limit of the material.

Standard:
Appendix U, paragraph 3.7.18.2.5.
Appendix U, paragraph 4.10.18.2.5.

Method of Compliance:
A turbocharger critical speed test showing compliance with Appendix U, paragraph 3.7.18.2.5. shall be conducted for PFR IAW Appendix U, paragraph 4.10.18.2.5. The airworthiness substantiation shall include a Turbocharger Critical Speed Analysis IAW

DI-MISC-80711, a Turbocharger Critical Speed Test Plan IAW DI-NDTI-80566, and a Turbocharger Critical Speed Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.12.2.6. Blade and Disk Deflection

The purpose of the analysis and tests is to ensure turbocharger blades and disks have adequate structural integrity to preclude contact with any static part of the turbocharger during operation.

Criteria:

Blades and disks shall not contact any static part of the turbocharger, other than seals and shrouds, during all engine operation conditions. Seals and clearances shall remain effective under all internal and external operational loads.

Standard:

Appendix U, paragraph 3.7.18.2.6.
Appendix U, paragraph 4.10.18.2.6.

Method of Compliance:

A turbocharger blade and disk deflection test showing compliance with Appendix U, paragraph 3.7.18.2.6. shall be conducted for PFR IAW Appendix U, paragraph 4.10.18.2.6. The airworthiness substantiation shall include a Turbocharger Blade and Disk Deflection Analysis IAW DI-MISC-80711, a Turbocharger Blade and Disk Deflection Test Plan IAW DI-NDTI-80566, and a Turbocharger Blade and Disk Deflection Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.12.2.7. Turbocharger Rotating Assembly Balance

Balance testing shall be conducted as part of the endurance tests specified in 4.14.1.1. The turbocharger rotating assembly balance shall be measured before and after the 150 hour endurance test and at the conclusion of the 50 hour bench test.

Criteria:

The rotating assembly shall not exhibit dynamic imbalance beyond manufacturer specifications under overspeed conditions.

Standard:

Appendix U, paragraph 3.7.18.2.7.
Appendix U, paragraph 4.10.18.2.7.
Appendix U, paragraph 4.14.1.1.1.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.18.2.7. shall be verified by tests. Balance testing shall be conducted as part of the endurance test specified in Appendix U, paragraph 4.14.1.1.1. The turbocharger rotating assembly balance shall be measured before and after the 150 hour engine endurance test and at the conclusion of the 50 hour bench test. The airworthiness substantiation shall be included in the Engine Test Plan IAW DI-NDTI-80566, and the Engine Endurance Test Report IAW DI-NDTI-80809 (reference Appendix U, paragraph 4.14.1.1.1.)

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.12.2.8. Turbocharger Containment
The purpose of this analysis is to determine that the turbocharger has adequate containment capability. For safety of personnel and equipment, it is imperative to contain all blade and/or disk failures.

Criteria:
The turbocharger rotor case shall contain a bi-hub burst of the compressor and a tri-hub burst of the turbine rotor which fail at the highest obtainable speed with normal speed control devices inoperative.

Standard:
Appendix U, paragraph 3.7.18.2.8.
Appendix U, paragraph 4.10.18.2.8.

Method of Compliance:
A turbocharger containment analysis showing compliance with Appendix U, paragraph 3.7.18.2.8. shall be conducted IAW Appendix U, paragraph 4.10.18.2.8. The airworthiness substantiation shall include a Turbocharger Containment Analysis IAW DI-MISC-80711, Turbocharger Containment Test Plan IAW DI-NDTI-80566, and a Turbocharger Containment Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.12.2.9. Disk Burst Speed
The purpose of the turbocharger disk burst test is to demonstrate the disk burst margin to prevent the occurrence of a catastrophic failure.

Criteria:
The loaded disk burst speed of the complete disk assembly shall be not less than 120 percent of the maximum allowable steady-state.

Standard:
Appendix U, paragraph 3.7.18.2.9.
Appendix U, paragraph 4.10.18.2.9.

Method of Compliance:
A turbocharger disk burst speed test showing compliance with Appendix U, paragraph 3.7.18.2.9. shall be conducted IAW Appendix U, paragraph 4.10.18.2.9. The airworthiness substantiation shall include a Turbocharger Disk Burst Speed Analysis IAW DI-MISC-80711, a Turbocharger Disk Burst Speed Test Plan IAW DI-NDTI-80566, and a Turbocharger Disk Burst Speed Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.12.3. Turbocharger System Components

7.4.7.12.3.1. Turbocharger Lubrication
The purpose of this requirement is to demonstrate that the turbocharger lubrication system will survive throughout the full range of environments and continue to meet its performance requirements throughout its operating envelope.

Criteria:
The turbocharger lubrication system shall have capacity to provide oil to the turbocharger under the most adverse oil consumption conditions.

Standard:
Appendix U, paragraph 3.7.18.3.1.
Appendix U, paragraph 4.10.18.3.1.

Method of Compliance:
The turbocharger lubrication requirements showing compliance with Appendix U, paragraph 3.7.18.3.1. shall be conducted IAW Appendix U, paragraph 4.10.18.3.1. The airworthiness substantiation shall include a Turbocharger Lubrication Analysis IAW DI-MISC-80711, a Turbocharger Lubrication Test Plan IAW DI-NDTI-80566, and a Turbocharger Lubrication Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.12.3.2. Turbocharger Control System
The purpose of the requirement is to ensure that the control system’s turbocharger speed control loop controls the turbocharger speed as required and prevents overspeed conditions during operation.

Criteria:
The turbocharger control system shall regulate the turbocharger speed under all engine operating conditions. Failure of control features (e.g. passive relief valves) shall not result in an unsafe engine condition.

Standard:
Appendix U, paragraph 3.7.18.3.2.
Appendix U, paragraph 4.10.18.3.2.

Method of Compliance:
The turbocharger speed control requirements showing compliance with Appendix U, paragraph 3.7.18.3.2. shall be conducted IAW Appendix U, paragraph 4.10.18.3.2. The airworthiness substantiation shall include a Turbocharger Control System Analysis IAW DI-MISC-80711, a Turbocharger Control System Test Plan IAW DI-NDTI-80566, and a Turbocharger Control System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.7.12.3.3. Intercooler
The purpose of the intercooler requirement is to verify that the component can safely withstand all vibration, inertia, thermal and pressure loads throughout the aircraft operational envelope and life cycle without rupture.

Criteria:
Each intercooler shall withstand all vibration, inertia, thermal, and pressure loads encountered through the entire operating envelope and life cycle without rupture. Each intercooler shall be mounted to prevent the transmittal of harmful vibration to and from the intercooler.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.6.3.
Appendix E, paragraph 5.10.
Appendix U, paragraph 3.7.18.3.3.
Appendix U, paragraph 4.10.18.3.3.
Appendix U, paragraph 4.15.

Method of Compliance:
The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Intercooler Proof and Cycling Pressure Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, an Intercooler Proof and Cycling Pressure Test Report IAW DI-NDTI-81897 or a Component Similarity Argument Report IAW DI-NDTI-81896. Airworthiness substantiation shall also include an Intercooler Vibration Test Plan IAW DI-NDTI-80566 and an Intercooler Vibration Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.8. Software Resources

Software resources includes all software necessary to perform all computations, data processing, and interfacing functions necessary for the propulsion system to meet the performance and operability requirements.

7.4.8.1. Software Performance and Design

The purpose of the software performance and design requirement is to ensure software the documentation requirements of the system and software design flow down, are traceable, and functions as intended. Due to its increased complexity, amount of code and airworthiness implication, software verification and qualification is necessary.

Criteria:

Software shall perform all computations, data processing, and interfacing functions necessary for the engine to meet the aircraft platform performance and operability requirements.

Standard:

RTCA/DO-0178C
ARP 4671
AMACC Section 15 Software Airworthiness
AMACC Section 14 Design Assurance Level (DAL) substantiation
Appendix E, paragraph 5.8.1.
Appendix U, paragraph 3.8.1.
Appendix U, paragraph 4.11.1.

Method of Compliance:

The engine software shall be designed, developed and tested IAW RTCA/DO-178C and Appendix E, paragraph 5.8.1. for the DAL level determined by AMACC Section 14. The airworthiness substantiation shall include documentation IAW paragraph 15.0., software airworthiness.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.8.1.1. Computer Reprogramming

The purpose of the computer reprogramming requirement is to require the engine control computer design to allow for the capability to make software changes in the field. Safety design provisions shall be provided to prevent unauthorized reprogramming.

Criteria:

The engine control shall be designed to allow software changes to be made in the field without the need to remove the unit from the engine or airframe.

Safety design provisions shall be provided to prevent unauthorized reprogramming. Each software version shall be identified by a unique software version number that shall be verified during the loading process.

Notwithstanding the above requirement for re-programmability, neither the unit serial number nor the full authority digital engine control (FADEC) accumulated operating hours shall be changeable once the unit leaves the OEM facility.

Standard:
AMACC Section 15 Software Airworthiness
Appendix U, paragraph 3.7.2.1.
Appendix U, paragraph 3.8.1.1.
Appendix U, paragraph 4.11.1.1.

Method of Compliance:
The requirements of Appendix U, paragraph 3.8.1.1. shall be verified by demonstrations and tests. The computer reprogramming capability shall be integrated into the engine software shall be designed, developed and tested IAW RTCA/DO-178C and Appendix E, paragraph 5.8.1. for the DAL level determined by AMACC Section 14. The airworthiness substantiation shall include documentation IAW paragraph 15.0., software airworthiness.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.8.2. Spare Resources

The purpose of the spare resources requirement is to ensure the engine control system has software growth capability.

Criteria:
The software partition, memory allocation, scheduling, tasking, interrupt, control flow, and data flow for the engine control system shall be documented in the ICD.
Standard:
Appendix U, paragraph 3.7.2.1.
Appendix U, paragraph 3.8.2.
Appendix U, paragraph 4.11.2.

Method of Compliance:
The requirements of Appendix U, paragraph 3.8.1.1. shall be verified by demonstrations and tests. The computer reprogramming capability shall be integrated into the engine software, which shall be designed, developed and tested IAW RTCA/DO-178C and Appendix E, paragraph 5.8.1. for the DAL level determined by AMACC Section 14. The airworthiness substantiation shall include documentation IAW paragraph 15.0., software airworthiness.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.9. Production Facilities, Capabilities, and Processes

The purpose of the production facilities, capabilities, and processes requirement is to ensure that the propulsion system is producible using the contractor's manufacturing system.

Criteria:

The engine shall be producible using the contractor's manufacturing system. The manufacturing system shall have the facilities, capabilities, processes, and process controls to provide products of consistent quality that meet performance requirements. Production processes shall have the stability, capability, and controls to maintain product characteristics within design tolerances and to reduce the variability of key product characteristics.

Standard:

Appendix U, paragraph 3.9.
Appendix U, paragraph 4.12.

Method of Compliance:

The requirements of Appendix U, paragraph 3.9. shall be verified by inspection.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.10. Not Used

7.4.11. Engine, Control System and Accessories Verification

The complete propulsion system with its controls and accessories (C&A) that require a test for verification shall utilize the test procedures IAW the following subsections.

7.4.12. Engine Tests

7.4.12.1. Endurance Tests

7.4.12.1.1. Engine Endurance

The purpose of the endurance test is to demonstrate the engines' ability to sustain a minimum level of operability and durability within the approved engine ratings and operating limitations.

Criteria:

The engine shall be subjected to an endurance test of not less than 150 hours of operation to a duty cycle, operating limits and conditions IAW Appendix U, paragraph 4.14.1.1.1. Additional testing shall be required for engines with Turbocharger(s).

Standard:

Appendix U, paragraph 4.14.1.1.1.

Method of Compliance:
The engine shall be subjected to an engine endurance test IAW Appendix U, paragraph 4.14.1.1.1. The airworthiness substantiation shall include an Engine Endurance Test Plan IAW DI-NDTI-80566, and an Engine Endurance Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.12.1.2. Accelerated Mission Test (AMT)
The purpose of the test is to demonstrate the durability and reliability of the engine to establish an initial engine service life limit.

Criteria:
An engine mission cycle endurance test of duration equal to 1.5 times the initial service life of the engine.

Standard:
Appendix U, paragraph 4.14.1.1.2.

Method of Compliance:
The Accelerated Mission Test (AMT) requirements showing compliance with Appendix U, paragraph 4.14.1.1.2. shall be performed with the field representative engine configuration propulsion system and gearbox installed. The airworthiness substantiation shall include an Accelerated Mission Test Plan IAW DI-NDTI-80566, and an Accelerated Mission Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.12.1.3. Propeller Cyclic Durability Test
The purpose of the cyclic durability test requirement is to determine if the propeller can withstand cyclic operation without the onset of part deterioration, failure, or irregularities in propeller function over the initially declared overhaul period or service life interval.

Criteria:
The propeller and engine shall be subjected to a cyclic test consisting of 50 one-hour cycles of operation.

Standard:
Appendix U, paragraph 4.14.1.1.4.

Method of Compliance:
The propeller cyclic durability test requirements showing compliance with Appendix U, paragraph 4.14.1.1.4. shall be performed with the field representative propulsion system

configuration with propeller installed. The airworthiness substantiation shall include a Propeller Cyclic Durability Test Plan IAW DI-NDTI-80566, and a Propeller Cyclic Durability Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.12.1.4. Engine/Gearbox Durability Test

The purpose of the engine/gearbox durability test is to demonstrate its ability to withstand physical damage from normal use over its design service life while providing mechanical power to components required for engine and aircraft operation.

Criteria:
The engine drivetrain and external gearboxes shall be durable.

Standard:
Appendix U, paragraph 4.14.1.1.5.
Method of Compliance:
The engine drive train and associated gearboxes which drive engine components and customer accessories shall be subjected to an engine/gearbox durability endurance test IAW Appendix U, paragraph 4.14.1.1.5. The airworthiness substantiation shall include an Engine Gearbox Durability Endurance Test Plan IAW DI-NDTI-80566, and an Engine Gearbox Durability Endurance Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.12.1.5. Altitude Tests

The purpose of the altitude test is to demonstrate the operation and air starting capability of the engine at altitude. Thorough testing of the engine around the envelope extremes in an altitude test facility has been a cost-effective method of reducing the possibility of encountering engine problems during initial flight testing of the weapon system.

Criteria:
The engine shall start and operate at altitude to ensure safe aircraft operation.

Standard:
Appendix U, paragraph 4.14.1.2.
Appendix U, paragraph 4.14.1.2.1.
Appendix U, paragraph 4.14.1.2.2.
Appendix U, paragraph 4.14.1.2.3.
Appendix U, paragraph 4.14.1.2.4.

Method of Compliance:
An engine, conforming to the same parts list and configuration as the endurance test engine, shall be subjected to altitude tests which consist of operation and air starting checks at several selected conditions within the engine operating envelope in accordance with Appendix U, paragraph 4.14.1.2. The airworthiness substantiation shall include an engine Altitude Analysis IAW DI-MISC-80711, an engine Altitude Test Plan IAW DI-NDTI-80566, and an Engine Altitude Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.12.1.5.1. Detonation Test
The purpose of the detonation test is to define detonation characteristics throughout the operating envelope and ensure they are within limits to preclude damage to the engine.

Criteria:
Detonation tests are intended to demonstrate that there is margin against the occurrence of detonation for the most critical operating conditions to be approved for the engine as installed in an aircraft.

Standard:
Appendix U, paragraph 4.14.1.2.4.

Method of Compliance:
The detonation requirements of Appendix U, paragraph 4.14.1.2.4. .shall be substantiated during the Altitude Test (reference Appendix U, paragraph 4.14.1.2.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.12.1.6. Vibration Survey
The purpose of the survey is to demonstrate the propulsion system is free of damaging dynamic response. Absence of damaging vibration and dynamic response is essential to maintain the desired mechanical and structural integrity of the propulsion system prior to initial flight tests.

Criteria:
The engine shall be free of damaging vibration and dynamic response.

Standard:
Appendix U, paragraph 4.14.1.3.

Method of Compliance:
The vibration survey requirement showing compliance with Appendix U, paragraph 4.14.1.3. shall be performed with the field representative propulsion system configuration

with propeller installed. The airworthiness substantiation shall include a Propulsion System Vibration Test Plan IAW DI-NDTI-80566, and a Propulsion System Vibration Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.12.1.7. Acceptance Test (AT)
The purpose of the Acceptance Test (AT) requirement is to demonstrate the engine and propulsion system components are produced to the correct configuration and meet performance standards to the extent specified in the Engine Model Specification (EMS).

Criteria:
Acceptance Test Procedures for the engine and propulsion system components (including the control system) shall be prepared by the contractor and submitted to the Using Service for approval and shall be conducted on each asset submitted for delivery.

An acceptance test shall be conducted on each engine, control and accessory/component submitted for delivery.

Standard:
Appendix U, paragraph 3.12.5.
Appendix U, paragraph 4.14.1.4.
Appendix U, paragraph 4.14.1.4.1.

Method of Compliance:
The Acceptance Test (AC) requirement showing compliance with Appendix U, paragraph 3.12.5. and 4.14.1.4. shall substantiated by the submittal of a detailed Acceptance Test Procedure (ATP) IAW DI-NDTI-80566. With this ATP, an Acceptance Test Log Sheet shall be developed to include, at a minimum, the information and instruction cited in Appendix U, paragraph 4.14.1.4.1.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.4.13. Control System and Engine Accessory Components
Control system components, powerplant accessory components, and other functional subsystems of the powerplant, which are classified as an LRU (line replaceable unit), require qualification testing separate from the powerplant.

Criteria:
Control system and accessory components (and subsystems) shall each undergo component level bench qualification, as distinct from propulsion system level qualification.

Standard:
Appendix E, paragraph 6.4.
Appendix E, Tables II through VIII, Table XIII and Table XIV
Appendix U, paragraph 3.1.1.15.
Appendix U, paragraph 3.11.
Appendix U, paragraph 4.15.

Method of Compliance:
The requirements of Appendix U, paragraph 3.11. shall be verified by tests. The airworthiness substantiation shall be IAW and Appendix U, paragraph 4.15. The airworthiness substantiation shall include documentation IAW Appendix E, paragraph 6.4. and Tables II through VIII, Table XIII and Table XIV requirements.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5. Electrified Propulsion
The powerplant and associated components will operate safely within the flight and maneuver envelope and operational environment.

7.5.1. Design and Construction
The powerplant and associated components shall be designed following an open system approach where feasible.

7.5.1.1. Item and Interface Definition
The powerplant configuration and interface definition shall be defined by the air vehicle manufacturer and approved by the Using Service. A typical electrified powerplant configuration consists of an Electric Motor, Inverter, Motor Controller, Gearbox, and Propeller. However, other powerplant configurations are supported.

7.5.1.1.1. Interface and Installation
The purpose of the interface and installation requirement is to ensure all interfaces adhere to aircraft specifications.

Criteria:
The powerplant ICD shall define all mechanical, electrical, software, and dynamic interface requirements necessary to safely install and operate the powerplant in an air vehicle.

Standard:
Appendix V, paragraph 3.1.1.1.
Appendix V, paragraph 3.1.1.1.1.
Appendix V, paragraph 4.3.2.1.1.
Appendix V, paragraph 4.4.1.1.

Method of Compliance:
The interface and installation requirements of Appendix V, paragraph 3.1.1.1., 3.1.1.1.1., 4.3.2.1.1. and 4.4.1.1. shall be substantiated by documentation, inspection and demonstration.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.1.2. Interface Loads
The purpose of the interface loads requirement is to ensure the actual interface loads are within analytical values.

Criteria:
The maximum allowable loads for all parts that interface with the air vehicle shall be as shown in the Powerplant ICD.

Standard:
Appendix V, paragraph 3.1.1.3.
Appendix V, paragraph 4.4.1.3.

Method of Compliance:
The interface loads requirements of Appendix V, paragraph 3.1.1.3. shall be verified by analysis. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.4.1.3. and include an Interface Loads Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.1.3. Installation Hardware
The purpose of the installation hardware requirement is to ensure all propulsion system components are capable of being installed in the intended platform aircraft (i.e., drop in configurations).

Criteria:
The propulsion system shall be capable of installation in any air vehicle configuration to include multi-engine air vehicles with different engine locations.

Standard:
Appendix V, paragraph 3.1.1.2.
Appendix V, paragraph 4.4.1.2.

Method of Compliance:
The installation hardware requirements of Appendix V, paragraph 3.4.1.2. shall be substantiated by inspection and demonstration.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.1.4. External Forces and Mounts
The purpose of this analysis is to ensure powerplant components are designed to withstand the relatively infrequent, non-repetitive shocks, or transient vibrations induced by the external forces during flight maneuvers.

Criteria:
The powerplant shall operate after external forces are induced and not degrade performance.

Standard:
Appendix V, paragraph 3.1.1.4.1.
Appendix V, paragraph 3.1.1.4.2.
Appendix V, paragraph 4.4.1.4.1.
Appendix V, paragraph 4.4.1.4.2.

Method of Compliance:
The installation hardware requirements of Appendix V, paragraphs 3.1.1.4.1. and 3.1.1.4.2. shall be substantiated by analysis and test. An analysis shall be performed that provides sufficient evidence that the powerplant shall function satisfactorily under the conditions specified in Appendix V, paragraph 3.1.1.4.1. and 3.1.1.4.2., and that the powerplant shall withstand those conditions without permanent deformation and shall operate satisfactorily thereafter. The airworthiness substantiation shall include an External Forces and Mounts Analysis IAW DI-MISC-80711, an External Forces and Mounts Test Plan IAW DI-NDTI-80566, and an External Forces and Mounts Test Report IAW DI-NDTI-80809 prior to the initiation of the PFR.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.1.5. Powerplant Stiffness
The purpose of the powerplant stiffness requirement is to ensure the powerplant is tolerant of external loads and moments without distortion.

Criteria:
The estimated stiffness of the powerplant in resisting loads and moments shall be IAW the ICD.

Standard:
Appendix V, paragraph 3.1.1.4.3.
Appendix V, paragraph 4.4.1.4.3.

Method of Compliance:
The engine stiffness requirements of Appendix V, paragraph 3.1.1.4.3. shall be verified by analysis. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.4.1.4.3. and include an Powerplant Stiffness Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.1.6. Power Command Signal
The purpose of the power command signal requirement is to define the commanded power (% max power) for operational ratings and signals.

Criteria:
The commanded power (% max power) for operational ratings and signals shall be IAW the ICD. Powerplant power response shall be continuous from Idle to Maximum power.

Standard:
Appendix V, paragraph 3.1.1.5.1.
Appendix V, paragraph 4.4.1.5.1.

Method of Compliance:
The power command signal requirements of Appendix V, paragraph 3.1.1.5.1. shall be verified by analysis and test. The power command signal requirements of Appendix V, paragraph 3.1.1.5.1. shall be conducted IAW Appendix V, paragraph 4.4.1.5.1. The airworthiness substantiation shall include a Power Commanded Signal Analysis IAW DI-MISC-80711, Power Commanded Signal Test Plan IAW DI-NDTI-80566, and a Power Commanded Signal Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.1.7. Emergency Engine Shutdown
The purpose of the emergency shutdown requirement is to demonstrate rapid shutdown of the powerplant to preclude a runaway condition which may result in catastrophic damage to the aircraft or injury to personnel.

Criteria:
There shall be a means to allow the operator to rapidly shut off the powerplant to preclude a runaway of the air vehicle.

Standard:
Appendix V, paragraph 3.1.1.5.4.
Appendix V, paragraph 4.4.1.5.4.

Method of Compliance:
An emergency powerplant shutdown demonstration, analysis and test shall be conducted IAW Appendix V, paragraph 4.4.1.5.4. The airworthiness substantiation shall include a Powerplant Emergency Shutdown Analysis IAW DI-MISC-80711, a Powerplant Emergency Shutdown Test Plan IAW DI-NDTI-80566, and a Powerplant Emergency Shutdown Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.1.8. Not Used.

7.5.1.1.9. Subsystem Interfaces
The purpose of the subsystem interfaces requirement is to ensure all interfaces adhere to aircraft specifications. The powerplant control system should be an integral part of the powerplant maintenance system and should be compatible with the aircraft data collection, ground support systems, and the maintenance support concept.

Criteria:
The powerplant electronic components with data bus communication interfaces shall properly operate to ensure safe operation of the aircraft.

Standard:
Appendix E, paragraph 5.10.
Appendix V, paragraph 5.6.4.6.
Appendix V, paragraph 3.1.1.6.
Appendix V, paragraph 4.4.1.6.

Method of Compliance:
Data bus communication interfaces shall be verified for compliance with aircraft specifications IAW Appendix E, paragraph 5.6.4.6. The airworthiness substantiation shall include a Data Bus Interfaces Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, a Data Bus Interfaces Test Reports IAW DI-NDTI-81897 or Component Similarity Argument Report IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.1.10. Not Used

7.5.1.1.11. Not Used

7.5.1.1.12. Power Absorber Characteristics

The purpose of the power absorber characteristics requirement is to characterize the component's ability to absorb and dampen impact energy or shocks at powerplant interfaces.

Criteria:
The allowable range of characteristics of a shaft power absorber at the power absorber to powerplant interface shall be IAW the ICD.

Standard:
Appendix V, paragraph 3.1.1.9.
Appendix V, paragraph 4.4.1.9.

Method of Compliance:
The power absorber characteristics requirements of Appendix V, paragraph 3.1.1.9. and 4.4.1.9. shall be verified by diagram inspection, analysis and tests. The airworthiness substantiation shall include a Power Absorber Characterization Analysis IAW DI-MISC-80711, a Power Absorber Characterization Test Plan IAW DI-NDTI-80566, and a Power Absorber Characterization Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.1.13. Power Takeoff (PTO)

The purpose of the Power Takeoff (PTO) requirement is to ensure the PTO is functionally and dimensionally replaceable with respect to installation and performance.

Criteria:
When PTO pads and drives are provided for driving aircraft accessories, the ratings, clearance envelopes, dimensions, and other pertinent information shall be as shown in the ICD.

Standard:
Appendix V, paragraph 3.1.1.10.
Appendix V, paragraph 4.4.1.10.

Method of Compliance:
The Power Takeoff (PTO) requirements of Appendix V, paragraph 3.1.1.10. and 4.4.1.10. shall be verified by demonstration of clearance envelopes, drawing review for dimension validation, a demonstration of accessibility, and capability tests of the PTO. The airworthiness substantiation shall include a PTO Capability Test Plan IAW DI-NDTI-80566, and a PTO Capability Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.1.14. Starting Drivetrain

The purpose of the starting drivetrain requirement is to ensure that the starting drivetrain caln meet the starting torque and speed requirements within the times specified in the ICD throughout the aircraft operational envelope.

Criteria:
The starter drivetrain shall meet powerplant torque acceptance capability as specified in the ICD.

Standard:
Appendix V, paragraph 3.1.1.11.
Appendix V, paragraph 4.4.1.11.

Method of Compliance:
The starting drivetrain requirements IAW Appendix V, paragraph 3.1.1.11. shall be substantiated by analysis and testing. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.4.1.11. and include a Starting Drivetrain Analysis IAW DI-MISC-80711, a Starting Drivetrain Test Plan IAW DI-NDTI-80566, and a Starting Drivetrain Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.1.15. Starting Torque and Speed

The purpose of the test is to ensure that the powerplant starts with the specified minimum starting torque characteristics, as defined by the EMS, to prevent field starting problems.

Criteria:
The powerplant shall start with minimum starting torque and speed.

Standard:
Appendix V, paragraph 3.1.1.11.1.
Appendix V, paragraph 4.4.1.11.1.

Method of Compliance:
The starting torque and speed requirements shall be subjected to a test to demonstrate the starting torque and speed requirements IAW Appendix V, paragraph 3.1.1.11.1. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.4.1.11.1. and include an Powerplant Starting Torque and Speed Test Plan IAW DI-NDTI-80566, and an Powerplant Starting Torque and Speed Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.1.16. Not Used

7.5.1.1.17. Compatibility – Powerplant and Air Vehicle
The purpose of this testing is to demonstrate the interface requirements between the powerplant and the airframe are met to assure safe operation of the platform throughout its operating envelope and mission set.

Criteria:
The powerplant and airframe shall be functionally compatible.

Standard:
Appendix F, paragraph 3.
Appendix V, paragraph 3.1.1.14.
Appendix V, paragraph 4.4.1.14.

Method of Compliance:
The powerplant and airframe meets their respective ICD requirements and satisfactory operation is demonstrated IAW Appendix F, paragraph 3 engine/airframe compatibility testing. The airworthiness substantiation shall include an Powerplant-Airframe Compatibility Test Plan IAW DI-NDTI-80566, and an Powerplant-Airframe Compatibility Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.1.18. Control System and Engine Accessory Components
Control system components, powerplant accessory components, and other functional subsystems of the powerplant, which are classified as an LRU (line replaceable unit), require qualification testing separate from the powerplant. These components and subsystems shall be identified.

Criteria:
Line Replaceable Unit (LRU) components and subsystems shall be identified.

Standard:
Appendix V, paragraph 3.1.1.15.
Appendix V, paragraph 4.4.1.15.

Method of Compliance:
The requirements of Appendix V, paragraph 3.1.1.15. shall be verified by inspection. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.4.1.15. and include Line Replaceable Unit Component List IAW DI-SAFT-81932 which shall be verified by inspection.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.1.19. Instructions for Continued Airworthiness

The purpose of the Instructions for Continuing Airworthiness (ICA) is to provide information to ensure the aircraft and subsystems are operated, modified, repaired, overhauled, and maintained in accordance with the approved design and are kept compliant with said design.

Criteria:

All installation, operation, and maintenance instructions necessary to maintain airworthiness shall be defined in the ICA.

Standard:

MIL-STD-40051-1
MIL-STD-40051-2
DI-TMSS-81676
Appendix V, paragraph 3.1.1.16.
Appendix V, paragraph 4.4.1.16.

Method of Compliance:

The requirement of Appendix V, paragraph 3.1.1.16. shall be substantiated by the submittal of, at a minimum, the supplied information cited in Appendix V, paragraph 4.4.1.16. The airworthiness substantiation shall provide Technical Data essential for the instructions for continuing airworthiness of the aircraft, engine, ground control/support components, major dynamic and flight control components IAW MIL-STD-40051-1 and MIL-STD-40051-2. The technical data shall be prepared IAW DI-TMSS-81676.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.2. Physical Characteristics

7.5.1.2.1. Dry Weight of Complete Propulsion System

The purpose of the weight of complete propulsion system requirement is to ensure the propulsion system weight does not exceed the specification value.

Criteria:

The weight of the complete propulsion system shall not exceed that specified in the Engine Model Specification (EMS). Each qualification and production propulsion system should be weighed, using the same procedure, to ensure consistency.

Standard:

Appendix V, paragraph 3.1.2.1.
Appendix V, paragraph 4.4.2.1.

Method of Compliance:
The weight requirements of Appendix V, paragraph 3.1.2.1. shall be conducted IAW Appendix V, paragraph 4.4.2.1. The airworthiness substantiation and include a Propulsion Physical Characteristics Summary Report IAW DI-MISC-80711. These values shall be verified or modified prior to any Qualification Test.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.2.2. Not Used

7.5.1.2.3. Not Used

7.5.1.2.4. Not Used

7.5.1.2.5. Mass Moment of Inertia of Complete Engine
The purpose of the mass moment of inertia of complete powerplant requirement is to provide data for use in design and evaluation of aircraft subsystems, and overall aircraft design.

Criteria:
The Engine Model Specification (EMS) shall specify the maximum effective mass moment of inertial (slug-feet squared) of the complete dry engine core about three mutually perpendicular axes with the origin at the center of gravity.

Standard:
Appendix V, paragraph 3.1.2.5.
Appendix V, paragraph 4.4.2.5.

Method of Compliance:
The mass moment of inertia requirements of Appendix V, paragraph 3.1.2.5. shall be verified by analysis. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.4.2.5. and include a Propulsion Physical Characteristics Summary Report IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.3. Materials, Processes and Parts
The purpose of the analysis is to ensure the materials and processes used during the design and manufacture of the engine will meet all specification requirements.

Criteria:
The materials, coatings and processes used in the design and manufacture of the complete propulsion system shall be chosen, applied, and utilized such that they meet the specified requirements.

Standard:
Appendix V, paragraph 3.1.3.
Appendix V, paragraph 3.1.3.1.
Appendix V, paragraph 3.1.3.2.
Appendix V, paragraph 3.1.3.3.
Appendix V, paragraph 3.1.3.4.
Appendix V, paragraph 4.4.3.

Method of Compliance:
The materials, adhesives, and sealants used in the propulsion system shall meet the requirements of Appendix V, paragraph 3.1.3., 3.1.3.1., 3.1.3.2., 3.1.3.3. and 3.1.3.4. The airworthiness substantiation shall include a Material and Process Analysis IAW DI-MISC-80711, Material and Process Test Plan IAW DI-NDTI-80566, and a Material and Process Test Report IAW DI-NDTI-80809. The Material and Process Analysis report may include any powerplant manufacturer's documents that are used for materials and processes.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.4. Fasteners
The purpose of the fasteners requirement is to ensure the suitability and locations where loss of the fastener could affect safety of flight or ability to control the powerplant.

Criteria:
A self-retaining, secondary means of retention, feature shall be used at points where loss of the fastener could affect safety of flight or ability to control the powerplant. Cotter pins, safety wire, or safety cable shall not be used to secure aforementioned fasteners.

Standard:
Appendix V, paragraph 3.1.4.
Appendix V, paragraph 4.4.4.

Method of Compliance:
The fastener requirements of Appendix V, paragraph 3.1.4. shall be verified by inspection and analysis. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.4.4. and include a Fasteners Assessment IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.5. Nameplate and Product Marking

The purpose of the marking/identification requirement is to provide positive designation, identification, tracking and management for engineering configuration control.

Criteria:

A plan for serialization and marking shall be defined. All Critical Safety Items (CSI) shall be serialized and marked.

Standard:

AMCOM Regulation 702-7
MIL-STD-130
Appendix V, paragraph 3.1.5.
Appendix V, paragraph 4.4.5.
Appendix V, paragraph 4.4.5.2.

Method of Compliance:

All CSIs, and depot repairable CAIs shall be marked and identified. Locations and methods of markings must be IAW drawings, technical data packages, contract quality assurance provisions, or through other contract requirements/clauses. Data format shall be IAW MIL-STD-130. All CSIs require individual serialization or identification by lot number for traceability. Serial number requirements may be identified on drawings in the technical data packages IAW MIL-STD-31000, and in contract quality assurance provisions, or through other contract requirements/clauses. An internal system for assigning serial numbers shall be developed. Serialization shall occur so that any individualized inspection/process that involves a critical characteristic is traceable to a specific serial number. All serial numbers approved for issue or provided by the Government shall be accounted for; this includes material scrapped during manufacturing (if item/product serialization has been assigned prior to final marking). Serial numbers used in this program shall not be used on any other part with the same basic part number (i.e., only a dash number or revision letter difference) manufactured by that contractor. The airworthiness substantiation shall include a Marking and Identification Plan developed IAW AMCOM Regulation 702-7, Appendix B, and MIL-STD-130 and prepared IAW DI-MISC-80508."

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.6. Transportability

The purpose of the transportability requirement is to ensure that materiel systems are designed, engineered, and constructed to preclude environmental or mechanical damage during handling or transportation. Transportability approval is required prior to engineering and manufacturing development as well as prior to production and fielding.

Criteria:
The powerplant shall be designed for movement on, and be compatible with, standard aircraft maintenance trailers. Features shall be provided to permit installation on and use of appropriate static and mobile ground equipment.

Standard:
AR 70-47
Appendix V, paragraph 3.1.6.
Appendix V, paragraph 4.4.6.

Method of Compliance:
The transportability requirements of Appendix V, paragraph 3.1.6. shall be verified by analysis and demonstration. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.4.6. and include a Transportability Engineering Analysis IAW DI-MISC-80711. The analysis shall include all information necessary for the handling and transportation of the propulsion system components (e.g., blocking, bracing, slinging, lifting, and tiedown detail and procedures to assure safe handling; procedures to disassemble, load, restrain, and offload materiel; environmental preservation, etc.)

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.7. Interchangeability
The purpose of the interchangeability requirement is to ensure that parts with the same part number are interchangeable to reduce logistic support requirements, minimize maintenance and repair problems, and assure that powerplant performance and operability are not compromised.

Criteria:
The powerplant components and individual parts shall be functionally and dimensionally interchangeable and replaceable with each other with respect to installation and performance.

Standard:
Appendix V, paragraph 3.1.7.
Appendix V, paragraph 4.4.7.

Method of Compliance:
The interchangeability requirement shall meet the requirements of Appendix V, paragraph 3.1.7. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.4.7. and include an Interchangeability Analysis Report IAW DI-MISC-80711 of any matched or selected fit parts as well as any module replacement limits prepared prior to the initiation of the PFR.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.8. Safety

7.5.1.8.1. Not Used

7.5.1.8.2. Fire Prevention
The purpose of the fire prevention requirement is to ensure propulsion system components surface temperatures which can ignite flammable fluids are identified in the EMS.

Criteria:
Components with surface area temperatures sufficient to ignite flammable fluid shall be specifically identified in the EMS. If a fire shield is required, it shall be identified in the EMS.

Standard:
Appendix V, paragraph 3.1.8.2.
Appendix V, paragraph 4.4.8.2.

Method of Compliance:
The fire prevention requirement shall meet the requirements of Appendix V, paragraph 3.1.8.2. An analysis shall be performed to annotate propulsion system component surface areas in which temperatures may be sufficient to ignite flammable fluids used for operation or maintenance of the aircraft. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.4.8.2. and include a Fire Prevention Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.8.3. Explosion Proof
The purpose of the explosion proof requirement is to ensure that all electrical/electronic components are explosion proof since an explosive atmosphere may exist near the component.

Criteria:
The powerplant subsystem components shall be capable of operation in an explosive atmosphere without incident.

Standard:
Appendix E, paragraph 5.4.9.
Appendix E, paragraph 5.10.
Appendix V, paragraph 3.1.8.3.
Appendix V, paragraph 4.4.8.3.

Method of Compliance:
The explosion proof requirement shall meet the requirements of Appendix V, paragraph 3.1.8.3. All electrical components not hermetically sealed, or components with moving parts capable of creating a spark, shall be subjected to explosive atmosphere testing IAW Appendix E, paragraph 5.4.9. The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include an Explosive Atmosphere Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, an Explosive Atmosphere Test Report IAW DI-NDTI-81897 or a Component Similarity Argument Report IAW DI-NDTI-81896, prior to the initiation of the PFR.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.8.4. Not Used

7.5.1.8.5. Not Used

7.5.1.8.6. Not Used

7.5.1.8.7. Not Used

7.5.1.8.8. Ground Safety
The purpose of the ground safety requirement is to ensure warning notices are provided where applicable to preclude safety hazards to aircraft maintainers.

Criteria:
Warning notices shall be provided, where applicable, for high voltage systems and sources, radioactive devices, explosive devices, high powered optical sources, and high temperature components.

Standard:
Appendix V, paragraph 3.1.8.8.
Appendix V, paragraph 4.4.8.8.

Method of Compliance:
The ground safety requirement shall meet the requirements of Appendix V, paragraph 3.1.8.8. and shall be verified by analysis and inspection. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.4.8.8. .and include a Ground Safety Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.8.9. Not Used

7.5.1.8.10. Fire Protection
The purpose of the fire protection requirement is to demonstrate the propulsion system is designed to have fire resistant/fireproof capability.

Criteria:
The propulsion system is designed to minimize the probability of the occurrence and spread of fire during normal operation and failure conditions as well as minimize the hazardous effects in the event of a fire.

Standard:
Appendix V, paragraph 3.1.8.10.
Appendix V, paragraph 4.4.8.10.

Method of Compliance:
The fire protection requirements IAW Appendix U, paragraph 3.1.8.10. shall be substantiated by analysis and testing IAW Appendix U, paragraph 4.4.8.10. and include a Fire Protection Analysis IAW DI-MISC-80711, a Fire Protection Test Plan IAW DI-NDTI-80566, and a Fire Protection Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.9. Design Control

7.5.1.9.1. Parts List.
The purpose of the parts list requirement is to freeze the propulsion system configuration undergoing qualification. The parts list for the propulsion system configuration that successfully completes the PFR and QT verifications shall be the approved parts list for the respective engine model.

Criteria:
The parts list for the propulsion system, including software version, that successfully completes the designated engine milestone verifications shall constitute the approved parts list.

Standard:
Appendix V, paragraph 3.1.9.1.
Appendix V, paragraph 4.4.9.1.

Method of Compliance:
The parts list requirement IAW Appendix V, paragraph 3.1.9.1. shall be substantiated by inspection and a Parts List IAW Appendix V, paragraph 4.4.9.1. and include a Parts List IAW DI-MISC-80711, which shall include hardware and software configuration.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.9.2. Assembly of Components and Parts
The purpose of the assembly of components and parts requirement is to ensure the propulsion system components are designed to consider replaceability, serviceability, and (Murphy proof) interchangeability.

Criteria:
Components that are not structurally and functionally interchangeable with other parts on the same powerplant shall not be physically interchangeable (Murphy Proof). Parts and components shall be designed such that it is impossible to install them incorrectly. Connections located in close proximity to each other shall be made physically non-interchangeable. Each connection provided for powerplant instrumentation necessary to ensure operation of the powerplant shall be marked to identify it with its corresponding instrument IAW the ICD.

Standard:
Appendix V, paragraph 3.1.9.2.
Appendix V, paragraph 4.4.9.2.

Method of Compliance:
The assembly of components and parts requirement of Appendix V, paragraph 3.1.9.2. shall be substantiated by inspection and demonstration. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.4.9.2.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.9.3. Changes in Vendors or Fabrication Processes
The purpose of the changes in vendors or fabrication processes requirement is to verify traceability for propulsion components and ensure that manufacturing planning and quality controls are being implemented and documented properly.

Criteria:
Parts, components, and assemblies affected by changes in vendors or fabrication process shall be documented.

Standard:
Appendix V, paragraph 3.1.9.3.
Appendix V, paragraph 4.4.9.3.

Method of Compliance:
The requirements of Appendix V, paragraph 3.1.9.3. shall be substantiated by inspection, documentation, and testing IAW Appendix V, paragraph 4.4.9.3. as deemed appropriate by the Using Authority. Substantiation IAW Appendix V, paragraph 4.4.9.3. shall include a Vendor and Fabrication Summary IAW DI-NDTI-81896. A Vendor and

Fabrication Test Plan IAW DI-NDTI-80566, and a Vendor and Fabrication Test Report IAW DI-NDTI-80809 may be requested at the Using Authority discretion if testing is deemed necessary.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.9.4. Standardization
The purpose of the standardization requirement is to ensure uniformity and compatibility for propulsion system components and configurations.

Criteria:
Standardization principles, standard parts, materials, processes, tools, subsystems, and components shall be used to the maximum extent possible without compromise in design, performance, operability, or economic life of the engine.

Standard:
Appendix V, paragraph 3.1.9.4.
Appendix V, paragraph 4.4.9.4.

Method of Compliance:
The standardization requirement IAW Appendix V, paragraph 3.1.9.4. shall be substantiated by documentation, inspection and demonstration. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.4.9.4.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.1.10. Preservation and Storage
The purpose of the preservation and storage requirement is to ensure materials are protected from harm, damage, pilferage, or destruction by environmental factors with the intent of extending their serviceable life.

Criteria:
The propulsion system shall have a storage life as defined by the Engine Model Specification (EMS) and approved by the Using Service. Upon removal from storage, the propulsion system shall be readily returned to an operational status.

Standard:
Appendix V, paragraph 3.1.10.
Appendix V, paragraph 4.4.10.

Method of Compliance:
The preservation and storage requirement of Appendix V, paragraph 3.1.10. shall be substantiated by inspection and analysis. The airworthiness substantiation shall be IAW

Appendix V, paragraph 4.4.10. and include a Preservation and Storage Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.2. Performance and Operability

Powerplant performance under various conditions and loads (i.e., altitude, sea level, varying temperatures, power extraction, attitudes, power settings, etc.) as well as environmental conditions (icing, sand and dust, etc.) needs to be specified and measured to assess aircraft performance under these conditions.

Operability is the powerplant's ability to start, accelerate and decelerate within prescribed limits.

7.5.2.1. Performance Characteristics

The minimum powerplant performance characteristics (the poorest performing powerplant that would be submitted for acceptance) shall be based on specified criteria.

7.5.2.1.1. Not Used

7.5.2.1.2. Steady-State Performance Model

The purpose of the engine performance model is to provide a means of assessing performance without actual testing of engine hardware. Engine performance information is of critical importance in the evaluation of the aircraft mission capability.

Criteria:

Powerplant power and power consumption (i.e.: battery) shall be characterized.

Standard:

Appendix V, paragraph 3.2.1.4.
Appendix V, paragraph 3.2.1.5.
Appendix V, paragraph 3.2.1.6.
Appendix V, paragraph 4.5.1.2.
Appendix V, paragraph 4.5.1.5.

Method of Compliance:

A steady state performance program shall be developed based on powerplant and component testing and as well as performance analysis in accordance with Appendix U, para 3.2.1.2. The performance model shall be a component level simulation, with validated control simulation, in which identity is maintained for all major components throughout the propulsion system, including sensors and actuators. Each component must be identifiable as entities in the model logic as required to obtain and maintain an accurate simulation. Computer Program and Rating Tables shall be updated after the Qualification Test (QT) Altitude Test if the Deck and engine do not lapse within ±2% of each other. The definition of ambient temperature and pressure lapse rates shall be a

part of the substantiation test data for all the operational rating conditions as per the aircraft specification or as provided by the Using Service. The airworthiness substantiation shall include a steady state performance computer program in accordance with Appendix V, paragraph 3.2.1.5. Additionally, airworthiness substantiation of the performance programs shall be IAW Appendix V, paragraph 4.5.1.5. prepared IAW DI-MISC-80711 and updated prior to initiation of the Qualification endurance test.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.2.1.3. Performance Ratings

The purpose of the performance ratings requirement is to provide a ensure that rated powerplant performance data from the Steady State Performance Program do not lapse the Altitude Test data by more than 2%.

Criteria:

The rated propulsion system performance data from the Steady State Performance Program shall not lapse the Altitude Test data by more than 2%.

Standard:

Appendix V, paragraph 3.2.1.3.
Appendix V, paragraph 4.5.1.3.

Method of Compliance:

The performance ratings requirement of Appendix V, paragraph 3.2.1.3. shall be substantiated by analysis and tests. Propulsion system performance ratings shall be included in the Engine Model Specification (EMS). The airworthiness substantiation shall be IAW Appendix V, paragraph 4.5.1.3. and shall be verified in parallel with the Performance Computer Model (reference Appendix U, paragraph 3.2.1.5. and 4.5.1.5.) by analysis, engine altitude tests and air vehicle performance tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.2.2. Operating Characteristics and Limits

The purpose of operating characteristic and limits requirement is to provide and demonstrate the engine operating characteristics and limits for the operator to know the full range of engine capabilities.

Criteria:

The engine shall function with positive durability margins as installed in the aircraft.

Standard:

Appendix V, paragraph 3.2.2.
Appendix V, paragraph 4.5.2.

Method of Compliance:
All powerplant steady state and transient operating limits (maximum, minimum) shall be specified per Appendix V, paragraph 3.2.2. The specified limits shall be predicated on the most critical tolerances of the powerplant. The airworthiness substantiation shall include an Powerplant Operating Limitation Analysis IAW DI-MISC-80711, a Powerplant Operating Limitation Test Plan IAW DI-NDTI-80566, and a Powerplant Operating Limitation Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.2.2.1. Operating Envelope
The purpose of this test is to ensure powerplant start and acceleration capability at low and high temperatures.

Criteria:
The powerplant shall start, accelerate, and operate during and after exposure to low and high temperatures.

Standard:
Appendix V, paragraph 3.2.2.1.
Appendix V, paragraph 4.5.2.1.

Method of Compliance:
The powerplant shall demonstrate low, high temperature starting and accelerating capability via testing IAW Appendix V, paragraph 3.2.2.1. and paragraph 4.5.2.1. The airworthiness substantiation shall include a Low and High Temperature Starting and Acceleration Test Plan IAW DI-NDTI-80566, and Low and High Temperature Starting and Acceleration Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.2.2.2. Altitude Tests
The purpose of the attitude test is to demonstrate the powerplant systems can successfully operate at anticipated attitudes during initial flight testing. Extended flight operation at certain weapon system attitudes has resulted in oil system malfunctions, such as oil starvation, bearing sump flooding, gearbox flooding, oil foaming problems, and seal leaks.

Criteria:
The powerplant shall be capable of operating at specified attitudes.

Standard:
Appendix V, paragraph 3.2.2.2.
Appendix V, paragraph 4.5.2.2.

Method of Compliance:
The powerplant shall be subjected to an attitude test to demonstrate satisfactorily operation IAW Appendix V, paragraph 3.2.2.2. and paragraph 4.5.2.2. The airworthiness substantiation shall include a Powerplant Attitude Analysis IAW DI-MISC-80711, a Powerplant Attitude Test Plan IAW DI-NDTI-80566, and a Powerplant Attitude Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.2.2.3. Starting
The purpose of this test is to ensure the powerplant makes successful ground and air starts under the conditions, limitations and operating procedures throughout the altitude starting envelope of the aircraft, including extreme low and high temperatures of the aircraft operating envelope.

Criteria:
The powerplant shall start at specified ambient temperatures, altitudes and airspeeds, and time frame IAW the air vehicle specification or as provided by the Using Service.

Standard:
Appendix V, paragraph 3.2.2.3.
Appendix V, paragraph 4.5.2.3.

Method of Compliance:
Testing shall be accomplished to show that the starting system can meet all starting requirements IAW Appendix V, paragraph 3.2.2.3. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.5.2.3., and include a Starting Analysis IAW DI-MISC-80711, a Starting Test Plan IAW DI-NDTI-80566, and a Starting Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.2.2.3.1. Not Used

7.5.2.2.3.2. Not Used

7.5.2.2.3.3. Starting Limits
The purpose of the starting limits requirement is to ensure the EMS starting requirements are within tested limits.

Criteria:
The starting altitude and ambient temperature limitations for starting shall be IAW the EMS.

Standard:
Appendix V, paragraph 3.2.2.3.3.
Appendix V, paragraph 4.5.2.3.3.

Method of Compliance:
Tests shall be conducted at a test facility that can simulate exact conditions for starting. The airworthiness substantiation shall include a Starting Limits Analysis IAW DI-MISC-80711, a Starting Limits Test Plan IAW DI-NDTI-80566, and a Starting Limits Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.2.2.3.4. Starting Procedure

The purpose of the starting procedure requirement is to ensure that established procedure for powerplant starts is simple to minimize false starts and burden to the operator.

Criteria:
The established starting procedure shall be simple and shall not require critical timing, within specified powerplant starting limits and without adversely affecting the powerplant durability or structural integrity.

Standard:
Appendix V, paragraph 3.2.2.3.4.
Appendix V, paragraph 4.5.2.3.4.

Method of Compliance:
The starting procedure requirements shall be accomplished IAW Appendix V, paragraph 3.2.2.3.4. The airworthiness substantiation shall include a Starting Procedure Test Plan IAW DI-NDTI-80566, and a Starting Procedure Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.2.2.4. Stopping

The purpose of the stopping requirement is to ensure that established procedure for powerplant stopping is simple, timely and does not negatively affect the integrity of the propulsion system.

Criteria:
Upon receiving a signal from the air vehicle for stopping, the powerplant shall shut down by a single, rapid method in any operating condition.

Standard:
Appendix V, paragraph 3.2.2.4.
Appendix V, paragraph 4.5.2.4.

Method of Compliance:
Propulsion system shutdown, IAW Appendix V, paragraph 3.2.2.4., shall be accomplished per established procedures. The airworthiness substantiation IAW Appendix V, paragraph 4.5.2.4. shall include a Propulsion System Shutdown Analysis IAW DI-MISC-80711, a IAW Propulsion System Shutdown Test Plan IAW DI-NDTI-80566, and a Propulsion System Shutdown Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.2.2.5. Not Used

7.5.2.2.6. Stability and Performance
The purpose of the stability and performance assessment is to ensure that positive stability margin exists at all flight conditions or that placards are documented in the flight manual.

Criteria:
The powerplant shall have positive stability margin during rapid throttle transients or load changes.

Standard:
Appendix V, paragraph 3.2.2.6.
Appendix V, paragraph 4.5.2.6.

Method of Compliance:
The powerplant stability and performance assessment shall be IAW Appendix V, paragraph 3.2.2.6. and paragraph 4.5.2.6., and verified during the Altitude test per Appendix V, paragraph 4.14.1.2. The airworthiness substantiation shall include a Stability Audit prepared IAW DI-MISC-80711 and verified with substantiation provided in the Altitude Test Report (reference Appendix V, paragraph 4.14.1.2.), a Ground and Flight Test Plan IAW DI-NDTI-80566 and a Ground and Flight Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.2.2.7. Transients
The powerplant must have adequate stability during throttle transients.

Criteria:
The powerplant shall perform any power transient throughout all operating conditions and the operating envelope of the powerplant while meeting the specified requirements. Power requests in any sequence and at any rate, including the effects of PTO demands, shall not result in exceeding any powerplant operating limit, result in unstable operation of the powerplant, or cause any mechanical damage.

Standard:
Appendix V, paragraph 3.2.2.7.
Appendix V, paragraph 3.2.2.7.1.
Appendix V, paragraph 4.5.2.7.
Appendix V, paragraph 4.5.2.7.1.

Method of Compliance:
The transient and over/undershoot requirements of Appendix V, paragraph 3.2.2.7. and 3.2.2.7.1. shall be verified by analysis and tests. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.5.2.7. and 4.5.2.7.1. and shall include a Transient Analysis IAW DI-MISC-80711 to assure the powerplant transient performance is consistent with aircraft performance requirements. Transient verification shall be included as part of the altitude test with substantiating included in the Altitude Test Report (reference Appendix V, paragraph 4.14.1.2.). Power, temperature, motor speeds, and other such pertinent parameters shall be recorded during each transient. Testing or analysis shall be performed for all control modes.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.2.2.8. Surface Temperature and Heat Rejection
The purpose of this requirement is to ensure the powerplant and associated subsystems will perform satisfactorily in the thermal environment. The surface temperature and heat rejection must be controlled to ensure compatibility between the propulsion system and the aircraft for safe and durable operation.

Criteria:
The propulsion system cooling and thermal management systems shall remove excess heat from the powerplant and associated subsystems to ensure proper system operation.

Standard:
Appendix V, paragraph 3.2.2.13.
Appendix V, paragraph 4.5.2.13.

Method of Compliance:
An analysis and testing shall be performed that provides sufficient evidence that the engine and its associated subsystems function satisfactorily under the conditions specified in Appendix V, paragraph 3.2.2.13. and Appendix V, paragraph 4.5.2.13. Such factors as powerplant bay cooling flows, accessory pad loading, lubrication system cooling requirements, skin temperature, radiation properties, etc. shall be taken into consideration in establishing propulsion system heat rejection rates. The airworthiness substantiation shall include a Heat Rejection Rate Analysis Report IAW DI-MISC-80711, a Heat Rejection Rate Test Plan IAW DI-NDTI-80566, and a Heat Rejection Rate Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.2.2.8.1. Control System and Engine Accessory Components
The purpose of this testing is to demonstrate that the mounted and off-mounted powerplant components do not exceed their allowable temperatures when surrounded by still air under worst case conditions.

Criteria:
The mounted and off-mounted powerplant components shall operate as required when surrounded by worse case ambient air temperatures as specified in the EMS and ICD.

Standard:
Appendix V, paragraph 3.2.2.13.1.
Appendix V, paragraph 4.5.2.13.1.

Method of Compliance:
The requirements of Appendix V, paragraph 3.2.2.13.1. shall be verified by analyses and tests. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.5.2.13.1. and include a Control and Accessory Limiting Temperature Analysis prepared IAW DI-MISC-80711. The analysis shall be verified using a thermal survey to substantiate temperatures, coolant flow rates, heat transfer coefficients, etc. This thermal survey shall be conducted in the installed configuration. The thermal survey plan and report shall be provided in a Control and Accessory Limiting Temperature Test Plan IAW DI-NDTI-80566, and a Control and Accessory Limiting Temperature Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.3. Environmental Conditions
Environmental conditions and operating envelope of the engine includes all extremes and limits such as externally applied loads, attitudes, and environmental extremes

independently and concurrently in all combinations within the scope of the engine specification.

7.5.3.1. Atmospheric Conditions

7.5.3.1.1. Humidity

The purpose of the humidity test is to determine the resistance of materiel to the effects of a warm, humid atmosphere.

Criteria:
The materiel shall perform IAW the equipment specification before, during, and after exposure to Aggravated Cycle Humidity environment.

Standard:
MIL-STD-810, Method 507
Appendix V, paragraph 3.3.1.1.
Appendix V, paragraph 4.6.1.1.

Method of Compliance:
The materiel shall perform IAW the equipment / platform specification before, during, and after exposure to Humidity environmental effects that occur over the life cycle of the materiel. Compliance may be by test, similarity analysis, analysis, demonstration, or a combination of methods. Testing shall be IAW MIL-STD-810, Method 507, procedure II (Aggravated Cycle). The airworthiness substantiation shall include Humidity Test Plans IAW DI-NDTI-80566 and Humidity Test Procedures IAW DI-NDTI-80603 prior to testing. Humidity Test Reports shall be prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.3.1.2. Fungus

The purpose of the fungus test is to assess the susceptibility of materials to fungal growth. The primary objectives of the fungus test are to determine:

a. If the materials or the assembled combination of same, will support fungal growth, and where possible, identify dominant species present.

b. How rapidly fungus will grow on the materiel.

c. How fungus may affect the materiel, its mission, and its safety for use following the growth of fungus on the materiel.

d. If the materiel can be stored effectively in a field environment.

e. If there are simple cleaning processes.

Criteria:
The materiel shall perform IAW the equipment specification before and after exposure to Fungus environment.

Standard:
MIL-STD-810, Method 508
Appendix V, paragraph 3.3.1.2.
Appendix V, paragraph 4.6.1.2.

Method of Compliance:
The materiel shall perform IAW the equipment / platform specification before and after exposure to fungal environmental effects that occur over the life cycle of the materiel. Compliance may be by test, similarity analysis, analysis, demonstration, or a combination of methods. Testing shall be IAW MIL-STD-810, Method 508. Coupon testing is allowed. The airworthiness substantiation shall include Fungus Test Plans IAW DI-NDTI-80566 and Fungus Test Procedures IAW DI-NDTI-80603 prior to testing. Fungus Test Reports shall be prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.3.1.3. Corrosive Atmosphere
The purpose of the corrosion requirement is to ensure the propulsion system can operate and perform to specification during and after exposure to a corrosive environment.

Criteria:
The propulsion system shall perform IAW the equipment specification before and after exposure to a corrosive environment.

Standard:
Appendix V, paragraph 3.3.1.3.
Appendix V, paragraph 4.6.1.3.

Method of Compliance:
The propulsion system shall perform IAW the equipment / platform specification before and after exposure to a corrosive environment that occur over the life cycle of the materiel. Compliance may be by analysis, inspection, demonstration, or test, or a combination of methods. Testing shall be IAW Appendix V, paragraphs 3.3.1.3. and 4.6.1.3. Coupon testing is allowed where applicable. The airworthiness substantiation shall include Corrosive Atmosphere Test Plans IAW DI-NDTI-80566 and Corrosive Atmosphere Test Procedures IAW DI-NDTI-80603 prior to testing. Corrosive Atmosphere Test Reports shall be prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.3.1.4. Environmental Icing

The purpose of the environmental icing test is to verify powerplant performance when operating in icing conditions prior to initial flight testing.

Criteria:
The powerplant shall start and operate during and after icing conditions.

Standard:
Appendix V, paragraph 3.3.1.4.
Appendix V, paragraph 4.6.1.4.

Method of Compliance:
The powerplant shall be designed to meet the powerplant environmental icing requirements of Appendix V, paragraph 3.3.1.4. and paragraph 4.6.1.4. The airworthiness substantiation shall include a Powerplant Environmental Icing Test Plan IAW DI-NDTI-80566, and an Powerplant Environmental Icing Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.3.2. Ingestion Capability

The purpose of the test is to demonstrate starting and operating capability of the powerplant under all expected ground, flight, and environmental (including ice, fluid, foreign object, sand, and dust, as applicable) conditions without adversely affecting propulsion system operation or resulting in damage.

Criteria:
The powerplant shall start and operate after and during exposure to environmental contaminants (including ice, fluid, foreign object, sand, and dust, as applicable).

Standard:
Appendix V, paragraph 3.3.2.
Appendix V, paragraph 4.6.2.

Method of Compliance:
The powerplant shall be designed to meet the ingestion capability requirements of Appendix V, paragraph 3.3.2. and paragraph 4.6.2. The airworthiness substantiation shall include a Powerplant Ingestion Capability Analysis IAW DI-MISC-80711, a Powerplant Ingestion Capability Test Plan IAW DI-NDTI-80566, and a Powerplant Ingestion Capability Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.3.3. Electromagnetic Environmental Effects (E3)

All propulsion system electrical and electronic equipment and subsystems shall meet their performance requirements when subjected to the electromagnetic environmental effects of ADS-37A-PRF for flight critical systems, including Table I, Parts A and B (at full field strength); EMC, EMV, EMP, HERO, HERF, HERP, and control of static electricity.

7.5.3.3.1. Electrical Components E3 Test

The purpose of the testing is to demonstrate that the powerplant will operate satisfactorily in the E3 environment and the electromagnetic interface to the aircraft. Powerplant electrical components will be subjected to various electromagnetic environments from sources within the aircraft as well as those external which degrade engine performance.

Criteria:

The powerplant electrical and electronic equipment and subsystems shall not have emissions that could interfere with platform co-located equipment. The powerplant electronics shall not be susceptible when exposed to an external electromagnetic environment.

Standard:

MIL-STD-461
RTCA/DO-160
Appendix E, paragraph 5.7.
Appendix E, paragraph 5.10.
Appendix I
AMACC Section 13 Electromagnetic Environmental Effects (E3)
Appendix V, paragraph 3.3.3.1.
Appendix V, paragraph 3.3.3.2.
Appendix V, paragraph 3.3.3.3.
Appendix V, paragraph 3.3.3.4.
Appendix V, paragraph 4.6.3.1.
Appendix V, paragraph 4.6.3.2.
Appendix V, paragraph 4.6.3.3.
Appendix V, paragraph 4.6.3.4.

Method of Compliance:

All engine electrical and electronic equipment and subsystems shall meet their performance requirements when subjected to the susceptibility, emission, electromagnetic pulse and lightning requirements of MIL-STD-461, RTCA/DO-160 and Appendix E, paragraph 5.7. The airworthiness substantiation shall include an EMI Control Plan and EMI/EMC Test Plan prepared prior to the initiation of the PFRT IAW DI-EMCS-80199 and DI-EMCS-80201. An EMI/EMC System Analysis shall be prepared prior to PFRT IAW DI-MISC-80711. EMI/EMC Test Reports shall be submitted IAW Appendix E, paragraph 5.10. and DI-EMCS-80200. In addition, E3 requirements are defined in paragraph 13. herein, and Appendix I.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.3.3.2. High Altitude Electromagnetic Pulse (HEMP)
The purpose of EMP/HEMP testing is to determine how flight critical subsystems and equipment respond to exposure to an EMP.

Criteria:
The aircraft electronics and ordnance items shall survive, remain safe, and meet their operational performance requirements when exposed to the EMP/HEMP environment.

Standard:
MIL-STD-2169
MIL-STD-464, paragraph 5.6.
Appendix V, paragraph 3.3.3.5.
Appendix V, paragraph 4.6.3.5.
Method of Compliance:
If specified by the procuring authority, the platform, and its associated electronic components and ordnance items, shall meet its operational performance requirements when exposed to the EMP/HEMP environment of MIL-STD-464, paragraph 5.6.

This environment is classified and is defined in MIL-STD-2169. EIDs defined as having a safety function shall have a minimum of 16.5. dB safety margin. EIDs defined as having a reliability function shall have a minimum of 6 dB safety margin.

The item under test, to include ordnance system electronics, shall be production representative. Compliance shall be verified by test and/or analysis. The airworthiness substantiation shall include an EMP Test Plan and Procedure Report IAW DI-EMCS-81541, and an EMP Test Report IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.3.3.3. Initial Nuclear Radiation (INR)
The purpose of the Initial Nuclear Radiation (INR) requirement is to ensure propulsion system survivability when subject to INR.

Criteria:
All powerplant electrical and electronic equipment and subsystems shall enter a fail fixed mode, if normal operation cannot be maintained when subjected to initial nuclear radiation (INR).

Standard:
Appendix V, paragraph 3.3.3.6.
Appendix V, paragraph 4.6.3.6.

Method of Compliance:
The requirements of Appendix V, paragraph 3.3.3.6. shall be verified by tests. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.6.3.6. and include a Initial Nuclear Radiation (INR) Test Plan IAW DI-NDTI-80566, and a Initial Nuclear Radiation (INR) Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.3.4. External Contamination

The purpose of the external contamination requirement is to ensure no contaminants may accumulate on propulsion system external surfaces without access to flush them away.

Criteria:
The design of components shall not allow contaminants to be trapped in external surfaces or around seals without the ability to run off or be flushed away.

Standard:
Appendix V, paragraph 3.3.4.
Appendix V, paragraph 4.6.4.

Method of Compliance:
The external contamination requirements of Appendix V, paragraph 3.3.4. shall be substantiated by inspection and demonstration.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.4. Integrity

For the purpose of this section, integrity refers to the ability of a component, structure or asset to operate at optimum level under the pressure of a load, including the weight of the asset itself. The asset needs to sustain without drastically breaking and/or deforming, whilst still being able to perform its intended use.

7.5.4.1. Structural Integrity

7.5.4.1.1. Design Service Life

The powerplant is designed such that pertinent environmental variables and all sources of repeated loads are considered, and these considerations are included in the development of the design duty cycle.

Criteria:
The powerplant shall have a design service life IAW the air vehicle specification.

Standard:
Appendix V, paragraph 3.4.1.1.
Appendix V, paragraph 3.4.1.6.10.
Appendix V, paragraph 4.7.1.1.

Method of Compliance:
The requirements of Appendix V, paragraph 3.4.1.1. and 3.4.1.6.10. shall be verified by analysis, inspections and tests. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.7.1.1. and include analysis results included in the Strength and Life Analysis IAW DI-MISC-80711.

The durability tests cited in Appendix V, paragraph 3.4.1.5. shall be used to demonstrate the durability and reliability, and to characterize the wear points and patterns of the powerplant. Test results shall contribute to establishment of the initial service life limit for the major propulsion assemblies under test.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.4.1.1.1. Expendables Design Service Life

The purpose of the Expendables Design Service Life requirement is to ensure any expendables (i.e., air filter, oil filter, etc.) shall meet minimum maintenance-free operating requirements.

Criteria:
The design service life without replacement of all expendable parts and components shall be equal to, or greater than, the minimum maintenance-free operating period.

Standard:
Appendix V, paragraph 3.4.1.1.1.
Appendix V, paragraph 4.7.1.1.1.

Method of Compliance:
The requirements of Appendix V, paragraph 3.4.1.1.1. shall be verified by analysis, inspections and tests. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.7.1.1.1. and include an Expendables Service Life Analysis IAW DI-MISC-80711, an Expendables Service Life Test Plan IAW DI-NDTI-80566, and an Expendables Service Life Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.4.1.1.2. Bearing Design Service Life

The purpose of the Expendables Design Service Life requirement is to ensure propulsion system bearings can meet their design service life under actual operating conditions.

Criteria:
Rolling element bearings shall have an L1 contact fatigue life IAW applicable ABMA standards no less than the design service life of the powerplant.

Standard:
Appendix V, paragraph 3.4.1.1.2.
Appendix V, paragraph 3.4.1.6.9.
Appendix V, paragraph 4.7.1.1.2.
Appendix V, paragraph 4.7.1.6.9.

Method of Compliance:
The requirements of Appendix V, paragraph 3.4.1.1.2. and 3.4.1.6.9. shall be verified by analysis and tests. The airworthiness substantiation shall be IAW Appendix V, paragraphs 4.7.1.1.2. and 4.7.1.6.9. and include a Bearing Life and Loads Analysis Report IAW DI-MISC-80711. This report shall be submitted to provide detail and summary of how the bearing life is calculated. The report shall also include the bearing reaction loads from KISSsoft. The inputs and outputs of the KISSsoft analysis shall be included in an Appendix to this report. The results of the powerplant endurance test shall be used to verify the Bearing Life and Loads Analysis Report.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.4.1.2. Design Usage
The purpose of the design-usage-requirement is to characterize details related to the intensity, duration, and frequency of occurrence of various environmental conditions experienced by the structure in accordance with the aircraft system specification. Detailed characterization of the design usage environment supports design, analysis, and testing program activities. Environmental conditions may be natural or induced and include conditions related to temperature, altitude, precipitation, humidity, chemical, abrasive, vibratory, and corrosive environments.

Criteria:
The powerplant shall be capable of withstanding the design usage IAW the air vehicle specification or by the Using Service.

Standard:
MIL-STD-3063
Appendix V, paragraph 3.4.1.2.
Appendix V, paragraph 4.7.1.2.

Method of Compliance:
The airworthiness substantiation shall include a Design Usage Environment Spectra analysis for the propulsion system IAW the requirements of the Aircraft System Specification. Environments covered in the spectra shall include at a minimum exposure to rain, sand, corrosion, temperature, moisture absorption, ice, and snow. Unless

otherwise specified in the Aircraft System Specification or Engine Model Specification (EMS), the airworthiness substantiation may leverage simplified analysis based on environmental extremes that envelop the design-usage-environment spectra, with appropriate documentation in the structural design criteria. The design usage environment spectra and associated environmental extremes shall be updated IAW section 5.4.1. of MIL-STD-3063. When not incorporated into the structural design criteria, the airworthiness substantiation shall include a Design Usage Environment Spectra Analysis Report IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.4.1.2.1. Externally Applied Forces.
The purpose of this test is to demonstrate that adequate structural capability prior to deployment of the weapon system. The forces induced by acceleration can cause permanent deformations and fractures that disable or destroy equipment, fasteners and mounting hardware.

Criteria:
The propulsion system shall operate safely with externally applied forces prior to weapon deployment.

Standard:
Appendix V, paragraph 3.4.1.2.1.
Appendix V, paragraph 4.7.1.2.1.

Method of Compliance:
The propulsion system cases and mounts of the endurance test engine configuration shall be subjected to a static test to verify the requirements of Appendix V, paragraph 3.4.1.2.1. A static rig test shall be conducted to demonstrate the capability of the propulsion system and its supports to withstand maximum externally applied forces without permanent deformation of any component and 1.5 times those forces without failure of any component. In this test, maximum thrust loads, acceleration loads, torque and reaction loads will be applied separately and then in combination. Stress and deflection data will be obtained at critical locations as determined by analysis. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.7.1.2.1. and include a Static Load Analysis Report IAW DI-MISC-80711, a Static Load Test Plan IAW DI-NDTI-80566, and a Static Load Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.4.1.3. Material Characterization
The purpose of the material characterization requirement is to ensure the materials and processes used during the design and manufacture of the propulsion system will meet all specification requirements.

Criteria:
The materials used in the propulsion system shall be fully characterized using minimal allowables that are established considering statistical variability, the expected environments, fabrication processes, repair techniques, and quality assurance procedures.

Standard:
Appendix V, paragraph 3.4.1.3.
Appendix V, paragraph 4.7.1.3.

Method of Compliance:
The requirements of Appendix V, paragraph 3.4.1.3. shall be verified by documentation, analysis and tests. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.7.1.3. and include a Material Characterization Analysis Report which may include any manufacturer's documents that are used for materials and processes used throughout the propulsion system IAW DI-MISC-80711. Additionally, a Material Characterization Test Plan IAW DI-NDTI-80566 and a Material Characterization Test Report IAW DI-NDTI-80809 shall be submitted at the discretion of the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.4.1.4. Part Classification
The purpose of the part classification requirement is to classify all powerplant parts for criticality to identify Critical Safety Items (CSIs) with associated critical characteristics, and Critical Application Items (CAIs).

Criteria:
The FMECA and a CSI/CAI summary shall be submitted to the Using Service for approval.

Standard:
MIL-STD-882
AMCOM Regulation 702-7
Appendix V, paragraph 3.4.1.4.
Appendix V, paragraph 4.7.1.4.

Method of Compliance:
All powerplant parts shall be classified for criticality per MIL-STD-882 and a Failure Modes and Effects and Criticality Analysis (FMECA) performed to identify Critical Safety Items (CSIs) and Critical Application Items (CAIs). The critical characteristics for all

identified critical safety items shall be defined IAW AMCOM Regulation 702-7. The list of identified CSIs with their critical characteristics, and CAIs shall be submitted to the Using Service for approval.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.4.1.5. Durability

7.5.4.1.5.1. Low Cycle Fatigue Life
The purpose of the LCF life requirement is to ensure that generalized cracking will not occur prior to reaching the required design service life. Prediction of LCF life requires testing for increased confidence in predicted life limit.

Criteria:
Powerplant parts shall have minimum Low Cycle Fatigue (LCF) lives not shorter than the design service life.

Standard:
14 CFR Part 35
MIL-P-26366A
Appendix V, paragraph 3.4.1.5.1.
Appendix V, paragraph 4.7.1.5.1.

Method of Compliance:
Powerplant components shall have positive LCF margin. The airworthiness substantiation shall include a Low Cycle Fatigue Life Analysis IAW DI-MISC-80711, a Low Cycle Fatigue Life Test Plan IAW DI-NDTI-80566, and a Low Cycle Fatigue Life Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.4.1.5.2. High Cycle Fatigue Life
The purpose of the HCF life requirement is to ensure that combination of mean and alternating stresses will not preclude an engine component from reaching its design service life limit.

Criteria:
Powerplant parts shall not fail when subject to the maximum attainable combined steady state and vibratory stresses. Parts subjected to LCF loads in addition to HCF loads shall be designed considering the effect of LCF damage on the material HCF life.

Standard:
Appendix V, paragraph 3.4.1.5.2.

Appendix V, paragraph 4.7.1.5.2.

Method of Compliance:
Powerplant components shall have positive HCF margin. The airworthiness substantiation shall include a High Cycle Fatigue Life Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.4.1.5.3. Creep
The purpose of the creep requirement is to demonstrate that powerplant components and accessories do not exhibit creep throughout the operational envelope and design service life which would result in material contact or imminent failure.

Criteria:
Powerplant components and accessories shall not creep so that operation is impaired throughout the design service life. Part creep shall not affect disassembly and reassembly of the powerplant or new part replacement at overhaul throughout its design life.

Standard:
Appendix V, paragraph 3.4.1.5.3.
Appendix V, paragraph 4.7.1.5.3.

Method of Compliance:
A creep analysis and test showing compliance with Appendix V, paragraph 3.4.1.5.3. shall be conducted IAW Appendix V, paragraph 4.7.1.5.3. The airworthiness substantiation shall include a Creep Analysis IAW DI-MISC-80711, a Creep Test Plan IAW DI-NDTI-80566, and a Creep Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.4.1.6. Strength
The purpose of the strength requirement is to ensure that powerplant components and accessories can withstand maximum stresses when subject to limiting loads.

Criteria:
The powerplant shall meet all design requirements after exposure to limit loads, and not exhibit detrimental permanent set or deflect to the extent that operation or performance is impaired when operated to limit load conditions.

Standard:
Appendix V, paragraph 3.4.1.6.
Appendix V, paragraph 4.7.1.6.

Method of Compliance:
A strength analysis showing compliance with Appendix V, paragraph 3.4.1.6. shall be conducted IAW Appendix V, paragraph 4.7.1.6. The airworthiness substantiation shall include a Strength and Life Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.4.1.6.1. Factors of Safety
The purpose of the factors of safety requirement is to ensure the required load factors are applied to design usage induced load types to establish limit and ultimate conditions for all powerplant and accessory components.

Criteria:
The limit and ultimate conditions for the load types cited in Appendix V, paragraph 3.4.1.6.1. shall be applied to establish limit and ultimate conditions for all engine parts and accessories.

Standard:
Appendix V, paragraph 3.4.1.6.1.
Appendix V, paragraph 4.7.1.6.1.

Method of Compliance:
A factor of safety analysis showing compliance with Appendix V, paragraph 3.4.1.6.1. shall be conducted IAW Appendix V, paragraph 4.7.1.6.1. The airworthiness substantiation shall include a Factors of Strength Analysis which shall be included in the Strength Analysis (reference Appendix V, paragraph 3.4.1.6.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.4.1.7. Damage Tolerance
The purpose of the damage tolerance requirement is to establish inspection intervals and procedures necessary to ensure structural integrity in accordance with the fatigue and fracture methodologies. The choice of airworthiness substantiation via damage tolerance must include considerations for fleet maintenance strategies IAW the Aircraft System Specification and should include considerations for cost and schedule in the decision to substantiate via damage tolerance versus other fatigue methodologies.

Criteria:
The propulsion system structure shall meet the specified durability and reliability requirements.

Standard:
MIL-STD-3063
Appendix V, paragraph 3.4.1.7.
Appendix V, paragraph 3.4.1.7.1.
Appendix V, paragraph 3.4.1.7.2.
Appendix V, paragraph 4.7.1.7.
Appendix V, paragraph 4.7.1.7.1.
Appendix V, paragraph 4.7.1.7.2.

Method of Compliance:
The airworthiness substantiation shall include damage tolerance substantiation of inspection intervals and procedures IAW Appendix V, paragraph 3.4.1.7. (using section 5.4.3.1. of MIL-STD-3063 as guidance) and IAW the requirements of the Aircraft System Specification. The damage tolerance substantiation shall be IAW Appendix V, paragraph 4.7.1.7., 4.7.1.7.1. and 4.7.1.7.2. and the fatigue and fracture methodologies and shall be based on the damage tolerance analysis. The airworthiness substantiation shall include a Damage Tolerance Substantiation Report IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.4.1.8. Vibration and Dynamic Response
The purpose of this test is to ensure the powerplant is free of detrimental resonances throughout its operational range prior to initial flight testing.

Criteria:
The powerplant shall be free of damaging vibration and dynamic response.

Standard:
Appendix V, paragraph 3.4.1.8.
Appendix V, paragraph 3.4.1.8.1.
Appendix V, paragraph 4.7.1.8.
Appendix V, paragraph 4.7.1.8.1.

Method of Compliance:
Dynamic models shall be developed for major powerplant parts and components IAW Appendix V, paragraph 3.4.1.8. Critical speeds shall be determined and shall meet or exceed the speed margins specified in Appendix V, paragraph 3.4.8.1.1. Vibration test conducted per Appendix V, paragraphs 4.7.1.8. and 4.7.1.8.1. The airworthiness substantiation shall include a Powerplant Vibration and Stress Analysis Report IAW DI-MISC-80711, a Powerplant Vibration and Stress Test Plan IAW DI-NDTI-80566, and a Powerplant Vibration and Stress Test Report IAW DI-NDTI-80809; to be updated prior to Qualification Test.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.4.1.8.1. Critical Speeds
The purpose of the critical speed requirement is to ensure the propulsion system is free of resonance conditions at all shaft rotational speeds that would cause the propulsion system to not to meet all the requirements of the specification.

Criteria:
The propulsion system shall be free from damaging vibration and dynamic responses that may result in premature failure or loss of component life. Steady state operation at critical speeds can quickly consume high cycle fatigue life of components.

Standard:
Appendix V, paragraph 3.4.1.8.2.
Appendix V, paragraph 4.7.1.8.2.
Method of Compliance:
The requirements of Appendix V, paragraph 3.4.1.8.2. shall be verified by analysis and tests. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.7.1.8.2. and include a Critical Speed Analysis Report IAW DI-MISC-80711. The results of the critical speed analysis shall be verified as part of the Vibration and Dynamic Response requirement (reference Appendix V, paragraph 3.4.1.8.2.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.4.2. Software Integrity
The purpose of the software integrity requirement is to ensure software is developed and functions as intended. Due to its increased complexity, amount of code and airworthiness implication, software verification and qualification is necessary.

Criteria:
The software shall be developed, verified, and validated IAW the most stringent software level of DO-178 determined for the application IAW ARP 4754.

Standard:
ARP 4754
DO-178
Appendix V, paragraph 3.4.4.
Appendix V, paragraph 4.7.4.

Method of Compliance:
The requirements of Appendix V, paragraph 3.4.4. shall be verified by inspection, demonstration, analysis and tests. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.7.4. and include a Safety Analysis Report prepared IAW DI-MISC-80711 and documentation IAW paragraph 15.0., Software Airworthiness.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.5. Reliability and Maintainability
The as-designed powerplant reliability and maintainability shall be capable of meeting air vehicle availability goals for the mission mix profile as allocated from the air vehicle specification.

7.5.5.1. Maintainability
The purpose of the maintainability requirements is to ensure the propulsion system, subsystems, and components are integrated to consider accessibility, replaceability, serviceability, and (Murphy proof) interchangeability without degrading performance, effectiveness, or reliability.

Criteria:
The as-designed powerplant reliability and maintainability shall be capable of meeting air vehicle availability goals for the mission mix profile as allocated from the air vehicle specification.

Standard:
Appendix V, paragraph 3.5.
Appendix V, paragraph 3.5.2.
Appendix V, paragraph 3.5.2.1.
Appendix V, paragraph 3.5.2.2.
Appendix V, paragraph 3.5.2.3.
Appendix V, paragraph 3.5.3.
Appendix V, paragraph 4.8.
Appendix V, paragraph 4.8.2.
Appendix V, paragraph 4.8.2.1.
Appendix V, paragraph 4.8.2.2.
Appendix V, paragraph 4.8.2.3.
Appendix V, paragraph 4.8.3.

Method of Compliance:
A Maintenance Service Analysis IAW DI-MISC-80711 shall be provided to establish man-hours to perform maintenance, inspection intervals and criteria, and repair of serviceable propulsion system assemblies and/or sub-components. This analysis shall also include establish component accessibility and tool requirements for the maintenance procedures cited in the analysis report. This analysis shall be verified by demonstration. Testing shall be required at the discretion of the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.6. Survivability
The propulsion system shall have the ability to remain mission capable during and after a natural or man-made disturbance.

7.5.6.1. Susceptibility

7.5.6.1.1. Noise
The purpose of the noise requirement is to verify human safety requirements. Powerplant acoustic signature noise represents a health hazard to personnel, an annoyance to civilian communities, and an observable that can be used to detect combat and search and rescue aircraft.

Criteria:
The powerplant (including the propeller) shall operate such that the total powerplant noise is minimized.

Standard:
Appendix V, paragraph 3.6.1.1.
Appendix V, paragraph 4.9.1.1.

Method of Compliance:
An engine noise survey shall be conducted to substantiate the requirements of Appendix V, paragraph 3.6.1.1. IAW Appendix V, paragraph 4.9.1.1. The airworthiness substantiation shall include an Powerplant Noise Analysis IAW DI-MISC-80711, an Engine Noise Test Plan IAW DI-NDTI-80566, and an Engine Noise Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.6.2. Vulnerability

7.5.6.2.1. Cybersecurity
The purpose of the cybersecurity requirements is to provide a means to ensure airworthiness, or the ability of the propulsion system to safely attain, sustain and complete flight under adversary offensive cyber operations.

Criteria:
The powerplant and control system preliminary design shall implement best practices to mitigate potential cyber-attack. Any cybersecurity vulnerability gaps within the system software shall be identified and classified.

Standard:
NIST SP 800-53 Rev 4
DoDI 8510.01
AMACC Section 20.1. Cybersecurity

Appendix V, paragraph 3.6.2.1.
Appendix V, paragraph 4.9.2.1.

Method of Compliance:
The requirements of Appendix V, paragraph 3.6.2.1. and 4.6.2.1. shall be verified by analysis, demonstrations, and tests. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.9.2.1. and include standards, tools, and methods used to meet the identified cybersecurity requirements in paragraph 20 of the AMACC. Substantiation shall also include a Software Vulnerability Assessment IAW DI-MISC-80711 and prepared IAW NIST SP 800 161 and DFARS 252.239 7018. This assessment shall include a Program Protection Implementation Plan (PPIP). As a part of the Program Protection Implementation Plan (PPIP), the process shall document the evaluation of supplied software/firmware and reuse software/firmware (both initial acquisitions and updates) for vulnerability implications according to Government supplied criteria. This applies to both software development environment infrastructure software/tools and to deliverable software firmware. Any cybersecurity vulnerability gaps identified shall be classified.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.6.2.2. Chemical and Biological Agent Effects
The purpose of chemical and biological agent effects requirement is to ensure propulsion system performance and operability during and after hazardous chemical and biological exposure.

Criteria:
The propulsion system shall survive contamination from chemical and biological agents, and decontamination without losing mission capability.

Standard:
Appendix V, paragraph 3.6.2.3.
Appendix V, paragraph 4.9.2.3.

Method of Compliance:
The requirements of Appendix V, paragraph 3.6.2.3. shall be verified by analysis, demonstration, and test. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.9.2.3. and include a Chemical and Biological Agent Effects Analysis IAW DI-MISC-80711, a Chemical and Biological Agent Effects Test Plan IAW DI-NDTI-80566, and a Chemical and Biological Agent Test Report Effects IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7. Subsystems
Equipment that is installed as an integral part of an aircraft system that, if inoperable or removed, will prevent the aircraft from flying or make it unsafe.

7.5.7.1. Control System.
The purpose of the control system requirement is to ensure automatic control of the propulsion system in order to meet all specification requirements throughout the environmental conditions and operating envelope of the propulsion system.

Criteria:
The powerplant control system components and accessories shall maintain safe engine operation under all required conditions throughout their mission cycle.

Standard:
RTCA/DO-178
RTCA/DO-254
AMACC 15.0 (Software Airworthiness) and its subsections
Appendix E, paragraph 5.8.
Appendix E, paragraph 5.8.1.
Appendix E, paragraph 5.8.2.
Appendix E, paragraph 5.8.3.
Appendix E, paragraph 5.8.4.
Appendix E, paragraph 5.8.5.
Appendix V, paragraph 3.7.2.
Appendix V, paragraph 4.10.2.

Method of Compliance:
The requirements of Appendix V, paragraph 3.7.2. shall be verified by analysis, demonstration, and test. The airworthiness substantiation shall be IAW Appendix E, paragraph 5.8., 5.8.1. through 5.8.5. and Appendix U, paragraph 4.10.2.

Substantiation shall include:

a. Engine Control System: Engine Control System Analysis IAW DI-MISC-80711 and prepared IAW RTCA/DO-178, RTCA/DO-254; Engine Control System Test Plan IAW DI-NDTI-80566 and prepared IAW RTCA/DO-178, RTCA/DO-254; Engine Control System Test Report IAW DI-NDTI-80809; Software Standard Practices

b. Common-mode Multiple Signal Failure: Common-mode Multiple Signal Failure Test Plan IAW DI-NDTI-80566; Common-mode Multiple Signal Failure Test Report IAW DI-NDTI-80809

c. Complex Power Interrupts: Complex Power Interrupts Test Plan IAW DI-NDTI-80566; Complex Power Interrupts Test Report IAW DI-NDTI-80809

d. Aircraft Drive System Torsional Stability: A Linear and Non-linear Torsional Stability Analyses IAW DI-MISC-80711 of the combined engine and aircraft propeller/or

rotor system shall be performed prior to first flight, or whenever any engine or aircraft system component which may affect torsional stability is modified.

e. Fault Injection: Fault Injection Test Plan IAW DI-NDTI-80566; Fault Injection Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.1.1. Control System Performance

The purpose of the control system performance requirement is to demonstrate the design capability of the engine controls.

Criteria:

The control system shall provide engine power response and prevent exceedance of thermodynamic and mechanical limits when subjected to unrestricted power demand, and shall self-detect and accommodate failures during and after detected malfunction/failure.

Standard:

MIL-STD-704
MIL-HDBK-704
MIL-STD-1553
ARINC 429
Appendix E, paragraph 5.6.4.
Appendix E, paragraph 5.6.4.1.
Appendix E, paragraph 5.6.4.2.
Appendix E, paragraph 5.6.4.3.
Appendix E, paragraph 5.6.4.4.
Appendix E, paragraph 5.6.4.5.
Appendix E, paragraph 5.6.4.6.
Appendix E, paragraph 5.6.4.7.
Appendix V, paragraph 3.7.2.1.
Appendix V, paragraph 4.10.2.1.

Method of Compliance:

The requirements of Appendix V, paragraph 3.7.2.1. shall be verified by analysis and tests. The airworthiness substantiation shall be IAW Appendix E, paragraph 5.6.4., 5.6.4.1. through 5.6.4.7. and Appendix V, paragraph 4.10.2.1.

Substantiation shall include:

a. Failure Mode Effects and Criticality Analysis (FMECA) IAW DI-MISC-80711

b. PMA-Induced Damage: A PMA Neutral Short-to-Ground Analysis IAW DI-MISC-80711; a PMA Neutral Short-to-Ground Test Plan IAW DI-NDTI-80566, and a PMA Neutral Short-to-Ground Test Report IAW DI-NDTI-80809

c. Electrical Loads Analysis (reference Appendix E, paragraph 5.6.4.): A Load Measurements Test Plan IAW DI-NDTI-80566, a Load Measurements Test Report IAW DI-NDTI-80809. The Load Measurements Test shall be performed IAW MIL-HDBK-704, LDC101. At the discretion of the Using Service, an analysis by the supplier may be accepted in lieu of test, in which case the supplier shall submit an analysis conforming to the requirements of Appendix E, paragraph 5.10.4.3.

d. Overheat: A Engine Control Overheat Test Plan IAW DI-NDTI-80566 and a Engine Control Overheat Test Report IAW DI-NDTI-80809.

e. Power Compatibility: A Power Compatibility Test Plan IAW DI-NDTI-80566, a Power Compatibility Test Report IAW DI-NDTI-80809, a Short Circuit Protection Test Plan IAW DI-NDTI-80566, and a Short Circuit Protection Test Report IAW DI-NDTI-80809.

f. Data Bus Specification Compliance Analysis: A Data Bus Interfaces Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, Data Bus Interfaces Test Reports IAW DI-NDTI-81897 or a Component Similarity Argument Report IAW DI-NDTI-81896.

g. Crystal Oscillator: A Crystal Oscillator Test Plan IAW DI-NDTI-81895 & DI-RELI-80322, a Crystal Oscillator Test Report IAW DI-NDTI-81897 or a Component Similarity Argument Report IAW DI-NDTI-81896.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.1.1.1. Backup Control
The purpose of the backup control requirement is to demonstrate powerplant performance and stability during transfer from the primary control.

Criteria:
Transfer from the primary system to the backup control and back to the primary system shall be automatic at any power setting without powerplant performance instability or change to the control system input.

Standard:
Appendix V, paragraph 3.7.2.1.1.
Appendix V, paragraph 4.10.2.1.1.

Method of Compliance:
The requirements of Appendix V, paragraph 3.7.2.1.1. shall be verified by analysis and tests. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.10.2.1.1.

and include a Backup Control System Performance Analysis IAW DI-MISC-80711, a Backup Control Performance Test Plan IAW DI-NDTI-80566, and a Backup Control Performance Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.1.2. Control System Adjustment
The purpose of the control system adjustment requirement is to ensure that all engine calibration is performed in a controlled environment.

Criteria:
No field adjustment of the control system shall be required to enable operation throughout the entire operating envelope.

Standard:
Appendix V, paragraph 3.7.2.2.
Appendix V, paragraph 4.10.2.2.

Method of Compliance:
The requirements of Appendix U, paragraph 3.7.2.2. shall be verified by demonstration.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.1.3. Overspeed and Overtemperature Protection System
The purpose of the overspeed protection system requirement is to demonstrate the capability of the powerplant overspeed control system and take corrective action to prevent propulsion system limits from being exceeded.

Criteria:
The powerplant control system shall detect, store, and report all engine overspeed and overtemperature conditions.

Standard:
Appendix V, paragraph 3.7.2.3.
Appendix V, paragraph 4.10.2.3.

Method of Compliance:
The requirements of Appendix V, paragraph 3.7.2.3. shall be verified by tests. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.10.2.3. and include an Overspeed Control System Test Plan IAW DI-NDTI-80566, a Overspeed Control System Test Report IAW DI-NDTI-80809, a Overtemperature Control System Test Plan IAW DI-NDTI-80566, and a Overtemperature Control System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.1.4. Control System Safety

The objective of the Control System Safety requirement is to develop a Fault Tree Analysis (FTA) to recognize hazards that may occur, documenting their unwanted consequences and analyzing their potential causes. Using the data detailed in the FTA, a Functional Hazard Analysis (FHA) is to be developed to identify the consequence of failure for those hazards identified.

Criteria:

All system-level functions for consequence of failure shall be defined in a System-Level FHA. All hazards shall be identified and described in a Fault Tree Analysis (FTA) based on the Functional Hazard Analysis (FHA).

Standard:

SAE ARP 4761
MIL-STD-882E
Appendix V, paragraph 3.7.2.4.
Appendix V, paragraph 4.10.2.4.

Method of Compliance:

The requirements of Appendix V, paragraph 3.7.2.4. shall be verified by analyses, demonstrations, and tests. A Fault Tree Analysis (FTA) shall be prepared based on the Functional Hazard Analysis (FHA) for catastrophic and critical vehicle events. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.10.2.4. and include Fault Tree Analysis (FTA) IAW DI-MISC-80711 and prepared IAW and prepared IAW SAE ARP 4761, and a Functional Hazard Analysis (FHA) IAW DI-MISC-80711. The failure rate data in support of the FTA shall be sourced from a functional level FMECA (reference Appendix E, paragraph 5.6.4.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.2. Not Used

7.5.7.3. Electrical System

7.5.7.3.1. Not Used

7.5.7.3.2. Electrical Connectors and Cables

The purpose of the electrical connectors and cables requirement is to ensure that at cold atmospheric temperatures the electrical cables will flex to prevent damage to connectors and corresponding hardware during normal maintenance procedures.

Criteria:
Electrical cables shall flex at cold atmospheric temperatures to prevent damage to connectors and corresponding hardware during maintenance.

Standard:
Appendix V, paragraph 3.7.4.3.
Appendix V, paragraph 4.10.4.3.

Method of Compliance:
The requirements of Appendix V, paragraph 3.7.4.3. shall be verified by analyses, demonstrations, and tests. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.10.4.3. and verified as part of the Cold Soak Test (reference Appendix V, paragraph 4.5.2.3.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.3.3. Electrical Bonding

The purpose of the electrical bonding requirement is to ensure that all electrical and electronic components on the propulsion system shall have clearly defined electrical bonding interfaces that shall be identified in the design documentation, including drawings.

Criteria:
The propulsion system shall have a clearly defined electrical bonding interfaces with the air vehicle as identified in the ICD.

Standard:
MIL-STD-464D, paragraph 5.11.
Appendix V, paragraph 3.7.4.4.
Appendix V, paragraph 4.10.4.4.

Method of Compliance:
The requirements of Appendix V, paragraph 3.7.4.4. shall be verified by demonstration, inspection. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.10.4.4. and include identification of the electrical bonding interfaces in the Installation Control Document (ICD).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.3.4. Ground Isolation

The purpose of the ground isolation requirement is to ensure the propulsion system does not use the air vehicle structure for power or signal return.

Criteria:
The propulsion system to air vehicle interfaces shall not use vehicle structure for electrical grounding.

Standard:
Appendix V, paragraph 3.7.4.5.
Appendix V, paragraph 4.10.4.5.

Method of Compliance:
The requirements of Appendix V, paragraph 3.7.4.5. shall be verified by inspection and test. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.10.4.5. and include a Ground Isolation Test Plan IAW DI-NDTI-80566, and a Ground Isolation Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.3.5. Potting Compound

The purpose of the potting compound requirement is to ensure potting compounds are necessary, and if so that they are suitable for the application and do not impose damage to the connecting hardware due to higher mechanical loads, or allow contamination which may lead to electronic failure (i.e., water ingress).

Criteria:
The use of potting compounds shall not be permitted except where specifically approved by the Using Service.

Standard:
Appendix V, paragraph 3.7.4.6.
Appendix V, paragraph 4.10.4.6.

Method of Compliance:
The requirements of Appendix V, paragraph 3.7.4.6. shall be verified by inspection and test. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.10.4.6. Verification should be conducted on the powerplant endurance test that has the greatest number of thermal cycles to demonstrate the ability of the potting compound to resist cracking. (reference Appendix V, paragraph 4.14.1.1.1.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.3.6. Wiring Faults

The purpose of the wiring fault requirement is to ensure that the powerplant control system does not experience permanent damage or disruption or loss of function after an electrical wiring short circuit.

Criteria:
The electronic powerplant control system shall maintain normal operation during and after experiencing any wiring fault.

Standard:
Appendix V, paragraph 3.7.4.7.
Appendix V, paragraph 3.7.4.7.1.
Appendix V, paragraph 3.7.4.7.2.
Appendix V, paragraph 3.7.4.7.3.
Appendix V, paragraph 4.10.4.7.
Appendix V, paragraph 4.10.4.7.1.
Appendix V, paragraph 4.10.4.7.2.
Appendix V, paragraph 4.10.4.7.3.

Method of Compliance:
The requirements of Appendix V, paragraphs 3.7.4.7.2. and 3.7.4.7.3. shall be verified by test. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.10.7.2. and 4.10.7.2. and include a Wiring Faults Test Plan IAW DI-NDTI-80566, and a Wiring Faults Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.4. Not Used

7.5.7.5. Engine Health Monitoring System (EHMS)
The purpose of the Health Monitoring System (HMS) requirement is to ensure the propulsion system has the capability to perform advanced trending, monitoring, and prognostic functions relative to the powerplant performance.

Criteria:
The propulsion system shall incorporate equipment as required to monitor engine performance, electrical and mechanical condition. The HMS shall be able to interface and transfer data to a ground station for data review, trending, and interrogation. The failure of the HMS shall not cause a failure of any other mission or safety critical system.

Standard:
Appendix V, paragraph 3.7.6.
Appendix V, paragraph 4.10.6.

Method of Compliance:
The requirements of Appendix V, paragraph 3.7.6. shall be verified by analysis, demonstrations, and tests. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.10.6. and include a Health Monitoring System (HMS) System Analysis IAW DI-MISC-80711, a Health Monitoring System (HMS) System Test Plan IAW DI-NDTI-80566, and a Health Monitoring System (HMS) System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.5.1. Component Life Usage Tracking

The purpose of the powerplant and component life usage tracking requirement is to ensure the accuracy of information used to determine operation, maintenance and life limits. The powerplant monitoring system monitors and records parameters for safe platform operation, operational readiness improvements, and life limit updates.

Criteria:

The powerplant monitoring system shall monitor and calculate lives for life limited parts.

Standard:

Appendix V, paragraph 3.7.6.1.
Appendix V, paragraph 4.10.6.1.

Method of Compliance:

The requirements of Appendix V, paragraph 3.7.6.1. shall be verified by analysis, demonstrations, and test. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.10.6.1. and include a Monitoring System Performance Analysis IAW DI-MISC-80711, a Monitoring System Performance Test Plan IAW DI-NDTI-80566, and Monitoring System Performance Test Report IAW DI-NDTI-80809. Any algorithms used as part of this functionality shall be submitted for approval by the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.5.2. HMS Fault Detection/Isolation

The purpose of the Fault Detection/Isolation requirement is to ensure that the Health Monitoring System (HMS) has the capability to output a comprehensive suite of internal and Line Replaceable Unit (LRU) built in tests fault codes to facilitate the detection and isolation of faults.

Criteria:

The HMS shall output a comprehensive suite of internal and Line Replaceable Unit (LRU) built in tests fault codes to facilitate the detection and isolation of faults.

Standard:

Appendix V, paragraph 3.7.6.2.
Appendix V, paragraph 4.10.6.2.

Method of Compliance:

The requirements of Appendix V, paragraph 3.7.6.2. shall be verified by modeling, inspection, analysis, and Built-in-Test (BIT) test. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.10.6.2. with analysis and testing performed as part of

the Health Monitoring System (HMS) substantiation effort (reference Appendix V, paragraph 3.7.6.). Any algorithms used as part of this functionality shall be submitted for approval by the Using Service.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.5.3. Performance Monitoring/Trending
The purpose of the performance monitoring/trending requirement is for the HMS to measure the powerplant capability relative to the specified performance.

Criteria:
The HMS shall incorporate a propulsion system model that provides a metric of the propulsion system's capability relative to the specified performance.

Standard:
Appendix V, paragraph 3.2.1.5.
Appendix V, paragraph 3.7.6.3.
Appendix V, paragraph 4.10.6.3.

Method of Compliance:
The requirements of Appendix V, paragraph 3.7.6.3. shall be verified by inspection, demonstration and test. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.10.6.3. and shall be verified in parallel with the Engine Performance Presentation and Performance Computer Program (reference Appendix V, paragraph 3.2.1.5.) by analysis, engine altitude tests and air vehicle performance tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.5.4. Onboard Engine Diagnostic Functions
The purpose of the onboard engine diagnostic functions requirement is for the HMS to monitor propulsion system parameters to detect early failure symptoms and performance degradation, permit fault isolation, and provide long-term failure trending information.

Criteria:
The HMS shall incorporate on-board propulsion system diagnostic capability.
Standard:
Appendix V, paragraph 3.2.1.5.
Appendix V, paragraph 3.7.6.4.
Appendix V, paragraph 4.10.6.4.

Method of Compliance:
The requirements of Appendix V, paragraph 3.7.6.4. shall be verified by modeling, demonstration, analysis and test. The airworthiness substantiation shall be IAW

Appendix V, paragraph 4.10.6.4. and shall be verified in parallel with the Performance Computer Program (reference Appendix V, paragraph 3.2.1.5.) by analysis, engine altitude tests and air vehicle performance tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.5.5. Not Used

7.5.7.6. Lubrication System
The lubrication system of the powerplant shall function properly throughout all environmental conditions in the operating envelope of the aircraft, including all flight maneuver forces and attitudes which the air vehicle is required to perform.

7.5.7.6.1. Lubricants
The purpose of the lubrication oil requirement is to verify that the powerplant operates to all performance parameters when using designated lubricants.

Criteria:
The powerplant shall start, function and meet performance parameters throughout its complete environmental and operating envelope for all steady-state and transient operation when using designated lubricants.

Standard:
Appendix V, paragraph 3.7.8.1.
Appendix V, paragraph 4.5.2.3.
Appendix V, paragraph 4.10.8.1.

Method of Compliance:
The requirements of Appendix V, paragraph 3.7.8.1. shall be verified by analysis and tests. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.10.8.1. and include a Lubrication Analysis IAW DI-MISC-80711, a Lubrication Test Plan IAW DI-NDTI-80566, and a Lubrication Test Report IAW DI-NDTI-80809. A Cold Soak Test (reference Appendix V, paragraph 4.5.2.3.) shall also be used as verification of this requirement.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.6.1.1. Not Used.

7.5.7.6.1.2. Lubrication Consumption Limits
The requirement of 3.7.8.1.2. shall be verified by analyses and engine tests using assuming the test worse case attitude condition of 4.5.2.2., 4.16.3.4.1.

Criteria:
The oil consumption limits, including all forms of oil loss, shall be determined by the contractor and presented in the EMS.

Standard:
Appendix V, paragraph 3.7.8.1.2.
Appendix V, paragraph 4.3.4.1.1.
Appendix V, paragraph 4.5.2.2.
Appendix V, paragraph 4.10.8.1.2.

Method of Compliance:
The requirements of Appendix V, paragraphs 3.7.8.1.2. shall be verified by analysis and test. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.10.8.1.2. and include a Oil Consumption Limits Analysis IAW DI-MISC-80711, a Oil Consumption Limits Test Plan IAW DI-NDTI-80566, and an Oil Consumption Limits Test Report IAW DI-NDTI-80809. Testing shall use the test condition of Appendix V, paragraph 4.3.4.1.1., and assume the worst case attitude condition of Appendix V, paragraph 4.5.2.2.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.7. Not Used

7.5.7.8. Not Used

7.5.7.9. Not Used

7.5.7.10. Not Used

7.5.7.11. Cooling System
The purpose of the cooling system requirement is to ensure aircraft integrated cooling and thermal management systems safely remove excess heat from the powerplant and its subsystems.

Criteria:
The cooling system, when integrated in the host aircraft, shall maintain the temperatures of powerplant components and powerplant fluids within the established limits under all environmental conditions and operating envelope of the engine.

Standard:
Engine Model Specification (EMS)
Installation Control Document (ICD)
Appendix V, paragraph 3.7.17.
Appendix V, paragraph 4.10.17.

Method of Compliance:
The requirements of Appendix V, paragraphs 3.7.17. shall be verified by analyses and tests. The airworthiness substantiation shall be IAW Appendix U, paragraph 4.10.17. and include a Cooling System Analysis IAW DI-MISC-80711, a Cooling System Test Plan IAW DI-NDTI-80566, and a Cooling System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.11.1. Coolant

The purpose of the coolant requirement is to verify that the integrated propulsion system operates to all specified performance parameters when using designated coolant.

Criteria:
The integrated propulsion system shall meet all engine performance parameters throughout its complete environmental and operating envelope for all steady-state and transient operation when using designated coolant.

Standard:
Engine Model Specification (EMS)
Appendix V, paragraph 3.7.17.1.
Appendix V, paragraph 4.10.17.1.

Method of Compliance:
The requirements of Appendix V, paragraphs 3.7.17.1. shall be verified by analyses and tests. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.10.17.1. The airworthiness substantiation shall be included in the Cooling System Analysis and Coolant System Test Report (reference Appendix V, paragraph 4.10.17.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.11.2. Cooling System Components and Features

The purpose of the cooling system components and features requirement is to ensure performance and safety of the cooling system components or systems.

Criteria:
The cooling system components and systems shall meet performance standards and ensure safe operation.

Standard:
Appendix V, paragraph 3.7.17.2.
Appendix V, paragraph 4.10.17.2.

Method of Compliance:
The requirements of Appendix V, paragraphs 3.7.17.2. shall be verified by demonstration, analysis, and test. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.10.17.2. and include a Cooling System Components and Features Analysis IAW DI-MISC-80711, a Cooling System Components and Features Test Plan IAW DI-NDTI-80566, and a Cooling System Components and Features Test Report IAW DI-NDTI-80809. Additional verification of this requirement may be presented in engine altitude tests and air vehicle performance tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.11.2.1. Coolant Tank

The purpose of the coolant tank requirement is to ensure that the coolant tank has the required capacity and can withstand pressure cycling throughout the life cycle.

Criteria:
The total enclosed capacity of the coolant tank, usable coolant volume, unusable coolant volume, and expansion space shall be IAW the EMS.

Standard:
Engine Model Specification (EMS)
Appendix E, paragraph 5.6.1.
Appendix V, paragraph 3.7.17.2.1.
Appendix V, paragraph 4.10.17.2.1.

Method of Compliance:
The requirements of Appendix V, paragraphs 3.7.17.2.1. shall be verified by analysis and test. The airworthiness substantiation shall be IAW Appendix V, paragraph 4.10.17.2.1. and include a Coolant Tank Capacity and Pressure Analysis IAW DI-MISC-80711. Additionally, the complete coolant tank assembly shall be subjected to positive and negative differential pressures IAW Appendix E, paragraph 5.6.1. Additional airworthiness substantiation shall include a Coolant System Pressure Test Plan IAW DI-NDTI-80566, and Coolant System Pressure Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.11.2.2. Heat Exchanger

The purpose of the heat exchanger requirement is to verify that the component can safely withstand all vibration, inertia, thermal and coolant pressure loads throughout the aircraft operational envelope and life cycle without rupture.

Criteria:
Each heat exchanger shall withstand all vibration, inertia, thermal, and pressure loads encountered through the entire operating envelope and life cycle without rupture.

Standard:
Appendix E, paragraph 5.1.
Appendix E, paragraph 5.6.3.
Appendix E, paragraph 5.10.
Appendix V, paragraph 3.7.17.2.2.
Appendix V, paragraph 4.10.17.2.2.
Appendix V, paragraph 4.15.

Method of Compliance:
The airworthiness substantiation (IAW Appendix E, paragraph 5.10.) shall include a Heat Exchanger Proof and Cycling Pressure Test Plan prepared IAW DI-NDTI-81895 & DI-RELI-80322, a Heat Exchanger Proof and Cycling Pressure Test Report prepared IAW DI-NDTI-81897 or a Component Similarity Argument Report prepared IAW DI-NDTI-81896. Airworthiness substantiation shall also include a Heat Exchanger Vibration Test Plan IAW DI-NDTI-80566 and a Heat Exchanger Vibration Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.12. Drive Motor System
The drive motor rotor assembly shall remain within functional dimensions during and after exposure to an overspeed malfunction.

The rotating assembly shall not exhibit imbalance or damage under overspeed malfunction conditions.

The drive motor mount shall withstand all loads encountered in the operating envelope. The Drive motor mount shall prevent the transmittal of harmful vibration to and from the drive motor.

7.5.7.12.1. Drive Motor Performance
The purpose of this requirement is to verify drive motor meets the applicable specification performance requirements under various operating conditions (i.e., sea level, altitude, power settings, etc.). This includes consideration of all installation effects imposed by the air vehicle, and all intended operational environments.

Criteria:
The drive motor shall meet its individual performance requirements in all environmental conditions throughout the flight envelope.

Standard:
Appendix V, paragraph 3.7.18.1.
Appendix V, paragraph 4.10.18.1.

Method of Compliance:
A drive motor, conforming to the same parts list and configuration as the endurance test engine, shall be subjected to altitude tests which consist of operation at several selected conditions within the engine operating envelope. The airworthiness substantiation shall include a Drive Motor Performance Analysis IAW DI-MISC-80711, a Drive Motor Performance Test Plan IAW DI-NDTI-80566, and a Drive Motor Performance Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.12.2. Drive Motor System Integrity

7.5.7.12.2.1. Drive Motor Rotor Strength (Overspeed)
The purpose of the drive motor rotor strength (overspeed) requirement is to ensure adequate margin for the most critically stressed turbocharger rotor components for the entire aircraft flight envelope.

Criteria:
Analysis and testing shall show the drive motor has adequate overspeed capability to ensure safe flight. Testing shall demonstrate parts and assemblies to be within the allowable dimensional limits with no evidence of imminent failure.

Standard:
Appendix V, paragraph 3.7.18.2.1.
Appendix V, paragraph 4.10.18.2.1.

Method of Compliance:
A drive motor overspeed test shall be completed IAW Appendix V, paragraph 4.10.18.2.1. The airworthiness substantiation shall include a Drive Motor Overspeed Analysis IAW DI-MISC-80711, a Drive Motor Overspeed Test Plan IAW DI-NDTI-80566, and a Drive Motor Overspeed Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.12.2.2. Drive Motor Low Cycle Fatigue
The purpose of the LCF test is to demonstrate that drive motor rotating parts that are subjected to mechanical and thermal stresses during powerplant operation have sufficient LCF capability. Low cycle fatigue is the damage generated in a material by cyclic load reversals, which cause repeated plastic deformation.

Criteria:
The drive motor shall not experience a low cycle fatigue failure.

Standard:
Appendix V, paragraph 3.4.1.5.1.
Appendix V, paragraph 3.7.18.2.2.
Appendix V, paragraph 4.10.18.2.2.

Method of Compliance:
Drive motor low cycle fatigue test showing compliance with Appendix V-UAV, paragraph 3.7.18.2.2. shall be conducted IAW Appendix V, paragraph 4.10.18.2.2. The airworthiness substantiation shall include a Drive Motor Low Cycle Fatigue Test Plan IAW DI-NDTI-80566, and a Drive Motor Low Cycle Fatigue Test Report IAW DI-NDTI-80809 (Reference Appendix V, paragraph 3.4.1.5.1.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.12.2.3. Drive Motor High Cycle Fatigue
The purpose of the HCF test is to demonstrate that drive motor rotor, fans and cases are free of detrimental resonance frequencies and vibration amplitudes over the drive motor operational speed range.

Criteria:
Analysis and testing shall show the maximum vibration response be no greater than 70% of the -3σ material capabilities.

Standard:
Appendix V, paragraph 3.4.1.5.2.
Appendix V, paragraph 3.7.18.2.3.
Appendix V, paragraph 4.10.18.2.3.

Method of Compliance:
A Drive Motor high cycle fatigue test showing compliance with Appendix V, paragraph 3.7.18.2.3. shall be conducted for PFR IAW Appendix V, paragraph 4.10.18.2.3. The airworthiness substantiation shall include a Drive Motor High Cycle Fatigue Analysis IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.12.2.4. Drive Motor Creep
The purpose of the drive motor creep requirement is to demonstrate that drive motor rotating components do not exhibit creep throughout the operational envelope and service life which would result in material contact or imminent failure.

Criteria:
The drive motor rotating parts shall not exhibit material creep to the extent that operation is impaired for the operating envelope and the design service life.

Standard:
Appendix V, paragraph 3.7.18.2.4.
Appendix V, paragraph 4.10.18.2.4.

Method of Compliance:
A drive motor creep analysis and test showing compliance with Appendix V, paragraph 3.7.18.2.4. shall be conducted for PFR IAW Appendix V, paragraph 4.10.18.2.4. The airworthiness substantiation shall include a Drive Motor Creep Analysis IAW DI-MISC-80711, a Drive Motor Creep Test Plan IAW DI-NDTI-80566, and a Drive Motor Creep Test Report IAW DI-NDTI-80809. (reference Appendix V, paragraph 3.4.1.5.3.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.12.2.5. Drive Motor Critical Speeds
The purpose of the drive motor critical speed requirement is to ensure that drive motor rotating components are fee of damaging resonances at all operational speeds.
Criteria:
Drive motor analysis and testing shall demonstrate that any critical speed below the maximum operating speed will be traversed without causing any detrimental effects. Any critical speed within the operation range shall not produce stresses above the endurance limit of the material.

Standard:
Appendix V, paragraph 3.7.18.2.5.
Appendix V, paragraph 4.10.18.2.5.

Method of Compliance:
A drive motor critical speed test showing compliance with Appendix U, paragraph 3.7.18.2.5. shall be conducted for PFR IAW Appendix V, paragraph 4.10.18.2.5. The airworthiness substantiation shall include a Drive Motor Critical Speed Analysis IAW DI-MISC-80711, a Drive Motor Critical Speed Test Plan IAW DI-NDTI-80566, and a Drive Motor Critical Speed Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.12.2.6. Disk Deflection
The purpose of the analysis and tests is to ensure drive motor cooling blades have adequate structural integrity to preclude contact with any static part of the drive motor during operation.

Criteria:
Cooling blades shall not contact any static part of the motor, other than seals and shrouds, during all operating conditions. Seals and clearances shall remain effective under all internal and external operational loads.

Standard:
Appendix V, paragraph 3.7.18.2.6.
Appendix V, paragraph 4.10.18.2.6.

Method of Compliance:
A drive motor blade deflection test showing compliance with Appendix V, paragraph 3.7.18.2.6. shall be conducted for PFR IAW Appendix V, paragraph 4.10.18.2.6. The airworthiness substantiation shall include a Drive Motor Blade Deflection Analysis IAW DI-MISC-80711, a Drive Motor Blade Deflection Test Plan IAW DI-NDTI-80566, and a Drive Motor Blade Deflection Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.12.2.7. Drive Motor Rotating Assembly Balance
Balance testing shall be conducted as part of the endurance tests specified in 4.11.1.1. The drive motor rotating assembly balance shall be measured before and after the 150 hour endurance test.

Criteria:
The rotating assembly shall not exhibit dynamic imbalance beyond manufacturer specifications under overspeed conditions.

Standard:
Appendix V, paragraph 3.7.18.2.7.
Appendix V, paragraph 4.10.18.2.7.
Appendix V, paragraph 4.14.1.1.1.

Method of Compliance:
The requirements of Appendix V, paragraph 3.7.18.2.7. shall be verified by tests. Balance testing shall be conducted as part of the endurance tests specified in Appendix V, paragraph 4.14.1.1.1. The rotating assembly balance shall be measured before and after the powerplant endurance test. The airworthiness substantiation shall be included in the Powerplant Test Plan IAW DI-NDTI-80566, and the Powerplant Endurance Test Report IAW DI-NDTI-80809 (reference Appendix V, paragraph 4.14.1.1.1.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.12.2.8. Drive Motor Containment
The purpose of this analysis is to determine that the turbocharger has adequate containment capability. For safety of personnel and equipment, it is imperative to contain all blade failures.

Criteria:
The drive motor housing shall completely contain all damage in case of mechanical failure when operating at the maximum transient speed.

Standard:
Appendix V, paragraph 3.7.18.2.8.
Appendix V, paragraph 4.10.18.2.8.

Method of Compliance:
A drive motor containment analysis showing compliance with Appendix V, paragraph 3.7.18.2.8. shall be conducted IAW Appendix V, paragraph 4.10.18.2.8. The airworthiness substantiation shall include a Drive Motor Containment Analysis IAW DI-MISC-80711, Drive Motor Containment Test Plan IAW DI-NDTI-80566, and a Drive Motor Containment Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.12.2.9. Rotor Burst Speed
The purpose of the drive motor rotor burst test is to demonstrate the disk burst margin to prevent the occurrence of a catastrophic failure.

Criteria:
The loaded burst speed of the complete rotor assembly shall be not less than 120 percent of the maximum allowable steady state.

Standard:
Appendix V, paragraph 3.7.18.2.9.
Appendix V, paragraph 4.10.18.2.9.

Method of Compliance:
A drive motor rotor burst speed test showing compliance with Appendix V, paragraph 3.7.18.2.9. shall be conducted IAW Appendix V, paragraph 4.10.18.2.9. The airworthiness substantiation shall include a Drive Motor Rotor Burst Speed Analysis IAW DI-MISC-80711, a Drive Motor Rotor Burst Speed Test Plan IAW DI-NDTI-80566, and a Drive Motor Rotor Burst Speed Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.7.12.3. Drive Motor System Components

7.5.7.12.3.1. Not Used

7.5.7.12.3.2. Drive Motor Control System

The purpose of the requirement is to ensure that the control system's drive motor speed control loop controls the motor speed as required and prevents overspeed conditions during operation.

Criteria:
The drive motor control system shall regulate the speed under all operating conditions.

Standard:
Appendix V, paragraph 3.7.18.3.2.
Appendix V, paragraph 4.10.18.3.2.

Method of Compliance:
The drive motor speed control requirements showing compliance with Appendix V, paragraph 3.7.18.3.2. shall be conducted IAW Appendix V, paragraph 4.10.18.3.2. The airworthiness substantiation shall include a Drive Motor Control System Analysis IAW DI-MISC-80711, a Drive Motor Control System Test Plan IAW DI-NDTI-80566, and a Drive Motor Control System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.8. Software Resources

Software resources include all software necessary to perform all computations, data processing, and interfacing functions necessary for the propulsion system to meet the performance and operability requirements.

7.5.8.1. Software Performance and Design

The purpose of the software performance and design requirement is to ensure software the documentation requirements of the system and software design flow down, are traceable, and functions as intended. Due to its increased complexity, amount of code and airworthiness implication, software verification and qualification is necessary.

Criteria:
Software shall perform all computations, data processing, and interfacing functions necessary for the engine to meet the aircraft platform performance and operability requirements.

Standard:
RTCA/DO-0178C
ARP 4671
AMACC Section 15. Software Airworthiness

AMACC Section 14. Design Assurance Level (DAL) substantiation
Appendix E, paragraph 5.8.1.
Appendix V, paragraph 3.8.1.
Appendix V, paragraph 4.11.1.

Method of Compliance:
The engine software shall be designed, developed and tested IAW RTCA/DO-178C and Appendix E, paragraph 5.8.1. for the DAL level determined by AMACC Section 14. The airworthiness substantiation shall include documentation IAW paragraph 15.0., software airworthiness.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.8.1.1. Computer Reprogramming
The purpose of the computer reprogramming requirement is to require the engine control computer design to allow for the capability to make software changes in the field. Safety design provisions shall be provided to prevent unauthorized reprogramming.

Criteria:
The engine control shall be designed to allow software changes to be made in the field without the need to remove the unit from the engine or airframe.

Safety design provisions shall be provided to prevent unauthorized reprogramming. Each software version shall be identified by a unique software version number that shall be verified during the loading process.

Notwithstanding the above requirement for re-programmability, neither the unit serial number nor the full authority digital engine control (FADEC) accumulated operating hours shall be changeable once the unit leaves the OEM facility.

Standard:
AMACC Section 15 Software Airworthiness
Appendix V, paragraph 3.7.2.1.
Appendix V, paragraph 3.8.1.1.
Appendix V, paragraph 4.11.1.1.

Method of Compliance:
The computer reprogramming capability shall be integrated into the engine software shall be designed, developed and tested IAW RTCA/DO-178C and Appendix E, paragraph 5.8.1. for the DAL level determined by AMACC Section 14. The airworthiness substantiation shall include documentation IAW paragraph 15.0., software airworthiness.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.8.2. Spare Resources

The purpose of the spare resources requirement is to ensure the powerlift control system has software growth capability.

Criteria:

The software partition, memory allocation, scheduling, tasking, interrupt, control flow, and data flow for the engine control system shall be documented in the ICD.

Standard:

Appendix V, paragraph 3.7.2.1.
Appendix V, paragraph 3.8.2.
Appendix V, paragraph 4.11.2.

Method of Compliance:

The requirements of Appendix V, paragraph 3.8.1.1. shall be verified by demonstrations and tests. The computer reprogramming capability shall be integrated into the powerplant software, which shall be designed, developed and tested IAW RTCA/DO-178C and Appendix E, paragraph 5.8.1. for the DAL level determined by AMACC Section 14. The airworthiness substantiation shall include documentation IAW paragraph 15.0., software airworthiness.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.9. Production Facilities, Capabilities, and Processes

The purpose of the production facilities, capabilities, and processes requirement is to ensure that the propulsion system is producible using the contractor’s manufacturing system.

Criteria:

The propulsion system shall be producible using the contractor’s manufacturing system. The manufacturing system shall have the facilities, capabilities, processes, and process controls to provide products of consistent quality that meet performance requirements. Production processes shall have the stability, capability, and controls to maintain product characteristics within design tolerances and to reduce the variability of key product characteristics.

Standard:

Appendix V, paragraph 3.9.
Appendix V, paragraph 4.12.

Method of Compliance:

The requirements of Appendix V, paragraph 3.9. shall be verified by inspection.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.10. Not Used

7.5.11. Propulsion System, Control System and Accessories Verification
The complete propulsion system with its controls and accessories (C&A) that require a test for verification shall utilize the test procedures IAW the following subsections.

7.5.12. Powerplant Tests

7.5.12.1. Endurance Tests

7.5.12.1.1. Powerplant Endurance
The purpose of the endurance test is to demonstrate the powerplants ability to sustain a minimum level of operability and durability within the approved powerplant ratings and operating limitations.

Criteria:
The powerplant shall be subjected to an endurance test that includes not less than 50 hours of operation to a duty cycle, operating limits and conditions IAW Appendix V, paragraph 4.11.1.1.1.

Standard:
Appendix V, paragraph 4.14.1.1.1.

Method of Compliance:
The powerplant shall be subjected to an engine endurance test IAW Appendix V, paragraph 4.14.1.1.1. The airworthiness substantiation shall include a Powerplant Endurance Test Plan IAW DI-NDTI-80566, and a Powerplant Endurance Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.12.1.2. Accelerated Mission Test (AMT)
The purpose of the test is to demonstrate the durability and reliability of the engine to establish an initial engine service life limit.

Criteria:
An engine mission cycle endurance test of duration equal to 1.5 times the initial service life of the engine.

Standard:
Appendix V, paragraph 4.14.1.1.2.

Method of Compliance:
The Accelerated Mission Test (AMT) requirements showing compliance with Appendix V, paragraph 4.14.1.1.2. shall be performed with the field representative powerplant configuration propulsion system installed. The airworthiness substantiation shall include an Accelerated Mission Test Plan IAW DI-NDTI-80566, and an Accelerated Mission Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.12.1.3. Propeller Cyclic Durability Test
The purpose of the cyclic durability test requirement is to determine if the propeller can withstand cyclic operation without the onset of part deterioration, failure, or irregularities in propeller function over the initially declared overhaul period or service life interval.

Criteria:
The propeller and engine shall be subjected to a cyclic test consisting of 50 one-hour cycles of operation.

Standard:
Appendix V, paragraph 4.14.1.1.4.

Method of Compliance:
The propeller cyclic durability test requirements showing compliance with Appendix V, paragraph 4.14.1.1.4. shall be performed with the field representative propulsion system configuration with propeller installed. The airworthiness substantiation shall include a Propeller Cyclic Durability Test Plan IAW DI-NDTI-80566, and a Propeller Cyclic Durability Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.12.1.4. Not Used

7.5.12.1.5. Altitude Tests
The purpose of the altitude test is to demonstrate the operation and air starting capability of the powerplant at altitude. Thorough testing of the powerplant around the envelope extremes in an altitude test facility has been a cost-effective method of reducing the possibility of encountering powerplant problems during initial flight testing of the weapon system.

Criteria:
The powerplant shall start and operate at altitude to ensure safe aircraft operation.

Standard:
Appendix V, paragraph 4.14.1.2.
Appendix V, paragraph 4.14.1.2.2.
Appendix V, paragraph 4.14.1.2.3.

Method of Compliance:
A powerplant, conforming to the same parts list and configuration as the endurance test powerplant, shall be subjected to altitude tests which consist of operation and air starting checks at several selected conditions within the powerplant operating envelope in accordance with Appendix V, paragraph 4.14.1.2. The airworthiness substantiation shall include an engine Altitude Analysis IAW DI-MISC-80711, an engine Altitude Test Plan IAW DI-NDTI-80566, and an Engine Altitude Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.12.1.6. Vibration Survey

The purpose of the survey is to demonstrate the propulsion system is free of damaging dynamic response. Absence of damaging vibration and dynamic response is essential to maintain the desired mechanical and structural integrity of the propulsion system prior to initial flight tests.

Criteria:
The propulsion system shall be free of damaging vibration and dynamic response.

Standard:
Appendix V, paragraph 4.14.1.3.

Method of Compliance:
The vibration survey requirement showing compliance with Appendix V, paragraph 4.14.1.3. shall be performed with the field representative propulsion system configuration with propeller installed. The airworthiness substantiation shall include a Propulsion System Vibration Test Plan IAW DI-NDTI-80566, and a Propulsion System Vibration Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.12.1.7. Acceptance Test (AT)

The purpose of the Acceptance Test (AT) requirement is to demonstrate the powerplant and propulsion system components are produced to the correct configuration and meet performance standards to the extent specified in the Engine Model Specification (EMS).

Criteria:
Acceptance Test Procedures for the powerplant and propulsion system components (including the control system) shall be prepared by the contractor and submitted to the Using Service for approval and shall be conducted on each asset submitted for delivery.

An acceptance test shall be conducted on each powerplant, control and accessory/component submitted for delivery.

Standard:
Appendix V, paragraph 3.12.5.
Appendix V, paragraph 4.14.1.4.
Appendix V, paragraph 4.14.1.4.1.

Method of Compliance:
The Acceptance Test (AT) requirement showing compliance with Appendix V, paragraph 3.12.5. and 4.14.1.4. shall substantiated by the submittal of a detailed Acceptance Test Procedure (ATP) IAW DI-NDTI-80566. With this ATP, a Acceptance Test Log Sheet shall be developed to include, at a minimum, the information and instruction cited in Appendix V, paragraph 4.14.1.4.1.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

7.5.13. Control System and Powerplant Accessory Components
Control system components, powerplant accessory components, and other functional subsystems of the powerplant, which are classified as an LRU (line replaceable unit), require qualification testing separate from the powerplant.

Criteria:
Control system and accessory components (and subsystems) shall each undergo component level bench qualification, as distinct from propulsion system level qualification.

Standard:
Appendix E, paragraph 6.4.
Appendix E, Tables II through VIII, Table XIII and Table XIV
Appendix V, paragraph 3.1.1.15.
Appendix V, paragraph 3.11.
Appendix V, paragraph 4.15.

Method of Compliance:
The requirements of Appendix V, paragraph 3.11. shall be verified by tests. The airworthiness substantiation shall be IAW and Appendix V, paragraph 4.15. The airworthiness substantiation shall include documentation IAW Appendix E, paragraph 6.4. and Tables II through VIII, Table XIII and Table XIV requirements.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8. SUBSYSTEMS

This section establishes the requirements for the design, installation, arrangement and compatibility of aircraft subsystems and components with the overall air vehicle. The requirements are those necessary to ensure that the subsystems functionality, performance and operation allows safe operation of the air vehicle.

8.1. Propulsion Subsystems

Propulsion subsystems include hydraulic and pneumatics, environmental control, fuel and starter subsystems.

8.1.1. Hydraulic and Pneumatic

This section covers the design, installation, arrangement and compatibility of the air vehicle hydraulic and pneumatic systems.

8.1.1.1. Performance

The purpose of the hydraulic and pneumatic systems is to provide essential functionality to the air vehicle

Criteria:

The hydraulic and pneumatic systems shall meet all performance requirements.

Standard:

Appendix H, paragraph 4.
Appendix F, paragraph 14.
Appendix F, paragraph 15.

Method of Compliance:

The hydraulic system shall meet the performance requirements specified in Appendix H, paragraph 4. The pneumatic system shall meet the performance requirements specified in Appendix F, paragraph 15. For each hydraulic system, the airworthiness substantiation shall include a Hydraulic System Flight Test Plan IAW DI-NDTI-80566, and Hydraulic System Flight Test Report IAW DI-NDTI-80809. For each pneumatic system, the airworthiness substantiation shall include a Pneumatic System Flight Test Plan IAW DI-NDTI-80566, and Pneumatic System Flight Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.1.2. System Design

The purpose of the hydraulic and pneumatic system designs are to define all conditions and features that must be incorporated to include redundancy, single point failures, backup system, normal/emergency operations, fluid temperature limitations, fire hazards, structural loads, pressure limitations, fluid flow effects, isolation, ground servicing, entrapped air, power pump design, valves, maintenance, and pressure indication.

Criteria:
The hydraulic and pneumatic systems shall meet all design requirements

Standard:
Appendix H, paragraph 5.1. - 5.3.
Appendix F, paragraph 15.

Method of Compliance:
The hydraulic system shall be designed such that the requirements specified in Appendix H, paragraph 5.1.-5.3. have been satisfied and shall be verified by analysis IAW Appendix H, paragraph 4.2.1. For each hydraulic system, the airworthiness substantiation shall include a Hydraulic System Design Report IAW DI-NDTI-80711, and Hydraulic System Analysis Report IAW DI-NDTI-80711. For each pneumatic system, the airworthiness substantiation shall include a Pneumatic System Design Report IAW DI-NDTI-80711, and Pneumatic System Analysis Report IAW DI-NDTI-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.1.3. Utility Hydraulic System Design
The purpose of the utility system design is to provide the necessary hydraulic power for the services that are essential for the basic aircraft mission (i.e. weapons and cargo handling, APU starting, and braking). No failure of the Utility System shall result in the loss of the aircraft or damage that would prevent safe flight and safe landing of the aircraft.

Criteria:
The Utility System shall meet all design requirements

Standard:
Appendix H, paragraph 5.4.
Appendix F, paragraph 14.

Method of Compliance: :
The hydraulic system shall demonstrate that the utility system design requirements specified in Appendix H, paragraph 5.4. have been satisfied and shall be verified by test IAW Appendix H, paragraph 6. The airworthiness substantiation shall include a Utility Hydraulic System Design Report prepared IAW DI-MISC-80711, a Utility Hydraulic System Design Test Plan IAW DI-NDTI-80566, and Utility Hydraulic System Design Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.1.4. Flight Control Hydraulic System Design

The purpose of the flight control system (or primary system) design is to ensure that when hydraulic power is required for primary flight controls, a completely separate, integral, and adequate hydraulic system should be provided to supply only the primary flight controls. This hydraulic system should not be used to supply any other system or component in the aircraft.

Criteria:
The flight control hydraulic system design shall meet all performance requirements

Standard:
Appendix H, paragraph 5.5.
Appendix F, paragraph 14.

Method of Compliance:
The hydraulic system shall demonstrate that the flight control system design requirements specified in Appendix H, paragraph 5.5. have been satisfied and shall be verified by test IAW Appendix H, paragraph 6. The airworthiness substantiation shall include a Flight Control System Design Report prepared IAW DI-MISC-80711, a Flight Control System Flight Test Plan IAW DI-NDTI-80566, and Flight Control System Flight Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.1.5. Emergency System Design for Utility Hydraulic System

The purpose of the emergency system design for utility system is to ensure where emergency devices are required in hydraulic systems, the emergency systems should be completely independent of the main system. The system should be so designed that failure of an actuator in one subsystem should not prevent the operation of or cause the failure of both normal and emergency actuation of another subsystem. These emergency systems should utilize hydraulic fluid, compressed gas, gas-generating devices, direct mechanical connection, or gravity. Mechanical connections may include electromechanical units.

Criteria:
The Emergency System shall meet all design requirements and shall not degrade the operation of the aircraft when a failure occurs.

Standard:
Appendix H, paragraph 5.6.
Appendix F, paragraph 14.

Method of Compliance:
The hydraulic system shall demonstrate that the emergency system design requirements specified in Appendix H, paragraph 5.6. have been satisfied and shall be verified by test

IAW Appendix H, paragraph 6. The airworthiness substantiation shall include an Emergency Hydraulic System Design Report prepared IAW DI-MISC-80711, an Emergency Hydraulic System Flight Test Plan IAW DI-NDTI-80566, and Emergency Hydraulic System Flight Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.1.6. Component Design

The purpose of the component design is to ensure the hydraulic systems and components are designed to operate satisfactorily under all conditions that the aircraft may encounter within the structural limitations of the aircraft, including forces or conditions caused by acceleration, deceleration, zero gravity, negative g, or any flight attitudes obtainable with the aircraft, structural deflection, vibration, or other environmental conditions.

Criteria:
All hydraulic and pneumatic components shall meet all design requirements

Standard:
Appendix H, paragraph 5.1. through 5.3.
Appendix H, paragraph 5.7.
Appendix H, paragraph 5.8.

Method of Compliance:
The hydraulic system components shall meet the design requirements specified in Appendix H, paragraph 5.1. through 5.3. as well as Appendix H, paragraph 5.7. and 5.8. The airworthiness substantiation shall include Hydraulic System Component Design Reports prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.1.7. System Installation

The purpose of the hydraulic and pneumatic system installations is to ensure that consideration for improper connections, drains and vents, mounting, bonding vibration, clearances, and corrosion protection are addressed in the design.

Criteria:
The hydraulic and pneumatic systems shall have capabilities for safe operations during all conditions and environments

Standard:
Appendix H, paragraph 5.8.27.
Appendix F, paragraph 14.

Appendix F, paragraph 15.

Method of Compliance:
The hydraulic system shall demonstrate that the installation requirements specified in Appendix H, paragraph 5.8.27. have been satisfied and shall be verified by test IAW Appendix H, paragraph 6. The airworthiness substantiation shall include a Hydraulic System Installation Design Report prepared IAW DI-MISC-80711, a Hydraulic System Installation Flight Test Plan IAW DI-NDTI-80566, and Hydraulic System Installation Flight Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.1.8. Qualification

The purpose of the hydraulic component testing is to ensure it meets the airworthiness standards for proof, burst, impulse, endurance, EMI, vibration, containment, over-speed, acceleration, explosive atmosphere, pressure cycling, temperature cycling and fluid compatibility

Criteria:
All hydraulic and pneumatic components shall meet all environmental testing requirements.

Standard:
Appendix H, paragraph 6.1. - 6.6.
Appendix H, paragraph 6.8.

Method of Compliance:
The hydraulic components shall complete qualification testing IAW Appendix H, paragraph 6.1. through 6.6., and 6.8. The airworthiness substantiation shall include a Hydraulic System Qualification Test Plan IAW DI-NDTI-80566, and Hydraulic System Qualification Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.1.9. Flight Test

The purpose of the hydraulic component testing is to ensure they are demonstrated to be safe prior to first flight.

Criteria:
All hydraulic and pneumatic components those tests deemed necessary for flight shall meet all testing requirements prior to flight testing.

Standard:
Appendix H, paragraph 4.2. 2.
Appendix H, paragraph 6.1. - 6.8.

Method of Compliance:
The hydraulic components shall complete qualification testing IAW Appendix H, paragraph 6.1. through 6.8. prior to first flight. The airworthiness substantiation shall include qualification testing IAW Appendix H, paragraph 6.1. through 6.8. and test reports prepared IAW DI-NDTI-80809. The airworthiness substantiation shall include a Hydraulic Component Qualification Test Plan IAW DI-NDTI-80566, and Hydraulic Component Qualification Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.2. Environmental Control System

This section covers the design, installation, arrangement, compatibility and use of Environmental Control Systems (ECS) on the Air Vehicle which may include the following subsystems:

a. Transparent Surface Defrost, Defog, and Rain Removal

b. Bleed Air

c. Pneumatic System

d. Air Conditioning, Heating, Humidity Control

e. Ventilation

f. Pressurization

g. Nuclear/Biological/Chemical Protection

8.1.2.1. Design

The purpose of the ECS design is to ensure the system meets its performance requirements (i.e. maintainability, reliability, weight, reparability, etc.) for the design life of the aircraft (in its expected mission environment). This process ensures that the ECS components and the system have been optimally designed for reliability, weight, and performance.

Criteria:
The environmental control system shall meet performance requirements and not present a safety risk to crew members during operation.

Standard:
Appendix I, paragraph 4-1.0. through 4-4.2., and 4-4.6.

Appendix I, paragraph 4-5.0 .through 4-5.2., and 4-5.6.
Appendix F, paragraph 16.

Method of Compliance:
The environmental control system design shall meet the requirements of Appendix I, paragraph 4-1.0. through 4-4.2., and 4-4.6., analysis completed IAW Appendix I, paragraph 4-5.0. through 4-5.2., and 4-5.6., and flight testing IAW Appendix F, paragraph 16. The airworthiness substantiation shall include an Environmental Control System Performance Analysis Report prepared IAW DI-MISC-80711, an Environmental Control System Design Report prepared IAW DI-MISC-80711, an Environmental Control System Flight Test Plan IAW DI-NDTI-80566, and Environmental Control System Flight Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.2.2. Bleed Air

The purpose of the bleed air system is to provide high pressure, high temperature air to the ECS. The bleed air will be cooled and/or conditioned to an extent that it can be used to heat, cool, and pressurize the cockpit and avionics as required, and to provide a source of pneumatic pressure for other aircraft functions.

Criteria:
The bleed air system shall meet performance requirements and not present a safety risk to crew members during operation.

Standard:
Appendix I, paragraph 4-4.3.
Appendix I, paragraph 4-5.3.
Appendix F, paragraph 15.

Method of Compliance:
The bleed air system design shall meet the requirements of Appendix I, paragraph 4.4.3., analysis completed IAW Appendix I, paragraph 4-5.3. and flight testing IAW Appendix F, paragraph 15. The airworthiness substantiation shall include a Bleed Air System Performance Analysis Report prepared IAW DI-MISC-80711, a Bleed Air System Design Report prepared IAW DI-MISC-80711, a Bleed Air System Test Plan IAW DI-NDTI-80566, and Bleed Air System Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.2.3. Pressurization

The purpose of the pressurization system is to provide an acceptable and safe pressure environment for crew operation and equipment.

Criteria:
The pressurization system shall meet performance requirements and not present a safety risk to crew members during operation.

Standard:
Appendix I, paragraph 4-4.4.
Appendix I, paragraph 4-5.4.
Appendix F, paragraph 16.

Method of Compliance:
The environmental control system's pressurization design shall meet the requirements of Appendix I, paragraph 4-4.4., analysis completed IAW Appendix I, paragraph 4-5.4. and flight testing IAW Appendix F, paragraph 16. The airworthiness substantiation shall include an Environmental System Design Report prepared IAW DI-MISC-80711, an Environmental System Flight Test Plan IAW DI-NDTI-80566, and Environmental System Flight Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.2.4. Refrigeration Package

The purpose of the Refrigeration Package subsystem is to ensure adequate controls and displays for the environmental control system are provided for the crew to allow the ECS to be controlled as intended and all warnings, cautions, and advisories are displayed.

Criteria:
The Refrigeration Package subsystem shall meet performance requirements and not present a safety risk to crew members during operation.

Standard:
Appendix I, paragraph 4-4.5.
Appendix I, paragraph 4-5.5.
Appendix F, paragraph 16.

Method of Compliance:
The refrigeration package subsystem design shall meet the requirements of Appendix I, paragraph 4-4.5., analysis completed IAW Appendix I, paragraph 4-5.5. and flight testing IAW Appendix F, paragraph 16. The airworthiness substantiation shall include an Environmental Control System Performance Analysis Report prepared IAW DI-MISC-80711, an Environmental Control System Design Report prepared IAW DI-MISC-80711, an Environmental Control System Flight Test Plan IAW DI-NDTI-80566, and Environmental Control System Flight Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.3. Fuel Systems

This section covers the design, installation, arrangement and compatibility of the complete air vehicle fuel system and subsystem components including fuel tanks, fuel lines, valves, and pumps.

8.1.3.1. Performance

The purpose of the fuel system is to ensure it meets its allocated performance and function in such a manner that the aircraft shall be able to be operated safely throughout the operating envelope and meet the performance requirements as defined in the applicable contractual specification.

Criteria:

The fuel system shall meet its performance requirements.

Standard:

Appendix J, paragraph 4.1.
Appendix J, paragraph 5.1.

Method of Compliance:

The fuel system shall demonstrate design performance via system level tests, component tests, demonstration, analysis and/or inspection IAW Appendix J, paragraph 4.1. and 5.1. For bench testing, the airworthiness substantiation shall include a Fuel System Analysis Report prepared IAW DI-MISC-80711, a Fuel System Bench Test Plan IAW DI-NDTI-80566, and Fuel System Bench Test Report IAW DI-NDTI-80809. For flight testing, the airworthiness substantiation shall include a Fuel System Flight Test Plan IAW DI-NDTI-80566, and Fuel System Flight Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.3.2. Engine Feed and Transfer Subsystem

The purpose of the engine feed and transfer subsystem is to ensure fuel is provided to the engine and considers flow performance, suction feed, priming, pressure, surge pressure, contamination, redundancy, cross feed capability, transfer management, CG, cockpit warnings (CG, level, pressure), transfer rate, and fire shutoff capability of each engine feed system.

Criteria:

The engine fuel feed and fuel transfer subsystems shall provide fuel continuously and safely to the engine.

Standard:

Appendix J, paragraph 4.2.1.
Appendix J, paragraph 5.2.1.

Method of Compliance:
The engine fuel feed and fuel transfer subsystem shall meet the engine feed and transfer requirements of Appendix J, paragraph 4.2.1. and demonstrate design performance via component inspections/tests, simulated tests, ground and/or flight tests IAW Appendix J, paragraph 5.2.1. For bench testing, the airworthiness substantiation shall include a Fuel Feed and Transfer Subsystem Design Report prepared IAW DI-MISC-80711, a Fuel Feed and Transfer Subsystem Bench Test Plan IAW DI-NDTI-80566, and Fuel Feed and Transfer Subsystem Bench Test Report IAW DI-NDTI-80809. For flight testing, the airworthiness substantiation shall include a Fuel Feed and Transfer Subsystem Test Plan IAW DI-NDTI-80566, and Fuel Feed and Transfer Subsystem Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.3.3. Fuel Tank Subsystem

The purpose of the fuel tank subsystem is to ensure the fuel system is designed for crashworthiness and ballistic tolerance, protection of critical aircraft compartments, (surface) fuel resistance, capacity, (fuel) thermal expansion, water and sediment collection, leak protection/resistance, auxiliary fuel storage (loading, jettison, supply lines, attachment, gauging, ground clearance), and markings.

Criteria:
The fuel tank subsystem shall not present a safety risk to the crew members in the event of a crash or ballistic event.

Standard:
Appendix J, paragraph 4.3.
Appendix J, paragraph 5.3.
MIL-DTL-27422

Method of Compliance:
The fuel tank subsystem shall meet the requirements of MIL-DTL-27422 and Appendix J, paragraph 4.3. and verified by component inspection/tests, analysis, ground and/or flight tests IAW Appendix J, paragraph 5.3. The airworthiness substantiation shall include a Fuel Tank Subsystem Analysis Report prepared IAW DI-MISC-80711. For bench testing, the airworthiness substantiation shall include a Fuel Tank Subsystem Bench Test Plan IAW DI-NDTI-80566, and Fuel Tank Subsystem Bench Test Report IAW DI-NDTI-80809. For ground testing, the airworthiness substantiation shall include a Fuel Tank Subsystem Ground Test Plan IAW DI-NDTI-80566, and Fuel Tank Subsystem Ground Test Report IAW DI-NDTI-80809. For flight testing, the airworthiness substantiation shall include a Fuel Tank Subsystem Flight Test Plan IAW DI-NDTI-80566, and Fuel Tank Flight Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.3.4. Pressurization and Explosion Suppression Subsystem

The purpose of fuel tank pressurization and explosion suppression is to ensure that all tanks, vent systems and dry bay areas in proximity to fuel lines and tanks on the aircraft in which air-fuel vapors may be exposed to ignition sources are equipped with explosion suppression subsystems.

Criteria:

The fuel tank pressurization and explosion suppression subsystems shall be capable of providing fire and explosion prevention and suppression.

Standard:

Appendix J, paragraph 4.4.
Appendix J, paragraph 5.4.

Method of Compliance:

The fuel tank pressurization and explosion suppression subsystems shall meet the fuel system requirements of Appendix J, paragraph 4.4. and verified by component inspection/tests, analysis, ground and/or flight tests IAW Appendix J, paragraph 5.4. The airworthiness substantiation shall include a Pressurization and Explosion Suppression Subsystem Analysis Report IAW DI-MISC-80711. For bench testing, the airworthiness substantiation shall include a Pressurization and Explosion Suppression Subsystem Bench Test Plan IAW DI-NDTI-80566, and Pressurization and Explosion Suppression Subsystem Bench Test Report IAW DI-NDTI-80809. For ground testing, the airworthiness substantiation shall include a Pressurization and Explosion Subsystem Ground Test Plan IAW DI-NDTI-80566, and Pressurization and Explosion Subsystem Ground Test Report IAW DI-NDTI-80809. For flight testing, the airworthiness substantiation shall include a Pressurization and Explosion Suppression Subsystem Test Plan IAW DI-NDTI-80566, and Pressurization and Explosion Suppression Subsystem Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.3.5. Ground Refueling and Defueling Subsystem

The purpose of the fuel system ground refueling and defueling subsystem is to ensure the fuel system is capable of ground refueling and defueling within specified refueling time, with gravity refueling capability, and accounting for design pressure capability, surge pressure, attitude, single point refueling, hot refueling, filler cap/cover access, power, control location, personnel, tank selection, pre-check, defueling (with/without failures), defueling crashed aircraft, static discharge, grounding, adaptor isolation, and fuel isolation requirements.

Criteria:
The fuel system ground and defueling subsystem shall not present a safety risk to the crew members and shall be capable of operating safely.

Standard:
Appendix J, paragraph 4.5.
Appendix J, paragraph 5.5.

Method of Compliance:
The fuel system ground refueling, and defueling subsystem shall meet the fuel system requirements specified in Appendix J, paragraph 4.5. and verified by component inspections/tests, simulated tests, ground and/or flight tests IAW Appendix J, paragraph 5.5. The airworthiness substantiation shall include a Pressurization and Explosion Suppression Subsystem Analysis Report. For bench testing, the airworthiness substantiation shall include a Pressurization and Explosion Suppression Subsystem Bench Test Plan IAW DI-NDTI-80566, and Pressurization and Explosion Suppression Subsystem Bench Test Report IAW DI-NDTI-80809. For ground testing, the airworthiness substantiation shall include a Pressurization and Explosion Subsystem Ground Test Plan IAW DI-NDTI-80566, and Pressurization and Explosion Subsystem Ground Test Report IAW DI-NDTI-80809. For flight testing, the airworthiness substantiation shall include a Pressurization and Explosion Suppression Subsystem Test Plan IAW DI-NDTI-80566, and Pressurization and Explosion Suppression Subsystem Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.3.6. Aerial Refueling Subsystem
The purpose of the fuel system aerial refueling subsystem is to ensure the fuel system has provisions and capability for aerial refueling.

Criteria:
The fuel system aerial refueling subsystem provisions shall not degrade performance of the aircraft to ensure safe flight.

Standard:
Appendix J, paragraph 4.6.
Appendix J, paragraph 5.6.
MIL-F-17874

Method of Compliance:
The fuel system aerial refueling subsystem shall meet the fuel system requirements specified in Appendix J, paragraph 4.6. and be verified by component inspections/tests, simulated tests, ground and/or flight tests IAW Appendix J, paragraph 5.6. and MIL-F-17874. The airworthiness substantiation shall include a Pressurization and Explosion Suppression Subsystem Analysis Report. The airworthiness substantiation

shall include an Aerial Refueling Subsystem Analysis Report prepared IAW DI-MISC-80711. For bench testing, the airworthiness substantiation shall include an Aerial Refueling Subsystem Bench Test Plan IAW DI-NDTI-80566, and Aerial Refueling Subsystem Bench Test Report IAW DI-NDTI-80809. For ground testing, the airworthiness substantiation shall include a Pressurization and Explosion Subsystem Ground Test Plan IAW DI-NDTI-80566, and Pressurization and Explosion Subsystem Ground Test Report IAW DI-NDTI-80809, an Aerial Refueling Subsystem Ground Test Plan IAW DI-NDTI-80566, and Aerial Refueling Subsystem Ground Test Report IAW DI-NDTI-80809.For flight testing, the airworthiness substantiation shall include an Aerial Refueling Subsystem Flight Test Plan IAW DI-NDTI-80566, and Aerial Refueling Subsystem Flight Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.3.7. Fuel Vent Subsystem

The purpose of the fuel vent subsystem is to ensure it is capable of preventing fuel tank pressure from exceeding the proof pressure of the tank during ground and flight conditions, preventing siphoning and spillage of fuel beyond allowable limits, preventing liquid and vapor blow back (into critical areas), and preventing fuel transfer through interconnected vents.

Criteria:

The fuel system vent subsystems shall prevent over pressurization and improper fuel flow.

Standard:

Appendix J, paragraph 4.7.
Appendix J, paragraph 5.7.

Method of Compliance:

The fuel system fuel vent subsystem shall meet the fuel system requirements specified in Appendix J, paragraph 4.7. and verified by analysis, inspections/tests, simulator tests, ground and/or flight tests IAW Appendix J, paragraph 5.7. The airworthiness substantiation shall include a Pressurization and Explosion Suppression Subsystem Analysis Report. For bench testing, the airworthiness substantiation shall include a Pressurization and Explosion Suppression Subsystem Bench Test Plan IAW DI-NDTI-80566, and Pressurization and Explosion Suppression Subsystem Bench Test Report IAW DI-NDTI-80809. For ground testing, the airworthiness substantiation shall include a Pressurization and Explosion Subsystem Ground Test Plan IAW DI-NDT-80566, and Pressurization and Explosion Subsystem Ground Test Report IAW DI-NDTI-80809. For flight testing, the airworthiness substantiation shall include a Pressurization and Explosion Suppression Subsystem Test Plan IAW DI-NDTI-80566, and Pressurization and Explosion Suppression Subsystem Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR Amdt 23-63: 23.975 Amdt 23-64: 23.2430 (ASTM F3264-17) 14 CFR 25.975 14 CFR 27.975 14 CFR 29.975		

8.1.3.8. Fuel Dump Subsystem

The purpose of the fuel system dump subsystem is to specify the volume, rate, and time duration of the fuel dump and to provide the safety requirements for fuel dump operations.

Criteria:

The fuel system fuel dump subsystems shall be capable of dumping fuel safely.

Standard:

Appendix J, paragraph 4.8.
Appendix J, paragraph 5.8.

Method of Compliance:

The fuel system fuel dump subsystem shall meet the fuel system requirements specified in Appendix J, paragraph 4.8. and verified by fuel jettison tests IAW Appendix J, paragraph 5.8. The airworthiness substantiation shall include a Pressurization and Explosion Suppression Subsystem Analysis Report. For bench testing, the airworthiness substantiation shall include a Pressurization and Explosion Suppression Subsystem Bench Test Plan IAW DI-NDTI-80566, and Pressurization and Explosion Suppression Subsystem Bench Test Report IAW DI-NDTI-80809. For ground testing, the airworthiness substantiation shall include a Pressurization and Explosion Subsystem Ground Test Plan IAW DI-NDTI-80566, and Pressurization and Explosion Subsystem Ground Test Report IAW DI-NDTI-80809. For flight testing, the airworthiness substantiation shall include a Pressurization and Explosion Suppression Subsystem Test Plan IAW DI-NDTI-80566, and Pressurization and Explosion Suppression Subsystem Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.3.9. General Criteria

The purpose of the fuel system general requirements is to ensure all safety considerations are included in the fuel system design including approval of materials suitable for use with approved/standard fuels without external leakage during normal operating condition, taking into account the use of dissimilar metal, icing resistance, hose

and tubing (clearance, flexibility, self-sealability), drainage, static discharge, electrical wiring, and thermal expansion.

Criteria:
The fuel system shall not leak and present a safety risk to crew members.

Standard:
Appendix J, paragraph 4.9.
Appendix J, paragraph 5.9.
FUELS [MIL-T-5624, MIL-T-83133, AFLP-3747, ASTM-D-1655, MIL-G-5572, ASTM-D-910, VV-F-800 (DF-A, DF-1 and DF-2)]
ELECTRICAL BONDING (MIL-STD-464)

Method of Compliance:
The fuel system shall meet the general fuel usage, compatibility and electrical bonding requirements specified in Appendix J, paragraph 4.9. and shall be verified by drawing review, analysis, inspections/tests, ground and/or flight tests IAW Appendix J, paragraph 5.9. For bench testing, the airworthiness substantiation shall include a Pressurization and Explosion Suppression Subsystem Bench Test Plan IAW DI-NDTI-80566, and Pressurization and Explosion Suppression Subsystem Bench Test Report IAW DI-NDTI-80809. For ground testing, the airworthiness substantiation shall include a Pressurization and Explosion Subsystem Ground Test Plan IAW DI-NDTI-80566, and Pressurization and Explosion Subsystem Ground Test Report IAW DI-NDTI-80809. For flight testing, the airworthiness substantiation shall include a Pressurization and Explosion Suppression Subsystem Test Plan IAW DI-NDTI-80566, and Pressurization and Explosion Suppression Subsystem Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.3.10. Components

The purpose of the fuel system components requirements is to ensure that the fuel system is constructed using components that incorporate the specific features and restrictions. This includes restrictions on the use of threaded components. Components will also be designed with restrictions for electrical fault/explosive atmosphere capability/resistance, electrical equipment isolation, electromagnetic interference, electrical insulation, operation with contaminated fuel, fuel level control, boost and transfer pumping, and shut-off valve/fuel flow control.

Criteria:
The fuel system components shall not degrade the performance of the aircraft to ensure safe flight.

Standard:
Appendix J, paragraph 4.10.
Appendix J, paragraph 5.10.

MIL-STD-810
SAE ARP8615

Method of Compliance:
The fuel system components shall meet the general requirements specified in Appendix J, 4.10. and shall be verified by drawing review, analysis, inspections, and/or component level tests IAW Appendix J, paragraph 5.10. For bench testing, the airworthiness substantiation shall include a Pressurization and Explosion Suppression Subsystem Bench Test Plan IAW DI-NDTI-80566, and Pressurization and Explosion Suppression Subsystem Bench Test Report IAW DI-NDTI-80809. For ground testing, the airworthiness substantiation shall include a Pressurization and Explosion Subsystem Ground Test Plan IAW DI-NDTI-80566, and Pressurization and Explosion Subsystem Ground Test Report IAW DI-NDTI-80809. For flight testing, the airworthiness substantiation shall include a Pressurization and Explosion Suppression Subsystem Test Plan IAW DI-NDTI-80566, and Pressurization and Explosion Suppression Subsystem Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160G				

8.1.3.11. Environmental
The purpose of the fuel system operation is to define the environmental conditions the fuel system must safely operate within including temperatures, acceleration, shock, humidity, rain, sand and dust, fungus, salt fog, vibration, temperature extremes, explosive atmosphere, and altitude.

Criteria:
The fuel system shall not be functionally degraded throughout the full range of environments as determined by its Life Cycle Profile to ensure safe flight.

Standard:
Appendix J, paragraph 4.11.
Appendix J, paragraph 5.11.
MIL-STD-810, Method No. 500.6.
MIL-STD-810, Method No. 501.7.
MIL-STD-810, Method No. 506.6.
MIL-STD-810, Method No. 507.6.
MIL-STD-810, Method No. 508.8.
MIL-STD-810, Method No. 509.7.
MIL-STD-810, Method No. 510.7.
MIL-STD-810, Method No. 513.8.
MIL-STD-810, Method No. 514.8.
MIL-STD-810, Method No. 516.8.

Method of Compliance:
The fuel system shall operate safely within the environmental conditions specified in Appendix J, 4.11. and shall be verified by analysis, component and/or system level tests IAW Appendix J, paragraph 5.11. The airworthiness substantiation shall include Fuel System Component Analysis Reports prepared IAW DI-MISC-80711. For bench testing, the airworthiness substantiation shall include Fuel System Component Environmental Bench Test Plans IAW DI-NDTI-80566, and Fuel System Component Environmental Bench Test Reports IAW DI-NDTI-80809. For ground testing, the airworthiness substantiation shall include a Fuel System Environmental Ground Test Plan IAW DI-NDTI-80566, and Fuel System Environmental Ground Test Report IAW DI-NDTI-80809. For flight testing, the airworthiness substantiation shall include a Fuel System Environmental Flight Test Plan IAW DI-NDTI-80566, and Fuel System Environmental Flight Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160G				

8.1.3.12. Interface
The purpose of the fuel system interfaces is to define the aircraft electrical, hydraulic, and/or pneumatic power requirements with which the fuel system components must operate.

Criteria:
The fuel system shall operate safely with all aircraft electrical, hydraulic and pneumatic interfaces.

Standard:
Appendix J, paragraph 4.12.
Appendix J, paragraph 5.12.

Method of Compliance:
The fuel system interfaces shall meet the interface requirements specified in Appendix J, 4.12. and shall be verified by aircraft inspection, component test, and/or ground tests IAW Appendix J, paragraph 5.12. The airworthiness substantiation shall include a Fuel System Analysis Report prepared IAW DI-MISC-80711, Fuel System Interface Bench Test Plans IAW DI-NDTI-80566, and Fuel System Interface Bench Test Reports IAW DI-NDTI-80809. For ground testing, the airworthiness substantiation shall include a Fuel System Interface Ground Test Plan IAW DI-NDTI-80566, and Fuel System Interface Ground Test Report IAW DI-NDTI-80809. For flight testing, the airworthiness substantiation shall include a Fuel System Interface Flight Test Plan IAW DI-NDTI-80566, and Fuel System Interface Flight Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.3.13. Hazards and Failure Concept

The purpose of the fuel system analysis is to identify all fuel system hazards and failure concepts and identify all critical failure modes and hazards, taking into account single failures and multiple failures in critical flight modes and emergency conditions, fire hazards, lightning hazards, and fuel tank internal temperature limits.

Criteria:
The fuel system shall not experience a catastrophic failure to ensure safe flight.

Standard:
Appendix J, paragraph 4.13.
Appendix J, paragraph 5.13.
MIL-STD-882

Method of Compliance:
The fuel system shall meet the hazard and failure concept specified in Appendix J, paragraph 4.13. and shall be verified by analysis, inspection, and/or component tests IAW Appendix J, paragraph 5.13. The airworthiness substantiation shall include (at a minimum) a Functional Hazard Analysis Report prepared IAW DI-MISC-80711, a Fuel Hazard Report prepared IAW DI-MISC-80711, a Fuel Hazard Test Plan IAW DI-NDTI-80566, and Fuel Hazard Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.3.14. Reliability

The purpose of the fuel system reliability analysis is to ensure the fuel system is considered and included in the overall aircraft reliability program.

Criteria:
The fuel system and components shall be part of the aircraft reliability program.

Standard:
Appendix J, paragraph 4.14.
Appendix J, paragraph 5.14.
SAE ARP 5580
MIL-HDBK-338

Method of Compliance:
The fuel system shall meet the reliability requirements specified in Appendix J, paragraph 4.14. and shall be verified by analysis IAW Appendix J, paragraph 5.14. The airworthiness substantiation shall include a Failure Modes and Effects Analysis (FMEA) IAW SAE-ARP-5580, Criticality and Fault Tree Analysis per MIL-HDBK-338, and aircraft Safety Assessment Report (SAR) IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.3.15. Maintainability

The purpose of the fuel system maintainability program is to ensure the fuel system, fuel subsystems and components are integrated in the process and takes into account the system/component accessibility, replaceability, serviceability, and (Murphy proof) interchangeability.

Criteria:

The fuel system and components shall be part of the aircraft maintainability program.

Standard:

Appendix J, paragraph 4.15.
Appendix J, paragraph 5.15.

Method of Compliance:

The fuel system maintainability program shall meet the fuel system requirements specified in Appendix J, paragraph 5.15. and shall be verified by aircraft inspection, demonstration, component and/or flight test IAW Appendix J, paragraph 5.15. The airworthiness substantiation shall include a Fuel System Analysis Report prepared IAW DI-MISC80711. For bench testing, the airworthiness substantiation shall include a Fuel System Analysis Report prepared IAW DI-MISC-80711, a Fuel System Bench Test Plan IAW DI-NDTI-80566, and Fuel System Bench Test Report IAW DI-NDTI-80809. For ground testing, the airworthiness substantiation shall include a Fuel System Ground Test Plan IAW DI-NDTI-80566, and Fuel System Ground Test Report IAW DI-NDTI-80809.For flight testing, the airworthiness substantiation shall include a Fuel System Flight Test Plan IAW DI-NDTI-80566, and Fuel System Flight Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.3.16. International Standards.

The purpose of the use of international standards in the fuel system design is to provide interoperability with NATO partners.

Criteria:

The fuel system shall be compatible with NATO standards for interoperability.

Standard:

Appendix J, paragraph 4.16.
Appendix J, paragraph 5.16.
STANAG-3294
STANAG-3212

STANAG-3105
STANAG-3632

Method of Compliance:
The use of international standards identified in Appendix J, paragraph 4.16. shall be incorporated into the design approach and included in the fuel system design report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.3.17. First Flight Qualification Requirements

The purpose of the first flight qualification data review is to ensure that all fuel systems component and aircraft ground testing has been accomplished prior to first flight.

Criteria:
The fuel system shall be demonstrated safe for first flight.

Standard:
Appendix J, paragraph 4.17.
Appendix J, paragraph 5.17.

Method of Compliance:
Prior to first flight of any new system, all component level testing and aircraft ground testing shall be accomplished IAW Appendix J, paragraph 5.17. The airworthiness substantiation shall include review of all fuel system design reports, inspection reports, analysis, and/or test reports prepared IAW DI-MISC-80711 and DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.4. Fire Protection

This section covers the design, installation, arrangement and compatibility of the air vehicle fire protection systems which includes fire containment, detection and extinguishing.

8.1.4.1. Fire Containment

The purpose of the aircraft fire containment system is to ensure all compartments of the air vehicle are properly zoned according to the fire and explosion hazards and that protection is provided to counter the hazards such that no fire or explosion hazards exist under normal operating conditions.

Criteria:
The fire containment system shall meet performance requirements and not present a safety risk to crew members during operation.

Standard:
Appendix I, paragraph 3-3.1.
Appendix I, paragraph 3-4.1.

Method of Compliance:
The air vehicle system design shall meet the fire containment requirements of Appendix I, paragraph 3-3.1. and components within a fire zone shall meet the fire testing requirements of Appendix I, paragraph 3-4.1. The airworthiness substantiation shall include a Fire Containment Analysis Report prepared IAW DI-MISC-80711, a Fire Containment Test Plan IAW DI-NDTI-80566, and Fire Containment Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.4.2. Fire Detection
The purpose of the aircraft fire detection system is to ensure all air vehicle potential fire zones (e.g., engine, auxiliary power unit and other compartments, such as engine-driven airframe accessory area) are designated as such and that suitable fire detection and warnings provided.

Criteria:
The fire detection system shall meet performance requirements and not present a safety risk to crew members during operation.

Standard:
Appendix F, paragraph 11
Appendix I, paragraph 3.3.2
Appendix I, paragraph 3.4.2.1
Appendix I, paragraph 3.4.2.2
Appendix I, paragraph 3.4.2.3
Appendix I, paragraph 3.4.2.4
Appendix I, paragraph 3.4.2.5
Appendix I, paragraph 3.4.2.6
Appendix I, paragraph 3.4.2.7
Appendix I, paragraph 3.4.2.8
Appendix I, paragraph 3.4.2.9

Method of Compliance:
The air vehicle system design shall meet the fire detection requirements of Appendix I, paragraph 3.3.2, paragraph 3.4.2.1 thru 3.4.2.9 and Appendix F, paragraph 11. The airworthiness substantiation shall include a Fire Detection Analysis Report prepared IAW DI-MISC-80711, a Fire Detection Test Plan IAW DI-NDTI-80566, and Fire Detection Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.4.3. Fire Extinguishing

The purpose of the aircraft fire extinguishing system is to fill all the atmosphere within and entering a compartment with sufficient inert agent that it will not support combustion and continue the process for a duration sufficient that existing flame is extinguished and either the vapors are dissipated or ignition sources eliminated.

Criteria:
The fire extinguishing system shall meet performance requirements and not present a safety risk to crew members during operation.

Standard:
Appendix I, paragraph 3-3.3.
Appendix I, paragraph 3-4.3.
Appendix F, paragraph 11.

Method of Compliance:
The air vehicle system design shall meet the fire extinguishing requirements of Appendix I, graph 3-3.3. and testing completed IAW Appendix I, paragraph 3-4.3. and Appendix F, paragraph 11. The airworthiness substantiation shall include a Fire Extinguishing Analysis Report prepared IAW DI-MISC-80711, a Fire Extinguishing Test Plan IAW DI-NDTI-80566, and Fire Extinguishing Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.5. Starters

8.1.5.1. Output Torque

The purpose of the engine starter output torque is to ensure the starter provides sufficient torque to start the engine throughout the ambient operating temperature range.

Criteria:
The engine starter shall provide sufficient torque to start the engine and not present a safety risk to crew members.

Standard:
Appendix I, paragraph 2-3.0.
Appendix F, paragraph 3.5.

Method of Compliance:
The engine starter shall provide sufficient starter output torque and shall meet design duty cycle requirements IAW applicable paragraphs of Appendix I, paragraph 2-3.0. and Appendix F, paragraph 3.5. The airworthiness substantiation shall include an engine

Starter Designs Report prepared IAW DI-MISC-80711, an engine Starter Test Plan IAW DI-NDTI-80566, and an Engine Starter Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.5.2. Components

The purpose of the engine starter and its components is to ensure either individually or as part of a subsystem, have passed all safety-related qualification tests as required for airworthy performance.

Criteria:

The engine starter and its components shall meet all performance requirements and not present a safety risk to crew members.

Standard:

Appendix I, paragraph 2-3.0.
Appendix I, paragraph 2-4.0.

Method of Compliance:

The engine starter and its components shall meet the general criteria and component qualification requirements of Appendix I, paragraph 2-3.0. and testing requirements IAW Appendix I, paragraph 2-4.0. The airworthiness substantiation shall include an engine Starter Designs Report prepared IAW DI-MISC-80711, an engine Starter Test Plan IAW DI-NDTI-80566, and an Engine Starter Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.5.3. Control Valve

The purpose of the engine starter control valve is to ensure the control valve opens during the starting sequence to direct air flow to the engine starter and that the valve closes at the appropriate cutout speed.

Criteria:

The engine starter control valve and its components shall meet all performance requirements and not present a safety risk to crew members.

Standard:

Appendix I, paragraph 2-3.0.
Appendix I, paragraph 2-4.4.

Method of Compliance:

The engine starter control valve and its components shall meet the general criteria and component qualification requirements of Appendix I, paragraph 2-3.0. and testing

requirements IAW Appendix I, paragraph 2-4.4. The airworthiness substantiation shall include an engine Starter Control Valve Design Report prepared IAW DI-MISC-80711, an engine Starter Control Valve Test Plan IAW DI-NDTI-80566, and an Engine Starter Control Valve Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

8.1.5.4. Electrical Starter

The engine starter and its components shall meet all performance requirements and not present a safety risk to crew members.

Criteria:
Appendix I, paragraph 2-3.0.

Standard:
Reserved

Method of Compliance:
The electric starter (generator) shall meet all the physical and interface requirements of the hydraulic/pneumatic starters as described in AMACC Appendix I. Electric starter (generators) shall have overspeed protection with respect to containment of fragments. The electric starter (generator) shall meet all the performance characteristics described in AMACC Appendix I, paragraph 2-3.0. to include maximum applied generator load (voltage and/or current). The airworthiness substantiation shall include an engine Electric Starter (Generator) Design Report prepared IAW DI-MISC-80711, an engine Electric Starter (Generator) Test Plan IAW DI-NDTI-80566, and an Engine Starter Test Report IAW DI-NDTI-80809. In addition to the guidelines of this section, component- level qualification for an electric starter (generator) is supplemented and/or superseded by relevant requirements defined in AMACC, Appendix E. Harmonization of requirements shall be coordinated with the SRD.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9. HUMAN SYSTEMS INTEGRATION

The human, crew, and mission systems consist of the following elements: task analysis and management, human system integration and human engineering, operator-vehicle and human-systems interface, human error, advanced information and control systems, system safety, aircrew alerting systems, controls and displays, sensors and imaging systems, cockpit geometry and compatibility, crash survivability, lighting and night vision compatibility, toxicology, health and chemical, biological, radiological and nuclear hazards, weapon engagement, and laser safety.

The following criteria, standards and methods of compliance apply to all air vehicle systems and represent the minimum requirements necessary to establish, verify, and maintain an airworthy design.

9.1. Task Analysis and Management

9.1.1. Critical Task Analysis Report (CTAR)

The purpose of the Critical Task Analysis Report is to provide a description of the analyses results of the critical tasks performed by the end user and provide a basis for identifying high risk tasks affecting human-system performance, mission accomplishment, system suitability, and safety. The analyses and results described support verification that human engineering technical risks have been identified, minimized, or mitigated and that human-system performance has been adequately addressed from early design development through test and evaluation of the system, equipment, or facility. A critical task is one requiring human performance which, if not accomplished in accordance with system requirements, will likely have adverse effects on cost, system reliability, efficiency, effectiveness, or safety.

Criteria:
The aircraft system shall have human system interfaces described to ensure safe flight.

Standard:
MIL-STD-46855
AMACC, Appendix A

Method of Compliance:
The airworthiness substantiation shall include a Critical Task Analysis (CTA) of the human-system interactions be conducted and a CTAR prepared IAW DI-HFAC-81399. The report shall include appendices for all the Critical Task Analyses to include mission tasks, behavioral tasks, cognitive tasks, function allocation, information requirements, safety use cases, failed and degraded modes, and critical tasks as described in Appendix A. Any technical risk identified, minimized, or mitigated by human intervention in the safety documentation or safety and airworthiness process shall be verified by the CTA to include increased workload during critical phases of flight. Any risks identified as above negligible severity or extremely improbable probability per the applicable USG Risk Determination Memorandum (i.e., PEO Aviation, SOCOM, etc.) and utilizing human interaction as a mitigation shall be included in the CTAR and validated via demonstration. In addition, emergency procedures and any required workaround shall

be included in analyses. Each analysis shall be IAW MIL-STD-46855 and prepared IAW DI-HFAC-80745.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		PS-ACE100-2001-004, PS-ANM111-1999-99-2, PS-ANM100-01-03A		

9.1.2. Human Engineering Design Approach Document – Operator (HEDAD-O)

The purpose of the HEDAD-O document is to describe the equipment that interfaces with operators. This document provides a source of data to evaluate the extent to which equipment having an interface with operators meets human performance requirements and human engineering criteria and provides the human engineering rationale for the design.

Criteria:

The aircraft system shall have the human engineering design and approach described to ensure safe flight.

Standard:

MIL-STD-46855
MIL-STD-1472
MIL-HDBK-759
AMACC, Appendix A

Method of Compliance:

The airworthiness substantiation shall include a HEDAD-O Report IAW MIL-STD-46855 and prepared IAW DI-HFAC-80746. The HEDAD-O shall be used to 1) document the layout, detail design, and arrangement of crew station equipment having an operator interface; it shall also describe operator tasks associated with equipment in the report; 2) describe the extent to which human performance requirements and applicable human engineering design criteria have been incorporated into the layout, design, and arrangement of equipment having an operator interface. See MIL-STD-1472 and MILHDBK-759 for design criteria. The findings from the CTAR and subsequent analyses traceable to operator and mission tasks shall be included as part of the rational supporting the design of the content, layout, and integration of crew station equipment and information systems. This description of the integrated system shall include the detailed design, configuration, and operability of the human interface and shall be updated whenever there is a configuration change affecting the human interface.

All automation functions to either assist pilot(s)/crew or take the place of pilot(s)/crew control shall be described in the HEDAD-O IAW DI-HFAC-80746 using the automation/autonomy descriptions and taxonomy defined in Appendix A of the AMACC to inform the consequence of failure analysis. The automation description shall include the rationale and intended effect on the user to include performance, engagement, and retention of mental model, include clear descriptions of supervisory control interactions

and impacts to flight and mission operations, and descriptions of the pilot(s)/crew override function, as applicable. The automation descriptions shall include all flight director modes. The automation description shall be conducted at the aircraft level to include rationale and intended effect on human-system interdependencies.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		PS-ACE100-2001-004, PS-ANM111-1999-99-2, PS-ANM100-01-03A		

9.2. Human Performance Assessments

Human Engineering combines engineering and psychology to design systems consistent with human capabilities and limitations. In other words, making technology that works for humans. The purpose of the human performance assessments is to fund and provide resources for the evaluation and documentation of the human performance elements impacting airworthiness and flight safety, specifically operator workload and situational awareness assessments, and the impacts of human error and usability for the defined configuration (HEDAD-O) and all the tasks and functions as defined by the CTAR through the Crew Station Working Group Process.

Criteria:

The aircraft system shall have Human Performance Assessments to ensure safe flight.

Standard:

MIL-STD-46855
AMACC, Appendix A.2.

Method of Compliance:

The aircraft system must ensure efficient usability, minimize operator workload, and enhance situational awareness when displaying and presenting critical, essential, and mission related information. These aspects will be verified through testing. This documentation shall be a collection of applicable Human Performance Assessments. The assessments shall include considerations for Human Computer Interaction (HCI), Information Processing, Information Management, Autonomy, Artificial Intelligence and machine learning, and all forms of Human and System Interaction.

System designs must minimize or eliminate system characteristics that require excessive cognitive, physical, or sensory skills; entail extensive training or workload-intensive tasks; result in mission-critical errors; loss of situational awareness; or produce safety or health hazards IAW MIL-STD-46855.

The Human Performance Assessments shall also identify and evaluate impacts due to modifications or changes that may impact human performance of the system. Such modifications include, but are not limited to the following:

a. Changes that affect structural integrity characteristics, navigational system performance, flight control system power requirements or crashworthiness.

b. Changes that energize emission of electromagnetic energy that can affect the crew and any aircraft, subsystem, component or allied equipment controls, indicators, displays, or the navigational and communication systems.

c. Changes that emit light or sound energy that can raise crew station noise levels or distract and degrade crew or sensor performance.

d. Changes that can be energized to emit any form of radiation, gases, liquids, or debris that may be hazardous, such as explosive ordnance, explosive or flammable fluids, laser energy.

e. Changes to the intended use or function of a subsystem or component from the original airworthiness qualification of a standard aircraft system, subsystem, or component.

f. Changes to the system/subsystem hardware, firmware and/or software architecture.

g. Changes that affect the operating limits and/or emergency procedures.

h. Changes that affect the prescribed limits in the ICA. These changes include additions, deletions, or reconfiguration of hardware and material substitutions, software revisions, firmware revisions, and any repair or replacement not authorized in the technical manual.

i. Changes that are not secured to structure to withstand the aircraft's existing static, dynamic and crash loads, thereby increasing the danger to the operator and crew in the event of an accident.

j. Changes to software which may affect an existing hazard source or mitigation or may create a new hazard source or mitigation. These changes include modification, deletion, or addition of new software requirements, functionality, or source code regardless of how extensive the change is (e.g., percent of source lines of code change).

In short, all of these types of modifications shall be included in Human Engineering Program Report updates in the context of impacts to the human system interactions.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		PS-ACE100-2001-004, PS-ANM111-1999-99-2, PS-ANM100-01-03A		

9.2.1. Operator/Crew Workload

The purpose of the Operator/Crew Workload is to evaluate and document operator/crew workload evaluations for the defined configuration (HEDAD-O) for all the tasks and functions as defined by the CTAR and to validate that holistic workload can be maintained at acceptable levels throughout all expected flight conditions and operational/mission scenarios. Operator workload for complex systems including autonomous functions and other human-system interactions shall identify both high and low periods of operator workload in order to support optimal workload for crews during all mission segments.

Criteria:
The aircraft system shall have an Operator/Crew workload program to ensure safe flight.

Standard:
Aircraft System Specification
MIL-STD-46855
AMACC, Appendix A
AC 29.1302-1 (Human Error Analysis – See section 9.4)
AC 23.1523
14 CFR 23.1311.
14 CFR 29.1321.

Method of Compliance:
The aircraft system shall have an Operator/Crew Workload Assessments IAW Appendix A, and the aircraft system specification. An analysis of the full range of crew/operator missions, tasks, functions, and scenarios shall be conducted to identify all high workload segments and tasks based on the CTAR. Workload testing shall be conducted using a pre-approved (by the airworthiness authority) and validated workload scale and following the testing observation guidance within Appendix 1 and Appendix 3.c of AC23.1523.

Sample Set - Sample sets for workload and usability assessments shall be comprised of United States Army Force Command (FORSCOM) Soldiers without previous involvement in the designing process of any previous insertions. Statistically, four (4) crews using a minimum of seven (7) different pilots is the minimal acceptable sample set. The Sample set shall have a balanced range of experience from no less than two (2) low time and two (2) high time experience pilots. Crews shall receive the exact same type and duration training that will be representative of the fielding program for the new insertions.

Workload Assessment Reading - Instrument flight displays, controls and symbology will be designed so that during holistic operation of the aircraft workload does not exceed a 6.0 on the Bedford Workload Scale, or equivalent, with the understanding that the objective is less than a 3.0. Dual or secondary task techniques shall be utilized to understand the interaction between subsystem workload and simultaneous related task performance.

The airworthiness substantiation shall include: A Human Engineering Workload Analysis Report prepared IAW DI-HFAC-80745 to include the elements of the human error analysis (see Section 9.4.); a Human Engineering Simulation Concept prepared IAW DI-HFAC-80742 detailing the simulation concept based on the aircraft system configuration shall be developed to ensure that estimates of operator workload can be determined prior to flight test activities; a Workload Assessment Test Plan prepared IAW DI-HFAC-80743 based on an analysis of missions (including emergency procedure situations) as defined in the CTAR and the Human Engineering Workload Analysis Report; a Human Factors Workload Assessment(s) conducted in accordance with human factors workload assessment test plan(s); and a Human Factors Workload Assessment Test Report prepared IAW DI-HFAC-80744. The aircraft system shall be designed and tested IAW MIL-STD-46855, and 14 CFR 23.1311, 14 CFR 25.1321, AC23.1523 and Appendix A paragraph A.2.1. of this document.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		PS-ACE100-2001-004, PS-ANM111-1999-99-2, PS-ANM100-01-03A AC 29.1302-1 (Human Error Analysis – See section 9.4) AC 23.1523		

9.2.2. Situational Awareness (SA)

The purpose of Situational Awareness is to evaluate and document situational awareness assessments for the defined configuration (HEDAD-O) for all the tasks and functions as defined by the CTAR in conjunctions with Operator/Crew Workload evaluations, and to validate that Operator/Crew Situational Awareness can be maintained at acceptable levels throughout all expected flight conditions and operational/mission scenarios.

Criteria:

The aircraft system shall provide Operator/Crew Situational Awareness Assessments for all necessary tasks, functions, and operational conditions.

Standard:

Aircraft System Specification MIL-HDBK-516
AMACC, Appendix A

Method of Compliance:

The aircraft system shall have Human Engineering Situational Awareness Assessments IAW Appendix A, and the aircraft system specification. An analysis of operator (individual and crew) situational awareness shall be conducted and compared with performance criteria (MIL-HBK-516). A test plan shall be developed based on an analysis of missions (including emergency procedure situations) as defined in the

CTAR, the Human Engineering Simulation Concept, and all applicable Human Engineering Workload Analysis Reports.

Test and verify the full range of crew/operator missions, tasks, functions and scenarios have been analyzed to establish that operator/crew Situational Awareness has not been degraded and that the information does not present potentially hazardous or misleading information.

Test and verify crew/operator Situational Awareness has been validated through actual flight hardware and through simulation for the full range of operator missions, tasks, and functions. This simulation shall represent the integrated system as it regards human-in-the- loop, situational awareness, crew station or operator station geometry, controls, displays, display software, and aircraft and payload performance.

Test that crew/operator preliminary workload estimates and assessments of situational awareness that were evaluated in simulation(s) are also assessed during developmental and operational ground/flight test activities as concurrent evaluations. Situational Awareness shall be evaluated in flight to establish that the information presented to the crew contributes to SA (increases SA), does not increase operator workload (or create a distraction), and does not present potentially hazardous and misleading information to the crew. Formal comparisons between primary and alternate sources of information, efficiency of crosscheck, and usability and criticality of information shall be specifically assessed and include analyses of human error (See also Section 9.4, Human Error). A report for all of Situational Awareness assessments conducted during flight test operations shall be prepared IAW DI-HFAC-80744, Human Engineering Flight Test Report.

Additional Human Factors Situational Awareness Assessments shall be conducted, as applicable, when changes in the configuration of the aircraft system impact task or mission flow, processes or crew coordination activities, or when new, modified, or changes in operator functions are implemented.

The airworthiness substantiation shall include a Human Engineering Situational Awareness Program Plan prepared IAW DI-HFAC-80745, a Human Engineering Situational Awareness Test Plan prepared IAW DI-HFAC-80743 and a Human Engineering Situational Awareness Test Report prepared IAW DI-HFAC-80744. All results shall also be documented as part of the Human Engineering Design Approach Document-Operator (HEDAD-O).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		PS-ACE100-2001-004, PS-ANM111-1999-99-2, PS-ANM100-01-03A		

9.2.3. Crew Station Working Group Process

The purpose of the Crew Station Working Group Process is to provide a means to describe and document the system/subsystem human-system interface with respect to content, layout, form, color, shape, and dynamic movement of design elements in order to identify usability and safety concerns, and to reduce risk of performance related factors prior to flight test.

Criteria:

The aircraft system's pilot/crew vehicle interfaces and human system interfaces shall provide a cohesive single integrated solution to ensure safe operations.

Standard:

The Army Crew Station Working Group (CSWG) process shall consist of detailed design descriptions, storyboards, use cases, simulated functions and traceable to the CTAR.

Method of Compliance:

The aircraft system shall have a CSWG process to design, evaluate and reduce risk in support of an integrated crew station design prior to flight test activities. The airworthiness substantiation shall include a Crew Station Working Group Test Plan prepared based on the Human Engineering Simulation Concept and IAW DIHFAC80743 to evaluate the preliminary design of the pilot vehicle interface to include all identified tasks and functions documented in the CTAR based on the configuration, aircraft system specification, and the intended use of the system as defined by the HEDAD-O (or by specific design modifications), and a Human Engineering Crew Station Working Group Test Report IAW DI-HFAC-80744. Conduct operator workload and situational awareness assessment of crews conducting mission sets of the preliminary design PVI IAW the Human Engineering Program.

The Army Crew Station Working Group is an iterative process of design and development through the use of storyboards and simulated functions. The CSWG is used to work through conceptual designs, perform comparative evaluations of design elements, and refine the elements into a cohesive integrated pilot vehicle interface design.

The CSWG is used for the design, development and simulation evaluation of all system pilot/crew vehicle interface and human system integration content to include, but not limited to: Initial mission effectiveness, situational awareness, and operator workload assessments; physical reach/access, PVI/HSI design suitability determinations for entering into Developmental Flight Test; determining maturity of Primary Flight Information, Supplemental Information, and Mission Related Information; as well as Crew and Crew Coordination Procedures.

The overarching goal of any addition, modification or change to the PVI is to maintain the perception of a single integrated design. Even if subsystems or components are not truly integrated into the design, from the crew/operator perspective, the addition of a subsystem, component, or function should 'look and feel' as it had been an integrated part of the system all along.

The results of the CSWG shall be used to make determinations regarding potential hazards, to develop emergency procedures, WCA prioritization (see Section 9.6.), to explore potential mitigations for identified hazards, and make determinations related to when the design is mature enough to proceed to developmental flight test operations. CSWG efforts continue to monitor and assess changes and modification to the PVI throughout the life cycle of the aircraft system.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		PS-ACE100-2001-004, PS-ANM111-1999-99-2, PS-ANM100-01-03A		

9.3. Human Systems Interfaces

The purpose for analysis and documentation of the ~~OVI and~~ Human System Interfaces is to determine the pilot(s)/crew/operator/passenger is capable of managing and performing multiple simultaneous and necessary functions, and flight and mission tasks; and establishing that the interface presents the right control interface and/or the right information at the right time and in the right location.

9.3.1. Information Systems

The purpose of information display and management is to determine the critical information is presented and managed in a way that supports safe operation across all necessary tasks, missions, and functions. There are two levels (or categories) of information that must be addressed: 1) Primary or sole source information, and 2) Supplemental or Non-Primary information. Any information presented to the crew can or will affect their situational awareness. The extent to which the information is accurate, timely, reliable, and usable must be understood in order to make any determination of airworthiness qualification.

Criteria:

The aircraft information system shall maximize performance, efficiency and minimize the potential for human error as demonstrated by Human Performance Assessments (paragraph 9.2.). All data sources, data processing, and the subsequent presentation of that data as information shall be documented and traceable from the CTAR to system design. The system design shall support human performance for the comprehensive range of Army mission, tasks, and functions. Data source, data process and data presentation should be understood by the human in order to maximize performance (see section 9.2.) and efficiency in order to minimize the potential for human error (see Section 9.4.).

Standard:

AMACC, Appendix A
AMACC, Appendix A
US Army Initial Capability Refinement Document for the Family of Systems Modular Open Systems Approach (MOSA) ICRD
14 CFR 25.1302

AC 29-2c

AC 25.1302-1 Installed Systems and Equipment for Use by the Flightcrew
Method of Compliance:
In order to support human performance and safety in complex systems, a common approach for the design, layout and task management structure for Army systems is necessary to facilitate high reusability between like functions when applicable (e.g. aviation, navigation and communication tasks, etc.) The operator-vehicle interface shall be consistent with regard to information content, layout, and symbology, arrangement and function of controls and displays, switchology, and ergonomic factors for the pilot/operator, crew, and/or occupants. The operator-vehicle interface shall be an integrated and comprehensive design even if elements are structurally federated or elements are added post-production. The holistic crewstation design shall maintain a single integrated interface based on the application of a consistent design philosophy, and all future revisions, modifications, or changes to that cockpit design shall not be obvious to the crew.

Human performance measures shall support human information processing and task management (i.e., operator mental/physiological workload and situational awareness). Consistent and generalizable USG specified method for measuring human performance must be applied throughout the life cycle (e.g., system concept/design through operational test and fielding). Compliance to this requirement is documented through the CTAR, the HEDAD-O and verification of all requirements in Section 9.2. and Section 9.4. to include an analysis of human error IAW AC 25.1302-1.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 25.1301(a), 25.1309(c), 25.1321(a), 25.1321(e), 25.1541, 25.1543. AC 25.1302-1		

9.3.1.1. Primary and Sole Source Information
Information is used by either the human and/or the system using process data acquisition (perception), processing (comprehension and understanding), and decision-making (awareness and projection of future states) to complete aviation specific flight tasks (aviate, navigate, communicate, targeting/engagement, etc.) When this information provides primary information, sole source information, or information presented in a new or non- traditional layout or format in direct support of critical aviation tasks the criteria for data quality and usability must be established in accordance with the CTAR. The system shall be designed to provide necessary and sufficient situational awareness in order to accomplish those tasks and establish and maintain safe flight operations. Secondary systems may also fall under this category if the primary system requires redundancy and is intended to be used when the primary system fails. As such, these systems shall demonstrate the same validity, reliability,

accuracy, integrity, and acceptable timeliness (latency, continuity) as the primary system based on the nature of the information being displayed. Thus, backup systems shall be qualified for use as an approved means of receiving, processing, and/or presenting such information to the crew when by design or intent they become primary sources.

Criteria:
The aircraft systems shall provide primary and sole source information to ensure safe flight operations.

Standard:
AC 29-2C Certification of Transport Category Rotorcraft
AC 20-167 Airworthiness Approval of SVS, CVS, and EFVS Equipment AMACC Appendix A

Method of Compliance:
All primary and sole source information necessary to maintain safe flight shall be characterized and validated for appropriate levels of accuracy, reliability, integrity, continuity and availability as specified in appropriate civil or military standards for the specific application and functional use of that information.

Even for functions that do not apply to specific safety standards, the criticality of the information and the consequences of potentially hazardous or misleading information resulting in a hazard condition shall be characterized sufficiently (i.e., accuracy, reliability, integrity, continuity and availability) in order to provide inputs to analyses of human error (see Section 9.4.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-178C		AC 20-115D AC 29-2C AC 20-167		

9.3.1.2. Enhanced Flight Vision Systems
The purpose of Enhanced Flight Vision Systems is to provide a comprehensive primary flight reference suite including sensor imagery and/or command guidance cueing to support primary flight in one or more degraded visual environments.

Criteria:
The aircraft systems shall ensure safe operations in all DVE conditions.

Standard:
Aircraft System Specification
Paragraph 9.9. Sensors and Imaging Systems

Method of Compliance:
Aircraft Systems shall demonstrate safe operations in all identified DVE conditions for all necessary flight task and flight maneuvers for all mission profiles designated by the system and the aircraft system specification. Systems shall be defined by the scope of intended use. A critical reaction point (CRP) shall be determined to established threshold flight profiles to maintain safe flight (minimum altitude above known obstacles [Altitude Height above Obstacles (AHO)]). Time to Criticality (TTC), defined as the defined period of time required to detect, comprehend, and to plan and execute an appropriate and safe response as well as measures of Sensor Effectivity (SE) based on effective range, bearing, detection thresholds and probability of detection, etc. are based on projected flight profiles (i.e., airspeed, altitude, etc.) and shall be established a priori in support of safety case analyses and determine performance thresholds. The determination of a pilotage capability will be defined by the safety case.

There are 11 possible (9 environmental conditions plus two aircraft induced conditions) DVE conditions encountered during tactical operations where performance shall be demonstrated to ensure safe operation. Systems for use as either aids to situational awareness or as pilotage system shall be defined based on performance parameters desired and the aircraft system specification and validated by the safety case analysis for the system.

Emulating the external visual environment may be performed by the presentation of a real time VMC-type quality image, through sensor driven flight guidance cues, or other means to ensure safe navigation in tactical airspace in order to sense and avoid terrain and obstacles. Multi-modal presentation of proximity cues (audio and tactile) and flight guidance and flight control coupling may be necessary to achieve 360 degree situational awareness and to achieve Level 1 flying and handling qualities IAW MIL-DTL-32742.

An analysis for potential loss of instantaneous FOV and related degraded modes of operation (e.g., distributed aperture systems, overlapping sensor FOV, biocular HMDs, etc.) shall be conducted to understand the implications to loss of primary vision (or portions thereof), required transitions to reversionary modes of operation, and other procedures. The results of the analysis shall be included in the Primary Flight Display Human Engineering Test Plan

Conduct a test IAW the test plan to validate the presentation of primary flight information to demonstrate and test that the aircraft system can perform all necessary flight maneuvers and mission related tasks and functions in all necessary degraded visual environments and under high workload conditions.

The airworthiness substantiation shall include a Primary Flight Display Human Engineering Test Plan prepared IAW DI-HFAC-80743 and a Primary Flight Display Human Engineering Demonstration Test Report prepared IAW DI-HFAC-80744. All results shall also be documented as part of the Human Engineering Design Approach Document-Operator (HEDAD-O).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.3.1.2.2. Instrument Meteorological Conditions (IMC)/Instrument Flight Rules (IFR)

The purpose of IMC/IFR is to provide a comprehensive pilot vehicle interface equivalent to a civil certification for use in IFR flight operations in support of world-wide navigation.

Criteria:
The aircraft shall support Instrument Meteorological Conditions (IMC) and Instrument Flight Rules (IFR) certification.

Standard:
AR 95-1
MIL-STD-1472 NATICK/TR-89/044
NATICK/TR-15/007
MIL-STD-850
14 CFR Part 23/25/27/29
General Aviation Manufacturers Association (GAMA)

Method of Compliance:
The aircraft shall be equipped with all required primary and standby (backup) instrumentation to support IMC and International IFR certification. The aircraft shall be equipped per AR-95-1 for IMC operations.

Conduct a test IAW the test plan to perform a usability assessment using critical body dimensions of the 5th percentile female aviator through the 95th percentile male aviator using NATICK 89/044 and the NATICK TR 15/007 data sets, to demonstrate that the aircraft instruments are appropriate for the crew station configuration (i.e., side-by-side or tandem), and that separate instruments are incorporated for each pilot are usable during simulated and actual IMC flight where all IMC ATM tasks are performed to ATM standard. The primary and standby flight instruments shall be located in the primary field of view and legible to both pilots and can be read without error to safely fly the aircraft. In a tandem seating arrangement, both the front and back station shall be equipped with primary and standby (backup) instrumentation.

Standby instruments shall be independent and separate from each crew station in a tandem seat platform. The engine instruments shall always be available and be adjacent to the basic flight instruments. The engine instruments shall be arranged in a standard format IAW MIL-STD-1472 and MIL-STD-1787. Demonstrate by test that the arrangement of instruments is grouped functionally with priority of placement being given to the most important instruments during simulated and actual IMC flight. In addition, total system latency of critical flight information shall be not more than 100 milliseconds. For primary flight information provided on a head’s up/eyes out display (e.g., HMD), the latency shall not be more than 40 milliseconds. Instrument flight displays, controls and symbology will be designed so that during holistic operation of the

aircraft workload does not exceed a 3.0 on the Bedford Workload Scale, or equivalent. Obstruction to the pilots outside view shall be IAW MIL-STD-850.

The airworthiness substantiation shall include a Human Engineering Primary Flight Display Human Engineering Demonstration Test Plan prepared IAW DI-HFAC-80743 and a Primary Flight Display Human Engineering Demonstration Test Report IAW DI-HFAC-80744. All results shall also be documented as part of the Human Engineering Design Approach Document-Operator (HEDAD-O).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.3.1.2.3. Localized Airspace Deconfliction

The purpose of Localized Airspace Deconfliction is provide ownship cognizance of local airspace for the purposes of maintaining clear separation from other airborne vehicles, including UAS, and route planning to ensure safe flight in unregulated airspace including tactical operations.

Criteria:

The aircraft shall be capable of providing ownship position as well as range, bearing, altitude, airspeed and heading of other airborne vehicles, to include UAS, to be able to maintain clear separation and dynamic route planning to ensure safe flight in unregulated airspace including tactical operations.

Standard:

14 CFR 91.225.
14 CFR 91.227.
FM 3-52

Method of Compliance:

The aircraft shall provide ownship position information and position information (range, bearing, altitude, airspeed and heading) of other airborne vehicles, to include UAS, in order to maintain clear separation during flight. Position information and flight path trajectory information shall also support dynamic route planning, sense and avoid, and formation flight to ensure safe flight in unregulated airspace including tactical operations IAW FM 3-52 as well as during independent flight operations where the aircraft must provide ownship airspace deconfliction and out the window visibility is impaired. Localized Airspace Deconfliction systems must align with pilot out the window orientation, head’s up display, and alternate sources of information (e.g., tactical situation display, etc.) consist with the related requirements specified in Section 9 of the AMACC.

NOTE: ADS-B certification is not applicable for tactical operations and for ownship deconfliction for aircraft in close proximity (i.e., formation flight) due to latency concerns. See latency requirements.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.3.1.3. Secondary or Supplemental Information

Secondary, supplemental or non-primary information is a class of information system that provides similar, redundant, or supplemental information in support of a primary system and traceable to a critical task analysis. These systems either are 1) considered optional or non- essential equipment; 2) redundant systems that can be easily crosschecked with primary information; or 3) a means to display information that otherwise may not have been more readily available to the crews and/or presented in a new or non-traditional format but with access to effective crosscheck or verification, especially in near or real-time, and without increasing operator workload. However, this information still requires substantiation to verify the accuracy, reliability, integrity, continuity, and availability of the information presented to characterize usability and performance even if no specific criteria is established or known. The usability of the secondary or supplemental information will be evaluated as part of the system safety and human error analyses for potentially hazardous or misleading information (detected or undetected).

Criteria:

The aircraft system shall provide secondary or supplemental information that does not conflict with primary and approved information and does not lead to an unsafe flight condition.

Standard:

MIL-HDBK-516 Appendix A

Method of Compliance:

Although this information is secondary, all the information that is given to the crew effects their Situational Awareness and how they have mentally modeled their environment (e.g., speed, position in space, etc.) and potentially leading crewmembers to make decision on inaccurate or incomplete data. Data sources that fall under this “Secondary or Supplemental” category must still reach a level of reliability appropriate for its intended use.

As previously stated, any information that is presented to the crew can or will affect situational awareness. Therefore, if a system or piece of information is presented 'for situational awareness,' then performance must be demonstrated to prove that the information or system contributes to SA (increases SA), does not increase operator workload, or does not present potentially hazardous and misleading information to the crew.

If a system cannot be qualified (or was not designed to be qualified) as a primary or sole source system, then methods to characterize the criticality, the performance, and the usability of the information shall be employed, and verification of information quality shall still be applied to determine if the information can be used in some appropriate

manner. If it 1) fails the situational awareness criteria, 2) if performance cannot be substantiated, or 3) if the identified risks for potentially hazardous or misleading information cannot be mitigated, then the information shall not be presented to the crew or shall be qualified as primary information. Airworthiness substantiation shall include a Secondary/Supplemental Information Substantiation Report shall be prepared IAW DI-HFAC-80745.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-178C		AC 20-115D		

9.3.1.3.1. Portable Electronic Devices (PEDs)
The purpose of PEDs is to provide optional carry-on portable electronic devices in support of Commander's needs.

Criteria:
The aircraft system portable electronic devices shall be not degrade operation of the aircraft.

Standard:
Aircraft System Specification
SRD PED SOP
General Aviation Manufacturer's Association (GAMA)

Method of Compliance:
The aircraft system shall have portable electronic devices that are physically compatible with the aircraft system and IAW AC 120-76, as applicable. The process for the airworthiness assessment to use Portable Electronic Devices in either the cabin area of the crew station is only assessed from a physical, non-interference basis and does not assess operator workload, usability, or crew or mission effectiveness with regard to the functional use of the device. Procedures shall be established regarding the use of the PEDs aboard the aircraft, to include the following information:

a. Methods to inform the passengers of permissible times, conditions and limitations when various PEDs can be used.

b. Procedures to terminate the operation of PEDs suspected of causing interference with aircraft systems.

c. Procedures for reporting instances of suspected or confirmed interferences by a PED.

d. Cockpit to cabin coordination and cockpit flight crew monitoring procedures.

e. Procedures for determining non-interference acceptability of those PEDs to be operated aboard the aircraft.

f. Procedures prohibiting the operation of any PEDs during specific mission segments to include secure lighting, night vision compatibility, and other areas of potential lighting interference (glares and reflections) with crew performance as well as for all critical phases of flight, to include takeoff, approach, landing, and abnormal or emergency conditions.

g. Procedures to take in the event of cockpit/cabin fire during thermal runway of lithium batteries.

All controls must be within reach of the appropriate crewmember seated normally on the cockpit. Input devices shall provide feedback to indicate when operational. Assessments to evaluate any potential impacts to the configuration of the cockpit shall be conducted to include the following:

a. Reach and access to all controls and displays.

b. Control sweep evaluation.

c. Normal ingress/egress.

d. Emergency egress demonstration.

e. Stowage provisions.

A stowage area or a mounting device shall be required for all PEDs IAW the aircraft system specification. The PEDs shall have predetermined stowage provisions that will secure the devices during normal operations and provision for stowage during all critical phases of flight, including takeoff, approach and landing, and in any abnormal or emergency conditions. The PED shall not jam or interfere with the flight controls, damage cockpit equipment, or injure aircrew members should the device move about as a result of turbulence, maneuvering, or other action. The stowage area shall not obstruct visual or physical access to controls and/or displays, aircrew ingress or egress, or external vision. Acceptable stowage locations for a PED include inside a map case with a secure cover, or within the compartments of the pilot’s stowed flight bag. Furthermore, device weight shall be measured and assessed for potential impacts to crashworthiness and flail hazards.

The usability (i.e., legibility of text and displayed information) of the PED shall be evaluated under all normal ambient lighting conditions for day, night aided and night unaided, to include, but not limited to evaluations of the following:

a. Sunlight Readability.

b. Night Vision compatibility.

c. Glares and reflections.

The design of any PED shall minimize aircrew workload and head-down time. The positioning, use, and stowage of the device shall not affect aircrew workload and be assessed for potential safety implications. And, while PEDs are not qualified for functional use, crews shall have established procedures and planning in place so that a failure of the PED can be identified, and the device can be removed, powered down and stowed safely. If the functional use of any PED is desired, then qualification shall be based on the requirements specified by Electronic Flight Bags (Paragraph 9.3.1.2.2.). It shall also be noted that no more than one (1) electronic device or kneeboard may be worn by any individual crew member.

Analyze, demonstrate and test all PEDs. The airworthiness substantiation shall include a Human Engineering Portable Electronic Device Test Plan shall be prepared IAW DI-HFAC-80743, and a Human Engineering Portable Electronic Device Test Report documenting the results of the test IAW DI-HFAC-80744. All results shall also be documented as part of the Human Engineering Design Approach Document-Operator (HEDAD-O).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 120-76 AC 91.21		

9.3.1.3.2. Electronic Flight Bags (EFBs)
The purpose of Electronic Flight Bags (EFBs) is to provide required supplemental information and/or functions with the intent to remove or replace required paper in the cockpit.

Criteria:
The aircraft Electronic Flight Bag (EFB) systems shall not degrade operation of the aircraft to ensure safe flight.

Standard:
MIL-STD-1472
General Aviation Manufacturer’s Association (GAMA)

Method of Compliance:
In addition to meeting all requirements for Portable Electronic Devices (Section 9.3.1.2.1.), the aircraft Electronic Flight Bags (EFB) shall be evaluated and tested to provide the usability of its intended functions, e.g., the means to operate and reference the EFB such as access to desired charts, access to information within a chart, grouping of information, general layout, orientation (e.g., track-up, north-up), and depiction of scale information. The use of EFBs is addressed in AR 95-1; however, the qualification pedigree of the device and usability of specific functions shall meet the requirements herein.

The EFB shall meet the size, resolution, and legibility of symbols and text in accordance with MIL-STD-1472. The EFB shall display all digital representations of paper products in their native size and format, e.g., approach plates.

The system shall provide feedback to the user when user input is accepted. If the system is busy for an atypical time with internal tasks that preclude immediate processing of user input (e.g., calculations, self-test, or data refresh), the EFB shall display a “system busy” indicator (e.g., clock icon) to inform the user that the system is occupied and cannot process inputs immediately. The timeliness of system response to user input shall be consistent with an application’s intended function. The feedback and system response times shall be predictable to avoid crew distractions and/or uncertainty.

If the document segment is not visible in its entirety in the available display area, such as during “zoom” or “pan” operations, the existence of off screen content shall be clearly indicated in a consistent way. For some intended functions it may be unacceptable if certain portions of documents are not visible. The basis of this evaluation should be on the application and intended operational function. If there is a cursor, it should be visible on the screen at all times while in use. The default position should be easily accessible after any active manipulation (e.g., zooming, panning, or decluttering).

The EFB software design shall minimize crew workload and head-down time. The positioning, use, and stowage of the EFB shall not result in unacceptable crew workload (see Section 9.2.). Avoid complex, multi-step data entry tasks during takeoff, landing, and other critical phases of flight. An evaluation of EFB intended functions shall include a qualitative assessment of incremental pilot workload, as well as pilot system interfaces and their safety implications. If the intended function of an EFB includes use during critical phases of flight, such as during takeoff, landing, or abnormal and emergency operations, its use shall be evaluated during simulated and actual aircraft operations under those conditions.

The Operator Workload shall be evaluated as part of the Human Engineering Program (Paragraph 9.2.1.)

If a system or piece of information is presented 'for situational awareness,' then performance shall be demonstrated using the Situational Awareness Rating Technique (SART), Situational Awareness Global Assessment Technique (SAGAT), or equivalent method, to establish that the information presented on the EFB contributes to SA (increases SA), does not increase operator workload, and does not present potentially hazardous and misleading information to the crew IAW Paragraph 9.2.

The usage of hardware and/or software architectural features, people, procedures, and/or equipment to eliminate, reduce, or control potential hazards associated with an identified failure in a system shall be determined.

Procedural mitigations shall be established and verified/validated by test to provide a reliable means of displaying information that is required by the crew during failed or

degraded modes of operation. This will ensure an equivalent level of safety and integrity to that of the current paper-based products. Mitigation may be accomplished by a combination of the following:

a. System design.

b. Separate and backup power sources.

c. Redundant EFB applications hosted on different EFB platforms.

d. Paper products accessible for use by crewmembers; and/or

e. Procedural means.

If one or more onboard EFBs fail, resulting in loss of function or the presentation of false or hazardously misleading information, a contingency plan or process shall be in place to provide the required information. Crews shall have established procedures and planning in place so that a failure of the EFB can be identified, and the transition to an alternative information source shall not create a hazardous situation. It shall also be noted that no more than one (1) electronic device or kneeboard may be worn by any individual crew member.

The aircraft Personal Electronic Devices that pertain to Cockpit Compatibility, Emergency Egress, Lighting, and Night Vision Goggle Compatibility shall be tested and demonstrated IAW AC 120-76 to include software assurance and safety.

Analyze, demonstrate and test all EFBs and functional applications IAW AC 120-76.

Analyze, demonstrate and test all EFB functional applications to ensure that the configuration and intended use of the application meet the requirements of Type A or Type B software applications IAW AC 120-76.

The airworthiness substantiation shall include a Human Engineering System Analysis Report prepared IAW DI-HFAC-80745, a Human Engineering Electronic Flight Bag Test Plan prepared IAW DI-HFAC-80743, and a Human Engineering Electronic Flight Bag Test Report prepared IAW DI-HFAC-80744. All results shall also be documented as part of the Human Engineering Design Approach Document-Operator (HEDAD-O).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.3.2. Aircraft Symbology

9.3.2.1. Aircraft Display Symbology

The purpose of Aircraft Display Symbology is to provide a presentation of all required information through symbols for electro-optical displays for aircrew members for takeoff,

navigation, communication, terrain following/terrain avoidance, mission management, weapon engagement, hover, and landing tasks.

Criteria:
The aircraft systems display symbology characteristics shall provide safe flight and not degrade flight operations.

Standard:
MIL-STD-1472
MIL-STD-1787
MIL-STD-2525
FM 1-02

Method of Compliance: AC 29-2
Method of Compliance: AC 25-11
Method of Compliance:
The aircraft systems display Symbology for a primary flight reference shall be IAW MIL-STD-1787. Symbol requirements and symbol designs shall include descriptions of the fundamental relationships between symbol motion and aircraft system states IAW AC29-2 for specific primary flight tasks. The information shall include the symbols, symbol formats, and information content for aircraft flight displays that provide crewmembers with information for takeoff, navigation, terrain following (TF)/terrain avoidance (TA), weapon delivery, and landing as well as military operational terms and graphics and include information on symbol geometry, fonts, recommended dimensions, and mechanizations. The design of symbology for aircraft flight displays shall be based on the information requirements defined in the CTAR. An analysis shall be conducted to map task-based information requirements of the CTAR to specific symbology elements (and symbology sets) to support the communication of critical information to include color use IAW MIL-STD-1787 and AC 25-11. The results of the analysis and the rationale for the symbols used in the system design shall be included in the Human Engineering Design Approach Document-Operator (HEDAD-O).

Verification of flight symbology shall be accomplished by demonstration and test. All display symbology shall be verified by visual inspection of the shape and dimensions of each symbol and alphanumeric character. A functional verification (hot bench test or flight test) of the operational characteristics (dynamic movement) of each symbol shall also be performed. New symbols shall be functionally verified and meet the minimum visual angle subtended requirements for critical information IAW MIL-STD-1472. The test shall include assessments of symbology usability, detectability, legibility, compatibility, and readability.

The aircraft systems display symbology (individual elements as well as comprehensive symbol sets) shall be integrated across all pilot tasks and functions (e.g., primary flight displays, stand by displays, electronic warfare displays, UAS control displays, etc.), and shall not compete, conflict, or otherwise interfere with the recognition, discriminability, or comprehension of meaning of any individual symbol or symbol set.

The airworthiness substantiation shall include a Communication of Critical Information Analysis Report prepared IAW DI-MISC-80711, a Display Symbology Test/Inspection Plan prepared IAW DI-NDTI-80566, and a Display Symbology Test Report prepared IAW DI- NDTI-80809. All results shall also be documented as part of the HEDAD-O.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 29-2 AC 25-11		

9.3.2.2. Three Dimensional (3D) and Conformal Symbology Criteria

Criteria:
The aircraft systems shall provide augmented three dimensional or conformal symbology in a perspective view display that supports safe flight operations.

Standard:
MIL-STD-1472
MIL-STD-1787
MIL-STD-2525

Method of Compliance:
Three dimensional and conformal symbology shall be designed to enhance an understanding of the external visual environment. The symbology shall not clutter or otherwise obscure critical information. The symbology shall correlate in time and space features of the external environment in support of the CTAR and task objectives. The accuracy, reliability, integrity, continuity and availability of information provided as three-dimensional or conformal symbology shall be validated. New, novel and non-traditional means of displaying primary flight information represented as three-dimensional or conformal symbology shall be validated to perform as good if not better than traditional means of presenting the information in isolation (used independently). The use of three-dimensional or conformal symbology shall not complete or conflict with traditional means of information presentation. The presentation of symbol elements shall meet the standards described in Paragraph 9.3.

The three-dimensional and conformal symbology (individual elements as well as comprehensive symbol sets) shall be integrated across all pilot tasks and functions (i.e., tactical situation displays, primary flight displays, stand by displays, electronic warfare displays, UAS control displays, etc.), and shall not compete, conflict, or otherwise interfere with the recognition, discriminability, or comprehension of meaning of any individual symbol or symbol sets. See section 9.3. for criteria of primary and secondary/supplemental information.

Symbol requirements and symbol designs shall include descriptions of the fundamental relationships between symbol motion and aircraft system states IAW AC 29-2 for specific primary flight tasks. The information shall include the symbols, symbol formats, and information content for aircraft flight displays that provide crewmembers with

information for takeoff, navigation, terrain following (TF)/terrain avoidance (TA), weapon delivery, and landing as well as military operational terms and graphics and include information on symbol geometry, fonts, recommended dimensions, and mechanizations. The design of symbology for aircraft flight displays shall be based on the information requirements defined in the CTAR. An analysis shall be conducted to map task-based information requirements of the CTAR to specific symbology elements (and symbology sets) to support the communication of critical information. The results of the analysis and the rationale for the symbols used in the system design shall be included in the HEDAD-O.

Verification of flight symbology shall be accomplished by demonstration and test. All display symbology shall be verified by visual inspection of the shape and dimensions of each symbol and alphanumeric character. A functional verification (hot bench test or flight test) of the operational characteristics (dynamic movement) of each symbol shall also be performed. New symbols shall be functionally verified and meet the minimum visual angle subtended requirements for critical information IAW MIL-STD-1472. The test shall include assessments of symbology usability, detectability, legibility, compatibility, and readability.

The airworthiness substantiation shall include a Human Engineering Symbology Analysis Report prepared IAW DI-MISC-80711, a Human Engineering Symbology Test Plan prepared IAW DI-NDTI-80566, and a Human Engineering Symbology Test Report prepared IAW DI-NDTI-80809. All results shall also be documented as part of the Human Engineering Design Approach Document-Operator (HEDAD-O).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 29-2. AC 25-11		

9.3.2.3. Air-Air and Air-Ground Tactical Symbology Criteria

Criteria:
The aircraft systems shall provide air-ground tactical symbology and operational terms and graphics.

Standard:
MIL-STD-2525 FM1-02

Method of Compliance:
Air-to-Air and Air-to-Ground tactical symbology shall be designed IAW MIL-STD-2525 and FM 1-02 for operational terms and graphics. Tactical symbology (individual elements as well as comprehensive symbol sets) shall be integrated across all pilot tasks and functions (i.e., tactical situation displays, primary flight displays, stand by displays, electronic warfare displays, UAS control displays, etc.), and shall not compete, conflict, or otherwise interfere with the recognition, discriminability, or comprehension of meaning of any individual symbol or symbol sets.

Tactical symbology shall conform to operational standards to minimize training requirements and to maximize coordination and communication both inside the crew station as well as within tactical operation networks.

The Common Warfighting Symbology standard (MIL-STD-2525) addresses the efficient transmission of symbology information within the system through the use of a standard methodology for symbol hierarchy, information taxonomy, and symbol identifiers. The standard applies to both automated and hand-drawn graphic displays. Furthermore, US Army Operational Terms and Graphics (FM 1-02) extends the standardization of tactical information beyond the facilities, units and equipment described in MIL-STD 2525. The test shall verify that the aircraft warfighting symbology, along with details on its display and plotting to ensure the compatibility, and to the greatest extent possible, the interoperability of DoD Command, Control, Communications, Computer, and Intelligence (C4I) systems development, operations, and training. The display of air-to-air and air-to-ground tactical information shall provide mechanisms for managing prioritization, transparency, scalability, and other usability concerns.

Verification of flight symbology shall be accomplished by demonstration and test. All display symbology shall be verified by visual inspection of the shape and dimensions of each symbol and alphanumeric character. A functional verification (hot bench test or flight test) of the operational characteristics (dynamic movement) of each symbol shall also be performed. New symbols shall be functionally verified and meet the minimum visual angle subtended requirements for critical information IAW MIL-STD-1472. The test shall include assessments of symbology usability, detectability, legibility, compatibility, and readability.

The airworthiness substantiation shall include a Human Engineering Symbology Test/Inspection Plan IAW DI-NDTI-80566 and a Human Engineering Symbology Test Report prepared IAW DI-NDTI-80809. All results shall also be documented as part of the Human Engineering Design Approach Document-Operator (HEDAD-O).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.3.2.4. Helmet Display Symbology

The purpose of Helmet Display Symbology is to provide a presentation of all required information head's up and eyes out to support necessary flight activities and to maintain safe operations in conjunction with all available primary flight references.

Criteria:

The aircraft systems display symbology characteristics shall provide safe flight and not degrade flight operations.

Standard:

AMACC, Appendix U (ADS-46, Draft, 2002) MIL-STD-1472
Aircraft System Specification

Method of Compliance:
The design of the helmet mounted display symbology shall meet all requirements for primary flight control of the aircraft system and shall be consistent with the data, process and display information as presented in the pilot vehicle interface IAW the aircraft system specification. The design of symbology for helmet mounted displays shall be based on the information requirements defined in the CTAR. An analysis shall be conducted to map task- based information requirements of the CTAR to specific symbology elements (and symbology sets) to support the communication of critical information. The results of the analysis and the rationale for the symbols used in the system design shall be included in the HEDAD-O.

Helmet mounted display shall meet the requirements for primary flight reference, 3D and conformal symbology, air-to-air/air-to-ground tactical symbology, and latency requirements (40 milliseconds) as stated in other areas of Section 9 AMACC.

Verification of flight symbology shall be accomplished by demonstration and test. Prepare a Human Engineering Symbology Test/Inspection Plan IAW DI-NDTI-80566. All display symbology shall be verified by visual inspection of the shape and dimensions of each symbol and alphanumeric character. A functional verification (hot bench test or flight test) of the operational characteristics (dynamic movement) of each symbol shall also be performed. New symbols shall be functionally verified and meet the minimum visual angle subtended requirements for critical information per MIL-STD-1472. The test shall include assessments of symbology usability, detectability, legibility, compatibility, and readability.

The design of the helmet mounted display symbology shall meet all requirements for primary flight control of the aircraft system and shall be consistent with the data, process and display of the same information as presented elsewhere in the pilot vehicle interface. Symbology form, function and dynamic movement shall match the timeliness and latency of critical information and shall not present hazardous or misleading information to the crew, as described other requirements in this document.

The design of symbology for helmet mounted displays shall be based on the information requirements defined in the CTAR and the Aircraft System Specification. An analysis shall be conducted to map task-based information requirements of the CTAR to specific symbology elements (and symbology sets) to support the communication of critical information. The results of the analysis and the rationale for the symbols used in the system design shall be included in the HEDAD-O.

Verification of flight symbology shall be accomplished by demonstration and test All display symbology shall be verified by visual inspection of the shape and dimensions of each symbol and alphanumeric character. Symbology elements shall be consistent across display formats to prevent confusion or conflict with the presentation of the same information. A functional verification (hot bench test or flight test) of the operational characteristics (dynamic movement) of each symbol shall also be performed. New

symbols shall be functionally verified and meet the minimum visual angle subtended requirements for critical information per MIL-STD-1472.

The airworthiness substantiation shall include a Human Engineering Symbology Analysis Report prepared IAW DI-MISC-80711, a Human Engineering Symbology Test/Inspection Plan IAW DI-NDTI-80566 and a Human Engineering Symbology Test Report prepared IAW DI-NDTI-80809. All results shall also be documented as part of the Human Engineering Design Approach Document-Operator (HEDAD-O).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 25-11		

9.3.2.4.2. Binocular Head Mounted Display
The purpose of the Binocular Head Mounted Display would be to eliminate binocular rivalry where image contrast from a monocular HMD waxes and wanes due to suppression from the other eye.

Criteria:
The aircraft systems display characteristics shall provide safe flight and not degrade flight operations.

Standard:
USAARL-TECH-TR-2023-19
United States Army Aeromedical Research Laboratory
Head Mounted Display Guidelines for Future Vertical Lift Aircraft

Method of Compliance:
The design of the head mounted display shall meet all requirements for primary flight control of the aircraft system and shall be consistent with the data, process and display of the same information as presented elsewhere in the pilot vehicle interface. Symbology form, function and dynamic movement shall match the timeliness and latency of critical information and shall not present hazardous or misleading information to the crew. Line of sight verification to terrain intercept and conformal elements shall be analyzed and verified to meet latency and synchronization requirements in AMACC Section 9.4. All required information shall be presented within the minimum FOV for each eye such that loss of one channel shall not prohibit the display from providing all necessary information to maintain safe flight (e.g., biocular overlap).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.4. Human Error
The purpose of Human Error is to determine the potential for, and the consequences of, a crew-induced error(s) including acts of omission and commission), and to establish a simple means to prevent, mitigate, and/or correct any errors. In addition to the

requirements of Paragraph 14 of this document, the following activities, analyses, and documentation is required to “consider the human’ in complex aviation systems.

Criteria:
The aircraft human system interfaces shall not impact safe flight and include the human operator in the analysis of the complex system interactions.

Standard:
MIL-STD 882
System Theoretical Process Analysis (STPA)
SAE ARP 4761
SAE ARP 4754
MIL-STD-1472

AC 25-1302-1
Method of Compliance:
Human system interactions shall be included in all safety analyses and incorporated as a system component. System safety processes cannot be limited to defining failure conditions without understanding the impacts of human interaction. Safety case analyses included in the CTAR (Paragraph 9.1.1.) shall include causal scenarios using a structured process and based on a defined scope of intended use of the system.

Traditional approaches of using procedures and training to mitigate failure conditions in insufficient in advanced information systems. Advanced technologies layers human and system interactions in unprecedented ways, and the failure or degraded mode of operation for one function may have very different ways of propagating through the system and may afford multiple responses of the human operator.

In addition, software processes are logical expressions of interpreted requirements. As such, software is deterministic. SAE ARP 4761 has established that failure probabilities for software cannot be made. Regardless, failure conditions between human and system interactions must also be analyzed in the same way. Human interactions with system functions (as designed) shall be assumed to also be deterministic. In other words, if the human can make an inappropriate input (or other system interaction) then the hazard exists. Again, not just the failure condition, but the hazard itself. It is no longer acceptable to based historical anecdotal information to ignore base hazards. This means that the hazard conditions, when identified, shall also be evaluated for potential mitigations.

For any control process that requires an interaction of the human as an integral component of the system behavior shall be analyzed using System Theoretical Process Approach (STPA) to be able to adequately consider the human in system safety processes. See also Section 9.5. for additional substantiation requirements related to autonomous functions.

An analysis shall be performed to describe the Human Engineering design approach to identify, minimize, and mitigate human error in the system design IAW AC 25-1302-1.

The analysis shall include a review of human engineering design approach philosophies, and related methodologies (e.g., crew station working group). The results of the analysis shall be included in the HEDAD-O. The crew system interface shall be verified by subsystem integration test and based on the human use analysis, failure and degraded modes analysis, crew system working group and simulation evaluations as described in this document and include assessments during developmental flight test.

The aircraft human system interfaces (physical, graphical, perceptual, etc.) shall minimize the potential for, and the consequences of, a crew-induced error, and provide a simple means to correct any errors. Crew Systems interfaces are designed in accordance with human engineering principles (MIL-STD-1472). The intended crew population can conduct flight critical tasks with low risk of error. Errors which jeopardize flight safety shall be quickly corrected with a minimal number of steps. Note, human error includes both acts of commission as well as acts of omission.

The airworthiness substantiation shall include a Human Error System Analysis Report prepared IAW DI-HFAC-80745, a Human Error Evaluation Flight Test Plan prepared IAW DI-HFAC-80743, and a Human Error Evaluation Test Report prepared IAW DI-HFAC-80744. All results shall also be documented as part of the Human Engineering Design Approach Document-Operator (HEDAD-O).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 25-1302-1 AC 00-74		

9.4.1. Failed and Degraded Modes

The purpose of the Failed and Degraded Modes is to evaluate and document: the potential for failed and degraded states and modes throughout the system, how those failed and degraded states and modes propagate through the system, how those states and modes are presented to the crew, and all available mitigations are identified and understood.

Criteria:

The aircraft system failed, or degraded modes of operation shall not result in an unsafe flight operation.

Standard:

MIL-STD-882
SAE ARP4761
SAE ARP5580
AC 25.1302-1
14 CFR 23.1301
14 CFR 23.1309
14 CFR 25.1301
14 CFR 25.1309 plus any appropriate advisory circular(s) FAA AC 27-1
AC 25-1302-1

Method of Compliance:
An aircraft Human Engineering Failed, and Degraded Modes Analysis shall describe how failures and degraded modes propagate through the system and how they are presented to the crew IAW MIL-STD-882 and SAE ARP4761 (see also JSSG and CFR references).

Failed and degraded modes are identified initially during the development of the CTAR and verified by inspection. Timeline and latency data shall be included in the FMEA. Laboratory and flight testing shall be used to verify that no failed or degraded modes exist that result in an unsafe flight condition.

Failed and degraded modes of operation in all architecture elements (e.g., processors, buses, and memory) are defined, assessed, and compensated for as required to ensure safe operation. Failure and degraded modes include hardware and interface failures (i.e., hard, and intermittent) as well as failures due to priority inversions, lack of real time support (e.g., lack of rate monotonic scheduling), unpredictable software execution (e.g., unknown execution timeline), timing anomalies, as well as how the affected modes propagate through the system. All systems design and testing shall be IAW MIL-STD-882, SAE ARP-4761, SAE ARP-5580, 14 CFR 25.1301, 25.1309 plus any appropriate advisory circular(s); FAA AC 27-1 and FAA AC 29-2 provide guidance on helicopter equipment, see subpart "F".

The airworthiness substantiation shall include a Human Engineering Failed and Degraded Modes Analysis Report IAW AC 25.1302-1 and prepared IAW DI-HFAC-80745, a Human Engineering Failed and Degraded Modes Flight Test Plan prepared IAW DI-HFAC-80743, and a Human Engineering Failed and Degraded Modes Test Report prepared IAW DI-HFAC-80744. All results shall also be documented as part of the Human Engineering Design Approach Document-Operator (HEDAD-O) and included in the assessments of Human Performance (see Section 9.2.).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 25.1302-1 14 CFR 25.1302, 25.1322 AC 29-2 provide guidance on helicopter equipment, see subpart "F".		

9.4.2. Display of Unsafe or Misleading Information
The purpose of the display of unsafe or misleading information is to evaluate and document the accuracy and timely presentation of information.

Criteria:
The aircraft system shall not display information that degrades safe operation.

Standard:
MIL-STD-882 SAE ARP4761 14 CFR 23.2250
14 CFR 23.2500.
14 CFR 23.2505.
14 CFR 23.2510.
14 CFR 23.2605.
14 CFR 25.1301.
14 CFR 25.1302.
AC 25.1302-1.
14 CFR 25.1309. plus any appropriate advisory circular(s) AC 27-1

Method of Compliance:
An analysis shall be conducted to address the accuracy, integrity, continuity, reliability and related factors to the quality of information provided. The analysis shall be conducted to address, but not limited to, timing and latency of buses, latency in the presence of single point failures, and latency, BIT error rate and other parameters that define bus integrity and related factors to the quality of data source, the processing of that data, and the subsequent display of information to the crew that could lead to a misleading indication condition IAW MIL-STD-882 and civil regulations SAE ARP-4761, 14 CFR 23.2250, 23.2500, 23.2505, 23.2510, 23.2605, 25.1301, 25.1309 plus any appropriate advisory circular(s). FAA AC 27-1, FAA AC 29-2 provide guidance on helicopter equipment. See subpart "F" The analysis shall be traceable to the CTAR and all Information Systems Reports substantiating design elements in support of autonomous functions or information fusion (Paragraph 9.5. and Appendix A).

Aircraft/system/subsystem end to end timing and latency shall be tested for normal and fully loaded conditions of all bus components (e.g., networks, switches, hubs) and interfaces for each function. Bus retries, network data error rates, message size, non-blocking operation, numbers of priorities, and level of compliance with rate monotonic scheduling shall be evaluated. The results of the test shall be included in the CTAR. See Appendix A for related autonomous functions and information fusion requirements.

The airworthiness substantiation shall include an Unsafe/Misleading Information Analysis Report prepared IAW DI-HFAC-80745, documentation for an Unsafe/Misleading Information Analysis Test Plan prepared IAW DI-HFAC-80743 and an Unsafe/Misleading Information Analysis Test Report prepared IAW DI-HFAC-80744. All results shall also be documented as part of the Human Engineering Design Approach Document-Operator (HEDAD-O).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 29-2 subpart "F". 14 CFR 25.1302, 25.1322		

9.4.2.1. Display Latency and Update Rate

The purpose of the display latency and update rate is to evaluate and document the accuracy and timely presentation of information.

Criteria:

The aircraft system, subsystems and components critical tasks and functions shall not create visual distraction or impact human response dynamics.

Standard:

General Aviation Manufacturer's Association (GAMA) MIL-STD-1472
MIL-HDBK-516 MIL-STD-1787

Method of Compliance:

The information update rate and screen refresh rate shall provide for symbols to move smoothly and not flicker. The update rates range from once every few seconds, for a slow moving symbol, to 50 Hz minimum, for the highly dynamic attitude indicator presentation. A refresh rate of at least 60 Hz is needed to prevent significant flicker. Recent displays have moved to a 72 Hz refresh rate to further suppress flicker effects.

The total system latency for the presentation of primary flight information used for real-time control of an aircraft should not exceed 100 milliseconds (This 100ms requirement is the standard latency for GAMA, MIL-STD-1472, MIL-HDBK-516, and MIL-STD-1787). If the total system latency exceeds 100 milliseconds for the presentation of any primary flight parameter, then the exceedance must be documented so that the potential impacts to flight safety (e.g., the defined flight envelope) can be understood. However, for head's up/eyes out configurations (i.e., HMD), the total system latency shall be 40 milliseconds. Data latency time delays are measured from the instant of a control input to the time a recognizable response occurs.

The display shall not exhibit flicker that is discernible to the eye. The effects of electrical noise shall not cause any visible distortion, positional or dimensional instability, or luminance variation in any symbology or video and shall not interfere with proper presentation or usability of the display. Any flicker/jitter or other observed visual anomalies in the presentation of the primary flight information shall be documented.

Analyze the system, subsystem and component design elements and document the timing allocations and expected system response times (latencies) and to include the response time estimates and latencies for all critical functions within the system.

As the system design evolves or is modified, again analyze the system, subsystem and component design elements based on the updated and refined timing allocations and expected system response times (latencies) and prepare an update to the Human Engineering System Analysis Report including updates to the response time estimates and latencies for all critical functions within the system.

Test the system latencies for all critical tasks and functions using laboratory, ground and flight tests and demonstrate that no deficiencies result in an adverse safety of flight condition.

Test that the latency budgets for the aircraft system production configuration are valid for all critical and safety critical tasks and functions and are HEDAD-O traceable to both the CTAR and all Information Systems Reports substantiating design elements in support of autonomous functions or information fusion (Paragraph 9.5. and Appendix A).

The airworthiness substantiation shall include a Display Latency and Update Rate Analysis Report prepared IAW DI-HFAC-80745, a Display Latency and Update Rate Test Plan prepared IAW DI-HFAC-80743 and a Display Latency and Update Rate Test Report prepared IAW DI-HFAC-80744. All results shall also be documented as part of the Human Engineering Design Approach Document-Operator (HEDAD-O).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 25-11		

9.4.2.2. Timing/latency Anomalies
The purpose of the timing/latency anomalies is to evaluate and document the accuracy and timely presentation of information.

Criteria:
The aircraft system shall have no timing or latency anomalies that degrade safe operation.

Standard:
SAE ARP4761
SAE ARP5580 14 CFR 23.1301
14 CFR 23.2250(a).
14 CFR 23.2300.
14 CFR 23.2500.
14 CFR 23.2505.
14 CFR 23.2510.
14 CFR 23.2600.
14 CFR 23.2605.
14 CFR 25.1301.
14 CFR 25.1309.
14 CFR 25.1329.
14 CFR 25.1335.

Method of Compliance:
The presentation of information shall be accurate and timely in that information presented prematurely or late may precipitate unsafe response actions by the crew. Conduct an analysis of all timing and latency response characteristics related to system

design and critical human response tasks IAW civil regulations SAE ARP-4761, SAE ARP-5580, 14 CFR 23.2250(a), 23,2300, 23.2500, 23.2505, 23.2510, 23.2600, 23.2605, 25.1301, 25.1309, 25.1329, 25.1335, FAA AC 27-1, FAA AC 29-2 provide guidance on helicopter equipment, see subpart “F”, and prepare a Human Engineering System Analysis Report IAW DI-HFAC-80745.

Analyze and test that all normal, backup, and emergency modes of operation are safe for the integrated system. Timing (e.g., priorities, bounded timelines) and latency anomalies for normal, backup, and emergency modes shall be analyzed, tested and the results included in the Failure Modes, Effects, and Criticality Analysis (FMEA/FMECA) prepared IAW Paragraph 14. (System Safety) of this document. Verify that timing or latency anomalies do not result in unsafe system operation.

The airworthiness substantiation shall include a Timing and Latency Response Characteristic Analysis Report prepared IAW DI-HFAC-80745, a Timing and Latency Response Characteristic Test Plan prepared IAW DI-HFAC-80743 and a Timing and Latency Response Characteristic Test Report prepared IAW DI-HFAC-80744. All results shall also be documented as part of the Human Engineering Design Approach Document- Operator (HEDAD-O).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.4.2.3. Latencies and Synchronizations

The purpose of the latencies and synchronizations is to evaluate and document the usability and timeliness of the presentation of information.

Criteria:

The aircraft system shall have control functions, payloads, and ground systems latencies and synchronizations that ensure usability and safe operation.

Standard:

MIL-DTL-32742
MIL-HDBK-516

Method of Compliance:

The presentation of information shall be usable, accurate, and timely in that information presented prematurely or late may precipitate unsafe response actions by the crew. The vehicle control function integrated with any payload or ground functions shall not induce latencies that result in flying and handling qualities worse than Level I IAW MIL-DTL-32742 -PRF. Data latency time delays are measured from the instant of a control input to the time a recognizable response occurs. This is specified as 100 milliseconds for Level I flying qualities IAW MIL-DTL-32742 (Also see 40 millisecond requirement for HMDs).

The Vehicle Control Function (VCF) integration with the payload or the control station is evaluated for safe and adequate timing, synchronization rates, instruction set architecture, misinterpretation of instructions or data, degraded data link and inability to handle basic faults. Any synchronization done in any of the integrated functions, including a single synchronization failure or multiple single independent synchronization failures, shall not cause loss of the vehicle/crew and have flying quality levels no worse than Level I. Vehicle control, payload, and ground redundancy of the integrated portions of these functions are able to operate autonomously without loss of the vehicle/crew and shall not have flying quality levels worse than Level II.

The VCF integration with the ground or payload function is classified flight/safety critical. The VCF integration with the ground or payload function has a stability margin of 6 dB and 45 degrees in phase and gain for each feedback loop and control loop for all flight conditions throughout the entire flight envelope.

Verify that vehicle control, payload, and ground system latencies and synchronizations are safe. Verification methods include analysis, test, simulation, and review of documentation. The VCF vehicle control, payload, and ground system latencies and synchronizations are verified through simulation, systems analysis, failure modes evaluation test, and ground tests. For each control and feedback loop, analysis and simulation verify the phase and gain margins. The analysis and simulation are validated by actual flight test data, and the results of the test shall be included in simulation and flight test reports, as applicable.

The airworthiness substantiation shall include a VCF Integration Latency Analysis Report prepared IAW DI-HFAC-80745, a VCF Integration Latency Test Plan, prepared IAW DI- HFAC-80743, and a VCF Integration Latency Test Report, prepared IAW DI-HFAC-80744. All results shall also be documented as part of the Human Engineering Design Approach Document-Operator (HEDAD-O).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 25-11		

9.4.3. Undetected Failure and Degraded Modes

The purpose of Undetected Failed and Degraded Modes is to evaluate and document: the potential for failed and degraded states and modes that cannot be automatically detected by the system and may result in a failure of the human operator to correctly detect and respond appropriately.

Criteria:

The aircraft system undetected failed or degraded modes of operation shall not result in unsafe system operation.

Standard:

SAE ARP4761
SAE ARP5580

14 CFR 23.1301.
14 CFR 23.1309.
14 CFR 23.1329.
14 CFR 23.1335.
14 CFR 25.1301.
14 CFR 25.1309.
14 CFR 25.1329.
14 CFR 25.1335.

Method of Compliance:
An aircraft Human Engineering undetected failure and degraded modes analysis shall describe how failures and degraded modes propagate through the system and how they are presented to the crew. Undetected failure modes shall be defined (e.g., failure condition, timing, performance, graceful degradation) for normal, backup, and emergency modes. Safety assessments shall not include the human operator as part of a mitigation for undetected failure modes without validation of crew procedures and human responses to failed conditions. Undetected failure modes shall be verified by analysis, inspection of the FMEA, and test data. Testing (e.g., bench, SIL, ground, flight) establishes that each mode is safe and predictable. Software in the Loop and CSWG simulation, and Flight Test Operations shall be used to validate crew detection and response procedures. All systems design and testing shall be IAW SAE ARP4761, SAE ARP5580, 14 CFR 25.1301, 25.1309, 25.1329, and 25.1335, AC 27-1 and AC 29-2c provide guidance on helicopter equipment, see subpart "F".

The airworthiness substantiation shall include an Undetected Failure and Degraded Modes Analysis Report prepared IAW DI-HFAC-80745, an Undetected Failed and Degraded Modes

Test Plan IAW DI-HFAC-80743 and an Undetected Failed and Degraded Modes Test Report IAW DI-HFAC-80744. All results shall also be documented as part of the Human Engineering Design Approach Document-Operator (HEDAD-O).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.4.4. Functional Usability
The purpose of Functional Usability is to assess human performance with respect to task difficulty, timeline for completion, and human error.

Criteria:
The system/subsystem shall support task performance by minimizing task difficulty, time for completion, as well as potential for human error to include distractions, nuisances, and system trust and satisfaction.

Standard:
Standard Usability Scale (SUS)

MIL-STD-1472
MIL-STD-46855
14 CFR 23.1311.
14 CFR 25.1321.

Method of Compliance:
The system/subsystem shall support task performance by minimizing task difficulty, time for completion, as well as potential for human error to include distractions, nuisances, and system trust and satisfaction. Usability is not always directly a function of workload or situational awareness, but an overall assessment of the system with regard to functional use, overall task flow, and potential for error while managing the task.

The airworthiness substantiation shall include: A Human Factors Functional Usability Test Plan prepared IAW DI-HFAC-80743 based on an analysis of missions (including emergency procedure situations) as defined in the CTAR and the Human Engineering Workload Analysis Plan; The plan shall include 1) task completion metrics to verify that users can complete tasks effectively. Metrics shall determine if task completion fails, succeeds, or indirectly succeeds due to other factors; 2) duration metrics to measure and track the average time needed to perform a task to include display dwell time and related comprehensive scan times; 3) error metrics to measure disruption in task flow or task success due to system interaction, confusions, distractions, or other nuisance interactions that confound the use of the system; and 4) satisfaction metrics to assess overall satisfaction with the use of the system, likelihood of use, and other insight that may require redesign or workaround. A SRD approved metric shall be used, such as the system usability survey (SUS) evaluate the overall usability of the system. The assessment(s) shall be conducted in conjunction with the Human Factors Workload Assessment(s) and Situational Awareness Assessment(s) plan(s); and a Human Factors Functional Usability Test Report prepared IAW DI-HFAC-80744. The aircraft system shall be designed and tested IAW MIL-STD-46855, and 14 CFR 23.1311, 14 CFR 25.1321, AC 23.1523 and Appendix A paragraph A.2.1. of this document.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.5. Advanced Information and Control Systems

9.5.1. Autonomy
The purpose of Autonomy is to define all autonomous functions to ensure traceability for functional allocation between human and machine (see CTAR), and to document the type and level of autonomy provided in order to establish airworthiness and safety impacts for the consequences of failure.

Criteria:
All control systems, tasks, or functions designated as automated or autonomous shall result in safe flight condition.

Standard:
Aircraft System Specification DOT/FAA/TC-16/56
AMACC, Appendix A.3.

Method of Compliance:
The aircraft system shall have automated or have autonomous functions incorporated IAW Aircraft System Specification and IAW AMACC, Appendix A. All autonomous tasks, functions, or task elements shall be defined by type and level of autonomy based on the analyses of task(s) as defined by the CTAR and the Airworthiness Process Framework for the Qualification of Autonomous Systems IAW AMACC, Appendix A.3., and the consequences of failure shall be documented and traceable to all appropriate system safety documentation. All automated functions shall be designed with an override that allows all control to shift to the owner of the system and proper alerting to all vested parties. Software shall not exceed the human capability to operate that system in a manual mode. In addition, the aircraft alerting system shall present crews with trend information and early detection of failing or degrading modes of operation. Provide an analysis to demonstrate that all automated functions afford the operator the ability to monitor system performance, detect and perceive the presentation of failed and degraded modes, and provide suitable controls surfaces to be able to engage and correct for anomalies. Prepare a Human Engineering System Automation Analysis Report IAW DI-HFAC-80745.

The design approach for automated functions shall be included as part of the HEDAD-O and any deviations from the design approach shall be included. All control systems, tasks, and functions designated as automated or autonomous functions, shall be identified. Automated functions shall include provisions for operator control and display arrangements that afford the operator to monitor system performance, immediate presentation of failed and degraded modes, and suitable controls surfaces to be able to engage and correct for anomalies in system performance. The aircraft alerting system shall be used to present crews with trend information and early detection of failing or degrading modes of operation.

All automated functions shall be included in the Failed and Degraded Modes Analysis and included as part of the System Safety process. Note, the automated function can only perform those tasks for which it was designed. Any system or environmental condition that is outside of the design function may create unsafe condition that will require the human operator to engage and correct prior to an undesired outcome. The status of all automated functions should be known and understood by the crew. Appropriate mode annunciations and system status shall be readily available to the crew. In addition, for systems with higher levels of autonomy, the aircraft alerting system may present crews with trend information and early detection of failing or degrading modes of operations, in order to better address the allocation of functions to systems. The aircraft alerting system may be used to present crews with trend information and early detection of failing or degrading modes of operation, providing that these features conform to the aircraft human factors design philosophy and must appropriately support the intended function.

The airworthiness substantiation shall include an Autonomous Functions Analysis Report prepared IAW DI-HFAC-80745 and Appendix A, an Autonomous Functions Test Plan, prepared IAW DI-HFAC-80743, and an Autonomous Functions Test Report, prepared IAW DI-HFAC-80744. All results shall also be documented as part of the Human Engineering Design Approach Document-Operator (HEDAD-O).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.5.2. Integrated and Variable Autonomy

The purpose of integrated and variable autonomy is to capture complex human-system interactions where the role and responsibility of the human changes over time, but within the same mission. Integrated autonomy is when one or more autonomous function relies on, interacts with, or contributes to another autonomous function. The degradation or failure of such functions has a dynamic effect on safety and usability.

Criteria:

The aircraft systems shall change levels of autonomy to compliment the limitations and strengths of the human operator.

Standard:

Aircraft System Specification AMACC, Appendix A

Method of Compliance:

The type and level of human-system interaction for autonomous functions shall be declared IAW paragraph 9.5.1. and Appendix A of this document and described in the HEDAD-O. Functions that are dependent on (receive inputs from), integrated with, provide data to (outputs to) other autonomous functions shall also be documented and analyzed as part of the safety case and analysis of the consequences of failure. Assumptions and dependencies on performance shall also be documented. If the level of autonomy for any given function or functions can adaptively change, the nature of the change shall also be documented whether the change in level was designed, instructed, or a consequence of another failure.

Provide an analysis to demonstrate that all automated functions afford the operator the ability to monitor system performance, detect and perceive the presentation of failed and degraded modes, and provide suitable controls surfaces to be able to engage and correct for anomalies. The airworthiness substantiation shall include a Human Engineering System Automation Analysis Report prepared IAW DI-HFAC-80745 and Appendix A.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.5.3. Information Fusion

The purpose of Information Fusion systems is to understand the process of collating disparate data sources into a cohesive piece of information with the intent of reducing uncertainty or increasing accuracy as compared to independent assessments of data elements. Data is data, but information is meaning.

Criteria:

The aircraft systems shall document and analyze all data, processing and presentation of subsequent information used by the operator or the system to perform all necessary missions, tasks and functions as defined by the CTAR.

Standard:

Aircraft System Specification
AMACC, Appendix A.4.

Method of Compliance:

The airworthiness substantiation shall include a Human Engineering System Information Fusion Analysis Report prepared IAW DI-HFAC-80745 and Appendix A and included as an appendix in the HEDAD-O. Data architectures and data interfaces shall be documented and analyzed. The analysis shall be conducted to identify data source and data quality issues both top down and bottom up in order to understand the impact to the information provided with respect to all mission, tasks and functions IAW the CTAR. The documentation shall provide data architecture definitions to understand the raw inputs and propagation of signals towards the creation of ‘information’ used by the system or the operator to perform all necessary missions, tasks and functions as defined by the CTAR. In addition, the system shall decompose information from the operator/crew station and derive the data paths necessary to maintain sufficient level of data quality to preserve integrity of decision processes and outcomes.

In order to qualify system and subsystem fusion capabilities, it is a prerequisite to substantiate the design intent especially with regard to layered autonomy or adaptive functions (Paragraph 9.5.). Thus, in line with the autonomy framework (AMACC Appendix A), the design of a fusion capability begins with a clear definition of the task to be performed to provide traceability between the mission, task or function and the data, process and presentation of the subsequent information. This is no different than the traditional approach of controls and displays management, but the substantiation detail shall gloss over or otherwise ignore direct or implied dependencies on the quality of the data and the characterization of information consumed by the human, the system, or both.

The limitations or risks for human error at each applicable level of fusion per AMACC Appendix A.4. shall be documented for airworthiness and safety. Substantiation artifacts for each layer of abstraction shall be documented, as applicable, in order to generate engineering cognizance of fusion system designs and to be able to further analyze the cost or consequence of failure. The substantiation of design shall be predicated in all documentation with a clear definition of the configuration and intended use of the system.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.5.4. Artificial Intelligence and Machine Learning

The purpose of artificial intelligence and/or machine learning systems is to facilitate computational cognition in near-real time to support dynamic sensing and analysis of information, decision selection, and potentially control action based on an experiential basis of non-deterministic inputs or outcomes.

Criteria:

The aircraft systems shall provide safe, moral, and ethical artificial intelligence and machine learning functions.

Standard:

Aircraft System Specification AMACC, Appendix A.5.

Method of Compliance:

The airworthiness substantiation shall include a Human Engineering System Artificial Intelligence and Machine Learning Analysis Report prepared IAW DI-HFAC-80745 and Appendix A, and included as an appendix in the HEDAD-O. There is DoD level guidance for an ethical, practical manner of integrating Artificial Intelligence and Machine Learning into the work force. Due to the non-deterministic nature of the output and its effect on decision making and control, these systems currently prove to be unsafe for long-term adaptation at this time due to the unpredictable effect on safety.

The scope of artificial intelligence and machine learning systems shall be clearly defined and documented with respect to the mission, tasks and functions it can support. Constraints on data, processing and outputs (especially with respect to decision-making or control actions) shall be analyzed for potential safety impacts. Safety boundaries and other mechanisms shall be defined and evaluated. Mechanisms for operator control of data, processing and outputs shall also be defined so that human-system interactions can be analyzed as stated in Paragraph 9.5.

All Artificial Intelligence and Machine Learning (AI/ML) functions, as with any autonomous function that supports or requires human-system interactions, shall be included in the Failed and Degraded Modes Analysis and included as part of the System Safety process. Note, the AI/ML function can only perform those tasks for which it was designed. Any system or environmental condition that is outside of the design function may create unsafe condition that will require the human operator to engage and correct prior to an undesired outcome. The status of all AI/ML and automated functions should be known and understood by the crew with respect to operator insight, oversight and override capabilities IAW AMACC Appendix A.4. Appropriate mode annunciations and system status shall be readily available to the crew. In addition, for systems with higher levels of autonomy, the aircraft alerting system may present crews with trend information and early detection of failing or degrading modes of operations, in order to better address the allocation of functions to systems. The aircraft alerting system may

be used to present crews with trend information and early detection of failing or degrading modes of operation, providing that these features conform to the aircraft human factors design philosophy and must appropriately support the intended function.

The airworthiness substantiation shall include an Artificial Intelligence/Machine Learning Functions Analysis Report prepared IAW DI-HFAC-80745 and Appendix A, an Artificial Intelligence/Machine Learning Functions Test Plan, prepared IAW DI-HFAC-80743, and an Artificial Intelligence/Machine Learning Functions Test Report, prepared IAW DI-HFAC-80744. All results shall also be documented as part of the Human Engineering Design Approach Document-Operator (HEDAD-O).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.6. Aircrew Alerting Systems

The purpose of aircrew alerting systems is to provide proper notification of system and subsystem states and modes in order to minimize aircrew response times and promote more effective aircrew action and crew coordination subsequent to the presentation of the alert. This includes general functions, operational logic, information content of messages, and physical characteristics of the alerting systems visual, auditory, and tactile signals.

Criteria:
The Aircraft System shall have an integrated crew alerting system to ensure safe flight.

Standard:
MIL-STD-411
MIL-STD-1472

Method of Compliance:
The aircraft system shall have warnings, cautions, and advisories are in accordance with MIL-STD-411 and MIL-STD-1472. The aircraft aircrew station alerting systems shall include general functions, operational logic, information content of messages, and physical characteristics. An Alerting System Analysis Report shall be prepared IAW DI-HFAC-80745 to include the alert priority approach and methodology. Prepare an Alerting System Test Plan IAW DI-HFAC-80743 to perform subsystem integration testing based on the requirements identified during the human use analysis, failure and degraded modes analysis, and crew system simulation. Prepare or revise the HEDAD-O Report IAW MIL- STD-46855 and prepared IAW DI-HFAC-80746.

The aircraft warning, caution and advisory (WCA) system shall be consolidated into a single priority based system. All alert messaging shall be integrated into the WCA categories based on the determined urgency of response. Determined urgency of response shall be dependent on the applicable safety analysis documentation. Aircraft aircrew station alerting systems, to maximize human performance and response time, shall including general functions; operational logic; information content of messages; and physical characteristics of the alerting system’s visual, auditory, and tactile signals.

The aircrew alerting system shall be salient (perception), easily and quickly comprehended (recognized), intuitive (decision is made direct/easy), and sufficient to afford adequate/appropriate response (response time).

a. Visual Alerting is the primary alerting method. Prioritization is critical to proper alerting of the crew. An on-aircraft ramp test shall be performed prior to first flight of all warnings and cautions, and if possible, all alerts. Attention should be given to the manner of acknowledgement of the alerts. All visual indications shall be located in the prime visual signal area and that all warning and caution situations are displayed and/or conveyed to the aircrew or operator in a fashion that permits recognition in sufficient time to take actions necessary for safe flight.

b. Audio Alerting is a secondary alerting method. However, when combined with visual alerting greatly reduces the likelihood of a missed or delayed alarm. Audio alerting signals, when used, shall conform to the requirements specified in MIL-STD-411 and to the audio display requirements of MIL-STD-1472. The audio alert should be used to direct visual attention, to reduce workload or response time in determining the comprehension of the alert, and should not be confused with other, perhaps similar alerts.

All aural warnings, cautions, and advisories are in accordance with MIL-STD-411 and MIL- STD-1472. Aural alerts are used in conjunction with visual alerts to direct attention to a critical change in system or equipment status and alert the pilot and/or operator of a critical action(s) that must be taken.

c. Tactile Alerting is considered a tertiary, yet very specific stimulus-response alerting condition that should be of such amplitude as to be detected by the part of the body being stimulated and should be delivered by an apparatus that will always be in contact with the body. Tactile signals shall also be coded such that they could not be misconstrued as a normal vibration of the equipment or crew station. Tactile stimuli should always correspond to a direct response or condition that is intuitive with regard to the expected response without requiring confirmation of visual information (i.e., low altitude alert to alert crews not to descend, if not increase altitude immediately).

The aircrew alerting system provides feedback of all events, conditions, and situations which could present a hazard to the safety of the occupants, endanger human life, or cause substantial damage to the aircraft. The alerting system is activated upon the occurrence of the condition. Warnings and cautions are not masked or obscured by other displayed information.

The test plan shall include assessments and inspections to ensure that all visual WCAs are located within a 30-degree cone centered on the pilot/operator’s normal line of sight and are of sufficient magnitude to ensure rapid detection. All warnings, cautions, and advisories shall be IAW MIL-STD-411. Location of visual alerting system components shall be verified by inspection and analysis of crew station layout drawings and mockups as well as inspection and physical measurements of display hardware.

Test that the aircrew alerting system is prioritized by urgency into warnings, cautions, and advisories categories. Additionally, alerts shall be prioritized by urgency of response of WCA messaging within Categories. Warnings are presented at the top of the aircrew alert display, followed by cautions and then advisories IAW MIL-STD-411F. When multiple alerts are present, the relative alert priorities shall be readily and easily detectable by the pilot and/or operator IAW AC 25.1322. The prioritization scheme within each category, as well as the rationale, shall be documented and evaluated IAW AC 25.1322. Aural alerts shall be prioritized so that only one aural alert is presented at a time and an active aural alert should finish before another aural alert begins. An active aural alert is interrupted by higher urgency level alerts if the delay to annunciate the higher priority alert affects the timely response of the pilot and/or operator.

The WCA triggering logic, message content, and prioritization scheme shall be tested with a WCA Ramp Test conducted on aircraft at each software configuration change. The WCA Ramp Test Plan shall be prepared IAW DI-HFAC-80743. The WCA Ramp Test Report shall be prepared IAW DI-HFAC-80746.

CSWG flight simulations and mockup evaluations shall be used to demonstrate the capacity of the alerting systems to garner attention in sufficient time to take appropriate actions for alerts, emergency procedures and related human-system interactions.

Hardware in the loop Systems Integration Laboratory (SIL) and Flight Test activities shall be used, to the extent possible, to validate all crew alerts. The airworthiness substantiation shall include an Alerting System Analysis Report prepared IAW DI-HFAC-80745, an Alerting System Test Plan prepared IAW DI-HFAC-80743, and an Alerting System Test Report prepared IAW DI-HFAC-80744 and included as an appendix in the HEDAD-O.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 25.1322		

9.7. Controls and Displays

The purpose of Controls and Displays is to define the arrangement, layout, switchology, and integration of all necessary controls and displays in the system.

9.7.1. Arrangement

The purpose of Arrangement is to evaluate and document the crew station design and layout of all operator controls and displays to determine that all Controls and Displays can be operated safely throughout all necessary flight and mission tasks and functions.

Criteria:

The aircraft system controls and displays shall be arranged to be completely functional and visible to the required crew and operator population.

Standard:

MIL-STD-1472

MIL-STD-1333
NATICK/TR-89/044
NATICK/TR-15/007
FAA AC 25-11
MIL-STD-3009
ADS-74-SP FAA
AC 29-2
FAA AC 27-1
FAA 23.1311-1

Method of Compliance:
All controls and displays shall be arranged so that they are completely functional and visible and that the crewstation/operator station geometry (including seats) shall accommodate the target population. Prepare a Controls and Display Arrangement Test Plan IAW DI-HFAC-80743. Conduct the test IAW with the test plan and ensure that the location, size, placement, range of travel, adjustment, and force requirements of primary flight controls are appropriate for the full range of operational tasks, maneuvers, and flight control techniques.

Test the aircraft controls are appropriate for the crew station configuration (i.e., side-by-side or tandem), and that separate controls are incorporated for each pilot, and a logical system of control authority has been established to prevent control conflicts or inadvertent activation of systems. All controls are properly designed and shall be operable through their complete range of travel without interference with other controls, structures, operators' bodies and that all emergency action controls are reachable by the operators IAW MIL-STD-1472 using NATICK TR-89-044 and NATICK TR 15/007 data sets, as appropriate. All flight safety and critical controls shall be operated normally while the operator is seated at the design eye point with the harness locked IAW MIL-STD-1333.

Test that all controls and displays are IAW MIL-STD-3009 and ADS-74-SP, this includes but is not limited to sunlight readability, aided and unaided night operations, balance, and uniformity.

Test the arrangement of instruments is grouped functionally with priority of placement being given to the most important instruments. All controls are properly designed and shall be operable through their complete range of travel without interference with other controls, structures, operators' bodies and that all emergency action controls shall be reachable by the operators. All flight safety and critical controls shall be operated normally while the operator is seated at the design eye point with the harness locked. This includes, but is not limited to, the following items:

a. The standby flight instruments shall be located in the primary field of view and legible to both pilots and can be read without errors to safely fly the aircraft IAW MIL-STD-1472. Obstruction to the pilot’s outside view is prohibited (manned aircraft).

b. The standby flight instrument, if located above the instrument panel, shall be clearly legible to both pilots, and can be read without errors to safely fly the aircraft. In a tandem seating arrangement, the standby (backup) instrumentation shall be located in the front aircrew station. Obstruction to the pilots' outside view shall be kept to a minimum.

c. The engine instruments shall always be available and be adjacent to the basic flight instruments. The engine instruments shall be arranged in a format using JSSG-2010 as a guide.

d. All primary flight and emergency action controls shall be properly marked and located within Zone 2 functional reach with restraint harness locked (manned aircraft) IAW MIL-STD-1333.

e. All electronic displays shall meet the design requirements IAW FAA Part 23 for Normal, Utility, and Acrobatic Category Airplanes, Part 25 for Transport Category Airplanes, Part 27 for Normal Category Rotorcraft and Part 29 for Transport Category Rotorcraft.

The airworthiness substantiation shall include a Controls and Display Arrangement Test Plan prepared IAW DI-HFAC-80743, and a Controls and Display Arrangement Test Report prepared IAW DI-HFAC-80744 and included as an appendix in the HEDAD-O.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 29-2 FAA AC 27-1		

9.7.2. Layout and Switchology

The purpose of Layout and Switchology is to evaluate and document the crew station design and layout of all operator controls and displays to determine that all Controls and Displays can be operated safely throughout all necessary flight and mission tasks and functions.

Criteria:

The aircraft system control and switch layout shall be arranged to be completely functional and visible to the required crew and operator population.

Standard:

MIL-STD-1472
MIL-STD-1333
NATICK/TR-89/044
NATICK/TR-15/007
MIL-STD-850
MIL-STD-1760
MIL-STD-1425

Method of Compliance:
The aircraft control and switch layout shall be designed and arranged so that they are completely functional and visible to accommodate a range of personnel from 5th percentile female aviator through the 95th percentile male aviator IAW NATICK 89/044 and the NATICK TR 15/007 data sets in all required personal and protective clothing and equipment IAW MIL-STD-1472. The aircraft control and switch layout shall be adequately lit and considered usable by the target population for the design purpose as defined in the CONOPS. All cockpit controls shall meet the design requirements IAW Part 29 for Transport Category Rotorcraft unless superseding by the AMACC, MIL-STD-1472, or MIL-STD-1425

Assessments of the user interface shall be conducted in a progressive manner ultimately leading up to a holistic and representative configuration to be assessed.

a. Switches shall be appropriately labeled, intuitive, and easy to use IAW MIL-STD-1472 and MIL-STD-3009.

(1) Switches shall be properly labeled and back lit so that they are Type 1, Class A Night Vision Goggle (NVG) compatible (see Night Vision Goggle compatibility). Switches shall meet the minimum lighting requirements of MIL-STD-3009.

(2) Switches shall not be repurposed. Repurposing is taking a switch that had a specific function and is labeled for that function and then giving that switch a different function without changing the label.

(3) Switches shall not be multiplexed. Multiplexing is having a switch that is labeled for a specific function and can complete that function as intended but can also be used for a different unrelated function through a software unique design.

(4) The use of multi-moding switches shall be minimized but may be used for operational necessity. The multi-moding of a switch or switch cluster shall not restrict or interfere with required systems. Multi-moding is defined as having more than one mode for a switch or a group of switches with the primary philosophy being that each switch will maintain the same function in either mode. For example, a switch used to operate the sensor on the aircraft can change modes so that same switch will operate another sensor in the same manner on a remotely controlled vehicle.

(5) Critical switches such as “Jettison” switches shall also be guarded. These switches shall stand out with a distinct Black and Yellow color scheme.

(6) Switch clusters that provide redundant functionality that are located in several areas of the crew station shall maintain the same cluster pattern so as to avoid confusion for the user.

(7) Circuit Breakers shall not be used for everyday switch operations and shall be made accessible to the pilot.

(8) Critical Hard switches shall employ unique shapes for no look tactile reference to the pilot.

(9) In tandem seat platforms, critical switches and mission essential switches shall be provided in both the front and back crew station.

(10) Switches needed for Emergency Procedures shall take priority over other switches for the most accessible locations.

(11) For tactical necessity and efficient workload during night system flight, cockpit light shall have a single point of control for dimming all cockpit lighting in a uniform manner IAW MIL-STD-3009.

(12) All crew stations shall be functionally the same by way of function and switchology for all flight critical functions or additional analysis may be required.

(13) The engine instruments shall always be available and be adjacent to the basic flight instruments. The engine instruments shall be arranged in a format using JSSG-2010 as a guide.

(14) The primary and standby flight instruments shall be located in the primary field of view and legible to both pilots and can be read without errors to safely fly the aircraft.

(15) In a tandem seating arrangement, both the front and back station shall be equipped with a standby (backup) instrumentation.

(16) Switchology shall maintain a philosophy of no more than 3 button pushes to initiate an operation or function. Functions that are determined to be critical in nature shall be kept to 1 button push and will be located so that the user can action the button within 1 second when needed.

(17) Emergency controls and/or their panel backgrounds shall be provided with orange-yellow and black striping.

(18) Controls, including switches, shall be so spaced as to permit ease and accuracy of operation with gloved hands and shall be in accordance with the requirements of MIL-C-81774.

(19) The more frequently used controls shall be located closer to the operator. The location of controls on the panel shall also be determined by the following, not necessarily in order of importance:

(a) Size

(b) Type of control

(c) Number of controls

(d) Interlinkage of the controls

(e) Operating requirements, either specified or necessitated

(f) Visual display on the control panel.

(20) Touch screen switchology is not recommended for aircraft. A touchscreen shall not be the sole input device for mission critical or safety critical interfaces (such as flight control information) IAW MIL-STD-1472. Refer to AC 20-175 for additional touch screen design guidance.

b. Weapons related switches shall undergo additional analysis to ensure switches are properly guarded and abide by applicable safety standards IAW MIL-STD-1472 and MIL-STD-1425.

(1) Weapon related switches shall be tied into an OFF/SAFE/ARM three step process design.

(2) Laser switches shall be guarded “Deadman” in design IAW MILSTD1425. In rare cases, a guarded watchdog timer may be used for some lasers when operational necessity can justify the design.

(3) Weapon switches shall comply with the unique design requirements outlined on MIL-STD-1760 paragraph 4.3. Specifically, the release consent interface shall be a low power discrete used only to enable, and inhibit, safety critical store functions which are commanded by the aircraft over the data bus interface.

c. Flight controls

(1) In aircraft not equipped with stabilization systems, no emergency control that is used during flight shall be so located as to require removal of the pilot’s right hand from the cyclic pitch stick for operation.

(2) Actuation of controls and switches involving safety of flight shall be consistent with practice of previous models of the particular aircraft or of similar aircraft of the same mission time as defined in the CONOPS, provided accepted design methods have been adhered to using MIL-STD-250 as a guide.

The test plan assessments shall include, but not limited to, the following: Demonstrate that location, size, placement, range of travel, adjustment, and force requirements of primary flight controls are appropriate for the full range of operational tasks, maneuvers, and flight control technique are IAW MIL-STD-1472. Demonstrate that the aircraft controls are appropriate for the crew station configuration (i.e., side-by-side or tandem), and that separate controls are incorporated for each pilot, and a logical system of control authority has been established to prevent control conflicts or inadvertent activation of systems. Demonstrate that the arrangement of instruments is grouped functionally with priority of placement being given to the most important instruments. Interface assessments shall exercise all flight controls and switches through the full

range of motion while wearing the worst-case ensemble of personal and protective clothing and equipment required.

The airworthiness substantiation shall include a Controls and Displays Demonstration Test Plan prepared IAW DI-HFAC-80743, and a Controls and Displays Demonstration Test Report prepared IAW DI-NDTI-80809. This test and associated test report shall be updated when changes to the control arrangement or switchology configuration is made. Prepare or revise the HEDADO Report IAW MIL-STD-46855 and prepared IAW DI-HFAC-80746.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	JSSG-2010	AC 29-2 AC 23.1311-1		

9.7.3. Control and Displays Integration

The purpose of Controls and Displays Integration is to evaluate and document that the comprehensive, holistic, integrated crew station interface supports all operability and safety constraints to support human performance.

Criteria:

The aircraft system controls and displays shall be arranged to be completely functional and visible to the required crew and operator population.

Standard:

MIL-STD-1472
MIL-STD-1333
NATICK/TR-89/044
NATICK/TR-15/007
AVSCOM TR 89-D-22A
MIL-C-81774
ADS-74A-SP

Method of Compliance:

All controls are properly designed and shall be operable through their complete range of travel without interference with other controls, structures, operators' bodies and that all emergency action controls are reachable by the operators. All controls and cockpit layout shall be IAW MIL-STD-1472, NATICK/TR-89/044, NATICK/TR-15/007, AVSCOM TR 89-D-22, and MIL-C-81774 using JSSG-2010 as a guide.

Arrangement, size, spacing, shape, and group of controls, latches, and switches shall permit tactile identification and position determination under normal or degraded light conditions while wearing required personal and protective clothing and equipment IAW MIL-STD-1472 and using NATICK/TR-89/044 and the NATICK/TR-15/007 data set, as appropriate. All flight safety and critical controls shall be operated normally while the operator is seated at the design eye point with the harness locked. Emergency displays and controls shall be located within 30-degree cone about the user's normal line of sight where they can be seen and operated without delay.

A Controls and Displays Arrangement Test Plan shall be prepared IAW DI-NDTI-80566. The test plan shall include, but not limited to the following: Verify by test the location, size, placement, range of travel, adjustment, and force requirements of primary flight controls are appropriate for the full range of operational tasks, maneuvers, and flight control techniques.

Verify by test the aircraft controls are appropriate for the crew station configuration (i.e., side-by-side or tandem), and that separate controls are incorporated for each pilot, and a logical system of control authority has been established to prevent control conflicts or inadvertent activation of systems.

Test that all controls and displays are IAW MIL-STD-3009 and ADS-74SP, this includes but is not limited to sunlight readability, aided and unaided night operations, balance, and uniformity. Test the arrangement of instruments is grouped functionally with priority of placement being given to the most important instruments. All controls are properly designed and shall be operable through their complete range of travel without interference with other controls, structures, operators' bodies and that all emergency action controls shall be reachable by the operators. All flight safety and critical controls shall be operated normally while the operator is seated at the design eye point with the harness locked. This includes, but is not limited to, the following items:

a. The standby flight instruments shall be located in the primary field of view and legible to both pilots and can be read without errors to safely fly the aircraft. Obstruction to the pilot’s outside view is prohibited (manned aircraft).

b. The standby flight instrument, if located above the instrument panel, is clearly legible to both pilots, and can be read without errors to safely fly the aircraft. In a tandem seating arrangement, the standby (backup) instrumentation shall be located in the front aircrew station. Obstruction to the pilots’ outside view shall be kept to a minimum.

c. The engine instruments shall always be available and be adjacent to the basic flight instruments. The engine instruments shall be arranged in a format using JSSG-2010 as a guide.

The airworthiness substantiation shall include a Controls and Displays Arrangement Test Plan prepared IAW DI-NDTI-80566, and a Controls and Displays Arrangement Test Report prepared IAW DI-NDTI-80809. This test and associated test report shall be updated when changes to the control arrangement or switchology configuration is made. Document the layout in the HEDADO Report IAW MIL-STD-46855 and prepared IAW DI-HFAC-80746.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	JSSG-2010			

9.8. Sensors and Imaging Systems

The purpose of Sensors and Imaging Systems is to provide emulated imagery of the external visual environment when out the window visibility may not be available or may be compromised.

9.8.1. Aircraft Sensors

The purpose of Aircraft Sensors is to provide emulated imagery of the external visual environment when out the window visibility may not be available or may be compromised.

Criteria:
The aircraft sensor system shall match the human head movement and vision capabilities in all flight profiles of the aircraft to ensure safe flight.

Standard:
Aircraft System Specification

Method of Compliance:
The aircraft shall be able to detect terrain, threats and obstacles and provide range and bearing from the aircraft to the identified hazard IAW the aircraft system specification. The detection range and means of presentation shall support the necessary reaction time for pilot-in-the-loop control systems and flight profiles to support corrective actions. The sensor data may be presented to the crew and operators as a visual image, as inputs to a sensor driven command guidance and flight control system, or some combination of the two. The intent of the system is provide the ability to sense other terrain or obstacles even if the obstacle or terrain is outside the crew's visual field (i.e., below or behind). This same capability may be used to detect friendly (i.e., wingman) as well as unknown or hostile entities that could be used for localized airspace deconfliction or targeting. The mode of presentation of information from an aircraft sensor system shall be traceable to the CTAR. The probability of detect and range criteria shall support the necessary timelines to accommodate human response characteristics given the expected flight profiles to be supported (i.e., airspeed, altitudes, etc.) IAW aircraft system specification. The design of the sensor system shall be provided. The designed modes of presentation and criteria of performance shall demonstrate the design is capable of supporting the aircraft system specification.

Prepare a Sensors and Imaging Test Plan IAW DI-HFAC-80743 to demonstrate the necessary performance characteristics of the system during all necessary flight maneuvers and flight profiles.

Demonstrate and test the sensor systems to characterize the performance of the system and verify the performance criteria have been met IAW the aircraft system specification.

The airworthiness substantiation shall include a Sensors and Imaging Test Plan prepared IAW DI-HFAC-80743, and a Sensors and Imaging Test Report prepared IAW DI-HFAC- 80744 and included as part of the Human Engineering Design Approach Document- Operator (HEDAD-O). HEDAD-O Prepare or revise the HEDAD-O Report IAW MIL-STD- 46855 and prepared IAW DI-HFAC-80746.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.8.2. Imaging Systems

The purpose of Imaging Systems is to provide emulated imagery of the external visual environment when out the window visibility may not be available or may be compromised.

Criteria:

The aircraft sensor system shall match the human head movement and vision capabilities in all flight profiles of the aircraft to ensure safe flight.

Standard:

Aircraft System Specification

Method of Compliance:

The aircraft sensor system shall allow the pilot to present an emulated image of the outside world in any required visual environment that supports realistic human head movements, to include matching how the human head stops and changes direction, as well as the field of view/field of regard requirements. Head movement speeds shall reflect real world movements and the system shall not dictate head movement speeds. Displays and their video refresh rates shall accommodate the sensors field of view with respect to realistic head movement speeds. For tactical flights, cockpit lighting will have a single point of control for dimming of all cockpit lighting in a uniform manner. For any aircraft that is providing sensor imagery intended for use as a primary flight system, a back-up pilotage system shall be available that is identical in performance as the primary system. The visual scene content shall be free from unique system visual illusion, vibration and other anomalies that are not components of the real world scene content. During high speed head movement, sensor video shall be presented to the human in a manner that is consistent to what the human is used to seeing while un-aided. There shall be no sensor induced illness to the user. The quality of the sensor video displayed shall be usable and match the movement capability of the human in all aspects throughout the entire flight profile of the aircraft. Unity magnification and other appropriate design features shall be IAW the aircraft system specification.

Prepare an Imaging and Systems Test Plan IAW DI-HFAC-80743 to demonstrate by completing ATM Flight Maneuvers while using the sensor. Sensor excitation/ movement must also be achieved and measured in all aspects of head movement at a hover and again during a horizontal flight airspeed (Vh) flight profile and not as a bench test. The airworthiness substantiation shall include an Imaging and Systems Test Plan IAW DI-HFAC-80743, an Imaging Systems Test Report prepared IAW DI-HFAC-80744 and included as part of the Human Engineering Design Approach Document-Operator (HEDAD-O).HEDAD- O Prepare or revise the HEDAD-O Report IAW MIL-STD-46855 and prepared IAW DI-HFAC-80746.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.8.3. Minimum Displayed Field of View (FOV)/ Field of Regard (FOR)

The purpose of a minimum displayed FOV/ FOR is to ensure that the required visibility of the external environment is provided in order to support the range of required tasks.

Criteria:

The aircraft system shall provide a FOV/FOR that supports the full range of flight maneuvers to ensure safe flight.

Standard:

For an aircraft system emulating the external visual environment, the instantaneous FOV should be no less than 30 degrees horizontal by 30 degrees vertical [30x30 (Threshold), 30X40 (Objective)] for hover/landing operations and [50x30 (Threshold), 50X40 (Objective)] for enroute. The Field of Regard (FOR) shall be large enough (vertical and horizontal) to support safe operations based on the maneuverability of the aircraft system and the needs to maintain all necessary tasks and functions. AC 20-167

Method of Compliance:

The aircraft's instantaneous FOV should be no less than 30 degrees horizontal by 30 degrees vertical (30x30 (Threshold), 30X40 (Objective)) for hover/landing operations and (50x30 (Threshold), 50X40 (Objective)) for enroute. The aircraft's FOR shall be large enough (vertical and horizontal) to s74upport safe operations based on the maneuverability of the aircraft systems. The FOR may be equal to or greater than the FOV depending on the range of visibility necessary to perform the full range of required tasks. Any limitations or deficiencies in the FOV/FOR shall be documented within the context of a defined safe envelope. The airworthiness substantiation of a test shall include the FOV and FOR to ensure the display system supports the full range of tasks and functions. Considerations and/or modifications of these requirements may be necessary based on the intended display format used by crews (i.e., panel mounted vs. helmet mounted display [HMD]). Perception of depth of field and other perceptual artifacts may require unity magnification in order to perform specific tasks. The FOR may be equal to or greater than the FOV depending on the range of visibility necessary to perform the full range of required tasks. See AC 20-167.

The airworthiness substantiation shall include a Test/Inspection Report prepared IAW DI- NDTI-80809 and included as an appendix to the HEDAD-O. Prepare or revise the HEDAD- O Report IAW MIL-STD-46855 and prepared IAW DI-HFAC-80746.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.9. Cockpit Geometry and Compatibility

The purpose of Cockpit Geometry and Compatibility is to evaluate the crew station design is safety operable by all members of the target population throughout all necessary flight and mission tasks and functions and to document the anthropometric and other related physical integration effects between the cockpit and crew station design and the human occupants.

Criteria:
The aircraft crewstation/operator station shall accommodate the 5th percentile female through the 95th percentile male soldier for critical body dimensions to include wearing all personal and protective clothing and equipment for functional reach, accessibility, ingress/egress, and crash effects of all members of the target population as defined by the criticality of function and requirements herein.

Standard:
MIL-STD-1472
NATICK/TR-89/044
NATICK/TR-15/007
AVSCOM TR 89-D-22
FAA AC 25-11
MIL-STD-3009
MIL-STD-3009
MIL-S-85510
MIL-R-8236
MIL-STD-1290
MIL-STD-2525
MIL-STD-411
MIL-STD-1280
MIL-STD-1474
MIL-W-5664
AMCP 706-203

Method of Compliance:
All system's crewstation/operator station shall be able to accommodate a range of personnel from the 5th percentile female to 95th percentile male IAW NATICK/TR-15/007. Prepare a Cockpit Geometry and Compatibility test plan IAW DI-HFAC-80743. Prepare a Cockpit Geometry and Compatibility test report IAW DI-HFAC-80746. Conduct the test IAW with the test plan and ensure that the location, size, placement, range of travel, adjustment, and force requirements of controls are appropriate for the full range of operational tasks, maneuvers, and flight control techniques. When fully equipped, all applicable functions for flight operations, crew mission functions, personnel restraints, emergency egress, and maintenance and support functions shall be tested.

The zones of reach shall be defined as follows:

a. ZONE 1 Restraint Harness Locked – Functional Reach. This zone shall include the area that can be functionally reached and actuated by any crewmember within the

5th percentile female to 95th percentile male range as defined in NATICK/TR-15/007 and supplemented with NATICK/TR-89/044 as appropriate, when located at the appropriate design eye position fully restrained and equipped without stretch of arm or shoulder muscles. Controls placed in this zone shall include those frequently used during operation of the aircraft in flight phases which require full restraint. This would include such flight phases as takeoff, landing, low altitude-high-speed flight, weapons delivery, and escape. This zone defines the maximum allowed for the placement of emergency (escape system) controls and establishes the forwardmost operation limit of primary flight and propulsion controls. At a minimum, the following controls (normal and emergency unless otherwise specified) shall be located in Zone 1 reach:

(1) Cyclic

(2) Collective

(3) Power (throttles, mixture, etc)

(4) External stores release

(5) Trim (aircraft/engine)

(6) Primary/alternate escape system

(7) Restraint device lock

(8) Landing gear selector

(9) Autopilot/flight director disconnect

(10) Bailout/ditching alarm

(11) Emergency electrical power

(12) Emergency engine shutdown and fire extinguishing (i.e., Fire Pull Handles)

(13) Primary fuel selector

(14) Stick positioner

(15) Air start

(16) Cargo hook release

(17) Cable cutters

(18) Master Arm Switch

b. ZONE 2 Restraint Harness Locked – Maximum Functional Reach. This zone shall include the area that can be functionally reached and actuated by any crewmember

within the 5th percentile female to 95th percentile male range as defined in NATICK/TR-15/007 and supplemented with NATICK/TR-89/044 as appropriate, when located at the appropriate design eye position fully restrained and equipped with maximum stretch of should and arm muscles. This zone defines the maximum limit allowed for the placement of helicopter primary flight and propulsion controls and the placement of emergency controls other than escape controls and any controls mentioned in the Zone 1 section above.

c. ZONE 3 Restraint Harness Unlocked – Maximum Functional Reach. This zone shall include the area that can be functionally reached and actuated by any crewmember within the 5th percentile female to 95th percentile male range as defined in NATICK/TR-15/007 and supplemented with NATICK/TR-89/044 as appropriate, when located at the appropriate design eye position with the shoulder restraint fully extended and the arms stretched full length.

Aircraft flight controls shall meet the anthropometric, positioning, and range of motion requirements below.

a. Pitch and Roll Controls

(1) Stick Type. The vertical location of the control grip reference point shall be operable within Zone 1 for the 5th percentile female to 95th percentile male range as defined in NATICK/TR-15/007 and supplemented with NATICK/TR-89/044 as appropriate. A minimum clearance of 1.5 inches shall be maintained between the stick and all structures when the stick is in any extreme position. Special consideration shall be given to the effect of personal and survival equipment, examples to be used as a guide are contained in Table I of MIL-STD-1333.

(2) Control Wheel Type. A minimum clearance of 1.5 inches between the wheel and structure shall be maintained in addition to a minimum clearance of 0.5 inch between the crewmembers hand and body and a minimum clearance of 1.5 inches between the bottom surface of the wheel and the aircrew member’s leg when operated throughout the 5th percentile female to 95th percentile male range as defined in NATICK/TR-15/007, and supplemented with NATICK/TR-89/044 as appropriate. The maximum wheel throw envelope shall be within Zone 1 reach while above the minimum clearances are maintained.

b. Propulsion Controls

(1) Single Throttle. The location of the forwardmost position of the throttle shall be within Zone 1 reach. All controls on the throttle shall be operable throughout the entire range of movement and provide 1.5 inches minimum structural clearance of the maximum specified arm. Figure 5 of MIL-STD-1333 may be used as a guide.

(2) Multiple Throttle. Locate the same as for single throttle, except the geometry of all throttles shall be based upon the forwardmost position of the throttle furthest from the crewmember laterally.

(3) Collective Lever. The collective control shall be located as shown in Figure 6 of MIL-STD-1333.

(4) Brake and Yaw Control Pedals. The yaw control requirements herein do not apply to aircraft which have the yaw control integrated into a multi-axis flight controller. The yaw control shall consist of two pedals of the configuration conforming to MIL-B-8584. Differential braking defined by MIL-B-8584 shall be provided by these pedals. The most forward adjustment position of the yaw controls shall be based upon the specified leg length seated with the seat full aft and full down, and yaw controls on, full forward throw, with the brake fully depressed. The most aft adjustment position of the yaw controls shall be based on the minimum specified leg length seated with seat full forward and full up and full forward yaw control throw, with the brake fully depressed. Yaw control pedals forward and aft range requirements shall be based on functional leg throw data provided by the acquiring activity. A minimum clearance of 1.5 inches above and 0.75 inches on either side of the pedal shall be maintained over the maximum specified foot in a flight boot, throughout the full pedal travel include brake application with the midheel at the fulcrum position of the pedal. With normal braking procedures, a 1.5 inch clearance between maximum size footwear and all adjacent instruments and structure shall be maintained for any flight station seating geometry and population member. Throughout the range of yaw control adjustment and travel, the distance from the brake fulcrum to the nearest point on the crewstation floor shall be a minimum of 4.75 inches. Pedal length shall be the minimum re quired to satisfy braking requirements.

c. Control Panel and Consoles

(1) 5th percentile female to 95th percentile male range as defined in NATICK/TR-15/007, and supplemented with NATICK/TR-89/044 as appropriate, shall have unrestricted visual access and functional reach of all controls.

d. Instrument Panel

(1) Instrument Panel Clearance. The instrument panel shall be located so as to provide a 1.5 inch clearance with the crewmember's legs through the full range of leg movement. Figures 3 and 7 in MIL-STD-1333 may be used as a guide.

(2) Instrument Panel Viewing Angle. The panel shall provide the most normal viewing angle as practicable from the design eye position.

e. Multi-Crew Station Requirements – Tandem Arrangement

(1) The single crew station geometry shall be duplicated for both crew stations.

(2) The minimum fore and aft spacing between the crew stations shall be based on the minimum space required to accommodate the largest specified crewmember in each station while maintaining full control movements in both stations.

f. Multi-Crew Station Requirements – Side-by-Side Arrangement

(1) This configuration shall consist of two crew stations side-by-side, similar in seating, clearances, and flight controls. Propulsion control locations shall be based on the requirements for equally adequate access and operation by either crewmember under all flight conditions.

(2) Both crew positions shall be on the same level, unless otherwise specified. The lateral centerline spacing between crewmembers shall be a minimum of 26 inches and a maximum of 42 inches centerline to centerline for configurations with displays and controls common for both crewmembers. In rotary wing aircraft, the dimensions shall be a minimum of 36 inches and a maximum of 50 inches.

(3) Minimum lateral spacing shall be based upon minimum clearances between seat and structure or controls and providing for no interference between crewmembers in performance of their flight tasks. The absolute minimum clearance between seats shall be 3 inches for non-ejection seats and 6 inches for ejection seats.

g. Anti-Torque Pedals. The location and method of actuation of anti-torque pedals in single/tandem/side-by-side pilot aircrew stations shall be conventional as defined by QBS with similar aircraft of similar missions using MIL-STD-250 as a guide.

h. Anti-Torque Pedal Adjustment Control. The anti-torque pedal adjustment control in single/tandem/side-by-side pilot aircrew stations shall be located and actuated as follows:

(1) Location. A single control to adjust both pedals is required and shall be located forward of and near the centerline of the pilot.

(2) Actuation. The control motion to extend the pedals shall be clockwise, push, or lift (depending on the type of mechanism employed).

i. Cyclic Pitch Stick Control. The location and method of actuation of the cyclic pitch stick controls in single/tandem/side-by-side pilot aircrew stations shall be conventional as defined by QBS with similar aircraft of similar missions using MIL-STD-250 as a guide. Separate controls shall be incorporated for each pilot Cyclic Pitch Stick Grip. The following functions, if required, shall be provided on the cyclic pitch stick grip:

(1) Electric trim control

(2) Force trim

(3) Radio – Intercommunication control system (ICS) switch

(4) Release (cargo hook, tow hook, external stores)

(5) Rocket firing

(6) Gun firing

(7) Auto pilot/ stability augmentation system (SAS) release

j. Collective pitch stick control. The collective pitch stick control in single/tandem/side-by-side pilot aircrew stations shall be in accordance with the following requirements:

(1) Location. To the left of the pilot(s) seat

(2) Actuation. shall be conventional as defined by QBS with similar aircraft of similar missions using MIL-STD-250 as a guide.

(3) Design. Separate controls of the same configuration shall be provided for each pilot. An adjustment friction device or irreversible mechanism shall be incorporated in the pilot-in-command control only.

k. Automatic Flight Control System controls. The location and actuation of the automatic flight control system controls shall be as follows:

(1) Single/tandem pilot:

(a) Location. On the left console convenient to the pilot

(b) Actuation. Performance related.

(2) Side-by-side pilot:

(a) Location. On the center console accessible to both pilots

(b) Actuation. Performance related

(3) An emergency cutoff switch shall be located on the cyclic pitch stick grip

l. Flight Trim Controls. The following requirements shall apply to the location, actuation, and design of trim controls:

(1) Single/tandem pilot:

(a) Location. On the left console convenient to the pilot, except when the trim controls are electrically actuated, in which case they shall be placed on the top aft portion of the cyclic stick grip

(b) Actuation. Performance related

(c) Design. Trim Controls shall be designed to safeguard again inadvertent or abrupt operation. An override switch shall be provided to stop overtrim action. If required, means shall be provided to indicate the direction of adjustment and position of the trim device with respect to the range of adjustment. The indicator shall be clearly distinguishable day and night over the entire trim range. Unless

otherwise specified by the procuring activity, the electrical trim shall be a four-way “Chinese hat” type control.

(2) Side-by-side pilot:

(a) Location. On the center console accessible to both pilots, except when the trim controls are electrically actuated, in which case they shall be placed on the top aft position of the cyclic control stick grip.

(b) Actuation. Performance related.

(c) Design. Requirements for single pilot apply.

m. Force trim. The following requirements shall apply to the force trim control in single/tandem/side-by-side pilot aircrew stations:

(1) Location. When an electrically actuated force trim is used, the control shall be located on the cyclic stick grip.

(2) Actuation. Performance related,

(3) Design. The force trim shall be a pushbutton-type switch.

n. Landing Gear Control. The landing gear control shall be in accordance with the following requirements:

(1) Single/tandem pilot:

(a) Location. Forward on the left and operable by the pilot with shoulder harness locked,

(b) Actuation. Performance related.

(c) Design. Landing gear control knob shape shall conform to MS26521. Indicator light shall be steady ON when landing gear position does not correspond with landing gear control selection.

(2) Side-by-side pilot:

(a) Location. On the lower center portion of the instrument panel or on the center console operable by both pilots in their normal positions while maintaining forward visibility out of the aircraft

(b) Actuation. Performance related.

(c) Design. Requirements for single pilot apply.

(3) Emergency retraction - Single/tandem/side-by-side pilot:

(a) Location. As close as practicable to the normal control.

(b) Actuation. Depress pushbutton or similar device and raise landing gear control lever.

(c) Design. Emergency override control shall be provided with a safety device to prevent inadvertent actuation on the ground.

o. Alternate Landing Gear Control. The alternate landing gear control in single/tandem/side-by-side pilot aircrew stations shall be in accordance with the following requirements:

(1) Location. The alternate control shall be separate from, but as close as practicable to the normal control, unless specific approval is granted for an integral control. Where cockpit space is at a premium, considera-tion shall be given to integrating this control with the normal gear control. The design shall be such as to preclude interaction between normal and alternate operation. Failure of the normal gear control shall not preclude subsequent successful actuation of the alternate gear system.

(2) Actuation. A separate and distinct motion from normal operation (performance related).

p. Wheel Brake Controls. The following requirements shall apply to wheel brake controls in single/tandem/side-by-side pilot aircrew stations:

(1) Location. Toe pedals, integral with each anti-torque (rudder) pedal.

(2) Actuation. Conventional.

(3) Design. When dual brake controls are incorporated, simultaneous braking action by both pilots shall be possible.

q. Parking Brake Control. The location and actuation of the parking brake control shall be as follows:

(1) Single/tandem pilot:

(a) Location. Under the instrument panel to the left of the pilot's centerline.

(b) Actuation. Pull to actuate. Press brake pedals to release.

(2) Side-by-side pilot:

(a) Location. On the center console or below the instrument panel, accessible to both pilots.

(b) Actuation. Actuation for single pilot applies.

r. Wheel Centering Lock. The wheel centering lock in single/tandem/side- by-side aircrew stations shall be located on the left or center console. Actuation shall be upward or forward, or both, to lock and reverse action to unlock.

s. Rotor Brake Control. The ·following requirements shall apply to the rotor brake control in single/tandem/side-by-side pilot aircrew stations:

(1) Location. Adjacent to the power quadrant, on left, center, or overhead console, operable by either pilot.

(2) Actuation. Performance related.

(3) Design. A safety device shall be incorporated in the system to prevent starting of rotor while brake is engaged. Design of the control shall be such that inadvertent operation will not be possible,

t. Rotor Blade Folding Controls (Ground). The following requirements shall apply to the rotor blade folding controls (ground) in single/tandem/ side-by-side pilot aircrew stations:

(1) Location. On the left console or overhead console accessible to the pilot(s).

(2) Actuation. Forward for the spread position, aft for the fold position.

(3) Design. Actuation of the control to fold the rotor blades shall automatically position the blades for folding. Positive interlocks shall be provided to prevent premature or accidental engagement and to prevent rotation of the rotor head during fold/spread cycle or while blades are folded.

u. The engine conditioner control shall be in accordance with the following requirements:

(1) Location. The control may be an integral part of the collective stick control grip, or it may be arranged on a separate engine control panel, depending on the mission requirement. If the engine conditioner control is located on the collective stick control, it shall be a twist-grip-type control. When a beta control (thruster propeller pitch) is employed on the collective stick, the engine conditioner control shall be located immediately aft of the beta control. When the engine conditioner control is arranged on an engine control panel, it shall be located on the left console in a tandem pilot seating arrangement or on the center pedestal in a side-by-side pilot seating arrangement. In the event space is not available on the pedestal, the engine control panel may be located on the overhead console when approved by the procuring activity.

(2) Actuation. Actuation shall be to rotate the twist grip control clock- wise (viewed from free end of stick), starting at the OFF position. Actuation of controls on the engine control panel shall be conventional or performance related. When required, the engine conditioner control shall be provided with the following functions:

(a) Off (stop engine)

(b) Start and ignition

(c) Ground idle

(d) Flight idle

(e) Run

(f) Friction control.

(3) Design. Maximum angle of rotation for the twist grip control shall not exceed 150 degrees, and it is preferred the rotation shall not exceed 120 degrees when possible. The rotation angle is measured starting from the OFF position. Positive stops shall be provided for each function. A safety feature shall be incorporated to prevent inadvertent rotation of the control to the next function. A friction device, adjustable by the pilot, shall be provided to control the effort required to rotate the control. The friction control shall be operable by the pilot with his left hand with- out releasing his hold on the collective stick grip. Markings shall be pro- vided to show each control function and arrowheads to show the direction of rotation.

v. Engine(s) Speed Trim Control(s). The engine(s) speed trim control(s) shall be in accordance with the following requirements:

(1) Location. On the top end of the collective stick control and accessible by the pilot without removing his left hand from the collective stick grip control. If two or more engines are installed, engine speed trim controls (beepers) shall be located side-by-side on the top forward end of the col-lective stick control head and shall be numbered from left to right in accor-dance with engine numbering convention.

(2) Actuation. Actuation shall be momentary (beep) type switch, forward to increase engine RPM and aft to decrease engine RPM.

(3) Design. Engine trim switch(es) shall provide fine adjustment of the engine speed when the engine conditioner control is in the run position. Markings shall be provided to show the increase and decrease RPM positions. When more than one engine is controlled, the trim switch(es) shall provide for individual adjustment of the engine speed. Markings shall be provided to identify the trim switch(es) corresponding to the engine.

(4) Emergency engine trim switch(es)

(a) Location. Aft of the engine condition levers on the console.

(b) Actuation. Actuation shall be momentary (beep) type switch forward to increase engine RPM and aft to decrease engine RPM.

(c) The emergency engine trim switch(es) shall provide for emergency engine trim if the power turbine control box (normal beep trim) malfunctions. Marking shall be provided as specified in (c) above.

w. Beta Control (thrust propeller). The beta control (thrust propeller) shall be in accordance with the following requirements:

(1) Location. The control shall be an integral part of the collective stick control grip and shall be a twist grip control similar to the engine conditioner control. It shall be located immediately forward of the engine conditioner control and shall adjust the pitch of the thrust propeller for forward and reverse thrust.

(2) Actuation. Actuation shall be accomplished by twisting or rotating the grip clockwise (viewed from free end of stick) to increase pitch and counterclockwise to decrease pitch in the forward thrust position. Reverse thrust shall be accomplished by rotating the control counterclockwise (viewed from free end of stick). Rotation counterclockwise while in reverse thrust shall increase the pitch of the thrust propeller in reverse. A positive stop or detent shall be provided at the neutral beta pitch setting to prevent inadvertent selection of reverse pitch and to provide a distinct point of reference between forward and reverse pitch settings.

(3) Design. The maximum angle of rotation shall be 120 degrees from full reverse thrust to full forward thrust. A friction control shall be provided for adjusting the friction on the beta twist control. The friction control shall be adjustable by the pilot without removing his left hand from the collective stick control. Markings shall be provided to show the position of the control, with arrowheads showing the direction of rotation.

x. Pitch Trim Speed, Range Control. Location, actuation, and design of the pitch trim speed, range control shall be as follows:

(1) Location. On the center pedestal in side-by-side aircrew station, accessible to both pilots. In tandem aircrew station, on the left side console.

(2) Actuation. Forward actuation to select the high-speed range for the beta control and aft to select the low-speed range.

(3) Design. The switch shall be marked to show the position corresponding to the speed range.

y. Gas Turbine Engine Ignition Control Switch(es). The following requirements shall apply to the ignition control switch(es) for gas turbine engines:

(1) Single/tandem pilot:

(a) Location. On the left console and operable by the pilot with shoulder harness locked.

(b) Actuation. Clockwise rotation from the off position shall produce the sequence IGNITION, START, NORMAL for systems which incorporate single as well as integrated functions.

(c) Design. Individual switches with provisions for emergency aborting shall be used on gas turbine engine aircraft. Ignition switches shall be separated electrically and mechanically with- out provision for multiple cutoffs.

(2) Side-by-side pilot:

(a) Location. On the overhead console in the number 3 position as shown on figure 4 of MIL-STD-250.

(b) Actuation. Actuation for single pilot applies.

(c) Design. Requirements for single pilot apply.

z. Ground Start Switches. The ground start switches shall be in accordance with the following requirements:

(1) Location. On power panel or collective stick control console or pedestal convenient for ground starting operations.

(2) Actuation. Conventional.

(3) Design. The start switch shall combine starter and ignition function.

aa. Stop Switch. The stop switch shall be in accordance with the following requirements:

(1) Location. On the collective stick control grip or on the power panel, accessible to the pilot.

(2) Actuation. Conventional.

(3) Design. The switch shall be clearly marked and located to prevent inadvertent actuation by the pilot while operating the collective stick control.

bb. In-Air Start Switch. The in-air start switch shall be in accordance with the following requirements:

(1) Location. On the collective stick control.

(2) Actuation. Pushbutton type switch. Press for ignition and spring return for OFF.

(3) Design - The pilot shall be capable of actuating the switch without removing his left hand from the collective stick control. Markings shall be provided to identify the

switch from other pushbutton-type switches. Inadvertent actuation of the in-air start switch shall have no adverse effect upon engine operation.

cc. Firefighting system controls. The following requirements shall apply to firefighting system controls:

(1) Single/tandem pilot:

(a) Location. On an emergency panel forward of the pilot, operable with his left hand when the shoulder harness is locked.

(b) Actuation. Pull to actuate.

(c) Design. Firefighting control shall consist of a single emergency control for each engine or critical area and one agent discharge switch per aircraft. The control knob(s) shall incorporate a warning light which is illuminated when the fire warning system for the area served by the control is activated. Additional fire warning lights shall be provided on the instrument panel when the control knob(s) or handle(s) cannot be placed in the 30-degree forward cone of vision. Actuation of the control shall perform all necessary fire extinguishing operations except discharge of the agent. Actuation of the agent discharge switch shall release the agent to the area selected by the fire emergency control. The control knob shape shall conform to MS26523.

(2) Side-by-side pilot:

(a) Location. Either on the instrument panel under the glare shield or on an emergency overhead panel in the number 1 position.

(b) Actuation. Pull to actuate.

(c) Design. Requirements for single pilot apply.

dd. Master Electrical Control Switches, Including the Battery, Generator, and Inverter Controls. The following requirements shall apply to the master electrical control switches, including the battery, generator, and inverter controls:

(1) Single/tandem pilot:

(a) Location. Functionally grouped in an electrical panel immediately aft of the fuel panel.

(b) Actuation. Performance related.

(c) Design. Battery and generator switches shall be operable by the pilot with shoulder harness locked.

(2) Side-by-side pilot:

(a) Location. Functionally grouped on the overhead console in the number 3 position (see figure 4 of MIL-STD-250).

(b) Actuation. Performance related.

ee. Lighting and Miscellaneous Switches. Lighting and miscellaneous switches shall be in accordance with the following requirements:

(1) Single/tandem pilot:

(a) Location. Switches and rheostats functionally grouped in a lighting panel on the aft portion of the console.

(b) Actuation. Performance related.

(2) Side-by-side pilot:

(a) Location. Switches and rheostats functionally grouped in the number 4 position of the overhead console (see figure 4 in MIL-STD-250).

(b) Actuation. Performance related.

ff. Landing Light and Searchlight Switch(es). The landing light and searchlight switch(es) in single/tandem/side-by-side pilot aircrew stations shall be in accordance with the following requirements:

(1) Location. On the forward end of the collective pitch stick.

(2) Actuation. Performance related.

(3) Design. Actuation of the switch(es) shall not require removal of the pilot's left hand from the collective pitch stick grip. The searchlight slew control shall be a four-way "Chinese hat" type switch.

gg. Circuit Protective Devices. The location, actuation, and design of circuit protective devices shall be as follows:

(1) Single/tandem pilot:

(a) Location. Inboard face of left-hand console grouped functionally.

(b) Actuation. Conventional.

(c) Design. In aircraft where available cockpit space is limited, only those circuit protective devices essential to safety of flight shall be located in a position accessible to and readable by the pilot. Circuit breakers not essential to the safety of flight may be placed elsewhere in the cockpit in such positions as not to occupy space considered more essential for operating controls but must be accessible to the pilot or copilot.

(2) Side-by-side pilot:

(a) Location. On the overhead console in the number 5 position, as shown on figure 4 of MIL-STD-250 and grouped functionally.

(b) Actuation. Push to reset.

(c) Design. Requirements for single pilot apply.

hh. Radio, Radar, and Navigation Controls. The location, actuation, and design of radio, radar, and navigation controls shall be as follows:

(1) Single/tandem pilot:

(a) Location. In a radio panel on the left-hand console aft of the electrical panel, as shown on figure 1 of MIL-STD-250.

(b) Actuation. Performance related.

(c) Design. The radio-ICS switch shall be a three-position switch located on the cyclic pitch stick grip. In aircraft equipped with a stabilization system, other radio, radar, and navigation controls may be located on the right-side console.

(2) Side-by-side pilot:

(a) Location. Radio panel aft of power quadrant on center console, as shown on figure 3 of MIL-STD-250.

(b) Actuation. Performance related.

(c) Design. Requirements for single pilot apply.

ii. Armament Controls. Armament controls shall be located and designed as follows:

(1) Location. On separate armament panel(s) forward of the pilot or crew-member, on the lower part of the instrument panel separate from the standard instrument arrangement. When space is provided, the armament panel may be located on the center or side console.

(2) Design. The controls shall be accessible to the pilot(s) or crewmember(s)1 having operational responsibility over the particular armament. The pilot(s) shall have primary control of all armament systems. They shall be function- ally grouped on the panel(s). Armament controls considered a safety hazard shall be provided with a safety device to guard against inadvertent actuation.

jj. Weapon(s) control and associated equipment. The following requirements shall apply to the designated weapon(s) control and associated equipment:

(1) Weapon(s) firing switch:

(a) Location. On the cyclic stick control grip, accessible to the pilot's forefinger of his right hand while holding the grip during flight conditions. When crewmembers other than the pilot are provided with a firing switch not on the cyclic stick control grip, it shall be similarly located on the armament grip provided.

(b) Actuation. Squeeze action shall actuate firing of the selected weapon(s). When required, the weapon(s) firing switch shall also operate the gun camera.

(c) Design. The weapon(s) firing switch shall be an on-off trigger switch incorporating a spring return to OFF when released (MIL-S-9487). A safety guard shall be provided over the trigger to prevent inadvertent actuation.

(2) Armament sight and range controls - tandem aircrew station:

(a) Location - Controls for the armament sight and ranging shall be located as follows:

Pilot: On the weapon/armament panel on the lower left side of the instrument panel or on the sight. The pilot direct sight shall be above the instrument panel. If required to facilitate crew visibility, a means of moving the armament sight to a stowed position when not in use shall be provided.

Copilot gunner: On the weapon/armament panel in the center of the instrument panel or on the sight. An auxiliary weapon panel may be located on the lower right side of the instrument.

(b) Actuation. Conventional.

(3) Armament sight and range controls - side-by-side aircrew station:

(a) Location. On the weapon/armament panel(s) below the instrument panel or on the sight, accessible to both pilots.

(b) Actuation. Conventional.

(c) Design. The pilot may have a direct sight located above the instrument panel. Provisions shall be made to stow the sight out of the way when not in use. If required to facilitate crew visibility, light indicators shall be provided on the weapon/armament panel to show the status of the weapons system. Counters shall be provided to show the number of rounds fired from each gun. Red indicator lights shall not be used for advisory on the armament panel. This design shall apply in the case of single and tandem pilot crew stations.

kk. External Stores Controls. External stores controls shall be in accordance with the following requirements:

(1) External stores release switch:

(a) Location. On the cyclic stick control grip, accessible to the pilot with his right thumb.

(b) Actuation. Press pushbutton-type switch to release external stores.

(c) Design. The external stores release switch may serve a dual function of releasing external stores or as cargo hook release when a selector control is provided. The selector switch on the armament panel must be selected to correspond with external stores release when provided. If a requirement for a dual function is not specified, approval shall be obtained from the procuring activity to provide the dual function. A feature shall be incor-porated to guard against inadvertent release of external stores.

(2) Emergency release of external stores:

(a) Location. On armament/weapons panel or adjacent to it accessible to the pilot.

(b) Actuation. Pull to release external stores.

(c) Design. The mechanical release control shall be provided in addition to the electrical release switch. Location of a mechani-cal release of external stores in other than the pilot aircrew station shall require approval by the procuring activity. Emer-gency markings shall be provided on the control handle in accordance with MIL-M-18012.

ll. Oxygen System Controls and Quick-Disconnect Hose. The following requirements shall apply to oxygen system controls and quick-disconnect hose:

(1) Location. Forward to the left side of the pilot's seat readily access-ible with his left hand and clearly visible from his operating position. For other crewmembers, conveniently located to correspond with their crew duties.

(2) Actuation. Conventional.

(3) Design. The type of oxygen regulator shall be provided as specified by the procuring activity.

mm. Release Switch (external, tow cable, cargo hook). The release switch (external, tow cable, cargo hook) shall be in accordance with the following requirements:

(1) Location. On the cyclic stick control grip accessible to the pilot with his right thumb or in the hoist operator's station on a hoist control panel or remote handgrip control.

(2) Actuation. Press pushbutton switch to release. Selector switch on the appropriate panel must be selected to correspond with release function.

(3) Design. A feature shall be incorporated to guard against inadvertent release of the cargo hook. When controls are provided for a crewmember, a release switch shall be provided for him as specified.

nn. Cargo Emergency Release Control. The location, actuation, and design of the cargo emergency release control shall be as follows:

(1) Location. Immediately accessible forward of the cyclic pitch stick and between the anti-torque pedals and guarded against inadvertent actuation,

(2) Actuation. Push foot pedal control to release cargo or pull when a hand-operated control is provided in the aircrew station for the hoist operator.

(3) Design. The mechanical release control shall be provided the pilot in addition to the electrical release switch. Location of a mechanical release in other than the pilot aircrew station shall require the approval of the procuring activity. Markings shall be provided to show for emergency use. The foot pedal control shall be so located as to require positive action by the pilot to guard against inadvertent actuation.

oo. Hoist Control Switch. The following requirements shall apply to the hoist control switch:

(1) Location. On the cyclic or collective stick control grip, on a panel, or on a remote handgrip in the hoist operator's aircrew station, as specified by the procuring activity.

(2) Actuation. Performance related. The switch shall spring return to OFF when released.

(3) Design. Responsibility for control of the hoist shall be as specified and as dictated by mission requirements.

pp. Tow Winch System - Cable Cutter Arm Switch and Tow Displavs. The tow winch system (cable cutter arm switch and tow displays) shall be located on the upper outboard ·area of the instrument panel. The design shall include provi-sions for monitoring cable tension payout and load yaw. A switch for activation of the able cutter shall be located on the pilot's collective stick control.

qq. Ventilating System Controls. The following requirements shall apply to the ventilating system controls:

(1) Location. When no air-conditioning system is provided, controls shall be located adjacent to the heater control panel. Vent controls shall be located on the lower part of the instrument panel.

(2) Actuation. Conventional.

(3) Design. Individual air outlets, when provided, shall be equipped with controls to regulate the flow of air.

rr. Auxiliary Power Unit (APU) controls. The location and actuation of APU controls shall be as follows:

(1) Location. Arranged on individual panel located un overhead console, if provided, or on center pedestal accessible to both pilots in side-by- side aircrew stations, in tandem aircrew stations, on the left console. The APU control panel shall be grouped with electrical power panels.

(2) Actuation. Momentary-type switch actuated forward to start and spring return to center (run position). Aft position shall stop operation of the APU. Instruments shall be provided adjacent to the control switch to show the engine speed and operating temperature. Any anthropometric analysis, demonstration, or testing shall be conducted with the seat and controls adjusted so that the crewmember is at the design eye position. Anthropometric positioning shall be conducted via analysis using the definitions below and MIL-STD-1333 as a guide.

(3) Design. Eye position shall be defined as the midpoint of the design eye line from which all crewstation dimensions are related and referenced.

(a) The design eye line shall be defined as a segment of the over the nose line connecting two points which represents the predicted eye positions of the ends of the 5th percentile female to 95th percentile male range as defined in NATICK/TR-15/007 and supplemented with NATICK/TR-89/044 as appropriate.

(b) Horizontal vision line shall be defined as a reference line passing through the design eye position and parallel to the fuselage reference line.

(c) Back tangent line shall be defined as a vertically inclined plan tangent to the back of a seated crewmember at the thoracic region and buttocks.

(d) Bottom tangent line shall be defined shown on a typical inboard profile drawing of an aircrew station as a line depicting a lateral plane on the seat back which is tangent to the compressed seat at the points where the posterior aspects of the buttocks and thorax, with appropriate clothing, contact the cushion. The amount of compression should be that which would occur with an aircrew member having a mean weight of the target population of 5th percentile female to 95th percentile male range as defined in NATICK/TR-15/007 and supplemented with NATICK/TR-89/044 as appropriate, under 1-g flight conditions.

(e) Seat reference point shall be defined as the intersection of the back tangent line and the bottom tangent line.

(f) Neutral seat reference point (NSRP) shall be defined as the seat reference point with the seat in the nominal midposition of the seat adjustment range.

(g) Buttock reference point shall be defined as the most forward limit of the bottom tangent line and represents the body pressure points located 5.75 inches forward of the seat reference pint. This represents the area of the lowest seat cushion compression under a static vertical load of 1-g.

(h) Thigh tangent line shall be defined as the average line of the aircraft seat when occupied by a crewmember with the maximum weight of the 5th percentile female to 95th percentile male range as defined in NATICK/TR-15/007 and supplemented with NATICK/TR-89/044 as appropriate. The thigh tangent line originates at the buttock reference point and extends upward and forward from that point to the forward edge of the seat.

(i) Control grip reference point shall be defined as the point at which the crewmember’s second finger (middle digit) is in contact with the forward or downward face of any grip-type control such as control stick, control wheel, collective stick, or throttle.

The contractor shall demonstrate via analysis and test that the aircraft controls configuration is appropriate for the crew station configuration (i.e., side-by-side or tandem), and that separate controls are incorporated for each pilot, and a logical system of control authority has been established to prevent control conflicts or inadvertent activation of systems. The test shall demonstrate that all controls are properly designed and operable through their complete range of travel without interference with other controls, structures, operators' bodies and that all emergency action controls are reachable by the operators using NATICK TR89044 and NATICK TR 15/007 data sets, as appropriate. Prepare a Cockpit Geometry and Compatibility Demonstration Test Plan IAW DIHFAC80743. Conduct a test IAW the test plan to:

a. Demonstrate the location, size, placement, range of travel, adjustment, and force requirements of primary flight controls are appropriate for the full range of operational tasks, maneuvers, and flight control techniques IAW MIL-STD-1472 and requirements herein.

b. Demonstrate that the arrangement of instruments is grouped functionally with priority of placement being given to the most important instruments.

c. Demonstrate all controls are properly designed and shall be operable through their complete range of travel without interference with other controls, structures, operators' bodies and that all emergency action controls are reachable by the operators.

d. Demonstrate all flight safety and critical controls shall be operated normally while the operator is seated at the design eye point with the harness locked.

e. Demonstrate all controls and displays shall be arranged so that they are completely functional and visible and that the crewstation/operator station geometry (including seats) accommodates the target population IAW AVSCOM TR 89-D-22, NATICK/TR-89/044, and NATICK/TR-15/007. All electronic displays shall be IAW FAA AC 25-11.

Prepare a Cockpit Geometry and Compatibility Demonstration Test Plan IAW DI-HFAC-80743. Conduct a test IAW the test plan to validate cockpit compatibility for the full anthropometric range of personnel attired in all configurations of personal and protective clothing and equipment for all human-system interactions to include, but not limited to: reach, control compatibility, head and knee clearance, ingress, egress/emergency egress, as well as other physical interaction domains identified in this document and the Aircraft System Specification. The results of the test shall be documented as part of the HEDADO Report IAW MIL-STD-46855 and prepared IAW DI-HFAC-80746.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		FAA AC 25-11 FAA AC 29-2 FAA AC 27-1		

9.9.1. Access/Storage/Retention

The purpose of Access/Storage/Retention is to evaluate and document reach, access, and stowage capabilities of carry-on, ancillary, and other related equipment necessary to support mission profiles and regulatory requirements IAW MIL-STD-1290 and AR 95-1.

Criteria:

The aircraft stowage space shall have dedicated spaces and tie down fittings outside the crew station for aircraft flyaway equipment, pilot gear, and survival kits and the equipment shall be accessible after a crash sequence even if there is there is deformation of the airframe.

Standard:

AVSCOM TR 89-D-22 (Crash Survival Design Guide)
MIL-STD-1290
AR 95-1

Method of Compliance:

Aircraft stowage areas shall include dedicated spaces and tie down fittings outside the crew station for aircraft flyaway equipment, pilot gear, and survival kits, and the equipment shall be accessible no matter how the aircraft comes to rest and even if there is deformation of the airframe. The systems design and testing shall be IAW AVSCOM TR89-D-22 Aircraft Crash Survival Design Guide, and AR 95-1.

An Access/Storage Test Plan shall be prepared IAW DI-HFAC-80743, and an Access/ Storage Test Report shall be prepared IAW DI-HFAC-80744. The test shall include a hands-on demonstration of loading and unloading equipment from each area. Unloading shall be done using either hand (i.e., one hand operation) for the demonstration/ assessment. The condition of the equipment in all storage areas will be evaluated for damage and usability after the equipment has been loaded, flown for the maximum duration flight that the aircraft is capable in extreme cold and hot conditions then unloaded in a timely manner. Use the specified standard for additional details regarding requirements to include the following:

a. Dedicated stowage spaces shall have tie down fittings in order to secure the load.

b. Survival kit storage areas shall be located in such a manner that no matter how the aircraft comes to rest after a crash, stowage areas can be accessed via several different paths and deformation of the airframe does not prevent access.

c. A dedicated stowage space shall be available in the crew station for critical survival equipment and first aid equipment that shall be within reach of all crew members.

d. All storage spaces be fire resistant IAW FAA Part 25.853 and Appendix F of this part and equipped with fire detection and suppression systems.

e. Reach, access and retrieval of necessary equipment shall support all necessary timeframes for egress to include escape and evade.

Note: Airworthiness approval can only be granted for mission equipment configurations that have been demonstrated for safe stowage, access, and retention. Mission equipment configurations, or stowage areas that have been compromised will not be authorized.

Include the report as part of the Human Engineering Design Approach Document-Operator (HEDAD-O). Prepare or revise the HEDAD-O Report IAW MIL-STD-46855 and prepared IAW DI-HFAC-80746 for any changes where stowage, access or retention systems have been added or modified.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.9.2. Pilot/Co-Pilot Compartment View
The purpose of Pilot/Co-Pilot Compartment View is to evaluate and document the internal and external vision plots of the aircraft.

Criteria:
The aircraft Pilot/Co-pilot compartment shall have visual field inside and outside of the aircraft cockpit to ensure safe flight.

Standard:
MIL-STD-1787
MIL-STD-1472
MIL-STD-3009
MIL-STD-850

Method of Compliance:
All displays shall be readable from the pilot/operator eye position under the full range of ambient conditions without the crew/operator having to assume an awkward or unsafe position. External cockpit visibility shall be IAW MIL-STD-850. Rectilinear plots are

recommended. All information shall meet the visual angle subtended and field of view specified in MIL-STD-1472 and MIL-STD-1787. There shall be no glares, reflections or other visual anomalies due to the coatings, controls, displays or other crew/operator station components that affect safety and normal operations IAW MIL-STD-3009.

The airworthiness substantiation shall include a Pilot/Co-Pilot Compartment View Analysis Report prepared IAW DI-HFAC-80745, a Pilot/Co-Pilot Compartment View Simulation Plan prepared IAW DI-HFAC-80742, a Pilot/Co-Pilot Compartment View Test Plan prepared IAW DI-HFAC-80743, and a Pilot/Co-Pilot Compartment View Test Report prepared IAW DI-HFAC-80744 and included as part of the Human Engineering Design Approach Document-Operator (HEDAD-O). Prepare or revise the HEDAD-O Report IAW MIL-STD-46855 and prepared IAW DI-HFAC-80746.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.9.2.1. External Visibility

The purpose of External Visibility is to evaluate and document that crew members have sufficient external visibility.

Criteria:

The cockpit transparencies shall provide sufficient external visibility to crew and operator population.

Standard:

MIL-STD-1472
NATICK/TR-89/044
NATICK/TR-15/007
AVSCOM TR 89-D-22A

Method of Compliance:

The maximum practicable external vision shall be provided for the pilot (s). The total vision envelope (plus and minus 180 degrees in azimuth and plus and minus 90 degrees in elevation) shall be plotted for each crew member in the flight compartment where the crewmember's duties require external vision and documented in the HEDAD-O using MIL-STD-850B as a guide.

External vision plots shall be created to show, by analysis, expected vision during landing for each crewstation. The vision plots shall document minimum vision during landing on a 300 by 11,600 foot runway on a 3 degrees glide slope at distances of 1 mile, ½ mile, and ¼ mile. Each vision plot shall include the subject pilot station, fuselage angle with relation to the horizon, and maximum rate of closure in feet per second. The vision plots shall be included in the HEDAD-O using MIL-STD-850B as a guide.

Radii-of-curvature and angles of incidence of the transparent components of the cockpit shall be consistent with the aerodynamic, structural, and fabricating considerations,

which will result in the least possible optical distortions in these ports and shall minimize reflections of objects both within and without the cockpit from interfering with the pilot's vision. At the intersection of the horizontal vision line and the windshield, the angle of incidence shall not exceed 60 degrees.

a. Side-by-side cockpit. The vision requirements set forth in this paragraph are applicable to side-by-side piloted helicopters and are given relative to the longitudinal fuselage reference line.

(1) Controls, consoles, and instrument panels shall be so located as not to restrict vision, with particular emphasis on adequate over-the-nose visibility. Insure that mounting and reinforcing frames or strips which divide transparent areas and form obstructions to vision are not more than 2 inches wide when projected onto a plane perpendicular to a line between the structure and the pilot's eye at the design eye position. Distribute such obstruction to avoid critical vision areas.

(2) The following minimum angles of unimpaired vision shall be available to the pilot from the design eye position:

At O degrees azimuth, 25 degrees down and 20 degrees up shall be available

(a) From 10 degrees left azimuth to 10 degrees right azimuth, downward vision shall increase from 20 degrees to 30 degrees.

(b) In the area between 10 degrees right azimuth and 135 degrees right azimuth, 50 degrees of downward vision shall be available.

(c) From 0 degrees to 80 degrees right azimuth, upward vision shall increase from 20 degrees to 40 degrees.

(d) From 80 degrees right azimuth to 100 degrees right azimuth, upward vision shall be 40 degrees.

(e) From 100 degrees right azimuth to 135 degrees right azimuth, upward vision requirement may decrease gradually from 40 degrees to 20 degrees.

(f) From 10 degrees left azimuth to 100 degrees left azimuth, 20 degrees up and 20 degrees shall be available.

(3) There shall be no vertical obstruction between 20 degrees right and 20 degrees left of the longitudinal axis relative to the design eye position.

(4) There shall be no horizontal obstructions in the area extending 15 degrees above the horizon from 135 degrees right to 40 degrees left and decreasing to a point 10 degrees above the horizon at 100 degrees left. No horizontal obstructions shall be in the area 15 degrees below the horizon between 135 degrees right and 100 degrees left. If necessary, horizontal obstructions in this area shall be limited to one above the horizon and one below the horizon and shall be restricted to 4 inches in width.

b. Single pilot/tandem pilot. The vision requirements set forth in this paragraph are applicable to single- and tandem-piloted helicopters with pilot in either forward or aft position and are given relative to the longitudinal fuselage reference line. The forward cockpit position if occupied by other than the primary pilot, also shall comply with these requirements.

(1) The following shall be the minimum angles of unimpaired vision available to the pilot from the design eye position:

(a) At 0 degrees azimuth, at least 25 degrees down and 70 degrees up.

(b) At 20 degrees azimuth, left and right, 25 degrees down and 70 degrees up.

(c) At 30 degrees azimuth, left and right, 30 degrees down and 70 degrees up.

(d) At 90 degrees azimuth, left and right, 50 degrees down and 70 degrees up.

(e) At 135 degrees azimuth, left and right, 34 degrees down and 70 degrees up.

(2) Visibility in elevation (up) above that specified above of at least 90 degrees shall be provided. Interruptions of vision by horizontal structure of not more than 2 inches of width along or above the elevation boundary specified above and vertical structural members of not more than 2 inches in width located IAW with section a.4 above are permitted.

The airworthiness substantiation shall include an External Visibility Analysis Report prepared IAW DI-HFAC-80745. The vision plots shall be included in the HEDAD-O. Prepare an External Visibility Test Plan IAW DI-HFAC-80743 and an External Visibility Test Report IAW DI-HFAC-80746.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.9.3. Windshields and Windows

The purpose of Windshields and Windows requirements are to determine that the aircraft system windshields and windows support safe operations to include impact protection, optical performance in tactical environments, and to support emergency egress.

Criteria:

The aircraft windshields and windows shall not degrade aircraft flight operations.

Standard:

AVSCOM TR 89-D-22
ASTM-F330
ATPD 2352N
MIL-T-5842

Aircraft System Specification

Method of Compliance:
The aircraft system shall have windshields and windows that meet the optical, bird impact, anti-icing, and de-fogging requirements and have a rain removal system as well as support emergency egress requirements (see Normal and Emergency Egress) IAW the aircraft system specification and IAW AVSCOM TR 89-D-22, ASTM-F330, A TPD2352N, and MIL- T-5842. The following tests shall be conducted on the windshields and windows:

a. Bird impact - The windshield, all supporting structure, and latching mechanisms that are positioned ahead of and protecting the pilot/crew shall be designed to withstand the impact of a four pound bird when the velocity of the aircraft (relative to the bird along the aircraft flight path) is equal to the maximum operational true airspeed achievable in level flight at altitudes up to 5000 feet. In the event of a bird impact, the design of the windshield system shall not permit more than 50 percent of the crew's forward visibility to be lost. Head clearance shall be considered to preclude the possibility of pilot or crew injury from excessive deflection of the windshield during bird impact. Cockpit equipment clearances with the windshield shall be considered to preclude equipment damage from excessive deflection of the windshield during bird impact. Internal damage such as glass or plastic parts spalled off, structural members broken free, or lining panels torn loose shall not injure the crew or restrict performance of the crew's normal duties in the cockpit. Bird impact capabilities shall be IAW ASTM-F330.

b. Optics General - The windshield shall be capable of meeting the optical requirements specified below and contained in MIL-W-81752 before and after a minimum of two lifetimes of pressure/temperature cycling as specified in the aircraft system specification.

c. Luminous transmittance:

(1) Fighter/attack type aircraft - The average luminous transmittance of the transparent material shall not be less than 80 percent when measured at normal angles of incidence to the surface. The luminous transmittance shall not be less than 65 percent when measured at the design eye position along a horizontal line with zero azimuth and the windshield in the installed position.

(2) Other aircraft - The average luminous transmittance of the transparent material shall not be less than 60 percent. The luminous transmittance shall not be less than 50 percent when measured at the observer's eye position along a horizontal line with zero azimuth and the windshield in the installed position.

d. Anti-icing coating - If an anti-icing conductive coating is used, the coating shall not reduce light transmittance by more than 5 percent.

e. Haze - The haze in the windshield shall not be greater than 3 percent at normal angles of Incidence.

f. Binocular disparity - The angular deviation between each eye from a point object shall not be greater than 10 minutes of arc in the horizontal plane and 2 minutes of arc in the vertical plane. If the aircraft is used for high altitude reconnaissance greater than 10,000 ft., the angular deviation shall not be greater than 3 minutes of arc in the horizontal plane and 2 minutes of arc in the vertical plane.

g. Aniseikonia - Aniseikonia shall not be greater than 2 percent.

h. Monocular distortion:

(1) Fighter/attack type aircraft - The angular deviation of the windshield, when measured normal to the surface, shall not be greater than 3 minutes of arc. The change in direction shall not be greater than 180 degrees within any linear 36 inches. With the transparency in the installed position, at least 60 points shall be selected for the determination of the apparent deviation in elevation and azimuth at each point. The apparent deviation at each point shall not be greater than 3 milliradians and the Root Mean Square (RMS) value for all the points shall be less than 1 milliradian.

(2) Other aircraft - The angular deviation of the windshield, when measured normal to the surface, shall not be greater than 3 minutes of arc. The change in direction shall not be greater than 180 degrees in any linear 36 inches. With the windshield in the installed position, 15 random points shall be selected for the determination of the apparent deviation in elevation and azimuth at each point. The apparent deviation shall not be greater than 10 minutes of arc at any single point, but the average deviation shall not be greater than 3 minutes of arc.

i. All transparent armor covering windscreen areas shall be IAW ATPD 2352N.

j. All de-ice/de-fog capabilities shall be IAW MIL-T-5842.

k. Emergency egress windows – Windows shall be IAW AVSCOM TR 89-D-22.

l. Drone Strike protection – See bird strike requirements.

The airworthiness substantiation shall include Windshields and Windows Analysis Report prepared IAW DI-HFAC-80745, a Windshields and Windows Simulation Plan prepared IAW DI-HFAC-80742, a Windshields and Windows Test Plan prepared IAW DI-HFAC-80743, and a Windshields and Windows Test Report prepared IAW DI-HFAC-80744 and included in the Human Engineering Design Approach Document-Operator (HEDAD-O). HEDAD-O Prepare or revise the HEDAD-O Report IAW MIL-STD-46855 and prepared IAW DI-HFAC-80746.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.9.4. Crashworthiness & Crash Survivability
The purpose of Crashworthiness and Crash Survivability is to ensure crash survivability and occupant restraints in order to maximize crew and occupant safety and minimize injury or loss of life.

Criteria:
The aircraft crew stations, and workstation shall be safe for the pilots, crew, and passengers in the event of a crash scenario.

Standard:
USAAVSCOM TR 89-D-22 .
SAE AS8049.
MIL-STD-1290.
MIL-S-85510.
MIL-S-58095.
MIL-DTL-9479 .
14 CFR 25.791.
14 CFR 23.853.
14 CFR 25.854.
14 CFR 25, Appendix F
Aircraft System Specification

Method of Compliance:
The aircraft seating and restraint system including structural attachment to the aircraft shall withstand static loads defined in SAE AS8049, table 4, and dynamic load defined in 5.3. for the full range of weighted occupants to include all necessary crew worn gear and equipment as defined by the Aircraft System Specification. Ejection seats shall be designed and tested IAW MIL-DTL-9479. For ejection seat equipped aircraft, the dynamic forward ±15 degrees off axis “g” load capability is 40 g's. Verify by test the ejection sled and parachute jump tests for the escape system restraint capability. Any combustible materials used shall be burn resistant and have low smoke generation properties IAW 14 CFR 25.791, 23.853, 25.854, 25 Appendix F. This applies to all interior components including:

a. Ceiling and wall panels (excluding lighting lenses and windows).

b. Partitions (excluding transparent panels needed to enhance cabin safety).

c. Seats.

d. Cabinets and cabin stowage compartments.

Prepare a Human Engineering System Crash Survivability Analysis Report IAW DI-HFAC- 807045. Prepare a Human Engineering Test Plan IAW DI-HFAC-80743. Conduct a test IAW the test plan to demonstrate that seating system load capabilities IAW aircraft system specification and that the design of the floor and load paths to the

seat attachments is capable of sustaining the loads of the seat system in applicable crash load conditions.

Demonstrate by test that the seating and restraint system has been designed to hold in place an occupant for design static and dynamic loading IAW MIL-STD-1290, AVSCOM TR89-D-22, and MIL-R-8236. Static and dynamic load capabilities are verified by testing defined in MIL-STD-1290 and MIL-S-85510 for side facing seats. For front facing pilot/copilot seats, use AVSCOM TR 89-D-22, MIL-STD-1290, and MIL-S-58095 for static and dynamic load capabilities shall use AVSCOM TR 89-D-22, MIL-STD-1290, and MIL-S-58095:

a. Demonstrate that the stroke clearance envelope for energy absorbing seats is clear of structures and equipment that could impede seat stroke. Stroke volume for both the functioning of the seat and the occupant is provided in the aircraft installation for the impact velocity environment specified for the aircraft. Stroke clearance envelope is verified by dynamic seat tests, analysis and documentation inspection, indicating the occupied stroke volume for the design impact velocity of the aircraft and that volume exists and is unobstructed in the aircraft design.

b. Demonstrate that restraint systems are designed to restrain the occupant properly for the escape system environment and the crash loading of the seat. The occupant is kept in position with respect to support of the seating system under both inertial and applied loads (such as aerodynamic pressure). The restraint system prevents "submarining" or translation of the pelvis under the lap belt. The shoulders are restrained to align the thoracic and lumbar spine with primary ejection seat catapult loads and vertical crash loads. Restraint systems in forward facing seats limit dynamic overshoot of reaction loads into the seating structure during required crash loads. Analysis and test documentation show that the restraint system properly restrains the occupant. Dynamic crash load tests verify restraint integrity and body restraint.

c. Demonstrate that the strike envelope of the occupant during crash loads are kept free of objects that are risks to survival or may cause serious injury that renders the crewmember unable to perform post-crash egress functions. Stowage provisions for required safety and emergency equipment are furnished and arranged so that the equipment is directly accessible, and its location is obvious.

d. Analytical models of human body motion under crash load conditions verify that no strike hazards exist and that there are no objects in the crew station that would cause major injury within the throw distance of restrained occupants during design crash loads.

e. Demonstrate that during a dynamic event the flail corridors of the torso and head do not contact surfaces, edges, corners, or structures/equipment with sufficient velocity to cause injury. Analysis and test reports shall document the flail envelope of the occupant’s body during dynamic events and confirm objects capable of causing major injury are outside of the respective flail envelope.

f. Demonstrate that any door, hatch or window used for emergency egress can be removed within 5 secs using one hand.

g. Demonstrate that any explosively cut exits are safe for normal and underwater operation IAW AVSCOM TR 89-D-22 and MIL-STD-1290.

h. Demonstrate that all removable equipment carried inside the aircraft, known as ancillary equipment, as defined in AVSCOM TR 89-D-22 and MIL-STD-1290, that constitutes a hazard if unrestrained during a crash is secured or stowed IAW AVSCOM TR 89-D-22 and MIL-STD-1290.

i. Demonstrate the occupied areas (cabin and crewstation) are not reduced more than 15% of the width, length, and height following a lateral (30ft/s), longitudinal (40ft/s), and vertical (42ft/s with landing gear extended) impact, respectively, IAW AVSCOM TR 89-D-22.

j. The airworthiness substantiation shall include a Crash Survivability Analysis Report prepared IAW DI-HFAC-807045, a Crash Survivability Test Plan prepared IAW DI-HFAC-80743, and a Crash Survivability Test Report prepared IAW DI-HFAC-80744 and included as an Appendix in the HEDAD-O. Prepare or revise the HEDAD-O Report IAW MIL-STD- 46855 and prepared IAW DI-HFAC-80746.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.9.5. Ingress/Egress and Emergency Egress

The purpose of Ingress/Egress and Emergency Egress is to evaluate and document the safe ingress, egress and emergency egress of the aircraft in accordance with established standards.

Criteria:

The aircraft entrance/exits, and layout shall not negatively impact occupants from safely entering and exiting the aircraft.

Standard:

Redstone Test Center Test Operating Procedure (TOP) 7-3--529A
USAAVSCOM TR 89-D-22
AMCP 706-203
14 CFR 29.803
NATICK/TR-89/044
NATICK/TR-15/007
MIL-STD-1472
MIL-HDBK-516

Method of Compliance:
Multi-place, cargo, transport aircraft and control station exit, and sizes shall have twice the capacity for the maximum number of occupants to egress in the specified time. The crew and passenger areas of aircraft shall have emergency means to allow for complete abandonment in the specified time during ground egress or ditching of the aircraft, with the landing gear extended as well as retracted, considering the possibility of the aircraft being on fire, and at maximum seating capacity.

For multi-place and cargo aircraft: All passengers and crew members shall be able to egress the aircraft within 60 seconds using only half the exits.

For transport aircraft the following apply:

a. For aircraft with 25 passengers or less: All passengers and crew shall be able to egress the aircraft within 45 seconds using only half the exits.

b. For aircraft with greater than 25 passengers: All passengers and crew shall be able to egress the aircraft within 90 seconds using only half the exits.

c. The 90 second evacuation criteria shall not be applicable for patients on aeromedical evacuation missions.

For rotary wing aircraft the following apply:

a. For aircraft with non-crashworthy fuel cells: All crew members shall be able to egress in 20 seconds using only one-half the exits.

b. For aircraft with crashworthy fuel cells: All crew members shall be able to egress in 30 seconds using only one-half the exits.

c. For all aircraft, all crew and passengers shall be able to egress in 45 seconds using only one half the exits.

Emergency exits shall have operating instructions and markings, both internally and externally. Emergency exits shall be clearly marked and have readily apparent, discernable operating instructions for use by operators, crewmembers and/or passengers internally, and shall be marked with relevant markings for external rescue. Printed instructions and procedures for Emergency exiting and ditching shall be provided for non-aircrew personnel in the applicable aircraft compartment(s). Emergency exits and egress paths shall have an emergency egress lighting system (internal and external). The System design and testing shall be IAW Redstone Test Center TOP 7-3-529, USAAVSCOM TR 89 -D22, AMCP 706-203,14 CFR 23.803, 25.803, 29.803, NATICK/TR89/044, NATICK/TR15/007, and MIL-STD-1472.

Testing, inspection, demonstration, and time study analyses documents shall verify that the appropriately equipped (mission representative) aircrew and passengers can egress the aircraft and control station from that combination of half the exits which results in the most restrictive configuration IAW TOP 7-3-529A. An emergency egress demonstration

from the vehicle, control station, or a high-fidelity mockup shall be used to verify egress capability and time required under both day and night lighting conditions. For transport aircraft, participants shall have no prior practice or rehearsal for the demonstration. For control stations located inside of permanent buildings, compliance shall be shown by a certificate of occupancy from the local building inspector.

Emergency exit covers shall be removable within 5 secs. Any explosively cut exits are safe for normal operation and underwater operation.

Prepare a Human Engineering Test Plan IAW DI-HFAC-80743. Conduct a test IAW the test plan to demonstrate that the crew station, aircraft and control station interior design permits all occupants to egress the aircraft and/or control station IAW AVSCOM TR89-D-22 and MIL-STD-1290. Emergency egress of the aircraft by fifth percentile female through ninety- fifth percentile male shall be demonstrated while wearing worst case (i.e. most cumbersome) personal and protective clothing and equipment is performed per (TOP) 7-3-529A.

Demonstrate that the design of the emergency egress system is IAW AVSCOM TR89-D-22.

The airworthiness substantiation shall include an Ingress/Egress and Emergency Egress Test Plan prepared IAW DI-HFAC-80743, and an Ingress/Egress and Emergency Egress Test Report prepared IAW DI-HFAC-80744 and included as an appendix in the HEDAD-O. Prepare or revise the HEDAD-O Report IAW MIL-STD-46855 and prepared IAW DI-HFAC- 80746.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.9.6. Environmental Control

The purpose of Environmental Control is to provide aircraft system environmental conditions to protect and promote human performance in all required mission environments.

Criteria:

The aircraft crew compartment shall have a heating & cooling system to ensure the crew members attain and maintain safe flight operations.

Standard:

AFGS-87145A
MIL-STD-1472

Method of Compliance:

The crew and avionics/electronics compartmental heating and cooling system(s) shall describe in detail the heating system, cooling system, defogging capability, environmental control unit (ENCU) system, ventilation capability, and smoke removal

capability IAW AFGS- 87145 and MIL-STD-1472 (also see Windshields and Windows). The ventilation system description shall include schematics. Calculations for the air changes per minute, air flow velocities, and filtration shall be provided. Prepare an analysis IAW DI-MISC-80711. In addition, the smoke removal, prevention of gun gas accumulation, and the removal of other contaminants shall be described in the analysis. The test shall include the following:

a. Outside fresh air shall be supplied at minimum rate of 0.57 m^3 (20 ft^3)/min/person.

b. Air flow rates for all environmental conditions IAW MIL-STD-1472.

c. Air velocity at each person's head location shall be adjustable either continuously or with not less than three settings (OFF, LOW, and HIGH) from near zero to at least 120 meters (400 feet)/minute.

d. The crew compartment shall be provided with a heating system capable of maintaining temperatures above 20 °C (68 °F) during occupancy when personnel are not wearing arctic clothing and exposure exceeds 3 hours. The heater shall achieve these requirements within one hour after the heater is turned on.

e. The cab heater controls shall be physically accessible to the operator and assistant operator.

f. When arctic clothing is worn, cab heaters shall be capable of maintaining a reference temperature of not less than 5.0 °C (41 °F) at the minimum ambient design temperature with the vehicle moving at two-thirds maximum speed and the defrosters operating at maximum capacity. The reference temperature is measured 61 centimeters (24 inches) above the seat reference point of each operator/passenger position.

g. The air temperatures around any part of the operator/passenger's body shall not vary more than ±5.0 °C (±9.0 °F).

h. The heater functionality designs shall meet the following:

(1) Any heater that uses oil, gas, liquefied petroleum gas, or any other combustible fuel for its operation shall discharge its exhaust products outside of the vehicle.

(2) Heaters shall be located or protected so that personnel cannot touch parts that are hot enough to cause burns (46 °C (114.8. °F)). The heater air inlet shall be positioned so it cannot ingest either engine or heater exhaust gases.

i. The effective temperature or corrected effective temperature within personnel enclosures used for detail work during extended periods will not be greater than 29.5 °C (85 °F), preferably not greater than 25.5 °C (80 °F).

The airworthiness substantiation shall include Environmental Control Test Procedure and be prepared IAW DI-NDTI-80603, an Environmental Control Analysis prepared IAW

DI-MISC-80711, an Environmental Control Demonstration Test Plan prepared IAW DI-NDT--80566, and an Environmental Control Demonstration Test(s) Report(s) prepared IAW DI-NDTI- 80809 and included as an appendix in the HEDAD-O.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.9.7. Ballistic Protection/Armor
The purpose of Ballistic Protection/Armor is to provide crew survivability and protection from known ballistic threats.

Criteria:
The aircrew ballistic protection shall ensure safe flight, personnel safety and emergency egress/ingress.

Standard:
MIL-STD-1472
NATICK/TR-89/044
NATICK/TR-15/007
MIL-STD-662

Method of Compliance:
Aircrew ballistic protection shall be IAW MIL-STD-1472 and MIL-STD-662 for both aircrew body armor and aircraft mounted systems. The aircraft armor shall not physically or functionally interfere with the aircraft, nor shall it create a hazard to the crew, passengers, or maintenance personnel. All personnel should be considered in their ‘worst case’ condition from the 5th percentile female to 95th percentile male of both aircrew and ground personnel populations.

a. For aircrew ballistic protection body armor systems: A test plan shall be prepared IAW DI-NDTI-80566 to:

(1) Demonstrate that the system accommodates anthropometric requirements for the 5th percentile U.S. Army female through the 95th percentile U.S. Army male by conformance to dimensions for size shown in Natick/TR-89/044 and the NATICK/TR-15/007 data set, as appropriate.

(2) Demonstrate that the system accommodates cockpit compatibility requirements.

(3) Demonstrate that the system accommodates egress/ingress requirements.

(4) Demonstrate that the system accommodates flotation requirements.

b. Aircraft mounted ballistic protection shall, by demonstration in the aircraft:

(1) Demonstrate that the system accommodates cockpit compatibility requirements.

(2) Demonstrate that the system accommodates egress/ingress requirements.

The airworthiness substantiation shall include a Ballistic Protection/Armor Test Procedure prepared IAW DI-NDTI-80603, a Ballistic Protection/Armor Test Plan prepared IAW DI- NDTI-80566, and Ballistic Protection/Armor Test Report prepared IAW DI-NDTI-80809 and MIL-STD-662. The Ballistic Protection/Armor Test Report shall be included as an appendix in the HEDAD-O.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.9.8. Oxygen Systems/Masks

The purpose of Oxygen Systems/Masks is to provide necessary protection for crew and occupants for mission profiles requiring operations at high altitudes.

Criteria:

The aircraft oxygen system shall ensure safe flight during high altitude flights and a pressurized cockpit. The oxygen system supply shall be appropriate for the mission requirements of the aircraft. The oxygen system shall operate and be compatible with the operational environment of the air vehicle. System components shall also meet environmental storage requirements.

Standard:

AR 95-1
14 CFR Part 23
MIL-HDBK-516
Aircraft System Specification

Method of Compliance:

The aircraft system, if certificated for supplemental oxygen equipment or the aircraft is approved for operations at or above altitudes where oxygen is required to be used by the operating rules, oxygen equipment shall be provided. If the cockpit is pressurized, oxygen equipment will be accommodated, as applicable. Supply types include gaseous oxygen (GOX), liquid oxygen (LOX), and on-board oxygen generating systems (OBOGS). Portable oxygen equipment is acceptable if the portable equipment is shown to comply IAW the Aircraft System Specification, is identified in the airplane type design, and its stowage provisions are found to be in compliance with 14 CFR, Part 23. Each required flight crewmember shall be provided with the following:

a. Demand oxygen equipment if the airplane is to be certificated for operation above 25,000 feet.

b. Pressure demand oxygen equipment if the airplane is to be certificated for operation above 40,000 feet.

c. Rotary wing aircraft may perform special missions that require high altitude flight. For such missions a breathing gas must be available for use by the crew during the higher altitude phase of the flight above 10,000 feet. Portable oxygen equipment is restricted above 18,000 feet.

Oxygen systems shall be used by aircraft crews and occupants IAW AR 95-1 Section 8-6. Requirements for oxygen systems in pressurized cockpits is defined in MIL-HDBK-516. Aircraft shall comply with the oxygen system requirements of 14 CFR, Part 23 and IAW aircraft system specification.

Prior to flight, the aircraft system shall confirm that the oxygen system has been properly serviced IAW the approved maintenance manuals and regulatory requirements (i.e., FAA). Demonstrate through testing that the oxygen masks are within reach of the 5th percentile female and 95th percentile male. Demonstrate by test that the oxygen system is free from hazards in itself, in its method of operation, and its effect upon other components. Demonstrate by test that the crew is able to determine the quantity of oxygen available in each source of supply during flight. Demonstrate by test that the crew can turn on and shut off the oxygen supply at the high pressure source during flight. This shutoff requirement does not apply to chemical oxygen generators. The airworthiness substantiation shall include an Oxygen Systems/Masks Test Procedure prepared IAW DI- NDTI-80603, an Oxygen Systems/Masks Demonstration Plan prepared IAW DI-NDTI-80566 and Oxygen Systems/Masks Demonstration Report prepared IAW DI-NDTI-80809 and included as an appendix in the HEDAD-O.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.9.9. Fire Suppression System

The purpose of Fire Suppression System is to provide crew and occupant protection from fire and fire related impacts.

Criteria:

The aircraft handheld fire extinguishers shall be accessible and not cause degraded flight during a fire.

Standard:

MIL-STD-1472
MIL-DTL-32412
MIL-DTL-32403
AC 20-42D
Aircraft System Specification

Method of Compliance:
The aircraft system shall be equipped with handheld fire extinguishers IAW MIL-STD-1472 and as defined by the aircraft system specification. Fire extinguishers shall be located so they are immediately and easily accessible to all crewmembers and usable by either hand IAW AC 20-42D. Fire extinguishers shall be selected for suitability to the class of fires most likely to occur in the area IAW MIL-DTL-32412 or MIL-DTL-32403:

a. Class A fire extinguishers shall be used for ordinary combustible materials (wood, paper, and rags) which can be extinguished with water or aqueous solutions.

b. Class B fire extinguishers shall be used for fires involving flammable liquids (gasoline and other fuels, solvents, greases, and similar substances) which must be extinguished by diluting, eliminating air, or blanketing.

c. Class C fire extinguishers shall be used for fires in electrical equipment (motors, transformers, and switches) which must be extinguished by a material that does not conduct electricity.

For fire detection, the type of system, location, cockpit indication, and test features for protection from false warnings shall be IAW the aircraft system specification. The airworthiness substantiation shall include all details of a fire detection, fire extinguishing and fire protection system, the sizing of the fire extinguishing system along with the functional schematic of operation, fire bottles, amount and type of agent, gages, check and control valves, pressure relief, discharge indicators, spray nozzles, etc., shall be described relative to the overall system operation in an Fire Suppression System Analysis and prepared IAW DI-HFAC-80745. The airworthiness substantiation shall also include a Fire Suppression System Test Procedure prepared IAW DI-NDTI-80603, a Fire Suppression System Test Plan prepared IAW DI-NDTI-80566, and Fire Suppression System Test Report prepared IAW DI-NDTI-80809 and included as an appendix in the HEDAD-O.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 20-42D		

9.9.10. Aviation Life Support Equipment (ALSE)
The purpose of Aviation Life Support Equipment (ALSE) is to provide all necessary personal and protective clothing and equipment in support of all required mission profiles.

Criteria:
Aircrew life support equipment shall be provided and not degrade the operation of the aircraft.

Standard:
AR 95-1

MIL-STD-1472
AVSCOM TR 89-D-22A
NATICK/TR-89/044
NATICK/TR-15/007
Aircraft System Specification

Method of Compliance:
The aircrew shall be provided Aviation Life Support Equipment (ALSE). The ALSE shall include clothing and survival items and can be aircrew mounted, aircraft mounted, and carry-on. Survival items include first-aid kits, portable searchlights, tools, flashlights, navigation kits, survival kits, life rafts, life jackets, locator beacons, special clothing, food and water, knives, and M-4's and other removable weapons IAW Aircraft Crash Survival Design Guide as defined by the aircraft system specification. Carry-on ALSE shall be stowed and secured during takeoff and landing. ALSE items shall be in view of the aircrew. ALSE items shall be accessible in an emergency and operable using one hand. Equipment shall not be placed in areas where cargo shifting, or fuselage distortion will prevent or impair access to it. ALSE shall incorporate passive signature reduction. Passive signature reduction shall be tested for both near and far infrared signatures, acoustic signatures, daylight visual and enhanced visual (binoculars) signatures, image intensified NVG signatures, and light emission signatures. The system signature test shall be detected less than ten percent of the time in all aspect scans for a given signature at the specified threshold distance. In the event that a ten percent probability of detection cannot be achieved, the system is acceptable if an improvement is shown over current existing equipment IAW MIL-STD-1472.

ALSE shall demonstrate by test that the system meets anthropometric requirements such that it accommodates sizing for the 5th percentile U.S. Army female through the 95th percentile U.S. Army male by conformance to dimensions for size shown in Natick/TR- 89/044 and the NATICK/TR TR-15/007 data set, as appropriate. Demonstrate by test IAW the aircraft system specification the following:

a. The system meets mission requirements for the given environment (i.e. hot, cold, dry, humid, over water, and CBRN).

b. The system meets cockpit compatibility requirements.

c. The system meets egress/ingress requirements.

The airworthiness substantiation shall include test and demonstration. The ALSE Test Procedures shall be prepared IAW DI-NDTI-80603, the ALSE Test Plan shall be prepared IAW DI-NDTI-80566 and the ALSE Test Report shall be prepared IAW DI-NDTI-80809 and included as an appendix in the HEDAD-O.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.9.11. Helmet Systems

The purpose of Helmet Systems is to provide crew head, neck and hearing protection for sustained mission operations and potential crash survivability.

Criteria:

The aircraft system helmet systems shall be safe, suitable and effective to ensure safe flight.

Standard:

The U.S. Army Aeromedical Research Lab is the proponent of requirements and testing of the helmet's crashworthiness (i.e., weight, CG, and crash attenuation), fit, comfort, retention, and audio characteristics.

Method of Compliance:

The aircraft helmet systems shall be safe, suitable and effective. The U.S. Army Aeromedical Research Laboratory (USAARL) is the proponent of requirements and testing of the helmet's crashworthiness (i.e., weight, CG, and crash attenuation), fit, comfort, retention, and audio characteristics, to include noise attenuation. Total helmet weight, including the Helmet Display Unit (HDU), visors, communication ear plugs, etc., shall not exceed 3.95 lbs. due to the crashworthy requirement established by the U.S. Army Aeromedical Research Laboratory. Airworthiness Substantiation shall include a Helmet System Substantiation Report IAW DI-HFAC-80745 including USAARL analysis, and test documentation as well as included as an appendix in the HEDAD-O.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.9.12. Acoustics and Noise

The purpose of Acoustics and Noise is to evaluate and document the effects of impact and steady state acoustic noise levels that may negatively affect crew performance and/or cause personal injury.

Criteria:

The aircraft acoustical noise shall not negatively impact crew's performance or cause personal injury.

Standard:

MIL-STD-1474
MIL-STD-1472

Method of Compliance:

The aircraft shall have an acoustic noise environment IAW MIL-STD-1474 and an assessment IAW with MIL-STD-1474 and Appendix D The operating environment shall not cause personnel injury, interference with voice communications, degrade system effectiveness or cause fatigue. Prepare an Acoustical Noise Assessment Test Plan IAW DI-HFAC-80743 to evaluate the effects of both steady state and impact noise on human

performance. The airworthiness substantiation shall include an Acoustical Noise Assessment Test Plan prepared IAW DI-HFAC-80743, and an Acoustical Noise Assessment Test Report prepared IAW DI-HFAC-80744 including measured acoustical noise levels and included as an appendix in the HEDAD-O. Provide the report to the United States Defense Centers for Public Health-Aberdeen (DCPH-A) and the United States Army Aeromedical Research Laboratory (USAARL) for adjudication for Health Hazard Assessment(s) or Health Hazard Analysis, as applicable (see below)

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.9.13. Speech Intelligibility

The purpose of Speech Intelligibility is to evaluate and document that all internal and external communications support clear and accurate voice communications.

NOTE: This is a separate requirement from the communications range testing e.g., 5X5 Signal to Noise Ratio Test, and the communication range testing shall not be accepted as a substitute or replacement for psychoacoustic speech intelligibility. See AMACC 11.3. for additional voice communications range testing that is separate from and not addressed by this requirement.

Criteria:

The aircraft audio communication system shall support speech intelligibility of sufficient quality to ensure safe and effective aircraft system operation.

Standard:

American National Standards Institute, ANSI S3.2A-2020
Guide for Aviation Medical Examiners, Federal Aviation Administration, 2022.
MIL-STD-1474E
MIL-STD-1472G

Method of Compliance:

The aircraft communication system shall be designed IAW MIL-STD-1472 and all critical audio communications paths shall be evaluated using the Modified Rhyme Test (MRT) for speech intelligibility (i.e., in addition to any range testing methods), in accordance with ANSI/ASA S3.2A, MIL-STD 1474E, and US Army Redstone Test Center (RTC) MEMORANDUM FOR U.S. Army Combat Capabilities Development Command, Aviation and Missile Center, SUBJECT: White Paper, Speech Intelligibility Assessments in Military Rotary-Wing and Fixed-Wing Aircraft.

Critical communication channels and paths shall include but are not limited to:

a. Pilot/operator audio communications with ground or mission personnel.

b. Pilot/operator communications with Air Traffic Control.

c. Pilot/operator with another external aircraft pilot/operator.

d. Pilots to aircrew and passengers.

e. Pilot to Co-pilot

Prepare a Human Engineering Test Plan IAW DI-HFAC-80743 and IAW ANSI/ASA S3.2 methods for speech intelligibility. For the baseline configuration and for any modifications to channels, communication architecture, path or source, including hardware, software updates, or antenna modifications or relocation, made to any communication system a Modified Rhyme Test shall be conducted IAW the test plan.

A “normal acceptable intelligibility” score for all operational military aircraft communication is 91 percent IAW MIL-STD-1472G and ANSI/ASA 3.2A, Appendix C. Deviations from this standard shall be assessed for impacts to safety of flight and residual risk determinations.

Modification	Tests Required	Test Conditions	
		Rotary-Wing	Fixed-Wing
ICS[1]	MRT[2] over ICS AND Radio MRTs over Air Traffic Control Frequencies	Ground: Rotors turning at 100% (or representative flight RPM[3]) with rotor blades at minimum pitch AND Flight: OGE[4] hover	Ground: Engines Idle AND Flight: High ambient noise (e.g., maximum level flight airspeed); mission-representative (e.g., cruise airspeed or loiter airspeed)
Primary Radio(s)		*Optimal positioning for radio transmission/reception* Ground: Rotors turning at 100% (or representative flight RPM) with rotor blades at minimum pitch OR Flight: OGE hover	*Optimal positioning for radio transmission/reception* Ground: Engines Idle OR Flight: Any profile
Mission Radio(s)	MRT over ICS only	See ICS Test Conditions	

NOTES:

[1]ICS – intercommunication system
[2]MRT – modified rhyme test
[3]RPM – rotations per minute
[4]OGE – out-of-ground-effect

Table 9-1 MRT Requirements (RTC Memorandum)

Each configuration, condition, location, direction, and transmission path shall be considered separately. Speech intelligibility of essential transmission paths shall be measured using the MRT. Essential transmission paths include the aircraft ICS and primary radio bands used for safety of flight with air traffic control (ATC) communications. Tests over radios should be designed to minimize the effects of communication range on speech intelligibility. At a minimum, one frequency per band per primary radio shall be tested. A summary of typical test requirements is presented in table 9-1.

The acoustical environment at the talker and listener locations shall be representative of the device's intended use. Noise environments used for testing should represent the worst case(s) in which communication is required over the specified channel. Typically, high engine power settings (e.g., hover, takeoff power), high airspeed, and/or high rotor/propeller settings result in the worst-case noise environments, but the application of other aircraft systems (e.g., auxiliary power units) should also be considered when determining representative noise environments. Case(s) shall be chosen based on analytical predictions or measurements using objective metrics. The test authority may qualitatively determine the test configurations resulting in representative worst-case noise environments. For each test condition, sound pressure levels in A-weighted decibels (dbA) at each participant location within the aircraft and ground station shall be measured. Speech intelligibility scores cannot be combined for different personnel locations and flight conditions, and predictive measures shall not be used for installed systems (i.e., ANSI/ASA 3.5). Furthermore, simulations are unacceptable replacements for ambient operational acoustical environments.

Signal, Interference, Noise, Propagation, and Overall Communications Rating Scale – To capture nuances in communications that may not affect speech intelligibility, participants should rate communications using the Signal, Interference, Noise, Propagation, and Overall (SINPO) Communications Rating Scale (Table 9-2, below). Ratings should be collected following each MRT talker word list. Following completion of the intercommunication system (ICS) MRT, test participants should rotate positions, each conduct a communications check (i.e., 10-count), and rate the communications using the SINPO scale to determine any issues related to participant equipment or participant location before conducting the radio MRT.

Rating	Signal Strength	Interference	Noise	Propagation	Overall Rating
	Relative Strength of Transmission	Interference from Other Stations	Amount of Atmospheric or Man-made Noise	Signal is Steady or Fades from Time to Time	
5	Excellent	Nil	Nil	Nil	Excellent
4	Good	Slight	Slight	Slight	Good
3	Fair	Moderate	Moderate	Moderate	Fair
2	Poor	Severe	Severe	Severe	Poor
1	Barely Audible	Extreme	Extreme	Extreme	Unusable

TABLE 9- 2. Signal, Interference, Noise, Propagation, and Overall Communications Rating Scale (RTC Memorandum)

For hardware, firmware and/or software changes to the aircraft ICS, MRTs over the ICS and the primary radio(s) used for ATC communications will be required.

For hardware, firmware and/or software, or antenna changes to the aircraft primary radios, MRTs over the ICS and over each primary radio will be required. Primary radio MRTs should be conducted in the frequency band(s) used to communicate with ATC, which may include bands outside the air route traffic control center very high frequency-amplitude modulation (VHF-AM) band of 118.000 to 136.975 megahertz, depending on the aircraft and mission. Results from radio communications range performance testing may be used to determine aircraft positioning relative to the ground station.

An ICS MRT is required following mission radio hardware and/or software modifications or when mission radios are added to the communication suite (e.g., high frequency, satellite communications). Mission radio MRTs over mission-representative frequency bands may be conducted at the discretion of the test authority.

For hardware, firmware and/or software, or antenna changes to primary and/or mission radios, additional communication range performance testing may be required. Communication range testing assesses the performance of the radio with regard to distance, relative azimuth, and elevation to/from a ground station. Communication range performance testing assesses signal strength and audio readability (e.g., 5x5 rating scale) and is separate from speech intelligibility testing. However, results from communication range performance testing may be used to determine optimal radio frequencies and aircraft positioning relative to the ground control station for speech intelligibility testing.

The airworthiness substantiation shall include a Speech Intelligibility Test Plan IAW DI-HFAC--80743 and ANSI/ASA S3, and a Speech Intelligibility Test Report prepared IAW DI-HFAC-80744 and included as an appendix in the HEDAD-O.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.9.14. Physiological Effects

The purpose of Physiological Effects is to provide a basis of system design elements that will alleviate any negative effects on human performance and safety.

Criteria:
Aircraft systems physiological effects on the aircrew shall not compromise safe flight.

Standard:
MIL-STD-1472
MIL-HDBK-516

Method of Compliance:
Human physiological limitations are subject to verification by the U.S. Army Aeromedical Research Laboratory (USAARL). The data and research related to physiological effects on aircraft crew and operators shall be evaluated by USAARL. Mission related functions such as expected mission duration, environment and other stressors shall be included in determining impacts to physiological effects.

The aircraft system shall minimize psycho-physiological stress effects of mission duration and fatigue under normal, adverse, and emergency conditions IAW MIL-STD-1472.

The system shall minimize potential human error in the operation of the system, particularly under the conditions of alert, battle stress, or other emergency or non-routine conditions.

The system shall not induce discomfort, pain, numbness, fatigue, injury, nausea, illness, or disorientation to the crew or operator.

The system shall minimize noise IAW with the associated noise impacts.

The system shall maximize speech intelligibility IAW the associated speech intelligibility.
The system shall minimize crew workload IAW the associated workload.

The system shall maintain body core and skin temperatures IAW the associated environmental control.

The system shall maintain lighting IAW the associated aircraft lighting.

Control operation shall require less force than the crew can provide to preclude reaching the crew fatigue threshold.

Control operation shall minimize the frequency of repetitions to preclude reaching the crew fatigue threshold.

The system shall minimize crew body motions for frequent actions to reduce fatigue.
The system shall provide support for crew body when performing frequent actions.

Weight distribution of crew mounted items shall be balanced to avoid or minimize muscle strain, fatigue, and undesired movement.

The system shall allow crew to change positions, to reduce fatigue and inattention.

Hydration/waste management recommendations for required mission durations shall be provided.

The system shall minimize hazardous exposure of the aircrew and passengers to radiation, chemicals, and toxins. Hazardous exposure shall be determined by the US Defense Centers for Public Health-Aberdeen (DCPH-A).

The airworthiness substantiation shall include USAARL test documentation, a Physiological Effects System Analysis Report IAW DI-HFAC-80745, Physiological Effects Test Plan(s) prepared IAW DI-HFAC-80743, and Physiological Effects Test Report(s) prepared IAW DI- HFAC-80744. All analyses and reports shall be included as part of the Human Engineering Design Approach Document-Operator (HEDAD-O). Prepare or revise the HEDAD-O Report IAW MIL-STD-46855 and prepared IAW DI-HFAC-80746.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.10. Aircraft Lighting and Night Vision Compatibility

The purpose of Aircraft Lighting and Night Vision Compatibility is to provide compatible lighting configurations (internal and external) in support of day, night-unaided, and night-aided mission configurations.

Criteria:

The aircraft lighting system shall not negatively impact the aircraft airworthiness, crew survivability, and hostile detectability during aided and unaided operations.

Standard:

MIL-STD-3009
MIL-STD-1472
MIL-L-85762
ADS-74-SP
FAA Part 23
FAA Part 25
FAA Part 27
FAA Part 29
MIL-PRF-85676

Method of Compliance:

The design and test the lighting system shall be performed IAW MIL-STD-3009. The aircraft interior and exterior lighting equipment (box-level) shall be verified by analysis

and test. The evaluation shall include light intensity, luminance, chromaticity, radiance, reflection, coverage angles, and flashing patterns IAW MIL-STD-3009; MIL-STD-1472; MIL-L-85762; ADS-74-SP; FAA Part 23 for Normal/Utility/Acrobatic/Commuter airplanes, Part 25 for Transport airplane, Part 27 for Normal Rotorcraft, and Part 29 Transport Rotorcraft. The aircraft lighting systems (aircraft level) shall perform a qualitative evaluation and demonstration by test. The evaluation and test shall include, Class A NVG compatibility, sunlight readability, reflections, light leakage, luminance uniformity/balance, minimum and maximum viewing distances for exterior lighting, intensity and coverage angles for exterior lights. The NVG compatibility evaluation shall be conducted using Class A NVGs (with a 625 nm cutoff filter), a medium contrast 1951 USAF Resolution Test Chart, and a 10,000 fc, 5000 ºK color temperature sun-gun. The NVG compatibility and cockpit lighting evaluation, including sunlight readability, shall be performed IAW U.S. Army Technical Test Center (ATTC) TOP 7-2-513.

The aircraft system shall provide the following performance criteria for interior lights and displays:

a. Chromaticity - The aircraft interior light chromaticity shall be IAW MIL-STD-3009 for Type I, Class A NVGs.

b. Luminance - The aircraft interior light luminance shall be IAW MIL-STD-3009.

c. Radiance. The aircraft interior light radiance shall be IAW MIL-STD-3009 for Type I, Class A NVGs.

d. Contrast - The aircraft interior light contrast shall be IAW MIL-STD-3009.

e. Reflection - The aircraft interior light reflection shall be IAW MIL-STD-3009.

f. Sunlight Readability - All aircraft lighting and displays shall meet the 10,000 fc direct sunlight requirement and the 2,000 fL specular readability requirements IAW Appendix C of MIL-STD-3009.

The aircraft exterior lighting shall include dual-mode [visible and infrared (IR)] anti-collision lights, dual-mode Position/Navigation lights, dual-mode Formation lights, dual-mode Search lights, and dual-mode Taxi lights. All other visible exterior lighting shall be IAW FAA Part 23 for Normal/Utility/Acrobatic/Commuter airplanes, Part 25 for Transport airplane, Part 27 for Normal Rotorcraft, Part 29 Transport Rotorcraft, and MIL-STD-3009. Both Visible and IR Anti-Collision Lights and both visible and IR Position Lights shall be detectable by both Class A and Class B NVGs at the minimum of 3 nm (Note: this is to assure that NVGs, especially Class B NVG, can detect LED lights).

The aircraft system shall provide the following performance criteria for anti-collision lights:

a. Visible Mode – The visible mode anti-collision lights shall comply IAW FAA Part 23 for Normal/Utility/Acrobatic/Commuter airplanes, Part 25 for Transport airplane, Part

27 for Normal Rotorcraft, Part 29 Transport Rotorcraft. The lights shall also comply with MIL-STD-3009.

b. IR Mode – The IR mode of the anti-collision lights shall comply IAW MIL-STD-3009. Also, the IR anti-collision lights field of coverage shall be at least 30 degrees above and -30 degrees below the centerline of the aircraft and provide a 360-degree ring of coverage (horizontally) around the aircraft. The lights shall be visible to both Class A and Class B NVGs at 3 nm anywhere within the above defined coverage angles. The lights field of coverage may go beyond -30 degrees below the centerline of the aircraft; however, its absolute cutoff point shall be at -45 degrees. The lights shall not be detectable by unaided eyes at distances beyond 100 meters.

The aircraft system shall provide the following performance criteria for position/navigation lights:

a. Visible Mode - The visible mode position lights shall comply IAW FAA Part 23 for Normal/Utility/Acrobatic/Commuter airplanes, Part 25 for Transport airplane, Part 27 for Normal Rotorcraft, Part 29 Transport Rotorcraft. The lights shall also meet the ANVIS “friendly” requirement IAW MIL-STD-3009.

b. IR Mode - The IR mode of the position lights shall be IAW MIL-STD-3009. Also, the IR position lights field of coverage shall be at least 30 degrees above and -30 degrees below the centerline of the aircraft and provide a 360-degree ring of coverage (horizontally) around the aircraft. The lights shall be visible to both Class A and Class B NVGs at 3 nm anywhere within the above defined coverage angles. The lights field of coverage may go beyond -30 degrees below the centerline of the aircraft; however, its absolute cutoff point shall be at -45 degrees. The lights shall not be detectable by unaided eyes at distances beyond 100 meters.

The aircraft system shall provide the following performance criteria for formation lights:

a. Visible Mode - The aircraft shall be equipped with a formation lighting system that will provide visual, unambiguous orientation information regarding the attitude and position of the lead aircraft to the pilots of aircraft in the formation. The lights shall also meet the ANVIS “friendly” requirement given in MIL-STD-3009.

b. IR Mode - The IR mode of the formation lights shall comply with MIL-STD-3009. Also, the IR formation lights shall be viewable through ANVIS at a distance of at least 500 feet (approximately 5 main rotor disk diameters [H-47]). The lights shall not be visible below the centerline of the aircraft. The lights shall not be detectable by unaided eyes at distances beyond 100 meters.

The aircraft system shall provide the following performance criteria for search lights:

a. Visible Mode - The visible mode search/landing lights shall have a minimum intensity of 200,000 peak candlepower with a beam spread of 15 degrees ± 5 degrees.

b. IR Mode - The IR mode of the search/landing lights shall have a minimum intensity of 10 NVIS Radiance Intensity (NRI) with a beam spread of 20 degrees ± 5 degrees and possess a wavelength of 875 ± 75 nm.

c. Dimming - The dual-mode search/landing lights shall provide lamp dimming in both the visible and the IR modes from 0% to 100% intensity.

d. Extended Angle - The search/landing lights shall have an extended angle from 0 to 120 degrees vertically from its fully stowed position.

e. Rotation Angle - The search/landing lights shall have a rotation angle of 360 degrees horizontally at 60 to 120 degrees vertically extended angles.

The aircraft system shall provide the following performance criteria for taxi/landing light:

a. Visible Mode - The visible mode taxi/landing lights shall comply with FAA Part 23 for Normal/Utility/Acrobatic/Commuter airplanes, Part 25 for Transport airplane, Part 27 for Normal Rotorcraft, Part 29 Transport Rotorcraft. The lights shall also meet the ANVIS- friendly requirement IAW MIL-STD-3009.

b. IR Mode - The IR mode of the taxi/landing lights shall be IAW MIL-STD-3009. All interior lighting shall comply with the Type I, Class A Requirement IAW MIL-STD-3009.

An aircraft lighting test plan shall be prepared IAW DI-NDTI-80566, test procedures IAW DI-NDTI-80603, and test report(s) IAW DI-NDTI-80809.

The aircraft shall provide the following performance criteria for emergency egress lighting. Emergency Egress Lighting shall be IAW FAA Part 23 for Normal/Utility/Acrobatic/ Commuter airplanes, Part 25 for Transport airplane, Part 27 for Normal Rotorcraft, Part 29 Transport Rotorcraft, the Aircraft Survivability Design Guide, and MIL-PRF-85676.

In order to meet the secure lighting mandate, all interior lighting shall comply with the Type I, Class A requirement as defined by MIL-STD-3009.

The airworthiness substantiation shall include Aircraft Lighting and Night Vision Compatibility Test Procedures prepared IAW DI-NDTI-80603, an Aircraft Lighting and Night Vision Compatibility Test Plan prepared IAW DI-NDTI-80566, and Aircraft Lighting and Night Vision Compatibility Test Report(s) prepared IAW DI-NDTI-80809 and included as an appendix in the HEDAD-O.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	TOP 7-2-513			

9.11. Toxicology/Health/ Chemical Biological Radiological Nuclear (CBRN)/ Hazards

The purpose of Toxicology/Health/Chemical/Biological/Radiological/Nuclear is to provide required mission configurations for operations during hazardous conditions and to minimize the potential effects of health hazards.

NOTE: In order to use the Defense Centers for Public Health-Aberdeen (DCPH-A) the system in question must be a program of record and must be used regularly.

Criteria:
The aircraft and its related systems shall not cause health hazards to the aircrew, ground crew, passengers, or to other third parties.

Standard:
AR 40-10
AR 602-2
Health Hazard Assessment Program in Support of the Army Acquisition Process
DoD Directive 5030.61
MIL-STD-882
Aircraft System Specification

Method of Compliance:
The aircraft and related systems shall not have radiation, gases, liquids or debris that are hazardous, such as explosive ordnance, explosive or flammable fluids, weapon system deployment, laser energy and impulse and steady state noise as defined by the Aircraft System Specification. The airworthiness substantiation shall include a Health Hazard Assessment Report IAW Paragraph 14.2.13. of this document for programs of record whereby “All MANPRINT [Human System Integration] issues will be resolved, or risk accepted prior to Milestone C.” IAW AR 602-2. Airworthiness substantiation shall include the report that contains assessments made by the DCPH-A. A Health Hazard Assessment Report (HHAR) shall be provided by the DCPH-A and updated or revised as changes to the configuration are made. The HHAR shall be integrated and coordinated with the program’s system safety assessment for decision milestones as required IAW AR 40-10 and IAW DI-SAFT-80106.

In addition, for procurements and modifications that are not included in the Health Hazard Assessment, a Health Hazard Analysis shall be conducted. The airworthiness substantiation shall include a Health Hazard Analysis IAW MIL-STD-882, Task 207 and IAW DI-SAFT-80106. The analysis shall include all applicable Material Data Handling Sheets for all system/subsystem component to identify hazardous materials (to include flammability and toxicity hazards).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.12. Weapon Engagement - Gun/Missiles/Rockets
The purpose of Gun/Missile/Rockets is to provide aircraft self-protection and weapon engagement functions.

Criteria:
The aircraft system shall provide controls and displays for the use of guns, missiles and rockets that shall not degrade safe operations.

Standard:
TC 3-04.45 (FM 3-04.140)
MIL-STD-1760

Method of Compliance:
The Pilot Vehicle interface for all weapon systems shall provide usable and accurate symbology with ballistic solutions that provide an accuracy capability to a standard (is the standard Combat Aviation Gunnery TC 3-04.45 (FM 3-04.140) and MIL-STD-1760) danger close engagements can be made during day, night and in a DVE conditions. Degraded modes and failures shall be displayed to the crew and “detailed” information of the degradation shall be accessible to the crew. No Health Hazards to the aircrew, ground crew, passengers, or to other third parties from any weapon system is acceptable, to include lasers. See paragraph 11.20. Weapon switches shall comply with the unique design requirements IAW MIL-STD-1760 paragraph 4.3. Specifically, the release consent interface shall be a low power discrete used only to enable, and inhibit, safety critical store functions which are commanded by the aircraft over the data bus interface. Demonstrate by test that all weapons systems standards are IAW Combat Aviation Gunnery TC 3-04.45 (FM 3- 04.140) and MIL-STD-1760).

The airworthiness substantiation shall include a Weapon System PVI Analysis Report prepared IAW DI-HFAC-80745, a Weapon System PVI Test Plan prepared IAW DI-HFAC- 80743, and a Weapon System PVI Test Report prepared IAW DI-HFAC-80744 and included as part of the Human Engineering Design Approach Document-Operator (HEDAD-O).

HEDAD-O Prepare or revise the HEDAD-O Report IAW MIL-STD-46855 and prepared IAW DI-HFAC-80746.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

9.13. Laser Safety
The purpose of Laser Safety is to provide a means of protecting crew, occupants, and ground personnel from injury due to laser system operations.

Criteria:
The aircraft sensors and lasers systems shall have laser systems that prevent the ability of Inadvertent Firing or prevent other unsafe conditions.

Standard:
MIL-STD-882
MIL-STD-1472

MIL-STD-1425
AR 40-10
Health Hazard Assessment Program in Support of the Army Acquisition Process

Method of Compliance:
The aircraft sensors and lasers systems shall have laser systems that prevent the ability of Inadvertent Firing or prevent other unsafe conditions. The method for firing and safety inhibits for lasers shall be evaluated and tested to ensure safety of maintenance personnel and ground crew. Evaluate and test the software and hardware inhibits for control of the laser field of regard to ensure the laser will not fire into the aircraft or stores (laser masking). Laser energy shall not be reflected back into the aircrew's eyes.

The laser system controls shall be designed to prevent inadvertent firing per
Docs Docs

10. RESERVED

11. AVIONICS AND NAVIGATION

The following criteria, standards and methods of compliance apply to all air systems and represent the minimum requirements necessary to establish, verify, and maintain an airworthy design. The requirements apply to all voice and data communication systems, navigation systems, and surveillance systems.

The criteria defined will be used to ensure airworthiness and safety of the aircraft, airspace entry requirements in the global civil airspace, and specific Communication, Surveillance, Datalink and Navigation system performance requirements. For subsystems that use computer systems and software, Paragraph 15 contains additional specific criteria, standards and methods of compliance that shall be considered.

11.1. Communication, Navigation and Surveillance (CNS) Master Plan and Report

Criteria:
A master plan of events to qualify the CNS system shall be defined

Standard:

Method of Compliance:
A master plan of all analyses, tests and demonstrations required to qualify the CNS system shall be summarized in a CNS Master Plan. The plan shall summarize all the detail requirements identified be below. Qualification events identified below can be combined and the master plan will identify those combined events and the detail requirements that are being satisfied. The results of the detail requirements below shall be summarized in a CNS Master Test report. The report will summarize the results of all detailed analyses, tests and demonstrations. The detail requirements below shall be traceable to the master test plan and report. The airworthiness substantiation shall include a CNS Master Test Plan prepared IAW DI-NDTI-80566 and a CNS Master Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-186	AR 95-1			

11.2. Avionics Communications Equipment (ACE) Parameters

The following ACE parameter and the analyses identified in each criterion are applicable to all waveforms and subsystems in the comm/surveillance system.

11.2.1. Antenna Coverage

Criteria:
The system antenna(s) shall provide coverage to preclude loss of signal to support its specified mission.

Standard:

Method of Compliance:
The system antenna(s) coverage shall be verified to provide coverage to preclude loss of signal to support its specified mission. The airworthiness substantiation shall include an antenna coverage analysis with an Antenna Coverage Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.2.2. Antenna Cosite

Criteria:
The system antenna(s) shall provide field of view that precludes loss of signal to support its specified mission.

Standard:

Method of Compliance:
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. The airworthiness substantiation shall include a cosite analysis with a Comm/Data Antenna Cosite Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.2.3. Spacing and Isolation

Criteria:
The system antenna(s) should provide a minimum spacing of 3/8 wavelength separation at the lowest frequency between any two antennas.

Standard:

Method of Compliance:
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. The airworthiness substantiation shall include an analysis and an Antenna Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.2.4. Interference

Criteria:
The installed system shall meet Electromagnetic Interference (EMI) Electromagnetic Compatibility (EMC) requirements IAW ADS-37

Standard:
ADS-37

Method of Compliance:
The installed system shall be verified to meet the EMI/EMC requirements in paragraph 13 of this document.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.2.5. COMSEC

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

Standard:
AR 380-5

Method of Compliance:
The installed COMSEC system shall be verified to meet COMSEC requirements IAW AR 380-5 and requirements of cognizant authorities. The airworthiness substantiation shall include a system analysis and a COMSEC System Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.2.6. Criticality of ACE Systems

Criteria: The ACE systems shall provide the level of criticality for its intended use.

Standard:

Method of Compliance:
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. The airworthiness substantiation shall include a criticality analysis with an ACE System Criticality Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.3. Voice Communication System

The purpose of voice communication is to provide the aircrew the capability to communicate with Command and Control.

Criteria:

The voice communication system shall provide at a minimum, two qualified radios for omnidirectional voice transmit and receive. When a UHF-AM radio is used in lieu of a secondary VHF-AM, as described in this paragraph, that UHF-AM radio must also provide Inter/Intra Communication System (ICS) bypass (11.3.7.4) and guard capability (11.3.7.3) as the secondary VHF-AM radio does.

Standard:

Method of Compliance:

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 Very High Frequency- Amplitude Modulated (VHF-AM) voice communications and a secondary radio capable of VHF-AM or Ultra High Frequency- Amplitude Modulated (UHF-AM) voice communications utilized via an integrated communication system IAW the aircraft system specification and Appendix B. The airworthiness substantiation shall include a Communication System Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.3.1. Reserved

11.3.2. Reserved

11.3.3. Reserved

11.3.4. Reserved

11.3.5. Reserved

11.3.6. Primary VHF-AM

The purpose of primary VHF-AM is to provide omnidirectional transmit and receive line-ofsight (LOS) voice communication between the aircrew and Command and Control over the 118-151.975 MHz frequency range (108-117.975 MHz receive only).

11.3.6.1. Primary VHF-AM - Component Functional Performance

Criteria:
The Primary VHF-AM radio (118-137 MHz) shall meet MIL-STD-188-242, Interoperability & Performance Standards for Tactical Single Channel VHF-AM Radio Equipment.

Standard:
MIL-STD-188-242

Method of Compliance:
The Primary VHF-AM radio (118-137 MHz) shall be verified to meet MIL-STD-188-242, Interoperability & Performance Standards for Tactical Single Channel VHF-AM Radio Equipment. The airworthiness substantiation shall include a VHF-AM Comm Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-186	ADS-37A-PRF MIL-STD-188-242	14 CFR Part 91 14 CFR 91.205(d) TSO-C169		

11.3.6.2. Primary VHF-AM - Voice Communication

Criteria:
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.

Standard:

Method of Compliance:
The Primary VHF-AM radio 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) for specified operations. The preferred method is a communication range survey Test/Demonstration; the standard test shall be performed at 1,200’ Above Ground Level (AGL) at 35 NM from the ground station at ground level IAW Appendix B. The airworthiness substantiation shall include a Comm range test with a VHF-AM Comm/Data Range Survey Flight Test Plan prepared IAW DI-NDTI-80566 and a VHF-AM Comm/Data Range Survey Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-186	ADS-37A-PRF MIL-STD-188-242	14 CFR Part 91 14 CFR 91.205(d) TSO-C169		

11.3.6.3. Primary VHF-AM - Monitoring the Guard Frequency

Criteria:
The Primary VHF-AM radio shall provide simultaneous monitoring of the guard frequencies, 121.5 and 243 MHz, to the ICS system.

Standard:

Method of Compliance:
The Primary VHF-AM radio shall be verified to provide simultaneous monitoring of the guard frequencies, 121.5 and 243 MHz, to the ICS system. The airworthiness substantiation shall include a system demo with a VHF-AM Comm System Demo Plan prepared IAW DI-NDTI-80566 and a VHF-AM Comm System Demo Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-186	ADS-37A-PRF MIL-STD-188-242			

11.3.6.4. Primary VHF-AM - Loss of Primary Power

Criteria:
The Primary VHF-AM radio installation shall provide the flight crew with continued operation after loss of primary power.

Standard:

Method of Compliance:
The Primary VHF-AM radio installation shall be verified to provide the flight crew with continued operation after loss of primary power. The airworthiness substantiation shall include a system demo with a VHF-AM Comm System Demo Plan prepared IAW DI-NDTI-80566 and a VHF-AM Comm System Demo Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-186	ADS-37A-PRF MIL-STD-188-242			

11.3.6.5. Primary VHF-AM - Guard Switch

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

Standard:

Method of Compliance:
The Primary VHF-AM radio shall be verified to provide tuning to a guard frequency when the Guard Switch is suppressed. The airworthiness substantiation shall include a system demo with a VHF-AM Comm System Demo Plan prepared IAW DI-NDTI-80566 and a VHF-AM Comm System Demo Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-186				

11.3.6.6. Primary VHF-AM - ICS Bypass

Criteria:
The Primary VHF-AM radio shall provide the ability to bypass the ICS system.

Standard:

Method of Compliance:
The Primary VHF-AM radio shall be verified to provide the ability to bypass the ICS system. The airworthiness substantiation shall include a system demo with a VHF-AM Comm System Demo Plan prepared IAW DI-NDTI-80566 and a VHF-AM Comm System Demo Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-186	ADS-37A-PRF MIL-STD-188-242			

11.3.6.7. Primary VHF-AM - Emergency Control

Criteria:
The Primary VHF-AM radio shall provide the capability for independent operation in emergency conditions.

Standard:

Method of Compliance:
The Primary VHF-AM radio shall be verified to provide a federated means of control. The airworthiness substantiation shall include a system demo with a VHF-AM Comm System Demo Plan prepared IAW DI-NDTI-80566 and a VHF-AM Comm System Demo Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-186	ADS-37A-PRF MIL-STD-188-242			

11.3.7. Secondary VHF-AM

The purpose of secondary VHF-AM is to provide an additional means of omnidirectional transmit and receive LOS voice communication between the aircrew and Command and Control over the 118-151.975 MHz frequency range (108-117.975 MHz receive only).

11.3.7.1. Secondary VHF-AM - Component Functional Performance

Criteria:
The Secondary VHF-AM radio (118-137 MHz) shall meet MIL-STD-188-242, Interoperability & Performance Standards for Tactical Single Channel VHF-AM Radio Equipment.

Standard:
MIL-STD-188-242

Method of Compliance:
The Secondary VHF-AM radio (118-137 MHz) shall be verified to meet MIL-STD-188-242, Interoperability & Performance Standards for Tactical Single Channel VHF-AM Radio Equipment. The airworthiness substantiation shall include a VHF-AM Comm Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-186	ADS-37A MIL-STD-188-242			

11.3.7.2. Secondary VHF-AM - Voice Communication

Criteria:
The Secondary 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.

Standard:

Method of Compliance:
The Secondary VHF-AM radio 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) 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 IAW Appendix B. The airworthiness substantiation shall include a Comm range test with a VHF-AM Comm/Data Range Survey Flight Test Plan prepared IAW DI-NDTI-80566 and a VHF-AM Comm/Data Range Survey Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-186	ADS-37A MIL-STD-188-242			

11.3.7.3. Secondary VHF-AM - Monitoring the Guard Frequency

Criteria:
The Secondary VHF-AM radio shall provide simultaneous monitoring of the guard frequencies, 121.5 and 243 MHz, to the ICS system.

Standard:

Method of Compliance:
The Secondary VHF-AM radio shall be verified to provide simultaneous monitoring of the guard frequencies, 121.5 and 243 MHz, to the ICS system. The airworthiness substantiation shall include a system demo with a VHF-AM Comm System Demo Plan prepared IAW DI-NDTI-80566 and a VHF-AM Comm System Demo Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-186 RTCA DO-186	ADS-37A MIL-STD-188-242			

11.3.7.4. Secondary VHF-AM - ICS Bypass

Criteria:
The Secondary VHF-AM radio shall provide the ability to bypass the ICS system.

Standard:

Method of Compliance:
The Secondary VHF-AM radio shall be verified to provide the ability to bypass the ICS system. The airworthiness substantiation shall include a system demo with a VHF-AM Comm System Demo Plan prepared IAW DI-NDTI-80566 and a VHF-AM Comm System Demo Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-186	ADS-37A MIL-STD-188-242			

11.3.8. UHF-AM/HAVEQUICK/HAVEQUICK II

The purpose of UHF-AM is to provide omnidirectional transmit and receive LOS voice communication between the aircrew and Command and Control over the frequency range 225 to 400 MHz. HAVEQUICK provides Electronic Counter-Counter Measures (ECCM), i.e., Frequency Hopping.

11.3.8.1. UHF-AM Component Functional Performance

Criteria:
The UHF-AM radio (225-400 MHz) shall meet MIL-STD-188-243, Interoperability & Performance Standards for Tactical HAVEQUICK/HAVEQUICK II waveform.

Standard:
MIL-STD-188-243

Method of Compliance:
The UHF-AM radio (225-400 MHz) shall be verified to 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. The airworthiness substantiation shall include a UHF-AM Comm Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-188-243			

11.3.8.2. UHF-AM - Voice Communication

Criteria:
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.

Standard:

Method of Compliance:
The UHF-AM radio shall be verified to 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 IAW Appendix B. The airworthiness substantiation

shall include a Comm range test with a UHF-AM Comm/Data Range Survey Flight Test Plan prepared IAW DI-NDTI-80566 and a UHF-AM Comm/Data Range Survey Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-188-243			

11.3.9. High Frequency (HF)

The purpose of HF is to provide omnidirectional transmit and receive beyond-line-of-sight (BLOS) voice communication between the aircrew and Command and Control over the 2 to 30 MHz frequency range when other means of communication are not feasible.

11.3.9.1. HF - Component Functional Performance

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

Standard:
MIL-STD-188-141

Method of Compliance:
The HF radio shall be verified to meet MIL-STD-188-141, Interoperability and Performance Standards for Medium and High Frequency Radio System. The airworthiness substantiation shall include a HF Comm Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-163	ADS-37A MIL-STD-188-141			

11.3.9.2. HF - Voice Communication

Criteria:
The HF radio shall provide omnidirectional transmit and receive BLOS voice communications over the 2 to 30 MHz frequency range for specified operations.

Standard:

Method of Compliance:
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 B. The airworthiness substantiation shall include a Comm range test with a HF Comm/Data Range Survey Flight Test Plan prepared IAW DI-NDTI-80566 and a HF Comm/Data Range Survey Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-188-141			

11.3.10. VHF-FM SINCGARS

The purpose of VHF-FM is to provide Single Channel Ground and Airborne Radio System (SINCGARS) LOS voice communication between the aircrew and Command and Control over the 30 to 88 MHz frequency range and provides ECCM, i.e., Frequency Hopping.

11.3.10.1. Component Functional Performance - Frequency Hopping

Criteria:
The VHF-FM SINCGARS radio (30-88 MHz) shall meet MIL-STD-188-241, Frequency Hopping Standard for VHF Frequency Hopping Radios

Standard:
MIL-STD-188-241

Method of Compliance:
The VHF-FM SINCGARS radio shall be verified to meet MIL-STD-188-241, Frequency Hopping Standard for VHF Frequency Hopping Radios. The airworthiness substantiation shall include a VHF-FM Comm Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A-PRF MIL-STD-188-241(S) MIL-STD-242			

11.3.10.2. VHF-FM Component Functional Performance- Interoperability

Criteria:
The VHF-FM SINCGARS radio (30-88 MHz) shall meet MIL-STD-188-242, Interoperability & Performance Standards for Tactical Single Channel VHF Radio Equipment

Standard:
MIL-STD-188-242

Method of Compliance:
The VHF-FM SINCGARS radio shall be verified to meet MIL-STD-188-242, Interoperability and Performance Standards for Tactical Single Channel VHF Radio Equipment. The airworthiness substantiation shall include a VHF-FM Comm Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A-PRF MIL-STD-188-241 MIL-STD-242			

11.3.10.3. VHF-FM - Voice Communication

Criteria:
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.

Standard:

Method of Compliance:
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. The airworthiness substantiation shall include a Comm range test with a VHF-FM Comm/Data Range Survey Flight Test Plan prepared IAW DI-NDTI-80566 and a VHF-FM Comm/Data Range Survey Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A-PRF MIL-STD-188-241) MIL-STD-242			

11.3.11. Satellite Communications (SATCOM)
The purpose of SATCOM is to provide omnidirectional transmit and receive BLOS voice communication between the aircrew and Command and Control when other means of communication are not feasible.

11.3.11.1. SATCOM Radio Single-Access 5 kHz and 25 kHz UHF Channels - Component Functional Performance

Criteria:
The SATCOM radio shall meet MIL-STD-188-181, Interoperability Standard for Single-Access 5-kHz and 25-kHz UHF Satellite Communications Channels

Standard:
MIL-STD-188-181

Method of Compliance:
The SATCOM radio shall be verified to meet MIL-STD-188-181, Interoperability Standard for Single-Access 5-kHz and 25-kHz UHF Satellite Communications Channels. The airworthiness substantiation shall include a SATCOM Comm Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-188-181 MIL-STD-188-182 MIL-STD-188-183			

11.3.11.2. SATCOM Radio Demand Assigned Multiple Access (DAMA) Orderwire Messages and Protocols - Component Functional Performance

Criteria: :
The SATCOM radio shall meet MIL-STD-188-182, Interoperability Standard for UHF SATCOM DAMA Orderwire Messages and Protocols

Standard:
MIL-STD-188-182

Method of Compliance:
The SATCOM radio shall be verified to meet MIL-STD-188-182, Interoperability Standard for UHF SATCOM DAMA Orderwire Messages and Protocols. The airworthiness substantiation shall include a SATCOM Comm Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-188-181 MIL-STD-188-182 MIL-STD-188-183			

11.3.11.3. SATCOM Radio Multiple-Access 5 kHz and 25 kHz UHF Channels - Component Functional Performance

Criteria:
The SATCOM radio shall meet MIL-STD-188-183, Interoperability Standard for Multiple-Access 5-kHz and 25-kHz UHF Satellite Communications Channels

Standard:
MIL-STD-188-183

Method of Compliance:
The SATCOM radio shall be verified to meet MIL-STD-188-183, Interoperability Standard for Multiple-Access 5-kHz and 25-kHz UHF Satellite Communications Channels. The airworthiness substantiation shall include a SATCOM Comm Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-188-181 MIL-STD-188-182 MIL-STD-188-183			

11.3.11.4. SATCOM Radio DAMA Control System - Component Functional Performance

Criteria:
The SATCOM radio shall meet MIL-STD-188-185, Interoperability UHF MIL SATCOM DAMA Control System.

Standard:
MIL-STD-188-185

Method of Compliance:
The SATCOM radio shall be verified to meet MIL-STD-188-185, Interoperability UHF MIL SATCOM DAMA Control System. The airworthiness substantiation shall include a SATCOM Comm Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-188-181 MIL-STD-188-182 MIL-STD-188-183			

11.3.11.5. SATCOM - Voice Communication

Criteria:
The SATCOM radio shall provide omnidirectional voice communications at specified bandwidths in dedicated satellite and DAMA modes.

Standard:

Method of Compliance:
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. The airworthiness substantiation shall include a Comm range test with a SATCOM Comm/Data Range Survey Flight Test Plan prepared IAW DI-NDTI-80566 and a SATCOM Comm/Data Range Survey Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-188-181 MIL-STD-188-182 MIL-STD-188-183			

11.3.12. Inter/Intracommunication System (ICS)
The purpose of the ICS is to provide management of platform audio signals for all specified radio communication systems and WCAs.

11.3.12.1. ICS Integration

Criteria:
The ICS shall provide integration of the audio signals from all platform specified radio communication systems, associated WCAs, and COMSEC equipment.

Standard:

Method of Compliance:
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. The airworthiness substantiation shall include a system demo with an ICS Demo Plan prepared IAW DI-NDTI-80566 and an ICS Demo Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-214	MIL-STD-1472	TSO-C139		

11.3.12.2. ICS Controls

Criteria:
The ICS shall provide platform specified communications controls for the integrated communication systems.

Standard:

Method of Compliance:
The ICS shall be verified to provide platform specified communications controls for the integrated communication systems. The airworthiness substantiation shall include a system demo with an ICS Demo Plan prepared IAW DI-NDTI-80566 and an ICS Demo Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-214	MIL-STD-1472	TSO-C139		

11.3.12.3. ICS Primary Communications Isolation from Passenger Station

Criteria:
The ICS shall provide the means to prevent a passenger ICS station from overriding flight crew control of the primary communication radios.

Standard:

Method of Compliance:
The ICS shall be verified to prevent a passenger ICS station from overriding flight crew control of the primary communication radios. The airworthiness substantiation shall include a system demo with an ICS Demo Plan prepared IAW DI-NDTI-80566 and an ICS Demo Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-214	MIL-STD-1472	TSO-C139		

11.3.12.4. ICS Loss of primary power

Criteria:
The ICS installation shall provide the flight crew with continued operation after loss of primary power.

Standard:

Method of Compliance:
The ICS installation shall be verified to provide the flight crew with continued operation after loss of primary power. The airworthiness substantiation shall include a system demo with an ICS Demo Plan prepared IAW DI-NDTI-80566 and an ICS Demo Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-214	MIL-STD-1472	TSO-C139		

11.3.13. Other Voice Communications
The purpose of other voice communication is to provide a LOS or BLOS voice communication between the aircrew and Command and Control.

Criteria:
Other voice communications shall meet platform defined specification requirements.

Standard:

Method of Compliance:
Other voice communications shall be verified to meet platform defined specification requirements. The airworthiness substantiation shall include a system demo with an Other Comm/Data Range Survey Flight Test Plan prepared IAW DI-NDTI-80566 and an Other Comm/Data Range Survey Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A-PRF			

11.4. Data Communication
The purpose of data communication is to provide the aircrew the capability to digitally communicate with Command and Control.

11.4.1. Availability

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

Standard:

Method of Compliance:
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. The airworthiness substantiation shall include a system demo with a Data Comm Demonstration Test Plan prepared IAW DI-NDTI-80566 and a Data Comm Demonstration Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-186	AR 95-1	CFR Title 14 Part 91		

11.4.2. Error Rate

Criteria:
Datalink error rate shall be IAW system specified data rate limits in all modes of operation.

Standard:

Method of Compliance:
Datalink error rate shall be verified IAW system specified data rate limits in all modes of operation. The airworthiness substantiation shall include a system demo with a Data Comm Demonstration Test Plan prepared IAW DI-NDTI-80566 and a Data Comm Demonstration Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-186	AR 95-1	CFR Title 14 Part 91		

11.4.3. Latency – Line of Sight (LOS) Systems

Criteria:
Datalink latency shall provide system specified limits.

Standard:

Method of Compliance:
Datalink latency shall be verified to provide system specified limits. The airworthiness substantiation shall include a latency analysis with a Data Latency Analysis Report prepared IAW DI-MISC-80711 and system demo with a Data Comm Demonstration Test Plan prepared IAW DI-NDTI-80566 and a Data Comm Demonstration Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-186	AR 95-1	14 CFR Part 91		

11.4.4. Latency – Beyond Line of Sight (BLOS) Systems

Criteria:
Datalink latency shall provide system specified limits

Standard:

Method of Compliance:
Datalink latency shall be verified to provide system specified limits. The airworthiness substantiation shall include a latency analysis with a Data Latency Analysis Report prepared IAW DI-MISC-80711 and system demo with a Data Comm Demonstration Test Plan prepared IAW DI-NDTI-80566 and a Data Comm Demonstration Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-186	AR 95-1	14 CFR Part 91		

11.4.5. Reliability, Monitoring/Displaying of Data Link Parameters

Criteria:
datalink parameters should provide monitoring/display in real time.

Standard:

Method of Compliance:
All data link parameters should be verified to provide monitoring/displaying in real time. The airworthiness substantiation shall include a system demo with a Data Comm Demonstration Test Plan prepared IAW DI-NDTI-80566 and a Data Comm Demonstration Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-186	AR 95-1	14 CFR Part 91		

11.4.6. Primary VHF-AM Data Communication
The purpose of primary VHF-AM is to provide omnidirectional transmit and/or receive LOS data transmission between the aircrew and Command and Control over the 118-151.975 MHz frequency range (108-117.975 MHz receive only).

11.4.6.1. Component Functional Performance – Interface

Criteria:
The Primary VHF-AM radio (118-137 MHz) shall meet MIL-STD-188-220 Interface Standard Digital Message Transfer Device Subsystems.

Standard:
MIL-STD-188-220

Method of Compliance:
The VHF-AM radio that is primary shall be verified to meet MIL-STD-188-220 Interface Standard Digital Message Transfer Device Subsystems. The airworthiness substantiation shall include a VHF-AM Data Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-219	ADS-37A MIL-STD-188-242 MIL-STD-188-220	14 CFR Part 91 & 91.123 AC 90-117 AC 20-140 TSO-160a		

11.4.6.2. Datalink Communication

Criteria:
The Primary VHF-AM radio system shall provide omnidirectional data communication in all modes of operation.

Standard:

Method of Compliance:
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. The airworthiness substantiation shall include a Data range test with a VHF-AM Comm/Data Range Survey Flight Test Plan prepared IAW DI-NDTI-80566 and a VHF-AM Comm/Data Range Survey Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-219	ADS-37A MIL-STD-188-242 MIL-STD-188-220	14 CFR Part 91 & 91.123 AC 90-117 AC 20-140 TSO-160a		

11.4.7. Secondary VHF-AM Data Communication
The purpose of secondary VHF-AM is to provide an additional means of omnidirectional transmit and/or receive LOS data communication between the aircrew and Command and Control over the 118-151.975 MHz frequency range (108-117.975 MHz receive only).

11.4.7.1. Secondary VHF-AM Data Communication - Component Functional Performance

Criteria:
The Secondary VHF-AM radio (118-137 MHz) shall meet MIL-STD-188-220 Interface Standard Digital Message Transfer Device Subsystems.

Standard:
MIL-STD-188-220

Method of Compliance:
The VHF-AM radio that is secondary shall be verified to meet MIL-STD-188-220 Interface Standard Digital Message Transfer Device Subsystems. The airworthiness substantiation shall include a VHF-AM Data Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-188-243 MIL-STD-188-220			

11.4.7.2. Secondary VHF-AM Data Communication - Datalink Communication

Criteria:
The Secondary VHF-AM radio system shall provide omnidirectional data communication in all modes of operation.

Standard:

Method of Compliance:
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. The airworthiness substantiation shall include a Data range test with a VHF-AM Comm/Data Range Survey Flight Test Plan prepared IAW DI-NDTI-80566 and a VHF-AM Comm/Data Range Survey Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-188-243 MIL-STD-188-220			

11.4.8. UHF-AM Data Communication

The purpose of the UHF-AM function is to provide omnidirectional transmit and/or receive LOS data communication between the aircrew and Command and Control over the frequency range 225 to 400 MHz. HAVEQUICK provides Electronic Counter-Counter Measures (ECCM), i.e. Frequency Hopping.

11.4.8.1. UHF-AM Data Communication - Component Functional Performance

Criteria:
The UHF-AM radio (225-400 MHz) shall meet MIL-STD-188-220, Interface Standard Digital Message Transfer Device Subsystems.

Standard:
MIL-STD-188-220

Method of Compliance:
The UHF-AM radio shall be verified to meet MIL-STD-188-220 Interface Standard Digital Message Transfer Device Subsystems. The airworthiness substantiation shall include a UHF-AM Data Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-188-243 MIL-STD-188-220			

11.4.8.2. UHF-AM Data Communication - Datalink Communication

Criteria:
The UHF-AM radio system shall provide omnidirectional data communications in all modes of operation.

Standard:

Method of Compliance:
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. The airworthiness substantiation shall include a Data range test with a UHF-AM Comm/Data Range Survey Flight Test Plan prepared IAW DI-NDTI-80566 and a UHF-AM Comm/Data Range Survey Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-188-243 MIL-STD-188-220			

11.4.9. HF Data Communication

The purpose of HF radio is to provide omnidirectional transmit and/or receive Beyond-Line-of-Sight (BLOS) data communication between the aircrew and Command and Control over the 2 to 30 MHz frequency range when other means of data communication are not feasible.

11.4.9.1. HF Data Communication - Component Functional Performance

Criteria:
The HF radio (2-30 MHz) shall meet MIL-STD-188-220, Interface Standard Digital Message Transfer Device Subsystems.

Standard:
MIL-STD-188-220

Method of Compliance:
The HF radio shall be verified to meet MIL-STD-188-220 Interface Standard Digital Message Transfer Device Subsystems. The airworthiness substantiation shall include a HF Data Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-188-141 MIL-STD-188-220	14 CFR Part 91 & 91.123 AC 90-117 AC 20-140		

11.4.9.2. HF Data Communication - Datalink Communication

Criteria:
The HF radio system shall provide omnidirectional data communications in all modes of operation.

Standard:

Method of Compliance:
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 B. The airworthiness substantiation shall

include a Data range test with a HF Comm/Data Range Survey Flight Test Plan prepared IAW DI-NDTI-80566 and a HF Comm/Data Range Survey Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.4.10. VHF-FM Data Communication

The purpose of VHF-FM is to provide omnidirectional transmit and/or receive LOS SINCGARS data communication between the aircrew and Command and Control over the 30 to 88 MHz frequency range and to provide ECCM, i.e. Frequency Hopping.

11.4.10.1. VHF-FM Data Communication - Component Functional Performance

Criteria:
The VHF-FM SINCGARS radio (30-88 MHz) shall meet MIL-STD-188-220, Interface Standard Digital Message Transfer Device Subsystems.

Standard:
MIL-STD-188-220

Method of Compliance:
The VHF-FM SINCGARS radio shall be verified to meet MIL-STD-188-220, Interface Standard Digital Message Transfer Device Subsystems. The airworthiness substantiation shall include a VHF-FM Data Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-188-241 MIL-STD-188-242 MIL-STD-188-220			

11.4.10.2. VHF-FM Data Communication - Datalink Communication

Criteria:
The VHF-FM SINCGARS radio system shall provide omnidirectional data communications in all modes of operation.

Standard:

Method of Compliance:
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. The airworthiness substantiation shall include a Data range test with a VHF-AM Comm/Data Range Survey Flight Test Plan prepared IAW DI-NDTI-80566 and a VHF-AM Comm/Data Range Survey Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-188-241 MIL-STD-188-242 MIL-STD-188-220			

11.4.11. SATCOM Data Communication

The purpose of SATCOM is to provide omnidirectional transmit and/or receive BLOS data communication between the aircrew and Command and Control when other means of communication are not feasible.

11.4.11.1. SATCOM Data Communication - Component Functional Performance

Criteria:
The SATCOM radio shall meet MIL-STD-188-184, Interoperability and Performance Standard for the Data Control Waveform.

Standard:
MIL-STD-188-184

Method of Compliance:
The SATCOM radio shall be verified to meet MIL-STD-188-184, Interoperability and Performance Standard for the Data Control Waveform. The airworthiness substantiation shall include a SATCOM Data Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-181 MIL-STD-182 MIL-STD-183 MIL-STD-188-184 MIL-STD-188-185	14 CFR Part 91 & 91.123 91.123 AC 90-117 AC 20-140		

11.4.11.2. SATCOM Data Communication - Datalink Communication

Criteria:
The SATCOM radio shall provide omnidirectional transmit and/or receive BLOS data communications and meet the requirements of paragraph 4.4.10.2. of Appendix B.

Standard:

Method of Compliance:
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. The airworthiness substantiation shall include a Data range test with a SATCOM Comm/Data Range Survey Flight Test Plan prepared IAW DI-NDTI-80566 and a SATCOM Comm/Data Range Survey Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-181 MIL-STD-182 MIL-STD-183 MIL-STD-188-184 MIL-STD-188-185	14 CFR Part 91 & 91.123 91.123 AC 90-117 AC 20-140		

11.4.12. Other Data Communication

Criteria:
Datalink communications shall meet platform defined specification requirements.

Standard:

Method of Compliance:
Other datalink communications shall be verified to meet platform defined specification requirements. The airworthiness substantiation shall include an Other Comm/Data Range Survey Flight Test Plan prepared IAW DI-NDTI-80566 and an Other Comm/Data Range Survey Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.4.12.1. Other Datalink Communications

Criteria:
Other datalink communications shall meet platform defined specification requirements.

Standard:

Method of Compliance:
Other datalink communications shall be verified to meet platform defined specification requirements. The airworthiness substantiation shall include an Other Datalink Performance Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.4.13. Tactical Data Link (TDL) Link 16

The purpose of the TDL Link 16 is to provide LOS data transmission and/or reception between the aircrew and Command and Control over the 960-1215 MHz frequency range.

11.4.13.1. TDL Link 16 - Component Functional Performance

Criteria:
The TDL Link 16 radio shall meet MIL-STD-6016, TDL 16 Message Standard.

Standard:
MIL-STD-6016

Method of Compliance:
The Link 16 radio shall be verified to meet MIL-STD-6016, TDL 16 Message Standard are met. The Link 16 radio shall provide JITC certification. The airworthiness substantiation shall include a Link 16 Certification Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-6016			

11.4.13.2. TDL Link 16 - Datalink Communication

Criteria:
The aircraft Link 16 installation shall have a JITC certification.

Standard:

Method of Compliance:
The Link 16 radio installation shall provide JITC certification. The airworthiness substantiation shall include a JITC Certification Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ADS-37A MIL-STD-6016			

11.5. Surveillance

The purpose of Identification, Friend or Foe (IFF)/Surveillance is to provide a means to identify the aircraft as friend of foe to Command and Control. In civil airspace, basic aircraft identifying information can be provided to include identification of aircraft type.

11.5.1. IFF/Surveillance

Criteria:
The IFF/Surveillance (1030/1090 MHz) shall meet DoD AIMS 17-1000, Air Traffic Control (ATC) Radar Beacon System (ATCRBS) IFF Mark XIIB Systems (AIMS). The IFF shall also have component-level certification by DoD AIMS IAW Appendix B.

Standard:
DoD AIMS 03-1000
DoD AIMS 17-1000

Method of Compliance:
The IFF/Surveillance shall be verified to meet AIMS certification component level IAW DoD AIMS 03-1000 and DoD AIMS 17-1000 IAW Appendix B. The airworthiness substantiation shall include a Component Level AIMS Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	DOD AIMS 03-1000 Air Traffic Control Radar Beacon System (ATCRBS) IFF Mark XII/XIIA Systems (AIMS) Certification aircraft level IAW DOD AIMS 03-1000	14 CFR 91.225 14 CFR 91-227		

11.5.2. Aircraft Identification

Criteria:
The IFF/Surveillance installation shall meet the combined airworthiness and AIMS certification aircraft level IAW DoD AIMS 17-1000. Aircraft-level certification by DoD AIMS IAW Appendix B.

Standard:
DoD AIMS 03-1000
DoD AIMS 17-1000

Method of Compliance:
The IFF/Surveillance installation shall be verified to meet AIMS certification aircraft level IAW DoD AIMS 03-1000 and DoD AIMS 17-1000 IAW Appendix B. The airworthiness substantiation shall include an AIMS certification analysis with a Component Level AIMS Certification Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	DOD AIMS 03-1000 Air Traffic Control Radar Beacon System (ATCRBS) IFF Mark XII/XIIA Systems (AIMS) Certification aircraft level IAW DOD AIMS 03-1000	14 CFR 91.225 14 CFR 91-227		

11.5.3. Other IFF/Surveillance

Criteria:
DoD AIMS 17-1000 Air Traffic Control Radar Beacon System (ATCRBS) IFF Mark XIIB Systems (AIMS) Certification aircraft level IAW DoD AIMS 17-1000

Standard:
DoD AIMS 17-1000

Method of Compliance:
Other IFF/surveillance shall be verified to meet platform defined specification requirements. The airworthiness substantiation shall include an IFF analysis with an Other IFF Performance Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	DOD AIMS 03-1000 Air Traffic Control Radar Beacon System (ATCRBS) IFF Mark XII/XIIA Systems (AIMS) Certification aircraft level IAW DOD AIMS 03-1000	14 CFR 91.225 14 CFR 91-227		

11.6. Network Based Communications

Criteria:
The aircraft shall provide network communications to support connectivity to theater operations supported by LOS/BLOS/SATCOM links as needed IAW the Aircraft System Specification.

Standard:

Method of Compliance:
The aircraft shall provide network communications to support connectivity to theater operations supported by LOS/BLOS/SATCOM links as needed IAW the Aircraft System Specification. The network communications shall provide support to on-the-fly reconfiguration and be scalable. The network communications shall provide support to topologies such as mesh, hierarchal, or user-defined and any combination thereof. The airworthiness substantiation shall include an analysis with a Network Based Comm/Data Analysis Report prepared IAW DI-MISC-80711 and a demo test with a Network Based Comm/Data Range Survey Flight Test Plan prepared IAW DI-NDTI-80566 and a Network Based Comm/Data Range Survey Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.7. Unmanned/Autonomous Operation Datalink

Criteria:
The AV shall provide unmanned/autonomous operation command and control datalink for all operations including loss data link (automatic loiter), return home, control by manned aircraft/helicopters, avionics data interfaces, payload control, takeoff and landing to include satellite denied IAW the Aircraft System Specification

Standard:
STANAG 4586
UAS IOP

Method of Compliance:
The AV shall provide unmanned/autonomous operation command and control datalink for all operations including loss data link (automatic loiter), return home, control by manned aircraft/helicopters, avionics data interfaces, payload control, takeoff and landing to include satellite denied IAW the Aircraft System Specification and Appendix B datalink metrics. The airworthiness substantiation shall include an analysis with an Unmanned/Autonomous Operation Analysis prepared IAW DI-MISC-80711 and a demo test with an Unmanned/Autonomous Operation Datalink Demo Test Plan prepared IAW DI-NDTI-80566 and an Unmanned/Autonomous Operation Datalink Demo Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.8. Navigation Airworthiness Requirements

The purpose of the Navigation Airworthiness Requirements section is to provide the necessary information for development of the system specification and an airworthiness evaluation for the navigation capabilities selected. The Operational Requirement Document Global Air Traffic Management (GATM), United States Army Aviation Center, 12 Jun 2000 is a source for required navigation capabilities for worldwide operations for US Army aircraft. Detailed and specific navigation equipment qualification requirements can be found in ADS-88 in Appendix C.

11.8.1.1. ADF - Airspace Interface

The purpose of the ADF is to provide electronic navigation equipment that allows tactical and civil navigation using the low- and medium-frequency radio wave bands to determine and display the number of degrees clockwise from the nose of the aircraft to the selected received radio wave from an identified non-directional beacon (NDB) station.

Criteria:

The navigation system shall comply with the GATM airspace Minimum Performance Standards (MPS) for ADF function IAW Category A of RTCA/DO-179 section 2.2. as modified by TSO C41d section a (1) or latest revision and modified for the intercommunication system specified for the aircraft.

Standard:

RTCA/DO-179

Method of Compliance:

Laboratory testing shall demonstrate/survey the navigation system performance IAW Category A of RTCA/DO-179 section 2.2. as modified for the intercommunication system specified for the aircraft under the intended environment. The laboratory testing shall perform verification of the sub-system interfaces IAW the interface requirement specification(s). A test plan shall be developed similar to RTCA/DO-179 sections 2.2. through 2.4. including equipment performance monitoring during military environmental testing. The airworthiness substantiation shall include a laboratory test with an ADF Laboratory Demo Test Plan prepared IAW DI-NDTI-80566 and an ADF Laboratory Demo Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.8.1.2. ADF - Installed Performance

Criteria:
The navigation system shall display bearing to the source to within the accuracies specified in Table 11-1 with omni-range coverage around the aircraft to the limit of the ICAO designated operational service volume of non-directional beacons navigation facilities IAW Table 11-2 and the operational service volume of AM radio stations.

Table 11-1 Accuracy - ADF bearing

Frequency (KHz)	Accuracy (±Degrees)
100 - 189.5	10
190 - 850	5
850.5 - 1799	10
1799.5 - 2199.5	10
(optional) 2200 - 2999.5	See Aircraft Specification

Table 11-2 Range - ADF

NDB Type	NDB Power	Range
Compass Locator	< 25 watts	15 NM
MH	< 50 watts	25 NM
H	< 2 kilowatts	50 NM

Standard:
AC 29-2

Method of Compliance:
a. Each antenna coverage/cosite test/analysis shall be developed IAW DI-MISC-80711 or as a subset of DI-EMCS-81540, DI-EMCS-81541, and/or DI-EMCS-81542. Antenna coverage analysis and/or testing including bonding checks and system electromagnetic compatibility testing shall be performed IAW ADS-70 section 5.1.1.

b. Ground testing and calibration shall demonstrate the readiness of the ADF installation for flight testing to include any installation requirements, calibration, and installation testing from laboratory test results, reception of test signals and built in test to show correct connectivity for voice communications, station identification, and system performance at least on one frequency. The airworthiness substantiation shall include a ground test with an ADF Ground Test and Calibration Plan prepared IAW DI-NDTI-80566 and an ADF Ground Test and Calibration Report prepared IAW DI-NDTI-80809.

c. Flight testing shall demonstrate/survey the system performance at least on the Table 11-3 frequencies to the accuracy of Table 11-1 with the aircraft with omni-range coverage (at least 0, 15, 30, 45, 60, 75, 90, 105, 120, 135, 150, 165, 180, 195, 210,

225, 240, 255, 270, 285, 300, 315, 330, 345 degrees, and probable worst case points from the co-site and blockage analysis) around the aircraft at the limit of the ICAO designated operational service volume of non-directional beacons navigation facilities IAW Table 11-2 of this document and the operational service volume of AM radio stations. The airworthiness substantiation shall include a flight test with an ADF Flight Test Plan prepared IAW DI-NDTI-80566 and an ADF Flight Test Report prepared IAW DI-NDTI-80809.

Table 11-3 Test frequencies – ADF

Frequency (KHz)	Test Frequency (KHz)
100 - 189.5	100 -0/+15%
190 - 850	200 -5/+10%, 415±10%, & 850 -15/+0%
850.5 - 2199.5	1799±10%
(optional) 2200 -	See Aircraft Specification
100 - 2999.5	Five frequencies selected by

*Note: * Based upon approved results of the co-site analysis, EMI, and EMC testing*

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.8.2. Instrument Landing System (ILS) and Very High Frequency (VHF) Omni-Range (VOR)

The purpose of the VOR is to provide electronic navigation equipment that allows tactical and civil navigation using the very high frequency radio wave band to determine and display the aircraft position in degrees relative to the North reference of the identified VOR station.

The purpose of the ILS is to provide localizer and glide slope electronic navigation equipment that allows tactical and civil category I ILS instrument approach navigation. The localizer uses the very high frequency radio wave band to determine and display the aircraft position in degrees left or right relative to the center line reference of the identified localizer station. The glide slope uses the ultra-high frequency radio wave band to determine and display the aircraft position in degrees up or down relative to the center line reference of the identified glide slope station.

The purpose of the marker beacon navigation equipment is to provide an automated position fix when using other navigation equipment. The marker beacon uses the very high frequency band to determine and display aircraft position when over the identified marker beacon station.

11.8.2.1. ILS/VOR - Airspace Interface

Criteria:
The navigation system shall comply with the GATM airspace Minimum Performance Standards (MPS) as modified for the intercommunication system and antenna impedances specified for the aircraft as follows:

a. VOR function IAW DO-196 section 2.2.1. through 2.2.13. as modified by TSO C40c section a (1) or latest revision,

b. Marker Beacon (MB) function IAW DO-143 section 1.6. through 2.8., 2.10., 2.11., and 2.13. through 2.17. for Category A as modified by TSO C35d section (a) or latest revision,

c. Localizer (LOC) function IAW DO-195 section 2.2.1. through 2.2.10. as modified by TSO C36e section a (1) or latest revision, and

d. Glide Slope (GS) function IAW DO-192 section 2.2.1. through 2.2.6. as modified by TSO C34e section a (1) or latest revision and the GS frequency shall be controlled by the LOC frequency selection IAW Table 11-4.

Table 11-4 LOC & GS Frequency Pairs (MHz)

LOC	GS	LOC	GS	LOC	GS	LOC	GS
108.10	334.70	109.10	331.40	110.10	334.40	111.10	331.70
108.15	334.55	109.15	331.25	110.15	334.25	111.15	331.55
108.30	334.10	109.30	332.00	110.30	335.00	111.30	332.30
108.35	333.95	109.35	331.85	110.35	334.85	111.35	332.15
108.50	329.90	109.50	332.60	110.50	329.60	111.50	332.90
108.55	329.75	109.55	332.45	110.55	329.45	111.55	332.75
108.70	330.50	109.70	333.20	110.70	330.20	111.70	333.50
108.75	330.35	109.75	333.05	110.75	330.05	111.75	333.35
108.90	329.30	109.90	333.80	110.90	330.80	111.90	331.10
108.95	329.15	109.95	333.65	110.95	330.65	111.95	330.95

Standard:
DO-196
DO-143
DO-195
DO-192

Method of Compliance:
Laboratory testing shall demonstrate/survey the navigation system performance IAW RTCA/DO-143 section 1.6. through 2.8., 2.10., 2.11., and 2.13. through 2.17. for Category A, DO-192 section 2.2.1. through 2.2.6., DO-195 section 2.2.1. through 2.2.10., and

DO-196 section 2.2.1. through 2.2.13. as modified for the intercommunication system and antenna impedances specified for the aircraft. The test shall include verification of GS frequency and LOC mode selection based upon VHF frequency IAW ILS frequency pairs. The laboratory testing shall perform verification of the sub-system interfaces IAW the interface requirement specification(s). A test plan shall be developed similar to RTCA/DO-143 section 3 and appendix A, DO-192 section 2.3. and 2.4, DO-195 section 2.3. and 2.4, and DO-196 section 2.3 and 2.4. including equipment performance monitoring during military environmental testing. The airworthiness substantiation shall include a laboratory test with an ILS/VOR Laboratory Test Plan prepared IAW DI-NDTI-80566 and an ILS/VOR Laboratory Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.8.2.2. ILS/VOR - Installed Performance

Criteria:

a. The navigation system shall display VOR bearing from station and course deviation in a non-mountainous area to within an accuracy of 6 degrees from the selected course with omni-range coverage around the aircraft at the limit of the ICAO designated operational service volume of VOR navigation facilities at least to the maximum certificated aircraft altitude.

b. The navigation system shall display MB modulation color and provide the station code, with lower hemi-spherical coverage around the aircraft at attitudes of at least to 45 degrees, from the limit of the ICAO designated operational service volume of the MB navigation facilities, and at least to the maximum certificated aircraft altitude through over flight of the MB station.

c. The navigation system shall display LOC and GS path deviation in a non-mountainous area to within the accuracy of 11% of LOC full scale deflection and 13% of GS full scale deflection with LOC omni-range coverage and GS nose centered hemispherical coverage around the aircraft at the limit of the ICAO designated operational service volume of Glide Slope navigation facilities, and of Localizer navigation facilities at least to the maximum certificated aircraft altitude.

Standard:

AC 00-31 and AC 29-2 contains ground station and aircraft allocations of the total accuracies and service ranges for different powers of transmitter.

Method of Compliance:

a. Each antenna coverage/cosite test/analysis shall be developed IAW DI-MISC-80711 or as a subset of DI-EMCS-81540, DI-EMCS-81541, and/or DI-EMCS-81542. Antenna coverage analysis and/or testing including bonding and voltage standing wave ratio (VSWR) checks and system electromagnetic compatibility testing shall be performed IAW ADS-70, section 5.1.1.

b. Ground testing and calibration shall demonstrate the readiness of the ILS/VOR installation for flight testing to include any installation requirements, calibration, and installation testing from laboratory test results, reception of test signals and built in test to show correct connectivity for voice communications, station identification, and system performance at least on one frequency. The airworthiness substantiation shall include a ground test with an ILS/VOR Ground Test and Calibration Plan prepared IAW DI-NDTI--80566 and an ILS/VOR Ground Test and Calibration Report prepared IAW DI-NDTI-80809.

c. Flight testing shall demonstrate/survey the voice communications, station identification, and system performance including under rotor modulation and attitude effects at locations near station through station passage on at least on one VOR frequency IAW AC 29-2 paragraph MG1b(3)(iii) and MG1b(3)(iii)(C), on at least one LOC/GS pair IAW AC 29-2 paragraph MG1b(4)(iii), MG1b(4)(iv), MG1b(4)(v), MG1b(5)(iii), and MG1b(5)(v), and on at least one MB IAW AC 29-2 section MG1b(6). Flight testing shall also demonstrate/survey the system performance at least on five frequencies evenly across the VOR band for VOR test, at least three frequencies evenly across the GS band for LOC/GS test, and ten frequencies from co-site and EMC results IAW the above installed performance criteria with the aircraft in a non-mountainous area at 900±100ft above station altitude. VOR tests shall demonstrate/survey omni-range coverage (at least 0, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300, 330 degrees, and survey probable worst case points from the co-site and blockage analysis) around the aircraft at the limit of the ICAO designated operational service volume of LOW VOR navigation facilities. LOC/GS tests shall demonstrate/survey at least +/-90 degree from the nose coverage and survey the rest of the omni-range coverage at the limit of the ICAO operational service volume of Glide Slope navigation facilities and of Localizer navigation facilities. The airworthiness substantiation shall include a flight test with an ILS/VOR Flight Test Plan prepared IAW DI-NDTI-80566 and an ILS/VOR Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.8.3. Tactical Air Navigation (TACAN)

The purpose of the TACAN is to provide electronic navigation equipment that allows tactical and civil navigation using the ultra-high frequency radio wave band to determine and display the aircraft range to the identified TACAN or DME station and to determine position in degrees relative to the North reference of the identified TACAN station.

11.8.3.1. TACAN - Airspace Interface

DoD AIMS 17-1000 paragraph 4.7.31.1. and 4.7.31.2. or latest revision.

Criteria:

a. The navigation system shall comply with the GATM airspace Minimum Performance Standards (MPS) for:

(1) TACAN air-to-ground distance function and Distance Measurement Equipment (DME) function IAW RTCA/DO-189 section 2.2. as modified by TSO C66c section a(1) or latest revision except the distance accuracy of ±0.17NM or ±0.25% of the distance within section 2.2.1. is replaced by ±0.1NM or ±0.033% of the distance, section 2.2.3. is replaced by MIL-STD-291 section 5.13, section 2.2.4. is replaced by MIL-STD-291 section 5.14. as modified by paragraph 3b, b.1, b.2 below,, section 2.2.5. tracking of 16 pp/s per frequency shall be 30 pp/s per frequency except as a test condition for other section of 2.2. performance with pp/s dependencies, and section 2.2.7.1. output power shall be replaced with at least 27dBw,

(2) TACAN air-to-ground bearing function and TACAN identification function IAW AC 00-31 paragraphs 189 through 191 or latest revision with a separate bearing memory from the distance memory, on-code undesirable signal rejection IAW AC 00-31 section 29a or latest revision, off-code on-frequency undesirable signal rejection from an air-to-ground TACAN station at least +20dB greater than the desired signal in the presence of 3600 pp/s random fruit while the receiver is in distance warning, and accuracy per section 3b.6 below,, and

(3) For systems with VOR/ILS, the system shall have a mode to be capable of TACAN/DME channel selection from the VOR/ILS frequency control with the VOR/ILS pairs stated in RTCA/DO-189 Appendix A.

b. The navigation system shall compute bearing, distance, station identification, distance rate (velocity), and time-to-station information relative to an airborne and surface beacon using the standard TACAN signal defined IAW MIL-STD-291 sections 4 and 5 or latest revision except:

(1) MIL-STD-291 Section 5.14. tolerances of ±0.5μs shall be ±0.1μs,

(2) Surface beacons shall have a Morse coding of a lower limit dot duration of 100ms, and shall comply with AC 00-31 or latest revision paragraphs 30a (2), 30a (3), 124a, 126a, 135, and 139,

(3) The navigation system shall at least perform X and Y channel air-to-ground modes and X and Y channel air-to-air modes,

(4) The navigation system shall suppress all MIL-STD-291 interrogations and air-to-air reply transmissions in all modes during manual transmission suppression,

(5) The system shall have a slant range distance error no greater than 0.1NM for ranges less than 300NM under static and dynamic conditions of DO-189 2.2.1c and 2.2.1d and over a signal level from 0 dBm to -91 dBm at reply efficiencies of 60 percent, and

(6) The system shall have a bearing error no greater than 0.5 degrees under static and dynamic conditions of DO-189 2.2.1c and 2.2.1d and over a signal level from 0 dBm to -85 dBm, and the system shall have a bearing error no greater than 3 degrees

under static and dynamic conditions of DO-189 2.2.1c and 2.2.1d and over a signal level from 0 to -91 dBm with 135Hz decode flagged.

c. The navigation system shall have at least a single input/output suppression interface complying with DoD AIMS 17-1000() paragraph 4.7.31.1. and 4.7.31.2. or latest revision.

Standard:
RTCA/DO-189
AC 00-31
MIL-STD-291
DoD AIMS 17-1000

Method of Compliance:
Laboratory testing shall demonstrate/survey the navigation system equipment performance for range, bearing, station identification, distance rate (velocity), and time to-station information relative to an airborne and surface beacon signals IAW the above airspace interface criteria. The laboratory testing shall perform verification of the sub-system interfaces IAW the interface requirement specification(s). The airworthiness substantiation shall include a laboratory test with a TACAN Laboratory Test Plan prepared IAW DI-NDTI-80566 and a TACAN Laboratory Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-STD-291	RTCA/DO-189 RTCA TSO C66c		

11.8.3.2. TACAN - Installed Performance

Criteria:
The navigation system shall display slat range distance to the station with an error less than 0.5NM with inspected TACAN and DME stations, and bearing from station and deviation from the selected course with an error less than 4.5 degrees with inspected TACAN stations compliant with AC 00-31 or latest revision with omni-range coverage around the aircraft at the limit of the ICAO designated operational service volume of TACAN/DME navigation facilities at least to the maximum certificated aircraft altitude.

Standard:
AC 00-31 contains ground station allocations of the total accuracies and service ranges for different powers of transmitter.

Method of Compliance:
Each antenna coverage/cosite test/analysis shall be developed IAW DI-MISC-80711 or as a subset of DI-EMCS-81540, DI-EMCS-81541, and/or DI-EMCS-81542. Antenna

coverage analysis and/or testing including bonding and VSWR checks and system electromagnetic compatibility testing shall be performed IAW ADS-70, section 5.1.1.

a. Ground testing and calibration shall demonstrate the readiness of the TACAN installation for flight testing to include any installation requirements, calibration, and installation testing from laboratory test results, reception of test signals, built in test, controls and displays for implemented functions are present and provide control of the functions, and wiring checks to show correct connectivity for systems including IFF & TACAN interference suppression, station identification, and system performance at least on one frequency for each TACAN antenna. The airworthiness substantiation shall include a ground test with a TACAN Ground Test and Calibration Plan prepared IAW DI-NDTI-80566 and a TACAN Ground Test and Calibration Report prepared IAW DI-NDTI-80809.

b. Flight testing shall demonstrate/survey the station identification, and system performance including under rotor modulation and attitude effects at locations near station through station passage on at least on one TACAN frequency for bearing IAW AC 29-2 paragraph MG1b(3)(iii) and MG1b(3)(iii)(C) using a TACAN facility in lieu of a VOR facility, and for range IAW AC 29-2 section MG1b(8). The TACAN test for bearing shall be performed for at least the combinations of diversity antenna modes and electronic countermeasure modes. Flight testing shall also demonstrate/survey the system performance at least on five interrogation frequencies evenly across the TACAN band, at least on five reply frequencies evenly across the TACAN band, and ten frequencies from co-site and EMC results in accordance with the above installed performance criteria with the aircraft in a non-mountainous area at 900±100ft above station altitude with omni-range coverage (at least 0, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300, 330 degrees, and probable worst case points from the co-site and blockage analysis) around the aircraft for each antenna separately at the limit of the ICAO designated operational service volume of LOW TACAN navigation facilities. The airworthiness substantiation shall include a flight test with a TACAN Flight Test Plan prepared IAW DI-NDTI-80566 and a TACAN Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.8.4. Aeronautical Database (Aircraft)

The purpose of the Aeronautical Database is to deliver the required data per the Data Quality Requirements (DQR) in a format that the aircraft can ingest without any corruption of the data. The responsibilities for an aeronautical database provider to obtaining a Type 2 Letter of Acceptance (LOA) is provided in Appendix C of ADS-88-HDBK Section 3.4. This section does not address the Standards and Methods of Compliance to obtain a Type 2 Letter of Authorization issued from the US Army.

11.8.4.1. System Developer Responsibilities

Criteria:
The system shall perform its intended functions without corrupting the database and shall verify and notify the operator of any Data Quality Requirement issues (e.g. integrity failure (bad CRC), timeliness failure (out of date)).

Standard:
AC 20-153, RTCA/DO-200

Method of Compliance:
A system (hardware/software) qualification process (this AMACC) shall be performed by the system developer, which includes verification of the Data Quality Requirements including non-corruptibility of airspace data in the system, timeliness of the data, and integrity of the database sent to the aircraft.

a. Preliminary Design Review (PDR) shall identify the allocated design for storage and processing of database data including design assurance levels, built in tests, intentional creation of user data through modification of a copy of database data, and database usage cases which would be incorporated into sub-system specifications per AMACC Appendix T and tests.

b. Supply all requested system documentation/information to the Program Management Office's database provider if not purchased as GFI. The following documents shall be submitted by the system developer to the airworthiness authority of the system, database provider, and airworthiness authority representative issuing the LOA 2 to the database provider for review and approval to ensure compatibility between the data provided and the aircraft avionics.

Data Quality Requirements (DQR) document shall be prepared IAW
(1) DI-MISC-80711 specific to their platform per AC 20-153 latest revision. The DQRs shall be derived according to the allocated design and usage of data (intended use) and shall ensure compatibility with all system requirements. The DQR include accuracy, resolution, assurance level, format, timeliness, completeness, and format for the data as required by the aircraft functions.

(2) Copies of documents containing Interface Control Document(s) (ICD) information per AMACC paragraph 4.1.5. applicable to the database and shall include the format of the data to ensure compatibility with the aircraft avionics and data transfer.

(3) Copies of System Safety Hazard Analysis (SSHA) or Functional Hazard Assessment (FHA) completed per SAE ARP4761 and AMACC paragraph 14.2.3. and 14.2.12. applicable to the database use cases.

c. Laboratory testing IAW the applicable AMACC paragraph 11.8. airspace interface test and CRDL shall demonstrate the aircraft system for functional qualification to include compliance with all data cases described by the DQR, non-corruptibility of the database by the system and operators, and failure mode detection including data

corruptions and timeliness. This test shall be conducted in the target (flight configuration) environment to ensure required functionality of the system including the probability of undetected corruption of essential data from the source data to the aircraft equipment does not exceed 10^{-5} and critical data does not exceed 10^{-9}.

d. For database providers requesting US Army issuance of the Type 2 Letter of Authorization (LOA), the database provider will need access to system laboratory test facilities to perform database testing by the database provider for functional compatibility with a production representative database generated by the DO-200 process.

e. Program Management Office Memorandum for Platform Acceptance of the Navigation Database. This signed and dated memorandum CDRL shall record the Program Management Office acceptance of the database provider's data and process as DQR compliant. It shall document acceptance of the DO-200 laboratory test results for any LOA issuance and acceptance of delivery method, error reporting process, etc. for the database process.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-200 RTCA/DO-330				

11.8.4.2. Database Provider Responsibilities

Criteria:
The system shall perform its intended functions with a Type 2 Letter of Authorization issued database IAW RTCA/DO-200 and AC 20-153 or latest revisions.

Standard:
AC 20-153, DO-200

Method of Compliance:
Obtain a LOA Type 2 certificate for providing data to the subject US Army system. Submit a copy of the Letter of Authorization to the Program Management Office as a CDRL.

For DEVCOM AvMC qualification of a data provider, the LOA applicant needs to obtain an Airworthiness Qualification Plan (AQP) for the LOA IAW AR 70-62 between DEVCOM AvMC and the applicant. The AQP will request a technical data package be created and audits to occur which is heavily based upon RTCA/DO-200 and AC 20-153 or latest revisions.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-200 RTCA/DO-330				

11.8.5. Inertial Navigation Systems (INS)

The purpose of the INS is to provide electronic navigation equipment that allows tactical and civil navigation using the Earth's properties, aircraft altitude, aircraft 3D turn rates, and aircraft 3D accelerations to determine and display the aircraft position in the Earth's latitude and longitude.

11.8.5.1. INS - Airspace Interface

Criteria:

The navigation system shall comply with the GATM airspace Minimum Performance Standards (MPS) for INS function IAW RTCA/DO-187 section 2.1. and 2.2. as modified by TSO C115b a(2), a(5), and a (6) for at least "TO-TO" en- route and terminal navigation equipment and with the following exceptions:

a. In addition to TSO C115b a(2)(ix), add the following requirement: The holding pattern maneuvering shall at least support all manual time based holding with course selection and TO-FROM and course deviation indications at the holding waypoint.

b. In lieu of Table 2-1 of RTCA/DO-187, substitute Table 11-5 of this document:

Table 11-5 Accuracy - INS

Error Type	En-Route Remote Area	En-Route Random Routes	En-Route (J/V Routes)	Terminal
Supported Leg Length (NM)	1100	300	300	150
Equipment (NM)	19.8	3.8	2.8	1.7
FTE (NM)	2.0	1.0	1.0	1.0
Total (NM)	20.0	4.0	3.0	2.0

Note: The equipment error type includes Total System Error as defined in RTCA/DO-236B paragraph 2.1.1. except FTE. This includes path definitions of RTCA/DO-236B paragraph 3.2.3.1. for the initial flight plan fix, paragraph 3.2.3.2. for the following fixes, paragraphs 3.2.3.8. and 3.2.4.2. for the direct-to function, and paragraph 3.2.5. path error terms.

c. The navigation system shall be capable of manual operator-initiated INS position updates from manually entered positions, waypoints in the non-corruptible database, and waypoints in the user defined database (e.g. flight plan). The equipment error during fly-over waypoint position update can be assumed to be 0.1NM.

d. The navigation system shall be capable of manual operator-initiated INS position updates from a selected valid RNAV system or position update computation system (e.g. DME/DME, TACAN).

e. The navigation system shall be capable of automated INS position updates from other sensors IAW RTCA/DO-187 as modified by TSO C115b for systems with multiple sensors.

f. The navigation system shall be capable of Gyro Compass (GC), Stored, Ship, and Air alignments to initialize the INS at the specified performance of paragraph 11.8.5.2. of this document.

(1) The navigation system shall be capable of GC alignments with an aircraft not moving in all 6 degrees of freedom from start to finish of GC alignment except for aircraft vibration. The navigation system shall accept the operator entered GC initialization of position with an accuracy within 0.5NM including any selected position from a valid RNAV system, then the navigation system shall complete a GC alignment within the larger of 4 or 4*cosine(60 degrees)/cosine(latitude) minutes between the latitudes of 80 degrees North and 80 degrees South. If the GC alignment is interrupted by aircraft movement or by a weight off wheels indication from the aircraft platform, the navigation system shall complete the alignment using an air alignment.

(2) The navigation system shall be capable of Stored alignments with an aircraft not moving in all 6 degrees of freedom from last aircraft shutdown to finish of Stored alignment except for aircraft vibrations.

(3) The navigation system shall be capable of Ship alignments with the aircraft moving in one constant velocity vector with 6 degrees of freedom low to high frequency oscillation for sea state. The navigation system shall accept the operator entered ship initialization of ship position and speed vector with an accuracy within 0.25NM, 0.1 knots and 0.1 degrees including any selected initialization set from a valid RNAV system.

(4) The navigation system shall be capable of Air alignments with an aircraft moving and stationary in 6 degrees of freedom from start to finish of alignment. The navigation system shall accept the selected initialization reference from a valid RNAV system.

Standard:
RTCA/DO-187

Method of Compliance:
Laboratory testing shall demonstrate the navigation system performs navigation IAW RTCA/DO-187 section 2.1. and 2.2. as modified by TSO C115b a (2), a (5), and a (6) as modified by section 11.8.5.1. of this document with the following exceptions:

a. Flight testing shall demonstrate/survey the Flight Technical Error, Position Estimation Error, an air alignment with the total alignment time surveyed to a 99% confidence, and interruption of alignment with completion of the alignment in air alignment for the navigation system.

b. Laboratory testing with INS accelerometer and turn rate sensor emulation, ground testing, flight testing, and/or shipboard operational testing shall demonstrate/survey the navigation system INS performance and alignment time required to a 99% confidence after performing GC, Stored, and Ship alignments. Ship alignments shall be at least tested at sea state 0 with analysis and laboratory testing with INS accelerometer and

turn rate sensor emulation shall survey alignments trending toward air alignment times for other sea states.

The airworthiness substantiation shall include an INS Laboratory Test Plan IAW DI-NDTI-80566, an INS Laboratory Test IAW DI-NDTI-80809, an INS Flight Test Plan IAW DI-NDTI-80566 which includes ground and shipboard tests, and an INS Flight Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.8.5.2. INS – Installed Performance

Criteria:
The navigation system shall compute position from last position update within 0.8NM 50% Circular Error Probability (CEP) per hour.

Standard:

Method of Compliance:
a. Ground testing and calibration shall demonstrate the readiness of the INS installation for flight testing to include any installation requirements, calibration (e.g. measurement of lever arms), and installation testing from laboratory test results, built in test, controls and displays for implemented functions are present and provide control of the functions, and wiring checks to show correct connectivity for systems. The airworthiness substantiation shall include a ground test with an INS Ground Test and Calibration Plan prepared IAW DI-NDTI-80566 and an INS Ground Test and Calibration Report prepared IAW DI-NDTI-80809.

b. Flight testing shall demonstrate/survey the navigation system performs navigation IAW 0.8NM 50% Circular Error Probability (CEP) per hour after each alignment mode. The airworthiness substantiation shall include a flight test with an INS Flight Test Plan IAW DI-NDTI-80566, and an INS Flight Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.8.6. Global Positioning System (GPS) – Supplemental
The purpose of the GPS is to provide electronic navigation equipment that allows tactical and civil navigation using the ultra-high frequency radio wave band sent from satellites to determine the aircraft position in the Earth's latitude and longitude. Supplemental navigation systems require an alternate means of navigation to be available IAW the rules of the airspace.

11.8.6.1. GPS - Supplemental - Airspace Interface

Criteria:
The navigation system shall be capable of navigation IAW RTCA/DO-208 section 2 as modified by TSO C129a class A1 or equivalent Flight Management System (FMS) with GPS for "TO-TO" GPS non-precision approach navigation equipment and with the following exceptions.

a. The navigation system shall be safe with the following Failure Condition Classifications.

(1) Failure of the function defined in TSO C129a causing misleading information is a major failure condition for oceanic/remote, en route and terminal navigation, and lateral navigation (LNAV) approaches.

(2) Loss of the function defined in TSO C129a is a minor failure condition for oceanic/remote, en route and terminal navigation, and LNAV approaches.

b. In addition to TSO C129a a(3)(xi)2b, add the following requirement: The holding pattern maneuvering shall at least support all manual time based holding with TO-FROM navigation, manual course selection with default course to the leg course, and course deviation indications at the holding waypoint.

c. The navigation system shall comply in all modes with RTCA/DO-316 sections 2.1.1.1.4., 2.1.1.3. through 2.1.1.4., and 2.1.1.11. through 2.1.2.2.2.5., and 2.1.2.5. through 2.1.3.6.5. except:

The GPS receiver should support building all the functions required in TSO C129a and equivalent FMS. Examples include FDE outputs to support RAIM requirements, FDE prediction outputs to support RAIM prediction requirements, and GPS position outputs.

(1) DO-316 Section 2.1.1.3.1. Append new text which reads: "Additionally, GPS Satellite shall be declared UNHEALTHY when the step detector function has declared a step error until recovered by the step detection function autonomous fault detection."

(2) DO-316 Section 2.1.1.3.2. GPS signals may have equivalent navigation messages with different formats than IS-GPS-200D C/A navigation message bit formats used in this requirement.

(3) DO-316 Section 2.1.1.3.2.b and 2.1.1.3.2.c. For degraded Encrypted PPS Mode and for degraded Unencrypted Mode tactical uses, the section 2.1.1.3.2.b and 2.1.1.3.2.c unhealthy detection maybe may be set to an alternate limit by the operator but a loss of Receiver Autonomous Integrity Monitoring (RAIM) shall be annunciated.

(4) DO-316 Section 2.1.1.3.2.d. The alert flag unhealthy function is not required when other means of URA and instantaneous URE bounding which meet the intent is used in replacement of or in addition to the scaled URA method that the alert flag warns as possibly invalid.

(5) DO-316 Section 2.1.2.5. and 2.1.3.5. SAASM requirement values for dynamic tracking supersede the values of these sections when more stringent.

(6) DO-316 Section 2.1.2.6. The navigation system shall also output $VFOM_P$, $HFOM_V$, $VFOM_V$, HUL, VUL, VPL, vertical position, and vertical velocity as position output data.

(7) The navigation system shall track for valid positioning up to at least 12 GPS satellites with both L1 and L2 signals tracked.

(8) The navigation system shall use barometric aiding for GPS position and Fault Detection and Exclusion (FDE) as a minimum IAW RTCA/DO-316 Appendix G for en-route, terminal, and non-Precision Approach.

(9) The navigation system shall perform GPS position, time, and navigation in the following modes:

(a) Encrypted Precise Positioning Service (PPS) Mode:

i. Whenever the equipment has been keyed with valid PPS keys, the equipment shall operate in the Encrypted PPS mode unless otherwise commanded by the operator.

ii. . All GPS direct encrypted code Satellite Vehicle (SV) acquisition, position, navigation, time, and integrity related information shall be derived exclusively from the M or Y code modulated signals IAW ICD-GPS-700D, IS-GPS-703F, and IS-GPS-200K or latest revision. The default selection shall be M code only.

The Y code direct SV acquisition and reacquisition may require a clock meeting the time uncertainty requirement associated with Hot Start.

iii. The navigation system shall be SAASM compliant IAW SS-GPS-001A or latest revision.

iv. When enabled by operator selection, non-direct encrypted code SV acquisition or reacquisition shall be IAW IS-GPS-200K or latest revision.

(b) Standard Positioning Service (SPS) Mode:

i. All GPS related information shall be derived IAW RTCA/DO-316 section 2.1.1.2. except IS-GPS-200D shall be IS-GPS-200K or latest revision, other SPS signals may be used, and multiple frequency measurement of GPS parameters may be used per IS-GPS-200K or latest revision.

ii. SPS code modulated signals shall consist of at least L1 C/A code signal of IS-GPS-200K or latest revision.

iii. The navigation system in SPS Mode shall comply with RTCA/DO-316 2.1.1.5. through 2.1.1.8., and 2.1.1.10.

(c) Unencrypted Mode: All GPS related information shall be derived from all supported GPS signals including PPS P signal of IS-GPS-200K or latest revision, SPS signals, and when PPS keyed, encrypted PPS signals.

(10) The navigation system shall calculate position to the accuracy of GPS IAW SS-GPS-300G or latest revision.

(11) The navigation system shall perform a GPS hot start from an external GPS via an external interface IAW IS-GPS-153D or latest revision.

(12) The navigation system shall provide GPS data via an external interface IAW IS-GPS-153D or latest revision to be perform GPS hot start to an external GPS.

(13) The navigation system shall provide Have-Quick timing to a device IAW ICD-GPS-060A or latest revision.

(14) The navigation system shall include a GPS Anti-Jamming Antenna. The interface most used is IS-GPS-099F or latest revision.

b. In the Encrypted PPS mode, the navigation system shall flight check and annunciate any excessive errors (e.g. station/satellite) within of the civil RNAV function(s) not reported by the civil RNAV function.

Standard:
RTCA/DO-208, DO-316

Method of Compliance:
Laboratory testing shall demonstrate the navigation system performs navigation IAW the above airspace interface criteria. Laboratory testing may require specialized test equipment for GPS receiver verification to include L1 and L2 GPS signal creation of the test constellation to the receiver antenna port with correlated barometric pressure emulation. The laboratory testing shall perform verification of the sub-system interfaces IAW the interface requirement specification(s). The airworthiness substantiation shall include a laboratory test with a GPS Supplemental Laboratory Test Plan prepared IAW DI-NDTI-80566 and a GPS Supplemental Laboratory Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.8.6.2. GPS - Supplemental – Installed Performance

Criteria:
The navigation system shall be capable of position estimation within 16m 50% Spherical Error Probability (SEP) for PPS and 17m 50% SEP for SPS under the full dynamic limits of the aircraft.

Standard:
AC 20-138

Method of Compliance:
a. Each antenna coverage/cosite test/analysis shall be developed IAW DI-MISC-80711 or as a subset of DI-EMCS-81540, DI-EMCS-81541, and/or DI-EMCS-81542. Antenna coverage analysis and/or testing including bonding and VSWR checks and system electromagnetic compatibility testing shall be performed IAW ADS-70 section 5.1.1. and AC 20-138 or latest revision. Electromagnetic compatibility tests in AC 20-138 only list VHF AM communication frequencies which have harmonics in the L1 GPS band. Actual EMC tests shall address the issue of harmonics from all airspace and mission equipment which occur in the L1 or L2 GPS bands.

b. Ground testing and calibration shall demonstrate the readiness of the GPS installation for flight testing to include any installation requirements of AC 20-138 or latest revision including rotor and blade modulation, calibration (e.g. lever arm measurement), and installation testing from laboratory test results, built in test, controls and displays for implemented functions are present and provide control of the functions, and wiring checks to show correct connectivity for systems including hot start and precision timing to mission systems. The airworthiness substantiation shall include a ground test with a Supplemental GPS Ground Test and Calibration Plan prepared IAW DI-NDTI-80566 and a Supplemental GPS Ground Test and Calibration Report prepared IAW DI-NDTI-80809.

c. Flight testing shall demonstrate/survey the navigation system performs position estimation within 16m 50% Spherical Error Probability (SEP) for PPS and 17m 50% SEP for SPS under the full dynamic limits of the aircraft to include: rotors not turning, changes in accuracy and satellite acquisition time from rotor modulation, and satellite aircraft masking for the antenna location during level flight, pitch limit maneuvers, and roll maneuvers (combat maneuvers and standard rate turns). If not already performed for another RNAV system with similar displays and controls, flight testing shall also demonstrate/survey the Flight Technical Error. Flight testing shall perform verification of the Laboratory Test Results through flight of actual airspace procedures. The airworthiness substantiation shall include a flight test with Supplemental GPS Flight Test Plan prepared IAW DI-NDTI-80566 and a Supplemental GPS Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.8.7. Global Positioning System (GPS) - Space Based Augmentation System (SBAS)

The purpose of the GPS with SBAS is to provide electronic navigation equipment that allows civil navigation including LPV approaches using the ultra-high frequency radio wave band sent from satellites to determine the aircraft position in the Earth's latitude and longitude.

11.8.7.1. GPS - SBAS - Airspace Interface

Criteria:
The navigation system shall comply with the GATM airspace Minimum Performance Standards (MPS) for GPS (SBAS) function IAW RTCA/DO-229E or latest revision for class gamma-3 equipment as modified by TSO-C146e or latest revision section 3 except:

It is expected that this capability will be updated to include L1C signal of IS-GPS-800F or latest revision, L2C signals of IS-GPS-200K or latest revision, and L5 signals of

IS-GPS-705F or latest revision.

a. MSO-C145a paragraph 4d is replaced by the environment specification of the aircraft,

b. DO-229 and MSO-C145a are as modified by AC 20-165 Appendix B or latest revision for the additional usage as the ADS-B sensor, and

c. The navigation system shall provide the SBAS receiver parameter data steam to the Supplemental GPS system for flight check of navigation environments and display the Supplemental GPS system flight check alert in the operator primary field of view.

Standard:
RTCA/DO-229
AC 20-165
MSO-C145a

Method of Compliance:
Laboratory testing shall demonstrate the navigation system performs navigation IAW MSO-C145a or latest revision section 4 or latest revision for class gamma-3 equipment as modified by AC 20-165 Appendix B or latest revision. Alternate method of compliance is the civil airworthiness authority compliance letter/document which may be sent as part of the GPS-SBAS laboratory test plan. Laboratory testing may require specialized test equipment for GPS receiver verification to include L1, L2, and L5 GPS and SBAS signal creation of the test constellation to the receiver antenna port with correlated barometric pressure emulation. The laboratory testing shall also perform verification of the sub-system interfaces IAW the interface requirement specification(s). The airworthiness substantiation shall include a laboratory test with a GPS-SBAS Laboratory Test Plan prepared IAW DI-NDTI-80566 and a GPS-SBAS Laboratory Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.8.7.2. GPS-SBAS – Installed Performance

Criteria:
The navigation system shall be capable of position estimation within 7.6m 95% Spherical Error Probability (SEP) for the FAA Wide Area Augmentation System (WAAS) with GPS under the full dynamic limits of the aircraft.

Standard:
AC 20-138

Method of Compliance:
a. Each antenna coverage/cosite test/analysis shall be developed IAW DI-MISC-80711 or as a subset of DI-EMCS-81540, DI-EMCS-81541, and/or DI-EMCS-81542. Antenna coverage analysis and/or testing including bonding and VSWR checks and system electromagnetic compatibility testing shall be performed IAW ADS-70 section 5.1.1. and AC 20-138 or latest revision. Electromagnetic compatibility tests in AC 20-138 only list VHF AM communication frequencies which have harmonics in the L1 GPS band. Actual EMC tests shall address the issue of harmonics from all airspace and mission equipment which occur in the L1 and any implemented L2 and L5 GPS bands.

b. Ground testing and calibration shall demonstrate the readiness of the GPS installation for flight testing to include any installation requirements of AC 20-138 or latest revision including rotor and blade modulation, calibration (e.g. lever arm measurement), and installation testing from laboratory test results, built in test, controls and displays for implemented functions are present and provide control of the functions, and wiring checks to show correct connectivity for systems including hot start and precision timing to mission systems. The airworthiness substantiation shall include a ground test with a SBAS GPS Ground Test and Calibration Plan prepared IAW DI-NDTI-80566 and a SBASl GPS Ground Test and Calibration Report prepared IAW DI-NDTI-80809.

c. Flight testing shall demonstrate the navigation system performs SBAS navigation through LPV IAW AC 20-138 or latest revision. Flight testing shall demonstrate/survey the navigation system performs position estimation within 7.6m 95% Spherical Error Probability (SEP) under the full dynamic limits of the aircraft to include: rotors not turning, changes in accuracy and satellite acquisition time from rotor modulation, and satellite aircraft masking for the antenna location during level flight, pitch limit maneuvers, and roll maneuvers (combat maneuvers and standard rate turns). If not already performed for another RNAV system with similar displays and controls, flight testing shall also demonstrate/survey the Flight Technical Error. Flight testing shall perform verification of the Laboratory Test Results through flight of actual airspace procedures. The airworthiness substantiation shall include a flight test with SBAS GPS Flight Test Plan prepared IAW DI-NDTI-80566 and a SBAS GPS Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.8.8. Required Navigation Performance (RNP)

The purpose of the RNP is to provide electronic navigation as a type of total operational performance-based navigation with accuracy, integrity, continuity, and flight management functionality requirements unassociated with navigation equipment type requirements for tactical and civil navigation. Sensors are managed and used to determine the accuracy, integrity, and aircraft position in Earth latitude and longitude as well as relative to the geodesic course path between two fixes.

Criteria:

a. The navigation system shall comply with the GATM airspace Minimum Performance Standards (MPS) for RNP function IAW RTCA/DO-236 section 2 and section 3 for RNP-0.3 through RNP-20 types. Time of Arrival Control (TOAC) is optional.

b. If using Global Navigation Satellite System signals, the navigation system shall also provide an alert if the probability of Global Navigation Satellite System signal-in-space errors causing a lateral position error greater than 2X NM exceeds 10^{-7} per hour for RNP-X legs.

c. The navigation system shall address the operator or system execution of at least VA, VI, VM, CA, and FM leg types and fly-over turns IAW AC 20-138 section 9-3h. This includes mode displays for when RNP is armed during execution of an RNAV leg without a defined containment area.

Standard:

RTCA/DO-236

Method of Compliance:

The system level verification of 10^{-7} per hour performance requirements require flight test times in excess of 10^{7} hours. This AQP requires the developer to develop an RNP design and an RNP AQS specific to their design detailing an alternate method of compliance with methods of compliance that can be performed at the most cost-effective sub-system levels. Program management offices are recommended to review and approve the Preliminary RNP Analysis and RNP AQS due to the cost trades inherent between them.

a. Perform the Preliminary RNP Analysis IAW DI-MISC-80508 to demonstrate that the preliminary system design allocation complies with DO-236 section 2 requirements through the lowest RNP type specified. The report of this analysis shall include:

(1) The system preliminary design including architecture, sensor selection and required sensor performance.

(2) The industry standards or statistical measurements for interface signals to the system preliminary design.

(3) The operational or other interface requirements of the system preliminary design.

(4) The analysis and resulting level of RNP capability per DO-236 section 2 for the system preliminary design.

b. Perform the RNP Master Test Plan IAW DI-MGMT-81861 to schedule RNP test events and RNP document deliveries for a complete alternate means of compliance qualification specification for RNP exists. The RNP Master Test Plan shall have requirement traceability to the data that the final RNP analysis will show alternate means of compliance to RNP requirements with. Much of the design related data should be identified by the preliminary aircraft level RNP RNAV analysis. The RNP update to the AQS, the Preliminary RNP Analysis, and the RNP Master Test Plan shall be delivered before the Preliminary Design Review approval meeting. Typical test events include the following:

(1) Flight testing shall demonstrate actual Total System Error accuracy achieved via confidence interval-based statistically significant sample of flight test points including any VNAV and tracked via an independent sensor. The airworthiness substantiation shall include flight test with an End Game RNP Test Plan prepared IAW DI-NDTI-80566, an End Game RNP Procedures prepared IAW DI-NDTI-80603 and an End Game RNP Report prepared IAW DI-NDTI-80809.

(2) Laboratory testing shall demonstrate/survey the navigation system performance IAW RTCA/DO-236 section 3 and allocated flight management requirements from the preliminary analysis. The laboratory testing shall perform verification of the sub-system interfaces IAW the interface requirement specification(s). The airworthiness substantiation shall include a laboratory test with an RNP FMS Test Plan prepared IAW DI-NDTI-80566 and an RNP FMS Test Report prepared IAW DI-NDTI-80809.

(3) Laboratory, ground, and flight testing shall survey to the criteria identified by the master test plan and AQS. The airworthiness substantiation shall include a variety of tests with Test Plan(s) prepared IAW DI-NDTI-80566 and Test Report(s) prepared IAW DI-NDTI-80809.

c. Perform the Final RNP Analysis IAW DI-MISC-80508 to demonstrate that the production representative system complies with DO-236 section 2 and 3 requirements through all the RNP types implemented. The RNP Analysis shall document the actual system performance parameters critical to the RNP system based upon the results of individual statistically significant sub-system, mode performance, and system level performance testing. This documentation shall incorporate the effects and parametric impacts to system performance including any dependences and be based upon statistically significant actual measured data including availability, reliability, accuracy,

integrity, continuity, and fault detection and characterization of the integrated aircraft RNP system in the context of the total sensor operational environment. Specific system limitations or non-compliances requiring waver shall be highlighted. Any location limitations and performance prediction requirements shall be annotated. The Final Aircraft Level RNP RNAV Analysis shall contain the following information:

(1) The system final design description including architecture, sensor selection and required sensor performance. This includes the program unique identification(s) and test, system safety, and reliability report(s) identification, and summary of limitations (specification/sub-specification issues) of the report which verified the final design description.

(2) The industry standards and statistical measurements for interface signals to the system final design. This includes the program unique identification(s) and test report(s) identification, and summary of limitations (specification/sub-specification issues) of the test report which verified the interface signals.

(3) The operational or other interface requirements of the system preliminary design. This includes the program unique identification(s) and test report(s) identification, and summary of limitations (specification/sub-specification issues) of the test report which verified the interface requirements.

(4) The analysis of each DO-236 section 2 requirement given the verified data provided in this analysis and resulting level of RNP capability per DO-236 section 2 for the system final design.

(5) The "end game" test report's program unique identification(s) and test report(s) identification, and summary of results validating the DO-236 section 2.1. requirements analysis.

(6) Each DO-236 section 3 requirement with program unique identification(s) and test report(s) identification, and summary of limitations (specification/sub-specification issues) of the test report which verified each DO-236 section 3 requirement. This shall include analysis of derived requirements and integration requirements imposed upon the system specification and sub-system specifications toward a DO-236 section 3 requirement.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

11.8.9. Active GPS Antenna

Criteria:
The purpose of the test is to demonstrate the component qualification performs to the equivalent level of safety.

Standard:
TSO-C190
MSO-C144
ADS-88

Method of Compliance:
Laboratory and aircraft testing shall demonstrate the component qualification performs to the equivalent level of safety as TSO-C190 for civil compliance, and MSO-C144 for tactical environments as discussed in ADS-88. Tactical capabilities and non-interference with civil functionality such as pseudolite compatibility, Blue Force Electronic Attack (BFEA), and Direction of Arrival (DOA) shall be evaluated, as well as compatibility with L1, L2, and L5 as well as Non-US GPS systems such as GLONASS and GALILEO per ADS-88.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12. ELECTRICAL SYSTEM

This section covers the design, installation, arrangement and compatibility of the complete aircraft electrical system. It covers both the electrical power generation system and electrical wiring system, including power distribution.

For airborne, shipborne or ground applications, the electric power generating system includes electrical power sources, main power buses, transmission cables, and associated control, regulation and protective devices.

This section does not list any reduced set of testing for “Safety of Flight”, as all of the tests are required to determine the electrical compatibility to a type of aircraft. Due to the nature of a specific devices' functionality: no interaction with critical flight functions, a minor electrical load, design similarity to existing device, and/or specific flight restrictions (WCNs, limited test flight scope) – the list of MIL-HDBK-704 tests being applied may be tailored.

The following criteria, standards and methods of compliance apply to all air systems and represent the minimum requirements necessary to establish, verify, and maintain an airworthy design.

12.1. Electrical Loads Analysis (ELA)

The purpose of the Electrical Loads Analysis is to provide a documentation and analysis of all electrical load requirements and power source capacities under all operating conditions of the aircraft. The electrical loads shall not exceed the limits of the power sources, during all operating conditions.

Criteria:
The aircraft electrical loads shall be within the aircraft's electrical power capacity.

Standard:
MIL-E-7016

Method of Compliance:
The aircraft shall provide electrical power for all electrical components during all aircraft operating conditions, including emergency conditions. An Electrical Loads Analysis shall be conducted IAW MIL-E-7016. Emergency load shedding procedures shall be included if necessary. Added/removed loads shall also be included if applicable. Battery analysis shall be conducted to calculate the operational duration in minutes, for all equipment on the bus powered by the battery, after all power generation has failed. Electric powered aircraft may require consideration of: extensive control surface movements or go arounds (weather); ability to clear faults. The airworthiness substantiation shall include an Electrical Loads Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
ASTM F2490	JSSG-2009: H.3.4.8., H.4.4.8., H.3.4.8.4., H.4.4.8.4. MIL-HDBK-454 MIL-STD-464 MIL-PRF-21480 AFGS-87219 ADS-51-HDBK: Section 8-7 MIL-E-7016 AFGS-87219 14 CFR 23.1351-23.1367, 25.1351-25.1363. MIL-PRF-7032, MIL-PRF-7115, MIL-E-85583	14 CFR part 23, 23.1351(a)(2). 14CFR 23.2525, 14CFR 27.1351. 14CFR 27.1351	Part 7 Installation Part 8 Maintenance Part 9 Flight Tests-Handling Part 10 Flight Test-Installations and Structures	

12.2. Aircraft Electrical Power Characteristics

The purpose of the aircraft electrical power characteristics test is to verify and validate the compatibility of the utilization equipment to operate and maintain performance when exposed to the electrical power environment. At a minimum the utilization equipment must not suffer damage or cause an unsafe condition.

12.2.1. Single Phase, Alternating Current, 400 Hz

Criteria:

For airborne, shipborne or ground applications, the electric power generating system includes electrical power sources, main power buses, transmission cables, and associated control, regulation and protective devices.

Standard:

MIL-STD-704
MIL-HDBK-704-2

Method of Compliance:

The aircraft utilization equipment shall operate IAW the equipment's specification when powered by the host aircraft's electrical power environment. The equipment shall not have failures or anomalies during testing. The electrical utilization equipment's compatibility to the host aircraft's electrical power system shall be IAW MIL-STD-704 and shall be tested IAW MIL-HDBK-704-2, Single Phase, 400 Hz, 115 Volt Electrical

Power. Tests include: SAC 101, SAC 102, SAC 103, SAC 104, SAC 105, SAC 106, SAC 107, SAC 108, SAC 109, SAC 110, SAC 201, SAC 301, SAC 302, SAC 303, SAC 401, SAC 501, SAC 601, SAC 602, and SAC 603. The airworthiness substantiation shall include SAC Power Compatibility Test Plans prepared IAW DI-NDTI-80566, SAC Power Compatibility Test Procedures prepared IAW DI-NDTI-80603 including pass/fail criteria, and SAC Power Compatibility Test Reports prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	*DoD/MIL Docs*	*FAA/EASA*	*Def-Stan 970*	*STANAG*
SAE-AS50881 DO-160 Section 16 DO-160 Section 17	MIL-HDBK-704 ADS-51-HDBK	14 CFR 23.1351-23.1367 (or 23.2525 ASTM F3231) Section 4.2; 25.1351-25.1363; 27.1351-27.1367; 29.1351-29.1363.	Part 7 Installation Part 8 Maintenance Part 9 Flight Tests-Handling Part 10 Flight Test-Installations and Structures	

12.2.1.1. Method SAC101 Load Measurements

Criteria:
Verify single phase, 115 Volt, 400Hz power utilization equipment utilizes only 115 Volt line-to-neutral power, does not require more power than allowed, maintains power factor within limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704. Additionally, when the utilization equipment performance specification document imposes current waveform requirements, this test procedure is used to verify that the utilization equipment current waveform is within total current distortion and current spectrum (current distortion vs. frequency) limits defined in the utilization equipment performance specification document.

Standard:
MIL-STD-704
MIL-HDBK-704-2
MIL-E-7016F

Method of Compliance:
The utilization equipment is considered to have passed if the utilization equipment requires less than or equal to the power limit for single phase equipment, is within the power factor limits, and does not use half-wave rectification for the applicable edition(s) of MILSTD-704 and as noted in table SAC101-I. If required by the utilization equipment performance specification document, the utilization equipment current waveform must be within the total current distortion and current spectrum limits defined in the utilization equipment performance specification document. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 23.1351-23.1367 (or 23.2525 ASTM F3231) Section 4.2; 25.1351-25.1363; 27.1351-27.1367; 29.1351-29.1363..		

12.2.1.2. Method SAC102 Steady State Limits for Voltage and Frequency

Criteria:
Power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Normal Low Steady State (NLSS) limits and the Normal High Steady State (NHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-2

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power of voltage and frequency at the specified normal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table SAC102-I. The utilization equipment should maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. The utilization equipment should demonstrate re-start at the steady state voltage and frequency limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.1.3. Method SAC103 (No Test Required)
No Test Required.

Test number SAC103 is not used so that the single phase, 400 Hz, 115V (SAC) test numbers coincide with the three phase, 400 Hz, 115 V (TAC) test sequence numbers.

12.2.1.4. Method SAC104 Voltage Modulation

Criteria:
Single phase, 115 volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to voltage modulation as specified in the application edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-2

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having voltage modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table SAC104-I. The utilization equipment should maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage modulation. The utilization equipment should not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.1.5. Method SAC105 Frequency Modulation

Criteria:
Single phase, 115 volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to frequency modulation as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-2

Method of Compliance:
the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having frequency modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table SAC105-I. The utilization equipment should maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having frequency modulation. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.1.6. Method SAC106 Voltage Distortion Spectrum

Criteria:
Single phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to voltage distortion of frequencies and amplitudes as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-2

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage distortions as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704 and as noted in table SAC106-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage distortion. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.1.7. Method SAC107 Total Voltage Distortion

Criteria:
Single phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to a voltage waveform having a distortion factor as specified by the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-2

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to a voltage waveform having a distortion factor as specified by the applicable edition(s) of MILSTD-704 and as noted in table SAC107-I. The utilization equipment must maintain specified performance for a length of time that

confirms the utilization equipment can operate continuously when subjected to a distorted voltage waveform and should be, not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.1.8. Method SAC108 DC Voltage Component

Criteria:
115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-2

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SAC108-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a direct current component of AC voltage and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.1.9. Method SAC109 Normal Voltage Transients

Criteria:
115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to normal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-2

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical

conditions when subjected to voltage transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SAC109-I. The utilization equipment must maintain specified performance during and after the voltage transients. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.1.10. Method SAC110 Normal Frequency Transients

Criteria:
115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to normal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-2

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to frequency transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SAC110-I. The utilization equipment must maintain specified performance during and after the frequency transients. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.1.11. Method SAC201 Power Interrupt

Criteria:
115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to power interrupts as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-2

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for transfer aircraft electrical

conditions when subjected to power interrupts as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SAC201-I. The utilization equipment must maintain the specified performance during power interrupts. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.1.12. Method SAC301 Abnormal Steady State Limits for Voltage and Frequency

Criteria:
115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Abnormal Low Steady State (ALSS) limits and the Abnormal High Steady State (AHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-2

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when supplied input power of voltage and frequency at the specified abnormal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table SAC301-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the abnormal steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the abnormal steady state voltage and frequency limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.1.13. Method SAC302 Abnormal Voltage Transients

Criteria:
115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to abnormal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-2

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to voltage transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SAC302-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.1.14. Method SAC303 Abnormal Frequency Transients

Criteria:
115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to abnormal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-2

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to frequency transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SAC303-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.1.15. Method SAC401 Emergency Steady State Limits for Voltage and Frequency

Criteria:
115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Emergency Low Steady State (ELSS) limits and the Emergency High Steady State (EHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-2

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for emergency aircraft electrical conditions when supplied input power of voltage and frequency at the specified emergency steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table SAC401-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the emergency steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the emergency steady state voltage and frequency limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.1.16. Method SAC501 (No Test Required)

12.2.1.17. Method SAC601 Power Failure (Single Phase)

Criteria:
115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to power failures as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-2

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SAC601-I. The utilization equipment must maintain the specified performance during the power failures. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.1.18. Method SAC602 (No Test Required)

12.2.1.19. Method SAC603 Phase Reversal (Single Phase)

Criteria:
115 Volt, 400 Hz power utilization equipment is not damaged by phase reversal or a positive physical means is employed to prevent phase reversal.

Standard:
MIL-STD-704
MIL-HDBK-704-2

Method of Compliance:
The utilization equipment is not damaged and does not cause an unsafe condition when the line and neutral connection are reversed for the applicable edition(s) of MIL-STD-704 and as noted in table SAC603-I. A positive physical means to prevent phase reversal may be used to fulfill this requirement.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.2. Three Phase, Alternating Current, 400 Hz

Criteria:
The aircraft Three Phase, Alternating Current, 400 Hz utilization equipment shall be compatible with the host aircraft's electrical power environment.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The aircraft utilization equipment shall operate IAW the equipment's specification when powered by the host aircraft's electrical power environment. The equipment shall not have failures or anomalies during testing. The electrical utilization equipment's compatibility to the host aircraft's electrical power system shall be IAW MIL-STD-704 and shall be tested IAW MIL-HDBK-704-3, Three Phase, 400 Hz, 115 Volt Electrical Power. Tests include: TAC 101, TAC 102, TAC 103, TAC 104, TAC 105, TAC 106, TAC 107, TAC 108, TAC 109, TAC 110, TAC 201, TAC 301, TAC 302, TAC 303, TAC 401, TAC 501, TAC 601, TAC 602, and TAC 603. The airworthiness substantiation shall include TAC Power Compatibility Test Plans prepared IAW DI-NDTI-80566, TAC Power Compatibility Test Procedures prepared IAW DI-NDTI-80603 including pass/fail criteria, and TAC Power Compatibility Test Reports prepared IAW DI-NDTI-80809."

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
SAE-AS50881 DO-160 Section 16 DO-160 Section 17	MIL-HDBK-704 ADS-51-HDBK	14 CFR 23.1351- 23.1367 (or 23.2525 ASTM F3231) Section 4.2; 25.1351- 25.1363; 27.1351- 27.1367; 29.1351- 29.1363.	Part 7 Installation Part 8 Maintenance Part 9 Flight Tests-Handling Part 10 Flight Test- Installations and Structures	

12.2.2.1. Method TAC101 Load Measurements

This section does not list any reduced set of testing for “Safety of Flight”, as all of the tests are required to determine the electrical compatibility to a type of aircraft. Due to the nature of a specific devices' functionality: no interaction with critical flight functions, a minor electrical load, design similarity to existing device, and/or specific flight restrictions (WCNs, limited test flight scope) – the list of MIL-HDBK-704 tests being applied may be tailored.

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment utilizes only 115 Volt line-to-neutral power, current inrush is within limits, has balanced power, the power factor is within limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704. Additionally, when the utilization equipment performance specification document imposes current waveform requirements, this test procedure is used to verify that the utilization equipment current waveform is within total current distortion and

current spectrum (current distortion vs. frequency) limits defined in the utilization equipment performance specification document.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment utilize only 115 Volt line-to-neutral power, is within current inrush limits, is within the balanced load limits, is within the power factor limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704 and as noted in table TAC101-I. If required by the utilization equipment performance specification document, the utilization equipment current waveform must be within the total current distortion and current spectrum limits defined in the utilization equipment performance specification document. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.2.2. Method TAC102 Steady State Limits for Voltage, Including Unbalance, and Frequency

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Normal Low Steady State (NLSS) limits and the Normal High Steady State (NHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power of voltage and frequency at the specified normal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC102-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. The utilization equipment must demonstrate re-start at the steady state voltage and frequency limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: If the utilization has exactly the same full performance requirements for abnormal steady state limits and emergency steady state limits as required for the normal aircraft electrical conditions, then performance of test methods TAC301 and TAC401 will constitute performance of test conditions A through I of TAC102.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.2.3. Method TAC103 Voltage Phase Difference

The following criteria, standards and methods of compliance apply to all air systems and represent the minimum requirements necessary to establish, verify, and maintain an airworthy design.

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided voltages having phase angles within the limits specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when provided voltages having phase angles at the limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC103-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate and should be not less than thirty (30) minutes for each of the test conditions. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.2.4. Method TAC104 Voltage Modulation

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to voltage modulation as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having voltage modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table TAC104-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage modulation. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.2.5. Method TAC105 Frequency Modulation

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to frequency modulation as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having frequency modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table TAC105-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having frequency modulation. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.2.6. Method TAC106 Voltage Distortion Spectrum

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to voltage distortion of frequencies and amplitudes as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage distortions as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704 and as noted in table TAC106-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage distortion. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.2.7. Method TAC107 Total Voltage Distortion

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to voltage waveforms having a distortion factor as specified by the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage waveforms having a distortion factor as specified by the applicable edition(s) of MILSTD-704 and as noted in table TAC107-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to distorted voltage waveforms and should be, not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.2.8. Method TAC108 DC Voltage Component

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TAC108-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a direct current component of AC voltage and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.2.9. Method TAC109 Normal Voltage Transients

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to normal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC109-I. The utilization equipment must maintain specified performance during and after the voltage transients. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.2.10. Method TAC110 Normal Frequency Transients

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to normal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to frequency transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC110-I. The utilization equipment must maintain specified performance during and after the frequency transients. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.2.11. Method TAC201 Power Interrupt

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to power interrupts as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for transfer aircraft electrical conditions when subjected to power interrupts as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TAC201-I. The utilization equipment must maintain the specified performance during power interrupts. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.2.12. Method TAC301 Abnormal Steady State Limits for Voltage and Frequency

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Abnormal Low Steady State (ALSS) limits and the Abnormal High Steady State (AHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when supplied input power of voltage and frequency at the specified abnormal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC301-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the abnormal steady state voltage and frequency limits and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the abnormal steady state voltage and frequency limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.2.13. Method TAC302 Abnormal Voltage Transients

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to abnormal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to voltage transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC302-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.2.14. Method TAC303 Abnormal Frequency Transients

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to abnormal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to frequency transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC303-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.2.15. Method TAC401 Emergency Steady State Limits for Voltage and Frequency

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at that the Emergency Low Steady State (ELSS) limits and the Emergency High Steady State (EHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment performance specification document for emergency aircraft electrical conditions when supplied input power of voltage and frequency at the specified emergency steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC401-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the emergency steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the emergency steady state voltage and frequency limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.2.16. Method TAC501 (No Test Required)

12.2.2.17. Method TAC601 Power Failure (Three Phase)

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to three phase power failures as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to three phase power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TAC601-I. The utilization equipment must maintain the specified performance during the three phase power failures. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to

within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.2.18. Method SAC602 (No Test Required)

12.2.2.19. Method TAC602 One and Two Phase Power Failures

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to one and two phase power failures (7 seconds and indefinitely) as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TAC602-I. The utilization equipment must maintain the specified performance during one and two phase power failures. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate with one and two phase power failures and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.2.20. Method TAC603 Phase Reversal (Three Phase)

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment is not damaged by phase reversal or a positive physical means is employed to prevent phase reversal.

Standard:
MIL-STD-704

MIL-HDBK-704-3

Method of Compliance:
The utilization equipment is not damaged and does not cause an unsafe condition when the input phase sequence is reversed for the applicable edition(s) of MIL-STD-704 and as noted in table TAC603-I. A positive physical means to prevent phase sequence reversal may be used to fulfill this requirement.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3. Three Phase, Alternating Current, 400 Hz.

Criteria:
The aircraft Three Phase, Alternating Current, 400 Hz utilization equipment shall be compatible with the host aircraft's electrical power environment.

Standard:
MIL-STD-704 MIL-HDBK-704-3

Method of Compliance:
The aircraft utilization equipment shall operate IAW the equipment's specification when powered by the host aircraft's electrical power environment. The equipment shall not have failures or anomalies during testing. The electrical utilization equipment's compatibility to the host aircraft's electrical power system shall be IAW MIL-STD-704 and shall be tested IAW MIL-HDBK-704-3, Three Phase, 400 Hz, 115 Volt Electrical Power. Tests include: TAC 101, TAC 102, TAC 103, TAC 104, TAC 105, TAC 106, TAC 107, TAC 108, TAC 109, TAC 110, TAC 201, TAC 301, TAC 302, TAC 303, TAC 401, TAC 501, TAC 601, TAC 602, and TAC 603. The airworthiness substantiation shall include TAC Power Compatibility Test Plans prepared IAW DI-NDTI-80566, TAC Power Compatibility Test Procedures prepared IAW DI-NDTI-80603 including pass/fail criteria, and TAC Power Compatibility Test Reports prepared IAW DI-NDTI-80809."

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3.1. Method TAC101 Load Measurements

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment utilizes only 115 Volt line-to-neutral power, current inrush is within limits, has balanced power, the power factor is within limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704. Additionally, when the utilization equipment performance specification document imposes current waveform requirements, this test procedure is used to verify that the utilization equipment current waveform is within total current distortion and

current spectrum (current distortion vs. frequency) limits defined in the utilization equipment performance specification document.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment utilize only 115 Volt line-to-neutral power, is within current inrush limits, is within the balanced load limits, is within the power factor limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704 and as noted in table TAC101-I. If required by the utilization equipment performance specification document, the utilization equipment current waveform must be within the total current distortion and current spectrum limits defined in the utilization equipment performance specification document. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3.2. Method TAC102 Steady State Limits for Voltage, Including Unbalance, and Frequency

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Normal Low Steady State (NLSS) limits and the Normal High Steady State (NHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power of voltage and frequency at the specified normal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC102-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. The utilization equipment must demonstrate re-start at the steady state voltage and frequency limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: If the utilization has exactly the same full performance requirements for abnormal steady state limits and emergency steady state limits as required for the normal aircraft electrical conditions, then performance of test methods TAC301 and TAC401 will constitute performance of test conditions A through I of TAC102.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3.3. Method TAC103 Voltage Phase Difference

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided voltages having phase angles within the limits specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when provided voltages having phase angles at the limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC103-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate and should be not less than thirty (30) minutes for each of the test conditions. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3.4. Method TAC104 Voltage Modulation

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to voltage modulation as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having voltage modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table TAC104-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage modulation. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3.5. Method TAC105 Frequency Modulation

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to frequency modulation as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having frequency modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table TAC105-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having frequency modulation. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3.6. Method TAC106 Voltage Distortion Spectrum

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to voltage distortion of frequencies and amplitudes as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage distortions as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704 and as noted in table TAC106-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage distortion. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3.7. Method TAC107 Total Voltage Distortion

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to voltage waveforms having a distortion factor as specified by the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage waveforms having a distortion factor as specified by the applicable edition(s) of MILSTD-704 and as noted in table TAC107-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to distorted voltage waveforms and should be, not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3.8. Method TAC108 DC Voltage Component

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TAC108-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a direct current component of AC voltage and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3.9. Method TAC109 Normal Voltage Transients

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to normal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC109-I. The utilization equipment must maintain specified performance during and after the voltage transients. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3.10. Method TAC110 Normal Frequency Transients

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to normal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to frequency transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC110-I. The utilization equipment must maintain specified performance during and after the frequency transients. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3.11. Method TAC201 Power Interrupt

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to power interrupts as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for transfer aircraft electrical conditions when subjected to power interrupts as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TAC201-I. The utilization equipment must maintain the specified performance during power interrupts. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3.12. Method TAC301 Abnormal Steady State Limits for Voltage and Frequency

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Abnormal Low Steady State (ALSS) limits and the Abnormal High Steady State (AHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when supplied input power of voltage and frequency at the specified abnormal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC301-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the abnormal steady state voltage and frequency limits and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the abnormal steady state voltage and frequency limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3.13. Method TAC302 Abnormal Voltage Transients

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to abnormal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to voltage transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC302-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3.14. Method TAC303 Abnormal Frequency Transients

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to abnormal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to frequency transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC303-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3.15. Method TAC401 Emergency Steady State Limits for Voltage and Frequency

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at that the Emergency Low Steady State (ELSS) limits and the Emergency High Steady State (EHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment performance specification document for emergency aircraft electrical conditions when supplied input power of voltage and frequency at the specified emergency steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC401-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the emergency steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the emergency steady state voltage and frequency limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3.16. Method TAC501 (No Test Required)

12.2.3.17. Method TAC601 Power Failure (Three Phase)

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to three phase power failures as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to three phase power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TAC601-I. The utilization equipment must maintain the specified performance during the three phase power failures. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to

within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3.18. Method TAC602 One and Two Phase Power Failures

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to one and two phase power failures (7 seconds and indefinitely) as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TAC602-I. The utilization equipment must maintain the specified performance during one and two phase power failures. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate with one and two phase power failures and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.3.19. Method TAC603 Phase Reversal (Three Phase)

Criteria:
Three phase, 115 Volt, 400 Hz power utilization equipment is not damaged by phase reversal or a positive physical means is employed to prevent phase reversal.

Standard:
MIL-STD-704
MIL-HDBK-704-3

Method of Compliance:
The utilization equipment is not damaged and does not cause an unsafe condition when the input phase sequence is reversed for the applicable edition(s) of MIL-STD-704 and as noted in table TAC603-I. A positive physical means to prevent phase sequence reversal may be used to fulfill this requirement

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.4. Single Phase, Alternating Current, Variable Frequency.

Criteria:
The aircraft Single Phase, Alternating Current, Variable Frequency utilization equipment shall be compatible with the host aircraft's electrical power environment.

Standard:
MIL-STD-704
MIL-HDBK-704-4

Method of Compliance:
The aircraft utilization equipment shall operate IAW the equipment's specification when powered by the host aircraft's electrical power environment. The equipment shall not have failures or anomalies during testing. The electrical utilization equipment's compatibility to the host aircraft's electrical power system shall be IAW MIL-STD-704 and shall be tested IAW MIL-HDBK-704-4, Single Phase, Variable Frequency, 115 Volt Electrical Power. Tests include: SVF 101, SVF 102, SVF 103, SVF 104, SVF 105, SVF 106, SVF 107, SVF 108, SVF 109, SVF 110, SVF 201, SVF 301, SVF 302, SVF 303, SVF 401, SVF 501, SVF 601, SVF 602, and SVF 603. The airworthiness substantiation shall include SVF Power Compatibility Test Plans prepared IAW DI-NDTI-80566, SVF Power Compatibility Test Procedures prepared IAW DI-NDTI-80603 including pass/fail criteria, and SVF Power Compatibility Test Reports prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160 Section 16 DO-160 Section 17	MIL-HDBK-704 ADS-51-HDBK	14 CFR 23.1351-23.1367 (or 23.2525 ASTM F3231) Section 4.2; 25.1351-25.1363; 27.1351-27.1367; 29.1351-29.1363.	Part 7 Installation Part 8 Maintenance Part 9 Flight Tests-Handling Part 10 Flight Test-Installations and Structures	

12.2.4.1. **Method SVF101 Load Measurements**

Criteria:
115 Volt, variable frequency power utilization equipment utilizes only 115 Volt line-to-neutral power, does not require more power than allowed, the power factor is within limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704. Additionally, when the utilization equipment performance specification document imposes current waveform requirements, this test procedure is used to verify that the utilization equipment current waveform is within total current distortion and current spectrum (current distortion vs. frequency) limits defined in the utilization equipment performance specification document.

Standard:
MIL-STD-704
MIL-HDBK-704-4

Method of Compliance:
The utilization equipment requires less than or equal to the power limit for single phase equipment, is within the power factor limits, and does not use half-wave rectification for the applicable edition(s) of MILSTD-704 and as noted in table SVF101-I. If required by the utilization equipment performance specification document, the utilization equipment current waveform must be within the total current distortion and current spectrum limits defined in the utilization equipment performance specification document. The utilization equipment must not suffer damage or cause an unsafe condition. The result is data for an Electrical Load Analysis per MIL-E-7016F.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.4.2. Method SVF102 Steady State Limits for Voltage and Frequency

Criteria:
Single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Normal Low Steady State (NLSS) limits and the Normal High Steady State (NHSS) limits as specified in the applicable edition(s) of MILSTD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-4

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power of voltage and frequency at the specified normal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table

SVF102-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be, not less than the time duration noted for the test conditions. The utilization equipment must demonstrate restart at the steady state voltage and frequency limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.4.3. Method SVF103 (No Test Required)

12.2.4.4. Method SVF104 Voltage Modulation

Criteria:
single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to voltage modulation as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-4

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having voltage modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table SVF104-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage modulation. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.4.5. Method SVF105 Frequency Modulation

Criteria:
Single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to frequency modulation as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704

MIL-HDBK-704-4

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having frequency modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table SVF105-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having frequency modulation and should be, not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.4.6. Method SVF106 Voltage Distortion Spectrum

Criteria:
Single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to voltage distortion of frequencies and amplitudes as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-4

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage distortions as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704 and as noted in table SVF106-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage distortion. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.4.7. Method SVF107 Total Voltage Distortion

Criteria:
Single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to voltage waveforms having a distortion factor as specified by the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-4

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage waveforms having a distortion factor as specified by the applicable edition(s) of MILSTD-704 and as noted in table SVF107-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to distorted voltage waveforms and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.4.8. Method SVF108 DC Voltage Component

Criteria:
Single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-4

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SVF108-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a direct current component of AC voltage and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.4.9. Method SVF109 Normal Voltage Transients

Criteria:
Single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to normal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-4

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SVF109-I. The utilization equipment must maintain specified performance during and after the voltage transients. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.4.10. Method SVF110 Normal Frequency Transients

Criteria:
Single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to normal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-4

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to frequency transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SVF110-I. The utilization equipment must maintain specified performance during and after the frequency transients. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.4.11. Method SVF201 Power Interrupt

Criteria:
Single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to power interrupts as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-4

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for transfer aircraft electrical conditions when subjected to power interrupts as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SVF201-I. The utilization equipment must maintain the specified performance during power interrupts. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.4.12. Method SVF301 Abnormal Steady State Limits for Voltage and Frequency

Criteria:
Single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Abnormal Low Steady State (ALSS) limits and the Abnormal High Steady State (AHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-4

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when supplied input power of voltage and frequency at the specified

abnormal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table SVF301-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the abnormal steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the abnormal steady state voltage and frequency limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.4.13. Method SVF302 Abnormal Voltage Transients

Criteria:
Single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to abnormal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-4

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to voltage transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SVF302-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.4.14. Method SVF303 Abnormal Frequency Transients

Criteria:
Single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to abnormal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-4

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to frequency transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SVF303-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.4.15. Method SVF401 Emergency Steady State Limits for Voltage and Frequency

Criteria:
Single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at that the Emergency Low Steady State (ELSS) limits and the Emergency High Steady State (EHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-4

Method of Compliance:
For MIL-STD-704F, the single phase, 115 Volt, variable frequency power utilization equipment normal steady state limits are the same as the emergency steady state limits. The emergency steady state limits for single phase, 115 Volt, variable frequency equipment are noted in table SVF401-I. Performance of test method SVF102 will constitute performance of test method SVF401.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.4.16. Method SVF501 (No Tests)

12.2.4.17. Method SVF601 Power Failure

Criteria:
Single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to power failures as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-4

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SVF601-I. The utilization equipment must maintain the specified performance during the power failures. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.4.18. Method SVF602 (No Tests)

12.2.4.19. Method SVF603 Phase Reversal

Criteria:
Single phase, 115 Volt, variable frequency power utilization equipment is not damaged by phase reversal or a positive physical means is employed to prevent phase reversal.

Standard:
MIL-STD-704
MIL-HDBK-704-4

Method of Compliance:
The utilization equipment is not damaged and does not cause an unsafe condition when the input phase sequence is reversed for the applicable edition(s) of MIL-STD-704 and as noted in table SVF603-I. A positive physical means to prevent phase sequence reversal may be used to fulfill this requirement.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.5. Three Phase, Alternating Current, Variable Frequency.

Criteria:
The aircraft Three Phase, Alternating Current, Variable Frequency utilization equipment shall be compatible with the host aircraft's electrical power environment.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
The aircraft utilization equipment shall operate IAW the equipment's specification when powered by the host aircraft's electrical power environment. The equipment shall not have failures or anomalies during testing. The electrical utilization equipment's compatibility to the host aircraft's electrical power system shall be IAW MIL-STD-704 and shall be tested IAW MIL-HDBK-704-5, Three Phase, Variable Frequency, 115 Volt Electrical Power. Tests include: TVF 101, TVF 102, TVF 103, TVF 104, TVF 105, TVF 106, TVF 107, TVF 108, TVF 109, TVF 110, TVF 201, TVF 301, TVF 302, TVF 303, TVF 401, TVF 501, TVF 601, TVF 602, and TVF 603. The airworthiness substantiation shall include TVFC Power Compatibility Test Plans prepared IAW DI-NDTI-80566, TVF Power Compatibility Test Procedures prepared IAW DI-NDTI-80603 including pass/fail criteria, and TVFC Power Compatibility Test Reports prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160 Section 16 DO-160 Section 17	MIL-HDBK-704 ADS-51-HDBK	14 CFR 23.1351-23.1367 (or 23.2525 ASTM F3231) Section 4.2; 25.1351-25.1363; 27.1351-27.1367; 29.1351-29.1363.	Part 7 Installation Part 8 Maintenance Part 9 Flight Tests-Handling Part 10 Flight Test-Installations and Structures	

12.2.5.1. Method TVF101 Load Measurements

Criteria:
Three phase, 115 Volt, variable frequency power utilization equipment utilizes only 115 Volt line-to-neutral power, current inrush is within limits, has balanced power, the power factor is within limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704. Additionally, when the utilization equipment performance specification document imposes current waveform requirements, this test procedure is used to verify that the utilization equipment current waveform is within total current

distortion and current spectrum (current distortion vs frequency) limits defined in the utilization equipment performance specification document.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
The utilization equipment utilize only 115 Volt line-to-neutral power, is within current inrush limits, is within the balanced load limits, is within the power factor limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704 and as noted in table TVF101-I. If required by the utilization equipment performance specification document, the utilization equipment current waveform must be within the total current distortion and current spectrum limits defined in the utilization equipment performance specification document. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.5.2. Method TVF102 Steady State Limits for Voltage (Including Unbalance) and Frequency

Criteria:
Three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Normal Low Steady State (NLSS) limits and the Normal High Steady State (NHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power of voltage and frequency at the specified normal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table TVF102-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be, not less than the time duration noted for the test conditions. The utilization equipment must demonstrate restart at the steady state voltage and frequency limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.5.3. Method TVF103 Voltage Phase Difference

Criteria:
Three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when provided voltages having phase angles within the limits specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when provided voltages having phase angles at the limits of the applicable edition(s) of MIL-STD-704 and as noted in table TVF103-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate and should be, not less than thirty (30) minutes for each of the test conditions. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.5.4. Method TVF104 Voltage Modulation

Criteria:
Three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to voltage modulation as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having voltage modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table TVF104-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage

modulation. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.5.5. Method TVF105 Frequency Modulation

Criteria:
Three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to frequency modulation as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having frequency modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table TVF105-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having frequency modulation and should be, not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.5.6. Method TVF106 Voltage Distortion Spectrum

Criteria:
Three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to voltage distortion of frequencies and amplitudes as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical

conditions when subjected to voltage distortions as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704 and as noted in table TVF106-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage distortion. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: This test method subjects the UUT to voltage distortion having frequencies components from 50 Hz to 10 kHz. These voltage distortions simulate voltage distortions within aircraft due to the cumulative effects of generators, electrical distribution systems reequipments, and aircraft loads. MIL-STD-461, (Requirements For The Control of Electromagnetic Interference Characteristics of Subsystems and Equipment), Test Method CS101, (Conducted Susceptibility, Power Leads, 30 Hz to 150 kHz) is a complimentary test. Power levels of the voltage distortions differ for the two test methods. Performance of Test Method TVF106 of this handbook does not relinquish the requirement to perform test Method CS101 of MIL-STD-461, and performance of Method CS101 of MIL-STD-461 does not relinquish the requirement to perform Test Method TVF106 of this handbook.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.5.7. Method TVF107 Total Voltage Distortion

Criteria:
Three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to voltage waveforms having a distortion factor as specified by the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage waveforms having a distortion factor as specified by the applicable edition(s) of MILSTD-704 and as noted in table TVF107-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to distorted voltage waveforms and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.5.8. Method TVF108 DC Voltage Component

Criteria:
Three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TVF108-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a direct current component of AC voltage and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.5.9. Method TVF109 Normal Voltage Transients

Criteria:
Three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to normal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TVF109-I. The utilization equipment must maintain specified performance during and after the voltage transients. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.5.10. Method TVF110 Normal Frequency Transients

Criteria:
Three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to normal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to frequency transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TVF110-I. The utilization equipment must maintain specified performance during and after the frequency transients. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.5.11. Method TVF201 Power Interrupt

Criteria:
Three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to power interrupts as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for transfer aircraft electrical conditions when subjected to power interrupts as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TVF201-I. The utilization equipment must maintain the specified performance during power interrupts. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.5.12. Method TVF301 Abnormal Steady State Limits for Voltage and Frequency

Criteria:
Three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Abnormal Low Steady State (ALSS) limits and the Abnormal High Steady State (AHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when supplied input power of voltage and frequency at the specified abnormal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table TVF301-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the abnormal steady state voltage and frequency limits and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the abnormal steady state voltage and frequency limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.5.13. Method TVF302 Abnormal Voltage Transients

Criteria:
Three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to abnormal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to voltage transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TVF302-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.5.14. Method TVF303 Abnormal Frequency Transients

Criteria:
Three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to abnormal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
Tthe utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to frequency transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TVF303-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.5.15. Method TVF401 Emergency Steady State Limits for Voltage and Frequency

Criteria:
Tthree phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Emergency Low Steady State (ELSS) limits and the Emergency High Steady State (EHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
The three phase, 115 volt, variable frequency power utilization equipment normal steady state limits are the same as the emergency steady state limits. The emergency steady state limits for three phase, 115 Volt, variable frequency equipment are noted in table TVF401-I. Performance of test method TVF102 will constitute performance of test method TVF401.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.5.16. Method TVF501 No Tests

12.2.5.17. Method TVF601 Power Failure (Three Phase)

Criteria:
Three phase, 115 volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to three phase power failures as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
Tthe utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to three phase power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TVF601-I. The utilization equipment must maintain the specified performance during the three phase power failures. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.5.18. Method TVF602 One and Two Phase Power Failures

Criteria:
Three phase, 115 volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to one and two phase power failures (7 seconds and indefinitely) as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
Tthe utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TVF602-I. The utilization equipment must maintain the specified performance during one and two phase power failures. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate with one and two phase power failures and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.5.19. Method TVF603 Phase Reversal (Three Phase)

Criteria:
Three phase, 115 volt, variable frequency power utilization equipment is not damaged by phase reversal or a positive physical means is employed to prevent phase reversal.

Standard:
MIL-STD-704
MIL-HDBK-704-5

Method of Compliance:
The utilization equipment is not damaged and does not cause an unsafe condition when the input phase sequence is reversed for the applicable edition(s) of MIL-STD-704 and as noted in table TVF603-I. A positive physical means to prevent phase sequence reversal may be used to fulfill this requirement.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6. Single Phase, Alternating Current, 60 Hz.

Criteria:
The aircraft Single Phase, Alternating Current, Variable Frequency utilization equipment shall be compatible with the host aircraft's electrical power environment.

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
The aircraft utilization equipment shall operate IAW the equipment's specification when powered by the host aircraft's electrical power environment. The equipment shall not have failures or anomalies during testing. The electrical utilization equipment's compatibility to the host aircraft's electrical power system shall be IAW MIL-STD-704 and shall be tested IAW MIL-HDBK-704-6, SXF 101, SXF 102, SXF 103, SXF 104, SXF 105, SXF 106, SXF 107, SXF 108, SXF 109, SXF 110, SXF 201, SXF 301, SXF 302, SXF 303, SXF 401, SXF 501, SXF 601, SXF 602, and SXF 603. The airworthiness substantiation shall include SXF Power Compatibility Test Plans prepared IAW DI-NDTI-80566, SXF Power Compatibility Test Procedures prepared IAW DI-NDTI-80603 including pass/fail criteria, and SXF Power Compatibility Test Reports prepared IAW DI-NDTI-80809."

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160 Section 16 DO-160 Section 17	MIL-HDBK-704 ADS-51-HDBK	14 CFR 23.1351-23.1367 (or 23.2525 ASTM F3231) Section 4.2; 25.1351-25.1363; 27.1351-27.1367; 29.1351-29.1363.	Part 7 Installation Part 8 Maintenance Part 9 Flight Tests-Handling Part 10 Flight Test-Installations and Structures	

12.2.6.1. Method SXF101 Load Measurements

Criteria:
Single phase, 115 volt, 60 Hz power utilization equipment shall utilize only 115 volt line-to-neutral power, shall not require more power than allowed, the power factor is within

limits, and will not use half-wave rectification for the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-6
MIL-E-7016F

Method of Compliance:
The electrical utilization equipment's compatibility to the host aircraft's electrical power system shall be IAW MIL-STD-704 and shall be tested IAW MIL-HDBK-704-6 SXF101. The result is data for an Electrical Load Analysis per MIL-E-7016F.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6.2. Method SXF102 Steady State Limits for Voltage and Frequency

Criteria:
Power utilization equipment that utilizes single phase, 115 Volt, 60 Hz power shall operate and maintain specified performance when provided power with voltage and frequency at that the Normal Low Steady State (NLSS) limits and the Normal High Steady State (NHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power of voltage and frequency at the specified normal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table SXF102-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. The utilization equipment must demonstrate re-start at the steady state voltage and frequency limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6.3. Method SXF103 No Test Required

Criteria:
N/A

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
N/A

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6.4. Method SXF104 Voltage Modulation

Criteria:
Single phase, 115 volt, 60 Hz power utilization equipment shall operate and maintain at a specified performance when subjected to voltage modulation as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having voltage modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table SXF104-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage modulation. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6.5. Method SXF105 Frequency Modulation

Criteria:
Single phase, 115 volt, 60 Hz power utilization equipment shall operate and maintain at a specified performance when subjected to frequency modulation as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having frequency modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table SXF105-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having frequency modulation. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6.6. Method SXF106 Voltage Distortion Spectrum

Criteria:
Single phase, 115 volt, 60 Hz power utilization equipment shall operate and maintain at a specified performance when subjected to voltage distortion of frequencies and amplitudes as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage distortions as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704 and as noted in table SXF106-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage distortion. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6.7. Method SXF107 Total Voltage Distortion

Criteria:
Single phase, 115 volt, 60 Hz power utilization equipment shall operate and maintain at a specified performance when subjected to a voltage waveform having a distortion factor as specified by the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to a voltage waveform having a distortion factor as specified by the applicable edition(s) of MILSTD- 704 and as noted in table SXF107-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a distorted voltage waveform and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6.8. Method SXF108 DC Voltage Component

Criteria:
Single phase, 115 volt, 60 Hz power utilization equipment shall operate and maintain at a specified performance when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
The utilization equipment is considered to have passed if the utilization operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD- 704 and as noted in table SXF108-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a direct current component of AC voltage and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6.9. Method SXF109 DC Normal Voltage Transients

Criteria:
Single phase, 115 volt, 60 Hz power utilization equipment shall operate and maintain at a specified performance when subjected to normal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SXF109-I. The utilization equipment must maintain specified performance during and after the voltage transients. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6.10. Method SXF110 Normal Frequency Transients

Criteria:
Single phase, 115 volt, 60 Hz power utilization equipment shall operate and maintain at a specified performance when subjected to normal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to frequency transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SXF110-I. The utilization equipment must maintain specified performance during and after the frequency transients. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6.11. Method SXF201 Power Interrupt

Criteria:
Single phase, 115 volt, 60 Hz power utilization equipment shall operate and maintain at a specified performance when subjected to power interrupts as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for transfer aircraft electrical conditions when subjected to power interrupts as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SXF201-I. The utilization equipment must maintain the specified performance during power interrupts. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6.12. Method SXF301 Abnormal Steady State Limits for Voltage and Frequency

Criteria:
Single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Abnormal Low Steady State (ALSS) limits and the Abnormal High Steady State (AHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment

performance specification document for abnormal aircraft electrical conditions when supplied input power of voltage and frequency at the specified abnormal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table SXF301-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the abnormal steady state voltage and frequency limits and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the abnormal steady state voltage and frequency limits.

Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6.13. Method SXF302 Abnormal Voltage Transients

Criteria:
Single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to abnormal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to voltage transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SXF302-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6.14. Method SXF303 Abnormal Frequency Transients

Criteria:
Single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to abnormal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to frequency transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SXF303-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6.15. Method SXF401 Emergency Steady State Limits for Voltage and Frequency

Criteria:
Single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Emergency Low Steady State (ELSS) limits and the Emergency High Steady State (EHSS) limits as specified in the applicable edition(s) of

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
For MIL-STD-704F, the single phase, 115 volt, 60 Hz power utilization equipment normal steady state limits are the same as the emergency steady state limits. The emergency steady state limits for single phase, 115 Volt, 60 Hz equipment are noted in table SXF401-I. Performance of test method SXF102 will constitute performance of test method SXF401.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6.16. Method SXF501 No Tests

Criteria:
N/A

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
N/A

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6.17. Method SXF601 Power Failure (Single Phase)

Criteria:
Single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to power failures as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SXF601-I. The utilization equipment must maintain the specified performance during the power failures. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6.18. Method SXF602 No Tests

Criteria:
N/A

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
N/A

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.6.19. Method SXF603 Phase Reversal (Single Phase)

Criteria:
Single phase, 115 volt, 60 Hz power utilization equipment is not damaged by phase reversal or a positive physical means is employed to prevent phase reversal.

Standard:
MIL-STD-704
MIL-HDBK-704-6

Method of Compliance:
The utilization equipment is considered to have passed if the utilization equipment is not damaged and does not cause an unsafe condition when the line and neutral connection are reversed for the applicable edition(s) of MIL-STD-704 and as noted in table SXF603-I. A positive physical means to prevent phase reversal may be used to fulfill this requirement.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.7. High Voltage, Direct Current, 270 Volts

Criteria:
The aircraft High Voltage, Direct Current, 270 Volts utilization equipment shall be compatible with the host aircraft's electrical power environment.

Standard:
MIL-STD-704
MIL-HDBK-704-7

Method of Compliance:
The aircraft utilization equipment shall operate IAW the equipment's specification when powered by the host aircraft's electrical power environment. The equipment shall not have failures or anomalies during testing. The electrical utilization equipment's compatibility to the host aircraft's electrical power system shall be IAW MIL-STD-704 and shall be tested IAW MIL-HDBK-704-7. This will be used for Demonstration of Utilization Equipment Compliance to Aircraft Supplied 270VDC Electrical Power. Tests include: HDC 101, HDC 102, HDC 103, HDC 104, HDC 105, HDC 201, HDC 301, HDC 302, HDC 401, HDC 501, HDC 601 and HDC 602. The airworthiness substantiation shall include HDC Power Compatibility Test Plans prepared IAW DI-NDTI-80566, HDC Power Compatibility Test Procedures prepared IAW DI-NDTI-80603 including pass/fail criteria, and HDC Power Compatibility Test Reports prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160 Section 16 DO-160 Section 17	MIL-HDBK-704 ADS-51-HDBK	14 CFR 23.1351-23.1367 (or 23.2525 ASTM F3231) Section 4.2; 25.1351-25.1363; 27.1351-27.1367; 29.1351-29.1363.	Part 7 Installation Part 8 Maintenance Part 9 Flight Tests-Handling Part 10 Flight Test-Installations and Structures	

12.2.7.1. Method HDC101 Load Measurements

Criteria:
270 volt DC power utilization equipment meets the load limits, inrush limits, current distortion limits and current spectrum limits that may be required by the utilization equipment performance specification document.

Standard:
MIL-STD-704
MIL-HDBK-704-7
MIL-E-7016F

Method of Compliance:
the utilization equipment is considered to have passed if the utilization equipment is within the load limits, inrush current limits, the current distortion limit, and the current spectrum limits specified in the utilization equipment performance specification document. As noted in table HDC101-I, the load limits, inrush current limits, the current distortion limit, and the current spectrum limits are not specified in MIL-STD-704 versions A through F. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: The utilization equipment performance specification document should include requirements that reduce the likelihood of the equipment having an adverse effect on the electrical power characteristics of the aircraft. Load, inrush currents, current distortion and current spectrum limits may be imposed to minimize undesirable effects to the electrical power characteristics. These limits should take into account the utilization equipment power draw, aircraft electrical system capacity and distribution characteristics, trade-offs with weight, volume, cost, and reliability that are specific to each type of equipment and aircraft.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.7.2. Method HDC102 Steady State Limits for Voltage

Criteria:
270 volt DC power utilization equipment operates and maintains specified performance when provided power with voltage at that the Normal Low Steady State (NLSS) limits and the Normal High Steady State (NHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-7

Method of Compliance:
the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power of voltage at the specified normal steady state limits of the applicable edition(s) of MILSTD-704 and as noted in table HDC102-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. The utilization equipment must demonstrate re-start at the steady state voltage limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: If the utilization has exactly the same full performance requirements for abnormal steady state limits and emergency steady state limits as required for the normal aircraft electrical conditions, then performance of test methods HDC301 and HDC401 will constitute performance of HDC102.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.7.3. Method HDC103 Voltage Distortion Spectrum

Criteria:
270 volt DC power utilization equipment operates and maintains specified performance when subjected to voltage distortion of frequencies and amplitudes as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-7

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage distortions as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704 and as noted in table HDC103-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage distortion. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: This test method subjects the UUT to voltage distortion having frequencies components from 50 Hz to 10 kHz. These voltage distortions simulate voltage distortions within aircraft due to the cumulative effects of generators, electrical distribution systems equipments, and aircraft loads. MIL-STD-461, (Requirements For The Control of Electromagnetic Interference Characteristics of Subsystems and Equipment), Test Method CS101, (Conducted Susceptibility, Power Leads, 30 Hz to 150 kHz) is a complimentary test. Power levels of the voltage distortions differ for the two test methods. Performance of Test Method HDC103 of this handbook does not relinquish the requirement to perform test Method CS101 of MIL-STD-461, and performance of Method CS101 of MIL-STD-461 does not relinquish the requirement to perform Test Method HDC103 of this handbook.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.7.4. Method HDC104 Total Ripple

Criteria:
270 volt DC power utilization equipment operates and maintains specified performance when subjected to voltage having a ripple as specified by the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-7

Method of Compliance:
the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to ripple as specified by the applicable edition(s) of MIL-STD-704 and as noted in table HDC104-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a distorted voltage waveform and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.7.5. Method HDC105 Normal Voltage Transients

Criteria:
270 volt DC power utilization equipment operates and maintains specified performance when subjected to normal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-7

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table HDC105-I. The utilization equipment must maintain specified performance during and after the voltage transients. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.7.6. Method HDC201 Power Interrupt

Criteria:
270 volt DC power utilization equipment operates and maintains specified performance when subjected to power interrupts as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704

MIL-HDBK-704-7

Method of Compliance:
the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for transfer aircraft electrical conditions when subjected to power interrupts as specified by the applicable edition(s) of MIL-STD-704 and as noted in table HDC201-I. The utilization equipment must maintain the specified performance during power interrupts. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.7.7. Method HDC301 Steady State Limits for Voltage

Criteria:
270 volt DC power utilization equipment operates and maintains specified performance when provided power with voltage at that the Abnormal Low Steady State (ALSS) limits and the Abnormal High Steady State (AHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-7

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when supplied input power of voltage at the specified abnormal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table HDC301-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the abnormal steady state voltage limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.7.8. Method HDC302 Abnormal Voltage Transients

Criteria:
270 volt DC power utilization equipment operates and maintains specified performance when subjected to abnormal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-7

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to voltage transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table HDC302-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.7.9. Method HDC401 Steady State Limits for Voltage

Criteria:
270 volt DC power utilization equipment operates and maintains specified performance when provided power with voltage at that the Emergency Low Steady State (ELSS) limits and the Emergency High Steady State (EHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-7

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for emergency aircraft electrical conditions when supplied input power of voltage at the specified emergency steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table HDC401-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the

emergency steady state voltage limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.7.10. Method HDC501 Starting Voltage Transients

Criteria:
270 volt DC power utilization equipment operates and maintains specified performance when subjected to starting voltage transients as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-7

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for starting aircraft electrical conditions when subjected to starting voltage transients for the applicable edition(s) of MIL-STD-704 and as noted in table HDC501-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.7.11. Method HDC601 Power Failure

Criteria:
270 volt DC power utilization equipment operates and maintains specified performance when subjected to Power Failures as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-7

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table HDC601-I. The utilization equipment must maintain the specified performance during power failures. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.7.12. Method HDC602 Phase Reversal

Criteria:
270 volt DC power utilization equipment is not damaged by phase reversal or a positive physical means is employed to prevent phase reversal.

Standard:
MIL-STD-704
MIL-HDBK-704-7

Method of Compliance:
The utilization equipment is not damaged and does not cause an unsafe condition when the positive and negative connection are reversed for the applicable edition(s) of MIL-STD-704 and as noted in table HDC602-I. A positive physical means to prevent phase reversal may be used to fulfill this requirement.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.8. Low Voltage, Direct Current, 28 Volts.

Criteria:
The aircraft Low Voltage, Direct Current, 28 Volts utilization equipment shall be compatible with the host aircraft's electrical power environment.

Standard:
MIL-STD-704
MIL-HDBK-704-8

Method of Compliance:
The aircraft utilization equipment shall operate IAW the equipment's specification when powered by the host aircraft's electrical power environment. The equipment shall not have failures or anomalies during testing. The electrical utilization equipment's compatibility to the host aircraft's electrical power system shall be IAW MIL-STD-704 and shall be tested IAW MIL-HDBK-704-8. Tests include: LDC 101, LDC 102, LDC 103, LDC 104, LDC 105, LDC 201, LDC 301, LDC 302, LDC 401, LDC 501, LDC 601 and LDC 602. The airworthiness substantiation shall include LDC Power Compatibility Test Plans prepared IAW DI-NDTI-80566, LDC Power Compatibility Test Procedures required IAW DI-NDTI-80603 including pass/fail criteria, and LDC Power Compatibility Test Reports prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160 Section 16 DO-160 Section 17 SAE-AS50881	MIL-HDBK-704 ADS-51-HDBK	14 CFR 23.1351-23.1367 (or 23.2525 ASTM F3231) Section 4.2; 25.1351-25.1363; 27.1351-27.1367; 29.1351-29.1363.	Part 7 Installation Part 8 Maintenance Part 9 Flight Tests-Handling Part 10 Flight Test-Installations and Structures	

12.2.8.1. Method LDC101 Load Measurements

Criteria:
The power utilization equipment shall meet the load limits, inrush limits, current distortion limits and current spectrum limits that may are required by the utilization equipment performance specification document.

Standard:
MIL-STD-704
MIL-HDBK-704-8
MIL-E-7016F

Method of Compliance:
The electrical utilization equipment's compatibility to the host aircraft's electrical power system shall be IAW MIL-STD-704 and shall be tested IAW MIL-HDBK-704-8 LDC101. The result is data for an Electrical Load Analysis per MIL-E-7016F.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.8.2. Method LDC102 Steady State Limits for Voltage

Criteria:
The power utilization equipment shall operate and maintain specified performance when provided power with voltage at that the Normal Low Steady State (NLSS) limits and the Normal High Steady State (NHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-8

Method of Compliance:
The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power of voltage at the specified normal steady state limits of the applicable editions(s) of MIL-STD-704 and as noted in table LDC102-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be not less than thirty (30) minutes for each of the test conditions. The utilization equipment must demonstrate re-start at the steady state voltage limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.8.3. Method LDC103 Voltage Distortion Spectrum

Criteria:
The power utilization equipment operates and maintains specified performance when subjected to voltage distortion of frequencies and amplitudes as specified by the voltage distortion spectrum in the applicable editions(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-8

Method of Compliance:
The utilization equipment shall operate and maintain performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage distortions as specified by the voltage distortion spectrum in the applicable editions(s) of MIL-STD-704 and as noted in table LDC103-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power

having voltage distortion. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.8.4. Method LDC104 Total Ripple

Criteria:
The utilization equipment operates and maintains specified performance when subjected to voltage having a ripple as specified by the applicable editions(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-8

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to ripple as specified by the applicable editions(s) of MIL-ST--704 and as noted in table LDC104- I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a distorted voltage waveform and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.8.5. Method LDC105 Normal Voltage Transients

Criteria:
The power utilization equipment operates and maintains specified performance when subjected to normal voltage transients as specified in the applicable editions(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-8

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage transients within the normal limits of the applicable

editions(s) of MIL-STD-704 and as noted in table LDC105-I. The utilization equipment must maintain specified performance during and after the voltage transients. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.8.6. Method LDC201 Power Interrupt

Criteria:
The power utilization equipment operates and maintains specified performance when subjected to power interrupts as specified in the applicable editions(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-8

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for transfer aircraft electrical conditions when subjected to power interrupts as specified by the applicable editions(s) of MIL-STD-704 and as noted in table LDC201-I. The utilization equipment must maintain the specified performance during power interrupts. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.8.7. Method LDC301 Steady State Limits for Voltage

Criteria:
The power utilization equipment operates and maintains specified performance when provided power with voltage at that the Abnormal Low Steady State (ALSS) limits and the Abnormal High Steady State (AHSS) limits as specified in the applicable editions(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-8

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when supplied input power of voltage at the specified abnormal steady state limits of the applicable editions(s) of MIL-STD-704 and as noted in table LDC301-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the abnormal steady state voltage limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.8.8. Method LDC302 Abnormal Voltage Transients

Criteria:
The power utilization equipment operates and maintains specified performance when subjected to abnormal voltage transients as specified in the applicable editions(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-8

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to voltage transients within the abnormal limits of the applicable editions(s) of MIL-STD-704 and as noted in table LDC302-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.8.9. Method LDC401 Steady State Limits for Voltage

Criteria:
The power utilization equipment operates and maintains specified performance when provided power with voltage at that the Emergency Low Steady State (ELSS) limits and the Emergency High Steady State (EHSS) limits as specified in the applicable editions(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-8

Method of Compliance:
The utilization equipment shall operate and maintain performance as specified in the utilization equipment performance specification document for emergency aircraft electrical conditions when supplied input power of voltage at the specified emergency steady state limits of the applicable editions(s) of MIL-STD-704 and as noted in table LDC401-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the emergency steady state voltage limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.8.10. Method LDC501 Starting Voltage Transients

Criteria:
Utilization equipment operates and maintains specified performance when subjected to starting voltage transients as specified in the applicable editions(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-8

Method of Compliance:
Utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for starting aircraft electrical conditions when subjected to starting voltage transients for the applicable editions(s) of MIL-STD-704 and as noted in table LDC501-I. Unless otherwise specified in the

utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.8.11. Method LDC601 Power Failure

Criteria:
Power utilization equipment operates and maintains specified performance when subjected to Power Failures as specified in the applicable editions(s) of MIL-STD-704.

Standard:
MIL-STD-704
MIL-HDBK-704-8

Method of Compliance:
The utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to power failures as specified by the applicable editions(s) of MIL-STD-704 and as noted in table LDC601-I. The utilization equipment must maintain the specified performance during power failures. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.8.12. Method LDC602 Power Reversal

Criteria:
Power utilization equipment is not damaged by phase reversal or a positive physical means is employed to prevent phase reversal.

Standard:
MIL-STD-704
MIL-HDBK-704-8

Method of Compliance:
the utilization equipment is not damaged and does not cause an unsafe condition when the positive and negative connection are reversed for the applicable editions(s) of MIL-

STD-704 and as noted in table LDC602-I. A positive physical means to prevent phase reversal may be used to fulfill this requirement.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.9. Vehicle Specific Voltages (aircraft voltages other than currently specified in MIL-STD-704)

The emergence of aircraft with power systems outside the limits currently documented by MIL-HDBK-704 require special consideration.

12.2.9.1. Aircraft Alternating Current Compatibility

Criteria:
Equipment utilizing aircraft Alternating Current shall be compatible with the host aircraft's electrical power environment.

Standard:
MIL-STD-704
MIL-HDBK-704

Method of Compliance:
The aircraft utilization equipment shall operate IAW the equipment's specification when powered by the host aircraft's electrical power environment. The equipment shall not have failures or anomalies during testing.

A test plan (using criteria similar to MIL-HDBK-704-3 as a guide) developed to simulate expected aircraft steady state, transient, and emergency conditions shall be submitted for approval.

The electrical utilization equipment's compatibility to the host aircraft's electrical power system shall be tested to this plan to establish the system performs as required.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.9.2. Aircraft Direct Current Compatibility

Criteria:
Equipment utilizing aircraft Direct Current shall be compatible with the host aircraft's electrical power environment.

Standard:
MIL-STD-704
MIL-HDBK-704

Method of Compliance:
The aircraft utilization equipment shall operate IAW the equipment's specification when powered by the host aircraft's electrical power environment. The equipment shall not have failures or anomalies during testing.

A test plan (using criteria similar to MIL-HDBK-704-8 as a guide) developed to simulate expected aircraft steady state, transient, and emergency conditions shall be submitted for approval.

The electrical utilization equipment's compatibility to the host aircraft's electrical power system shall be tested to this plan to establish the system performs as required.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.2.9.3. Aircraft Pulse Width Modulated Power Compatibility

Criteria:
Equipment utilizing aircraft which is provided as Pulse Width Modulated (PWM) energy shall be compatible with the host aircraft's electrical power environment.

Standard:
MIL-STD-704
MIL-HDBK-704

Method of Compliance:
The aircraft utilization equipment shall operate IAW the equipment's specification when powered by the host aircraft's electrical power environment. The equipment shall not have failures or anomalies during testing.

A test plan developed to simulate expected aircraft steady state, transient, and emergency conditions shall be submitted for approval.

The electrical utilization equipment's compatibility to the host aircraft's electrical power system shall be tested to this plan to establish the system performs as required.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.3. Electrical Wiring Interconnect System (EWIS).

12.3.1. EMS Suitability
The purpose of the EWIS is to provide wiring system safety, performance, reliability, maintainability throughout the service life of the system.

Criteria:
The aircrafts EWIS shall be suitable for the intended usages and physical environments and safely protects all personnel.

Standard:
SAE AS50881
MIL-HDBK-522

Method of Compliance:
The aircrafts EWIS shall be suitable for the intended usages and physical environments and safely protects all personnel. The airworthiness substantiation shall include electrical drawings of the aircraft, EWIS drawings, schematics & wiring diagrams that depict the EWIS components & installation IAW SAE-AS50881 and prepared IAW DI-SESS-81000. The wiring schematics shall include wire routing, clamping, wire gauge size, number of wires per bundle, wire identification numbers, circuit breaker size, circuit breaker placement, power source identification, any additional parts listing, and all other information to fulfil the requirements of SAE-AS50881.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
SAE-AS50881 DO-160 Section 16 DO-160 Section 17	TM 1-1500-323-24-1 TM 1-1500-204-23 MIL-HDBK-522		Part 7 Installation Part 8 Maintenance Part 9 Flight Tests-Handling Part 10 Flight Test-Installations and Structures	

12.3.2. EWIS above 300 Volts

12.3.2.1. Corona

Criteria:
The aircraft's EWIS shall be designed to prevent ionization, also referred to as corona, or partial discharges between the outside of an unshielded wire covering and grounded structural elements over which the wire passes, or between the insulation and a braided shield, the wire covering should have adequate "equivalent insulation thickness" for the conditions of operation.

Standard:
SAE AS50881 AIR7506

Method of Compliance:
The aircrafts EWIS shall be designed per SAE AS50881 Corona Prevention instruction.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.3.2.2. Identification (color and separation)

Criteria:
The aircraft's EWIS which operates at 600VAC/600VDC or greater shall be readily identifiable..

Standard:
SAE AS50881 AIR7506

Method of Compliance:
The aircraft's EWIS which operates at 600VAC/600VDC or greater shall meet the identification requirements of SAE AS50881 for color and identification markers.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.3.2.3. High Voltage Safety during Maintenance

Criteria:
The aircraft's EWIS shall be suitable for the intended usages and physical environments and safely protects all personnel.

Standard:
SAE AS50881 AIR7506

Method of Compliance:
The aircraft's EWIS shall incorporate safety interlocks to prevent hot front connectors during maintenance.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.4. Electrical Power

The aircraft shall provide uninterrupted electrical power for the onboard utilization equipment. Standards for AC generation and DC conversion are provided below and are necessary to maintain and validate good design practices and electrical compatibility principles.

12.4.1. Aircraft Electrical Power System

12.4.1.1. Aircraft Electrical Power System, 400 Hertz, Alternating Current Generation

Criteria:
The aircraft generated electrical power system shall safely provide power to the utilization equipment.

Standard:
MIL-PRF-21480

Method of Compliance:
The aircraft shall generate electrical power to be utilized by the electrical utilization equipment. The airworthiness substantiation shall include tests performed IAW MIL-PRF-21480. The airworthiness substantiation shall include Generator System Electric Power Test Plans prepared IAW DI-NDTI-80566, Generator System Electric Power Test Procedures prepared IAW DI-NDTI-80603 including pass/fail criteria, and Generator System Electric Power Test Reports prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 23.1351 (or 23.2525 ASTM F3231 Section 4.2); 25.1351; 27.1351; 29.1351.		

12.4.1.2. Aircraft Electrical Power System, Alternating Current Generation for Electric Propulsion Motors

Criteria:
The aircraft generated electrical power system shall safely provide power to the utilization equipment.

Standard:
MIL-PRF-21480

Method of Compliance:
The vendor shall develop a process which sufficiently tests the compatibility of the power generation system to the propulsion motor. Tests may be planned according to MIL-PRF-21480.

Additional Information

Comm Doc's	DoD/MIL Doc's	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 23.1351 (or 23.2525 ASTM F3231 Section 4.2); 25.1351; 27.1351; 29.1351.		

12.4.2. Aircraft Converted Electrical Power

12.4.2.1. Aircraft Converted Electrical Power, 115VAC, 3 Phase to 28VDC

Criteria:
The aircraft converted electrical power shall be safely provided to the utilization equipment.

Standard:
MIL-PRF-7115

Method of Compliance:
The aircraft shall convert electrical power to be utilized by the electrical utilization equipment. The airworthiness substantiation shall include tests performed IAW

MIL-PRF-7115. The airworthiness substantiation shall include Aircraft Converters Test Plans prepared IAW DI-NDTI-80566, Aircraft Converters Test Procedures prepared IAW DI-NDTI-80603 include pass/fail criteria, and Aircraft Converters Test Reports prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 23.1351 (or 23.2525 ASTM F3231 Section 4.2); 25.1351; 27.1351; 29.1351.		

12.4.2.2. Aircraft Converted Electrical Power, DC to DC, DC to AC, AC to DC (other than 12.4.2.1)

Criteria:
The aircraft converted electrical power shall be safely provided to the utilization equipment.

Standard:
MIL-PRF-7115

Method of Compliance:
The aircraft shall convert electrical power to be utilized by the electrical utilization equipment. The airworthiness substantiation shall include tests performed similar to MIL-PRF-7115. The airworthiness substantiation shall include Aircraft Converters Test Plans prepared IAW DI-NDTI-80566, Aircraft Converters Test Procedures prepared IAW DI-NDTI-80603 include pass/fail criteria, and Aircraft Converters Test Reports prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 23.1351 (or 23.2525 ASTM F3231 Section 4.2); 25.1351; 27.1351; 29.1351.		

12.4.3. Aircraft Power Quality and Availability

12.4.3.1. Aircraft Power Quality and Availability

Criteria:
The aircraft power quality and availability are maintained for all operating conditions and load combinations.

Standard:
ADS-51-HDBK,
Chapter 8-7 Electrical Subsystem

Method of Compliance:
The aircraft shall maintain the required power quality and availability for all operating conditions and load combinations, including start up and loss of power. Airworthiness substantiation of the electrical power system shall be verified by test and/or analysis of the electrical system architecture IAW ADS-51-HDBK, Chapter 8-7. Airworthiness substantiation shall include a Power Availability Analysis Report prepared IAW DI-MISC-80711, Power Availability Test Plans prepared IAW DI-NDTI-80566, Power Availability Test Procedures prepared IAW DI-NDTI-80603 including pass/fail criteria, and Power Availability Test Reports prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	JSSG-2009: H.3.4.8.1., H.4.4.8.1 MIL-STD-704 MIL-STD-1399-300 AFGS-87219 ADS-51-HDBK: Section 8-7	14 CFR 23.1351 (or 23.2525 ASTM F3231 Section 4.2); 25.1351; 27.1351; 29.1351.		

12.4.3.2. Electric Aircraft Power Quality and Availability

Criteria:
Battery powered aircraft operational time shall be limited to the time the battery is capable of fault clearing.

Standard:
ADS-51-HDBK, Chapter 8-7 Electrical Subsystem

Method of Compliance:
The aircraft shall maintain the required power quality and availability for all operating conditions and load combinations, including start up and loss of power. Airworthiness substantiation of the electrical power system shall be verified by test and/or analysis of the electrical system architecture IAW ADS-51-HDBK, Chapter 8-7. Airworthiness substantiation shall include a Power Availability Analysis Report prepared IAW DI-MISC-80711, Power Availability Test Plans prepared IAW DI-NDTI-80566, Power Availability Test Procedures prepared IAW DI-NDTI-80603 including pass/fail criteria, and Power Availability Test Reports prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		14 CFR 23.1351 (or 23.2525 ASTM F3231 Section 4.2); 25.1351; 27.1351; 29.1351.		

12.4.4. Independent and Uninterruptable Power Source

Criteria:
The aircraft electrical system has independent and uninterruptable power sources after failure of the primary power system.

Standard:
ADS-51-HDBK, Chapter 8-7.1. Electrical Power Testing

Emergency and alternate power loads should be identified and individually measured. The total load on each emergency power source should be determined. Each dc load should be measured in terms of voltage input and amperes of current flow or watts consumed; each ac load should be measured in terms of phase-to-neutral input voltage, amperes of current flow, and either power factor (phase angle) or volt-amperes. It should be demonstrated that the available emergency power and the emergency circuits are satisfactory for all required flight operating conditions of the aircraft. Emergency power should satisfy the performance and interface characteristics of MIL-STD-704 (Ref. 19) including voltage, frequency regulation, and waveform of an ac subsystem and voltage regulation and ripple voltage content of a dc subsystem. If the emergency dc source is a battery, adequacy of the battery to provide the required power to the emergency circuits for a specified time period at all ambient temperatures should be demonstrated.

Method of Compliance:
The aircraft electrical system shall have independent, uninterruptable power sources, including power control panels that are available to automatically satisfy the requirements of essential redundancy for flight-critical functions after failure of the primary power system. Airworthiness substantiation of uninterruptable power shall include analysis or test. This verification includes examination to assure that loss of primary electric power to a control station does not cause loss of control of its associated aircraft.

If the emergency dc source is a battery, adequacy of the battery to provide the required power to the emergency circuits for a specified time period at all ambient temperatures should be demonstrated. The airworthiness substantiation shall include Uninterruptable Power Analysis Report prepared IAW DI-MISC-80711, Uninterruptable Power Test Plans prepared IAW DI-NDTI-80566, Uninterruptable Power Test Procedures prepared IAW DI-NDTI-80603 including pass/fail criteria, and Uninterruptable Power Test Reports prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	JSSG-2009: H.3.4.8., H.4.4.8. MIL-E-7016 AFGS-87219 NAVSEA TM-S9310-AQ-SAF-010			

12.5. Lithium Batteries

12.5.1. Lithium Batteries supplied by MIL-STD-704 Aircraft Power

Lithium battery chemistry have inherently volatile characteristics. The following establishes safety guidelines for the use and charging of lithium batteries. The aircraft lithium batteries shall operate when supplied by MIL-STD-704 power.

Criteria:
The aircraft lithium batteries shall operate when supplied by MIL-STD-704 power.

The lithium battery shall not produce any smoke or flames inside the aircraft when tested IAW DO-311A and MIL-STD-704.

Standard:
NAVSEA TM-S9310-AQ-SAF-010
MIL-STD-704
MIL-HDBK-704-1/8.
RTCA/DO-311A

Method of Compliance:
Lithium batteries shall safely operate when supplied by MIL-STD-704 power. Lithium batteries, with or without embedded electronics, shall be tested IAW MIL-STD-704 using the test procedures IAW MIL-HDBK-704-1 through MIL-HDBK-704-8. Battery cell temperatures and pressures shall be maintained to safe levels during any probable charging and discharging conditions. The battery shall not have explosive or toxic gases emitted. Any corrosive fluids or gases which escape from the battery do not damage surrounding structures or adjacent essential equipment. Each battery installation shall have provisions to prevent any hazardous effect on structure or essential systems. The battery charging systems shall be designed to automatically control the charging rate of the battery in order to prevent overheating. Lithium battery (both rechargeable and non-rechargeable) safety requirements are defined in NAVSEA S9310-AQ-SAF-010. Airworthiness substantiation shall include analysis and test and they are as follows:

a. Bench and aircraft level testing of battery cell temperatures and pressures.

b. Analysis and test for any gases.

c. Analysis and test for fluid containment.

d. Analysis and test to ensure there is no battery overheating.

e. Analysis and subsystem tests of battery equipment/charger(s) and embedded electronics.

f. Analysis and test for safe application.

The airworthiness substantiation shall include Lithium Battery Analysis Report prepared IAW DI-MISC-80711, Lithium Battery Test Plans prepared IAW DI-NDTI-80566, Lithium

Battery Test Procedures prepared IAW DI-NDTI-80603 including pass/fail criteria and Lithium Battery Test Reports prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	JSSG-2009: H.6.3.2 AFGS-87219 NAVSEA TM-S9310-AQ-SAF-010			

12.5.2. Lithium Batteries

Criteria:
All aircraft installed lithium batteries shall be grouped by battery watt hours per DO-311A table 1-1 and tested IAW with the DO-311A table 2-2 test matrix. All aircraft installed lithium batteries over 200 watt hours shall be designed to safety vent overboard from the aircraft all gases, liquids and flames resulting from any and all battery malfunctions. All battery vents shall be protected from obstruction by insects and all other predictable sources of vent blockage. All lithium batteries over 2 watt hours shall have a Battery Management Unit (BMU) that shall monitor the voltage of “each” cell, the typical hottest cell temperature, and shall stop charging/discharging of the battery when the first cell reaches the under or over voltage limit or the battery core temperature reaches a maximum or minimum temperature for safe operation. All lithium batteries over 200-watt hours shall automatically balance cell voltage during charging.

Standard:
RTCA/DO-311A

Method of Compliance:
RTCA/DO-311A

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

12.5.3. Lithium Battery Safety

Criteria:
For all lithium type batteries (both rechargeable and non-rechargeable) employed, safety requirements are in accordance with NAVSEA TM-S9310-AQ-SAF-010, Lithium Battery System Design and Safety Assessment Testing. For any lithium battery under review, it may be determined that sufficient safety test data is available from other sources. Analyses or comparisons with similar cells or batteries in similar applications may be sufficient to eliminate the need for testing. For this instance, requirements in

accordance with NAVSEA TM-S9310-AQ-SAF-010, Exceptions to Testing, Review, and Certification Requirements must be met.

Standard:
NAVSEA TM-S9310-AQ-SAF-010

Method of Compliance:
NAVSEA TM-S9310-AQ-SAF-010

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13. ELECTROMAGNETIC ENVIRONMENTAL EFFECTS (E3)

This section deals with the impact of the electromagnetic environment (EME) upon Army Aviation platforms. E3 encompasses the electromagnetic effects addressed by the disciplines of electromagnetic compatibility (EMC), electromagnetic interference (EMI), electromagnetic vulnerability (EMV), electromagnetic pulse (EMP), electrostatic discharge (ESD), and hazards of electromagnetic radiation to personnel (HERP), ordnance (HERO), and volatile materials (HERF). E3 includes the electromagnetic effects generated by all EME contributors including radio frequency (RF) systems, ultra-wideband devices, high-power microwave (HPM) systems, lightning, precipitation static, and electrostatic discharge.

This section defines the standards and methods of compliance for all air systems (rotary wing, fixed wing, and unmanned (UAS)), to include energetics (e.g., ordnance loads). This section represents the minimum requirements necessary to establish, verify, and maintain an airworthy design by substantiating electromagnetic compatibility (EMC) within the air system and its intended operational electromagnetic environment (EME) – both internal and external. This section is applicable to: new air systems, modifications to air systems that include changes to electrical/electronic equipment (including form, fit, function updates, or diminishing manufacturing sources modifications), modifications to energetic systems, and modifications to the outer mold line (OML) that may impact lightning or p-static compliance. This section also addresses potentially harmful electro-magnetic effects on personnel, ordnance, fuel, and the associated defined E3 safety margins.

Requirements and verification approaches may be tailored based on engineering justification derived from the system's operational requirements and engineering analysis. Tailoring should be performed early in the development of an air system or its subsystems, and the technical rationale substantiating the tailoring should be documented in a program deliverable such as the Electromagnetic Environmental Effects Integration and Analysis Report (E3IAR). Tailoring shall not be used after qualification testing of equipment or the air system. E3 testing is required to be conducted at both the component / subsystem level and the aircraft or system level.

The criticality of components to be defined as flight or safety critical shall be determined by the Electromagnetic Environmental Effects Requirements Board (E3RB), the Electromagnetic Compatibility Advisory Board (EMCAB), or the E3 Working Group (E3WG) for the aircraft that the equipment will be installed on. Board members shall include, but not be limited to, representatives from the E3 Branch, the aircraft Program Manager's office, the aircraft manufacturer, and the User community.

For ordnance systems, verification shall address all life cycle aspects of the system, including (as applicable) normal in-service operation, checkout, storage, transportation, handling, packaging, loading, unloading, launch, and the normal operating procedures associated with each aspect.

Table 13.1 establishes the design parameters for Army Aircraft based upon a tailored Worldwide operational environment that includes shipboard operations.

Table 1. Table 13.1 - External EME for Army Aircraft, including Shipboard Operations

Start[(a)] **Freq** (MHz)	**Stop**[(a)] **Freq** (MHz)	**Modulation**	**Average**[(b)] **E-Field** (V/m RMS)	**Peak**[(b)] **E-Field** (V/m)
0.01	2	CW	200	--
		AM	200	--
2	30	CW	200	--
		AM	200	--
		PM	102	204
30	150	CW	200	--
		AM	200	--
		FM-1	200	--
150	225	AM	200	--
		FM-1	200	--
		PM	32	338
225	400	AM	200	--
		FM-1	200	--
		PM	43	140
400	700	CW	200	--
		AM	200	--
		FM-1	200	--
		PM	146	320
700	790	AM	200	--
		FM-1	200	--
		PM	22	317
790	1000	AM	200	--
		FM-1	200	--
		PM	485	2541
1000	2000	AM	200	--
		FM-2	200	--
		PM	171	2937
2000	2700	AM	200	--
		FM-2	200	--
		PM	92	2339
2700	3600	AM	200	--
		FM-2	200	--
		PM	4327	12667
3600	4000	AM	200	--
		FM-2	200	--
		PM	272	8553
4000	5400	CW	200	--
		FM-2	200	--

Start[(a)] **Freq** (MHz)	**Stop**[(a)] **Freq** (MHz)	**Modulation**	**Average**[(b)] **E-Field** (V/m RMS)	**Peak**[(b)] **E-Field** (V/m)
		PM	473	3434
5400	5900	CW	605	--
		FM-2	200	--
		PM	473	4844
5900	6000	CW	605	--
		FM-2	200	--
		PM	42	1134
6000	7900	CW	605	--
		FM-2	200	--
		PM	68	2261
7900	8000	CW	667	--
		FM-2	200	--
		PM	37	1197
8000	8400	CW	667	--
		FM-2	200	--
		PM	355	1391
8400	8500	CW	200	--
		FM-2	200	--
		PM	355	1391
8500	11000	CW	910	--
		FM-2	200	--
		PM	1617	4174
11000	14000	CW	361	--
		FM-2	200	--
		PM	642	3329
14000	18000	CW	200	--
		FM-2	200	--
		PM	642	3329
18000	50000	CW	576[(c)]	--
		FM-2	200[(d)]	--
		PM	57[(d)]	2862[(d)]

Notes:
(a) Frequency bands are in accordance with MIL-STD-464D format.
(b) The Peak and Average E-field levels for PM emitters may not be from the same emitter.
(c) Up to 45000 MHz (45 GHz).
(d) Up to 40000 MHz (40 GHz).

CW = Continuous Wave
AM = Amplitude Modulation: Modulated by 1 kHz tone; 50% modulation.
FM = Frequency Modulation
FM-1 (below 1 GHz): 20 kHz deviation modulated by 1 kHz tone.
FM-2 (above 1 GHz): 1 MHz deviation, modulated by a 10 kHz square wave.

Start[(a)] **Freq** (MHz)	**Stop**[(a)] **Freq** (MHz)	**Modulation**	**Average**[(b)] **E-Field** (V/m RMS)	**Peak**[(b)] **E-Field** (V/m)

PM = Pulse Modulation

13.1. Component/Subsystem E3 Qualification

Component/subsystem E3 qualification is a necessary step for compliance with Section 13.2., Aircraft Level Requirements. Equipment will be tested with higher fidelity during EMI qualification than during system E3 testing, and results can be used to tailor system E3 test plans to establish worst-case operational scenarios. Although MIL-STD-461 is the standard for DoD EMI qualification testing, other standards such as RTCA DO-160 may also be considered. When comparing other standards to MIL-STD-461, the primary consideration shall be potential impacts to Section 13.2 requirements. For example, an RF radiated susceptibility evaluation shall consider onboard RF transmitters and the tailored external electromagnetic environment for the system. The EMI qualification test setup must be compatible with the system installation for critical aspects such as grounding, harness shielding, electrical interfaces, and operating mode(s).

Verification shall be accomplished via test on EUT hardware, software, and firmware that is production representative.

For ordnance systems, verification shall address all life cycle aspects of the system, including (as applicable) normal in-service operation, checkout, transportation/storage, handling/loading, packaging, launch, platform loaded, and the normal operating procedures associated with each aspect. See Section 13.3.

13.1.1. Electromagnetic Interference (EMI)

DoD EMI testing is invoked by MIL-STD-461. The purpose of component-level EMI emissions testing is to evaluate component / subsystem electronic, electrical, and electromechanical equipment, for radiated and conducted emissions characteristics to a standardized electromagnetic environment.

Criteria:

All new and modified electronic, electrical, and electromechanical equipment, including ordnance and associated electronics, and PEDs, shall meet the emissions requirements of MIL-STD-461. All new and modified electronic, electrical, and electromechanical equipment shall meet their operational performance requirements when exposed to the susceptibility environments of MIL-STD-461. EMI test applicability is defined in MIL-STD-461, Table V, Requirement Matrix, “Aircraft, Army, Including Flight Line” and shall be performed in accordance with all Army defined aspects of MIL-STD-461, as described in the forthcoming EMI Sections.

Prior to first flight for equipment that is not flight nor safety critical, the following EMI tests are required: CE101, CE102, CE106/RE103 (transceivers only), CS118, and RE102.

Prior to first flight for flight/safety critical equipment, the following EMI tests are required: CE101, CE102, CE106/RE103 (transceivers only), CS101, CS114, CS115, CS118, RE102, and RS103.

Standard:
MIL-STD-461

Method of Compliance:
Compliance shall be verified by test. The airworthiness substantiation shall include an EMI Test Plan and procedure prepared IAW DI-EMCS-80201, and an EMI Test Report prepared IAW DI-EMCS-80200.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.1.1.1. CE101

Conducted emissions, audio frequency currents, power leads. This requirement is applicable from 30 Hz to 10 kHz for power leads, including returns, that receive power directly from the aircraft power bus, including flight line equipment.

For AC applications, this requirement is applicable starting at the second harmonic of the EUT power frequency.

This is a first flight requirement for all equipment.

Criteria:
New or modified aircraft electronic, electrical, or electromechanical components shall meet the emission limits of MIL-STD-461, Section 5.4, CE101, Figure CE101-4.

Standard:
MIL-STD-461
MIL-STD-464
TOP 01-2-511A

Method of Compliance:
Compliance shall be verified by test. The airworthiness substantiation shall include an EMI Procedure prepared IAW DI-EMCS-80201, and an EMI Test Report prepared IAW DI-EMCS-80200.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.1.1.2. CE102

Conducted emissions, radio frequency potential, power leads. This requirement is applicable from 10 kHz to 10 MHz for power leads, including returns, that receive power directly from the aircraft power bus.

This is a first flight requirement for all equipment.

Criteria:
New or modified aircraft electronic, electrical, or electromechanical components shall meet the emission limits of MIL-STD-461, Section 5.5, CE102, Figure CE102-1.

Standard:
MIL-STD-461
MIL-STD-464
TOP 01-2-511A

Method of Compliance:
Compliance shall be verified by test. The airworthiness substantiation shall include an EMI Procedure prepared IAW DI-EMCS-80201, and an EMI Test Report prepared IAW DI-EMCS-80200.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.1.1.3. CE106
Conducted emissions, antenna port. This requirement is applicable from 10 kHz to 40 GHz for the antenna ports of transmitters, receivers, and amplifiers. The requirement is not applicable to equipment designed with antennas permanently mounted to the EUT. The transmit mode portion of this requirement is not applicable within the bandwidth of the EUT transmitted signal or within ±5 percent of the fundamental frequency, whichever is larger.

Depending on the operating frequency range of the EUT, the start frequency of the test is as follows:

EUT Operating Frequency Range	Start Frequency of Test
10 kHz to 3 MHz	10 kHz
3 MHz to 300 MHz	100 kHz
300 MHz to 3 GHz	1 MHz
3 GHz to 40 GHz	10 MHz

The equipment will be tested to an upper frequency limit based on the highest frequency generated or received by the EUT. For systems with the frequencies generated or received less than 1 GHz, the upper frequency limit will be 20 times the highest frequency or 18 GHz whichever is greater. For systems with frequencies generated or received greater than or equal to 1 GHz, the upper frequency limit will be 10 times the highest frequency or 40 GHz whichever is less. For equipment using waveguide, the requirement does not apply below eight-tenths of the waveguide's cutoff frequency.

RE103 may be used as an alternative for CE106 for testing transmitters with their operational antennas permanently mounted to the EUT.

This is a first flight requirement for intentional radiating systems.

Criteria:
New or modified aircraft transceivers and amplifiers shall not exceed the conducted emissions limits of MIL-STD-461, Section 5.6., CE106, at the EUT antenna port as given below.

a. Receivers: 34 dBµV

b. Transmitters and amplifiers (standby mode): 34 dBµV

c. Transmitters and amplifiers (transmit mode): Harmonics, except the second and third, and all other spurious emissions shall be at least 80 dB down from the level at the fundamental. The second and third harmonics shall be suppressed to a level of -20 dBm or 80 dB below the fundamental, whichever requires less suppression.

Standard:
MIL-STD-461
MIL-STD-464
TOP 01-2-511A

Method of Compliance:
Compliance shall be verified by test. The airworthiness substantiation shall include an EMI Procedure prepared IAW DI-EMCS-80201, and an EMI Test Report prepared IAW DI-EMCS-80200.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.1.1.4. RE101
Radiated emissions, magnetic field. This requirement is applicable from 30 Hz to 100 kHz for radiated emissions from equipment and subsystem enclosures, including electrical cable interfaces. The requirement does not apply to radiation from antennas.

Criteria:
New or modified aircraft electronic, electrical, or electromechanical components shall meet the emission limits of MIL-STD-461, Section 5.17, RE101, Figure RE101-1.

Standard:
MIL-STD-461
MIL-STD-464
TOP 01-2-511A

Method of Compliance:
Compliance shall be verified by test. The airworthiness substantiation shall include an EMI Procedure prepared IAW DI-EMCS-80201, and an EMI Test Report prepared IAW DI-EMCS-80200.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.1.1.5. RE102
Radiated emissions, electric field. This requirement is applicable from 10 kHz to 18 GHz for radiated emissions from equipment and subsystem enclosures, and all interconnecting cables. For equipment with permanently mounted antennas, this requirement does not apply at the transmitter fundamental frequency and the necessary occupied bandwidth of the signal. This requirement is applicable to Army aircraft from 10 kHz to 18 GHz.

This is a first flight requirement for all equipment.

Criteria:
New or modified aircraft electronic, electrical, or electromechanical components shall meet the emission limits of MIL-STD-461, Section 5.18, RE102, Figure RE102-3. Above 30 MHz, the limits shall be met for both horizontally and vertically polarized fields.

Standard:
MIL-STD-461
MIL-STD-464
TOP 01-2-511A

Method of Compliance:
Compliance shall be verified by test. The airworthiness substantiation shall include an EMI Procedure prepared IAW DI-EMCS-80201, and an EMI Test Report prepared IAW DI-EMCS-80200.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.1.1.6. RE103
Radiated emissions, antenna spurious and harmonic outputs. This requirement may be used as an alternative for CE106 when testing transmitters with their intended antennas. This requirement is met if the emissions do not exceed the applicable RE102 limit in transmit mode. CE106 is the preferred requirement unless the equipment or subsystem design characteristics preclude its use. RE103 should be the preferred method for systems using active antenna or when the antenna impedance has a non-standard impedance curve. The requirement is applicable from 10 kHz to 40 GHz and

not applicable within the bandwidth of the EUT transmitted signal or within ±5 percent of the fundamental frequency, whichever is larger.

This is a first flight requirement for intentional radiating systems if CE106 cannot be tested.

Depending on the operating frequency range of the EUT, the start frequency of the test is as follows:

Operating Frequency Range(EUT)	Start Frequency of Test
10 kHz to 3 MHz	10 kHz
3 MHz to 300 MHz	100 kHz
300 MHz to 3 GHz	1 MHz
3 GHz to 40 GHz	10 MHz

The equipment will be tested to an upper frequency limit based on the highest frequency generated or received by the EUT. For systems with the frequencies generated or received less than 1 GHz, the upper frequency limit will be 20 times the highest frequency or 18 GHz whichever is greater. For systems with frequencies generated or received greater than or equal to 1 GHz, the upper frequency limit will be 10 times the highest frequency or 40 GHz whichever is less. For equipment using waveguide, the requirement does not apply below eight-tenths of the waveguide's cutoff frequency.

Criteria:
New or modified aircraft electronic, electrical, or electromechanical components shall meet the emission limits of MIL-STD-461, Section 5.19, RE103. Harmonics, except the second and third, and all other spurious emissions shall be at least 80 dB down from the level at the fundamental. The second and third harmonics shall be suppressed to a level of -20 dBm or 80 dB below the fundamental, whichever requires less suppression.

Standard:
MIL-STD-461
MIL-STD-464
TOP 01-2-511A

Method of Compliance:
Compliance shall be verified by test. The airworthiness substantiation shall include an EMI Procedure prepared IAW DI-EMCS-80201, and an EMI Test Report prepared IAW DI-EMCS-80200.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.1.1.7. CS101

Conducted susceptibility, power leads. This requirement is applicable from 30 Hz to 150 kHz for equipment and subsystem AC, limited to current draws ≤ 30 amperes per phase, and DC input power leads, not including returns. This is also applicable to systems that draw more than 30 amps if the system has an operating frequency 150 kHz or less and an operating sensitivity of 1 μV or better (such as 0.5 μV). If the EUT is DC operated, this requirement is applicable over the frequency range of 30 Hz to 150 kHz. If the EUT is AC operated, this requirement is applicable starting from the second harmonic of the EUT power frequency and extending to 150 kHz.

This is a first flight requirement for flight or safety critical components.

Criteria:
New or modified aircraft electronic, electrical, or electromechanical components shall not exhibit any malfunction, degradation of performance, or deviation from specified indications, beyond the tolerances indicated in the individual equipment or subsystem specification, when subjected to a test signal with voltage levels as specified on MIL-STD-461, Section 5.7., CS101, Figure CS101-1. The requirement is also met when the power source is adjusted to dissipate the power level of Figure CS101-2 in a 0.5-ohm load and the EUT is not susceptible.

Standard:
MIL-STD-461
MIL-STD-464
TOP 01-2-511A

Method of Compliance:
Compliance shall be verified by test. The airworthiness substantiation shall include an EMI Procedure prepared IAW DI-EMCS-80201, and an EMI Test Report prepared IAW DI-EMCS-80200.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.1.1.8. CS114

Conducted susceptibility, bulk cable injection. This requirement is applicable from 10 kHz to 200 MHz for all interconnecting cables, including power cables and is not applicable for coaxial cables to antenna ports of antenna-connected receivers.

This is a first flight requirement for flight or safety critical components.

Criteria:
New or modified aircraft electronic, electrical, or electromechanical components shall not exhibit any malfunction, degradation of performance, or deviation from specified indications beyond the tolerances indicated in the individual equipment or subsystem specification, when subjected to an injection probe drive level which has been pre-

calibrated to the appropriate current limit of MIL-STD-461, Section 5.12, CS114, Figure CS114-1, Curve #5 and is modulated as specified therein. Requirements are also met if the EUT is not susceptible at forward power levels sensed by the directional coupler that are below those determined during calibration provided that the actual current induced in the cable under test is Curve #5 = 115 dBμA, across the frequency range.

Standard:
MIL-STD-461
MIL-STD-464
TOP 01-2-511A

Method of Compliance:
Compliance shall be verified by test. The airworthiness substantiation shall include an EMI Procedure prepared IAW DI-EMCS-80201, and an EMI Test Report prepared IAW DI-EMCS-80200.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.1.1.9. CS115
Conducted susceptibility, bulk cable injection, impulse excitation. This requirement is applicable to all aircraft interconnecting cables, including power cables.

This is a first flight requirement for flight or safety critical components.

Criteria:
New or modified aircraft electronic, electrical, or electromechanical components shall not exhibit any malfunction, degradation of performance, or deviation from specified indications, beyond the tolerances indicated in the individual equipment or subsystems specification, when subjected to a pre-calibrated signal having rise and fall times, pulse width, and amplitude as specified in MIL-STD-461, Section 5.13, CS115, Figure CS115-1 at a 30 Hz rate for one minute.

Standard:
MIL-STD-461
MIL-STD-464
TOP 01-2-511A

Method of Compliance:
Compliance shall be verified by test. The airworthiness substantiation shall include an EMI Procedure prepared IAW DI-EMCS-80201, and an EMI Test Report prepared IAW DI-EMCS-80200.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.1.1.10. CS116

Conducted susceptibility, damped sinusoidal transients, cables and power leads. This requirement is applicable from 10 kHz to 100 MHz for all interconnecting cables, including power cables, and individual high side power leads. Power returns and neutrals need not be tested individually.

Criteria:

New or modified aircraft electronic, electrical, or electromechanical components shall not exhibit any malfunction, degradation of performance, or deviation from specified indications, beyond the tolerances indicated in the individual equipment or subsystem specification, when subjected to a signal having the waveform of MIL-STD-461, Section 5.14., CS116, Figure CS116-1 and having a maximum current as specified on Figure CS116-2. The limit is applicable across the entire specified frequency range. Compliance shall be demonstrated at the following frequencies: 0.01, 0.1., 1, 10, 30, and 100 MHz. If there are other frequencies known to be critical to the equipment installation, such as platform resonances, compliance shall also be demonstrated at those frequencies. The test signal repetition rate shall be no greater than one pulse per second and no less than one pulse every two seconds. The pulses shall be applied for a period of five minutes.

Standard:

MIL-STD-461
MIL-STD-464
TOP 01-2-511A

Method of Compliance:

Compliance shall be verified by test. The airworthiness substantiation shall include an EMI Procedure prepared IAW DI-EMCS-80201, and an EMI Test Report prepared IAW DI-EMCS-80200.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.1.1.11. S117

Conducted susceptibility, lightning induced transients, cables and power leads. This requirement is applicable to all safety-critical equipment interconnecting cables, including complete power cables, and individual high side power leads. It is also applicable to non-safety critical equipment with interconnecting cables/electrical interfaces that are part of or connected to equipment performing safety critical functions. It may be applicable to equipment performing non-safety critical functions when specified by the procuring activity.

Criteria:

New or modified aircraft electronic, electrical, or electromechanical components shall not exhibit any malfunction, degradation of performance, or deviation from specified

indications, beyond the tolerances indicated in the individual equipment or subsystem specification, when subjected to the levels and lightning transients specified in MIL-STD-461, Section 5.15, CS117, Table VII and supplemented by the waveform and timing definitions of Figures CS117-1 through CS117-8. The applicable transients of Table VII are considered default values and waveforms based upon previous experience and shall be used for the defined equipment functionality when the host platform lightning transient data does not exist. In the event that there is platform lightning transient data available, this data may be used to tailor the requirements with different selected levels or waveforms, pending approval by the procuring activity. Note that the power lines are tested separately as well as within the bundle as defined in the CS117 test procedures section and are tested at the levels defined in Table VII.

Standard:
MIL-STD-461
MIL-STD-464
TOP 01-2-511A

Method of Compliance:
Compliance shall be verified by test. The airworthiness substantiation shall include an EMI Procedure prepared IAW DI-EMCS-80201, and an EMI Test Report prepared IAW DI-EMCS-80200.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.1.1.12. CS118
Personnel borne electrostatic discharge. This requirement is applicable to electrical, electronic, and electromechanical subsystems and equipment that have a man-machine interface. It is applicable to the electronic components of ordnance items but not to the ordnance energetics.

This is a first flight requirement for all equipment.

Criteria:
New or modified aircraft electronic, electrical, or electromechanical components shall not exhibit any malfunction, degradation of performance, or deviation from specified indications, beyond the tolerances indicated in the individual equipment or subsystem specification, when subjected to the values shown in MIL-STD-461, Section 5.16, CS118, Table VIII while discharging from a 150 picofarads capacitor through a 330-ohm resistor with a circuit inductance not to exceed 5 microhenry. Contact discharge at 8kV is required for conductive surfaces. Air discharge is only required where contact discharge cannot be applied.

Standard:
MIL-STD-461
MIL-STD-464

TOP 01-2-511A

Method of Compliance:
Compliance shall be verified by test. The airworthiness substantiation shall include an EMI Procedure prepared IAW DI-EMCS-80201, and an EMI Test Report prepared IAW DI-EMCS-80200.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.1.1.13. RS101
Personnel borne electrostatic discharge. This requirement is applicable from 30 Hz to 100 kHz for equipment and subsystem enclosures, including electrical cable interfaces. The requirement is not applicable for electromagnetic coupling via antennas.

Criteria:
New or modified aircraft electronic, electrical, or electromechanical components shall not exhibit any malfunction, degradation of performance, or deviation from specified indications, beyond the tolerances indicated in the individual equipment or subsystem specification, when subjected to the magnetic fields of MIL-STD-461, Section 5.20, RS101, Figure RS101-2.

Standard:
MIL-STD-461
MIL-STD-464
TOP 01-2-511A

Method of Compliance:
Compliance shall be verified by test. The airworthiness substantiation shall include an EMI Procedure prepared IAW DI-EMCS-80201, and an EMI Test Report prepared IAW DI-EMCS-80200.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.1.1.14. RS103
Radiated susceptibility, electric field. This requirement is applicable for equipment and subsystem enclosures and all interconnecting cables. The requirement is applicable from 0.014 MHz through 40 GHz.

This is a first flight requirement for flight or safety critical components.

Criteria:
New or modified aircraft electronic, electrical, or electromechanical components shall not exhibit any malfunction, degradation of performance, or deviation from specified

indications, beyond the tolerances indicated in the individual equipment or subsystem specification, when tested in accordance with MIL-STD-461, Section 5.21, RS103. Up to 30 MHz, the requirement shall be met for vertically polarized fields. Above 30 MHz, the requirement shall be met for both horizontally and vertically polarized fields. Circularly polarized fields are not acceptable.

For receiver EUTs having permanently attached antennas only, unless otherwise stated in the system specification, reduced performance over the intended receiver band of operation is allowed. The receiver shall meet its performance requirements after in-band exposure to the radiated field.

For equipment that is neither flight nor safety critical, RS103 shall use the modulation defined in MIL-STD-461, Section 5.21 and the electric field strength limit shall be 200 volts/meter. For flight or safety critical equipment, the modulations defined in Table 13.1 shall be used and the full electric field strength levels shall apply.

Standard:
MIL-STD-461
MIL-STD-464
TOP 01-2-511A

Method of Compliance:
Compliance shall be verified by test. The airworthiness substantiation shall include an EMI Procedure prepared IAW DI-EMCS-80201, and an EMI Test Report prepared IAW DI-EMCS-80200.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.1.1.15. RS105

Radiated susceptibility, transient electromagnetic field. This requirement is applicable to flight or safety critical equipment, and subsystem enclosures which are exposed to the external electromagnetic environment.

Criteria:
New or modified aircraft electronic, electrical, or electromechanical components shall not exhibit any malfunction, degradation of performance, or deviation from specified indications, beyond the tolerances indicated in the individual equipment or subsystem specification, when subjected to a test signal having the waveform and amplitude per MIL-STD-461, Section 5.22, RS105, Figure RS105-1. At least five pulses shall be applied at the rate of not more than one pulse per minute.

Standard:
MIL-STD-461
MIL-STD-464
TOP 01-2-511A

Method of Compliance:
Compliance shall be verified by test. The airworthiness substantiation shall include an EMI Procedure prepared IAW DI-EMCS-80201, and an EMI Test Report prepared IAW DI-EMCS-80200.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.1.2. Fly-by-Wire Flight Control Subsystem (FCS) Radiated Susceptibility Test
This requirement is applicable for each platform type employing a fly-by-wire flight control system.

Criteria:
The Fly-by-Wire flight control systems shall remain airworthy and shall not be susceptible when exposed to the platform's specified operational electromagnetic environment (EME) – both internal and external. The Fly-by-Wire subsystem is considered flight critical therefore, full E-field levels and modulations, IAW Table 13.1., shall apply if a platform tailored EME has not been defined. A subsystem-wide (not on the aircraft), bench-level Radiated Susceptibility test shall be performed on the entire Fly-by-Wire flight control system. The Radiated Susceptibility testing shall be performed IAW the test methodology defined in MIL-STD-461, Section 5.21, RS103. The Radiated Susceptibility levels and modulations shall be IAW Table 13.1. Components used for testing shall be production and aircraft representative. This includes cable harnesses, cable breaks (for aircraft bulkheads), connectors, bond straps, ground wires, and mechanical installation. Components that include software shall have either the operational flight program installed or utilizing special test software/hardware to allow signal upset and anomaly monitoring and recording.

Standard:
MIL-STD-461
MIL-STD-464
TOP 01-2-511A

Method of Compliance:
Compliance shall be verified by test. The airworthiness substantiation shall include a Radiated Susceptibility Test Plan and procedure prepared IAW DI-EMCS-80201, and a Radiated Susceptibility Test Report prepared IAW DI-EMCS-80200.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.1.3. Lightning
The purpose of component lightning testing is to determine the response of flight and safety critical equipment to direct, indirect, and near strike lightning effects.

Lightning effects requirements for ordnance items are provided in Section 13.3, Ordnance.

Criteria:
Exterior-mounted radomes, canopies, externally mounted sensors, rotor blades, antennas, and fuel system components shall survive and remain safe when exposed to the direct lightning environment defined in MIL-STD-464, paragraph 5.5.

Exterior-mounted components shall meet their operational performance requirements for the near-strike environment of MIL-STD-464, paragraph 5.5.

Interior-mounted electronic components shall meet their operational performance requirements after exposure to the indirect lighting effects environment of MIL-STD-461, CS117, Table VII, see Section 13.1.1.11.

Standard:
MIL-STD-464, Paragraph 5.5
MIL-STD-461, CS117
TOP 01-2-511A

Method of Compliance:
Compliance shall be verified by test. The item under test shall be production-representative. The airworthiness substantiation shall include a Lightning Test Plan and Procedure prepared IAW DI-EMCS-81541, and a Lightning Test Report prepared IAW DI-EMCS-81542.

Additional Information

Comm Doc's	DoD/MIL Doc's	FAA/EASA	Def-Stan 970	STANAG

13.2. Aircraft Level Requirements

Aircraft-level E3 qualification is performed to demonstrate that the air system is compatible within itself and compatible with the electromagnetic environment in which it will operate, to ensure flight, personnel, and aircraft safety. System-level qualification incudes Intra-system electromagnetic compatibility (EMC), Electromagnetic Vulnerability (EMV), Lightning, precipitation static (P-static), Hazards of Electromagnetic Radiation to Personnel (HERP), Hazards of Electromagnetic Radiation to Fuels (HERF), High Power Microwave (HPM), Emission Control (EMCON) and TEMPEST. To effectively evaluate system level electromagnetic interoperability, box level EMI test results shall be considered as part of the overall E3 compliance. Full system level E3 qualification shall be performed to verify compatibility with all electromagnetic environments that the air system will be required to operate in.

Aircraft level testing requires the installation of production representative equipment on the platform. The platform shall have all modification work orders (MWOs), engineering change proposals (ECPs), and mission equipment installed prior to test execution.

13.2.1. Bonding

The purpose of the bonding and grounding test is to ensure electrical continuity across external mechanical interfaces on electrical and electronic equipment, both within the equipment and between the equipment and other system elements, for control of electromagnetic interference. This requirement is applicable for new, modified, relocated, or re-installed equipment. Good bonding ensures that the equipment will meet its performance specifications, reduces noise and interference from other systems.

This is a first flight requirement for all equipment.

Criteria:

The aircraft electronics, antennas, and ordnance systems, as installed on the platform, shall be bonded and electrically grounded to the airframe to meet their operational performance requirements. All electronic equipment, to include ordnance systems, installed on a platform shall meet the bonding requirements of MIL-STD-464, paragraph 5.11.

For instances where specific controls have not been established for a system and approved by the procuring activity, the following direct current (DC) bonding levels shall apply throughout the life of the system.

a. 10 milliohms or less from the equipment enclosure to system structure, including the cumulative effect of all faying surface interfaces, with cables disconnected, and

b. 2.5 milliohms or less across individual faying interfaces within the equipment, such as between subassemblies or sections, and

c. 5 milliohms or less from cable shields to the equipment enclosure, including the cumulative effect of all connector and accessory interfaces.

Additional bonding guidance and best bonding practices are available in SAE ARP1870.

Standard:

MIL-STD-464, Paragraph 5.11
SAE ARP1870

Method of Compliance:

Compliance shall be verified by test. Measurements shall be from each component's ground point to the aircraft frame, and from each component's connector to the aircraft frame. This includes rack-mounted equipment.

The airworthiness substantiation shall include a bonding test plan and procedure prepared IAW DI-EMCS-81541B, and a test report prepared IAW DI-EMCS-81542B.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.2.2. Electromagnetic Compatibility

The purpose of the EMC test is to ensure the system is electromagnetically compatible within itself. This test has two parts: source/victim (quantitative and qualitative EMC) and noise floor / spectrum analysis testing. Evaluation of ordnance EIDs is addressed in Section 13.3.2.1.

Criteria:

New, modified or re-located aircraft electronics shall be tested for EMC. The aircraft electronics shall meet their operational performance requirements when operated simultaneously with a single, or multiple combination of, other platform installed systems. This includes connected items external to the platform, such as ground support equipment.

Standard:

MIL-STD-464

Method of Compliance:

Noise Floor / spectrum analysis testing may be required if installed component RE102 and/or CE106/RE103 emissions are excessive. This test is required for installations of new or modified transmitters or antennas, to include re-located antennas. Frequencies with emissions over the ambient / baseline from noise floor measurements shall be evaluated during checklist and source / victim EMC testing.

Qualitative EMC testing / First Flight EMC testing shall be conducted in accordance with the DEVCOM AvMC SRD Qualitative EMC checklists, or contractor equivalent, for each platform type. This checklist, if not already existing, may be developed specifically for specific flight test aircraft and configuration. In the case of configuration changes, qualitative EMC / checklist testing is required to assess newly installed components. All frequencies to be used during flight shall be tested. Aircraft systems shall be checked as victims versus the newly installed components, to include instrumentation. Note: The Qualitative EMC test is often referred as Safety-of-Flight (SoF) EMC test.

Quantitative EMC, aka Source / Victim, testing shall be conducted in order to provide an airworthiness assessment. Each component shall be evaluated as both a source and a victim to every other installed subsystem and component. Each individual component shall be operated independently, as much as possible. Each operational mode for each subsystem / component shall be tested; this may require the use of test sets or sensor stimulators. For communication equipment, twenty frequencies evenly spaced across each operating band shall be evaluated. Frequency hopping radios shall utilize a hopsets(s) which covers the entire operating band. Both secure and non-secure modes shall be tested. Selected frequencies from noise floor testing shall be evaluated.

Compliance shall be verified by test. Testing is required for each platform type. Items under test shall be production-representative. The platform shall have all mission equipment installed. The airworthiness substantiation shall include an EMC test plan

and procedure prepared IAW DI-EMCS-81541B, and an EMC test report prepared IAW DI-EMCS-81542B.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.2.3. Electromagnetic Pulse (EMP)/High Altitude Electromagnetic Pulse (HEMP)
Electromagnetic Pulse (EMP) is an intense transient electromagnetic field which is most commonly caused by a nuclear explosion that can couple with electrical or electronic systems to produce damaging current and voltage surges; however, localized EMP can arise from other sources, such as lightning or Directed Energy Weapons (DEWs). High Altitude Electromagnetic Pulse (HEMP) is generated by a nuclear burst above the atmosphere which produces intense electromagnetic fields over large areas.

This requirement is applicable only if specifically invoked by the procuring activity.

Criteria:
The system shall meet its operational performance requirements after being subjected to the EMP environment. This environment is classified and is currently defined in MIL-STD-2169. MIL-STD-3023 specifies a user selectable design margin. Applicable field levels for a particular system shall be determined by the procuring activity based on operational scenarios, tactics, and mission profiles. In addition, equipment specified to meet the EMP requirement shall meet the requirements of MIL-STD-461, Section 5.14, CS116 and Section 5.22, RS105.

Standard:
MIL-STD-464
MIL-STD-2169
MIL-STD-3023

Method of Compliance:
Compliance shall be verified by system, subsystem, and component level tests, analysis, or a combination thereof. The data will be classified either by the item's or platform's Security Classification Guide (SCG). The airworthiness substantiation shall include an EMP Test Plan and Procedure Report prepared IAW DI-EMCS-81541, and an EMP Test Report prepared IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.2.4. Electromagnetic Vulnerability (EMV)
The purpose of the EMV test is to determine how the aircraft electronics when installed in the platform operate after exposure to the external electromagnetic environment. Ordnance electronics, to include firing and control subsystems, are addressed in Section 13.3.2.2.

Criteria:
The system shall be electromagnetically compatible with its external RF electromagnetic environment such that its system operational performance requirements are met. For new platforms, the levels and modulations of Table 13.1. shall apply.

Standard:
MIL-STD-464, Paragraph 5.3.
MIL-HDBK-235
Aircraft System Specification
DoDI 6055.11

Method of Compliance:
Compliance shall be verified by test. This requirement is applicable for each platform type, with all mission equipment installed. The data will be typically classified by the platform's Security Classification Guide (SCG). Radiating external antennas will be located at multiple aspect angles to the aircraft to evaluate potential RF entry points into different areas. The platform will be operating during the test.

As the aircraft crew are being exposed to RF, the EMV test environment may be restricted by the HERP limitations of DoD-I 6055.11. and IEEE C95.1-2345 (see Section 13.2.6).

The airworthiness substantiation shall include an EMV Test Plan and Procedure Report prepared IAW DI-EMCS-81541, and an EMV Test Report prepared IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.2.5. Hazards of Electromagnetic Radiation to Fuel (HERF)
The aircraft fuel system shall remain safe and not be affected during exposure to the external electromagnetic environment and to the internal electromagnetic environment created by the aircraft transmitters.

Criteria:
New and modified fuel system components and aircraft transmitters (radios, radars, missiles, ASE, etc.), as installed on the platform, shall meet the HERF requirements of MIL-STD-464, paragraph 5.9.2., using the methodologies of NAVSEA OP 3565, Vol. 1, chapter 6. This is required for each platform type.

Standard:
MIL-STD-464, Paragraph 5.9.2.
NAVSEA OP 3565, Vol. 1

Method of Compliance:
Compliance shall be verified by test and/or analysis. The airworthiness substantiation shall include a HERF Test Plan and Procedure Report prepared IAW DI-EMCS-81541, and a HERF Test Report prepared IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.2.6. Hazards of Electromagnetic Radiation to Personnel (HERP)
The aircraft system shall comply with current DoD criteria for the protection of personnel against the effects of electromagnetic radiation. Appropriate measures shall be implemented to prevent inadvertent exposure of personnel to electromagnetic levels higher than the maximum permissible exposure (MPE) levels specified in DoDI 6055.11 and IEEE C95.1-2345.

Criteria:
New and modified components and aircraft transmitters (radios, radars, missiles, ASE, etc.), as installed on the platform, shall meet the HERP requirements of MIL-STD-464, paragraph 5.9.1., using the methodologies of NAVSEA OP 3565, Vol. 1, chapter 2. The Maximum Permissible Exposure (MPE) levels for personnel are defined by DoDI 6055.11 and follow the Unrestricted and Restricted Exposure Levels of IEEE C95.1-2345, Tables 8 and 9, respectively.

Standard:
DoDI 6055.11
MIL-STD-464
IEEE C95.1-2345
NAVSEA OP 3565, Vol. 1

Method of Compliance:
Compliance shall be verified by test and/or analysis. HERP testing is required for each platform type. The airworthiness substantiation shall include a HERP Test Plan and Procedure Report prepared IAW DI-EMCS-81541, and a HERP Test Report prepared IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.2.7. Portable Electronic Devices (PEDs) and Patient Movement Items (PMIs)
This requirement is applicable to lightweight, electrically powered equipment capable of communication, data processing, computing, or medical equipment onboard an aircraft; these are defined as PEDs. This requirement is also applicable to electronic equipment temporarily installed for the purpose of flight test and other equipment performance evaluation missions (i.e. test instrumentation). These types of equipment (laptops, tablets, personnel-worn, carry-on medical, etc.) to be carried on and off the platform

shall not have emissions that could be a source of interference to permanently installed platform systems.

13.2.7.1. Portable Electronic Devices (PEDs)
This requirement is applicable to portable electronic devices as defined above.

Criteria:
All PEDs and other carry-on equipment (laptops, tablets, personnel-worn, etc.) shall meet the component-level EMI requirements of MIL-STD-461, CE101, CE102, CE106/RE103, and RE102 as defined in Section 13.1.1. of this document.

In accordance with Section 13.2.2., EMC testing is required on each platform type for which the PEDs and carry-on equipment will be used. The same quantity of PEDs and carry-on equipment to be used on the platform shall also be tested.

Standard:
MIL-STD-464, para. 5.7.1.
MIL-STD-461

Method of Compliance:
Compliance shall be verified by test. The airworthiness substantiation for EMI qualification shall include a test plan and procedure prepared IAW DI-EMCS-80201, and a test report prepared IAW DI-EMCS-80200. The airworthiness substantiation for EMC qualification shall include an EMC Test Plan and Procedure Report prepared IAW DI-EMCS-81541, and an EMC Test Report prepared IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.2.7.2. Patient Movement Items (PMI)
This section describes the test procedures for medical equipment that will be used on board Army aircraft during enroute patient care. This section defines the test methods required for airworthiness certification. EMI testing is conducted to determine if aircraft navigation and communication equipment is susceptible to electromagnetic emissions produced by the aeromedical equipment.

Criteria:
All PMI shall meet the component-level EMI requirements of MIL-STD-461, CE101, CE102 and RE102 as defined in Section 13.1.1. of this document.

In accordance with paragraph 2.3.2.1. of the JECETS, EMC testing, to include spectrum analyzer testing, is required on each platform type for which the PMI will be used depending on the results of component-level EMI testing.

Standard:
MIL-STD-461

MIL-STD-464
Joint En Route Care Equipment Test Standard (JECETS), Revision 1

Method of Compliance:
Compliance shall be verified by test. The airworthiness substantiation for EMI qualification shall include an EMI test plan and procedure prepared IAW DI-EMCS-80201, and an EMI test report prepared IAW DI-EMCS-80200. The airworthiness substantiation for EMC qualification shall include an EMC Test Plan and Procedure Report prepared IAW DI-EMCS-81541, and an EMC Test Report prepared IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.2.7.3. Life Cycle E3 Hardness

The system operational performance and E3 requirements of Section 13 shall be met throughout the rated life cycle of the system and shall include, but not be limited to, the following: maintenance, repair, surveillance, and corrosion control.

Criteria:
The platform and its installed components shall meet their operational performance requirements and E3 requirements throughout the rated life cycle of the system in accordance with MIL-STD-464, paragraph 5.10.

Standard:
MIL-STD-464

Method of Compliance:
Compliance shall be verified by test, analysis, inspections, or a combination thereof. Maintainability, accessibility, and testability, and the ability to detect degradations shall be demonstrated. The airworthiness substantiation shall include an E3 Life Cycle Hardness Test Plan and Procedure Report prepared IAW DI-EMCS-81541, and an E3 Life Cycle Hardness Test Report prepared IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.2.7.4. Precipitation Static (P-static)

P-static occurs as a result of triboelectric charging of granular materials, such as ice crystals, bombarding onto the surfaces of aircraft at high speeds. The electrostatic charge that accumulates on the outer surface can have deleterious effects that arise during discharge events. These discharges can cause loss of communication to and from the aircraft from ground stations, EMI interference, radio frequency noise, etc. The purpose of precipitation static testing is to ensure the aircraft can control and dissipate the build-up of electrostatic charges caused by triboelectric effects.

Criteria:
In accordance with MIL-STD-464, para. 5.8.2., the aircraft system shall control p-static interference to antenna-connected receivers onboard the host platform such that system operational performance requirements are met. The system shall protect against puncture of structural materials and finishes and shock hazards from charge density of 30 µA/ft2 (326 µA/m2).

Standard:
MIL-STD-464, Paragraph 5.8.2.

Method of Compliance:
Compliance shall be verified by test. P-static testing is required for each platform type. The platform shall have all mission equipment installed. The airworthiness substantiation shall include a P-static test procedure prepared IAW DI-EMCS-81541B, and a P-static test report prepared IAW DI-EMCS-81542B.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.2.7.5. Helicopter Electrostatic Discharge (HESD)
The purpose of HESD testing is to determine the response of aircraft systems to an electrostatic discharge caused by inflight helicopter operations. Ordnance item HESD is addressed in Section 13.3.1.2.

Criteria:
Exterior-mounted electronic components, cargo hooks, fuel system components and items that can be sling loaded shall survive and remain safe when exposed to the Helicopter ESD (HESD) environment defined in MIL-STD-464, paragraph 5.8.1. The HESD level associated with a hovering helicopter is +/-300 kV, represented by a 1000 pF capacitor discharging through a 1-ohm resistor.

Standard:
JOTP-062
MIL-STD-464, Paragraph 5.8.1.

Method of Compliance:
Compliance shall be verified by test. The item under test shall be production-representative. The airworthiness substantiation shall include a HESD test plan and procedure prepared IAW DI-EMCS-81541B, and a HESD test report prepared IAW DI-EMCS-81542B.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.2.7.6. Aircraft Lightning Protection and Analysis

The air system (i.e., aircraft) shall meet its operational performance requirements when subjected to direct, and indirect lightning effects. This requirement is to ensure the aircraft design prevents hazardous temporary upset and permanent damage to flight-critical electrical and electronic subsystems, prevents lightning ignition of fuel, and prevents catastrophic structural damage to the aircraft and associated flight-critical equipment.

Component level lightning requirements (not including ordnance) are provided in Section 13.1.1.11. of this document, for interior components.

Exterior-mounted radomes, canopies, externally mounted sensors, rotor blades, antennas, and fuel system components shall survive and remain safe when exposed to the direct lightning environment defined in MIL-STD-464, paragraph 5.5.

Lightning requirements to ordnance are provided in Section 13.3.

13.2.7.7. Aircraft Direct Effects

This section demonstrates the aircraft will survive the direct lightning effects of a severe lightning strike and that arcing and sparking occurring during these events will be at acceptable levels for flight crew, fuel system, other external stores, and mission- and flight-critical equipment (Note: These tests are generally conducted by the Government at a Government test facility. The contractor aids the Government in the form of test planning, procedure, and reports. The contractor provides appropriate engineering consultation to the Government to resolve anomalies observed during the testing). These tests are performed on a completely provisioned aircraft.

Criteria:

The air system shall withstand the direct effects of lightning when exposed to the external lightning environment defined in MIL-STD-464, paragraph 5.5., Figure 1 and Table VII, or an equivalent environment such as in SAE ARP 5412, Section 6, using the test methodologies of RTCA DO-160, Section 23, Lightning Direct Effects or an equivalent test method, such as SAE ARP 5416, Section 5, Direct Effects Test Methods. The system shall protect against physical damage to aircraft structures, systems, and components that may adversely impact safe flight. A lightning hazard assessment can be used for determining potential hazards following SAE ARP 5577, Perform Lightning Hazard Assessment section. The requirement for eliminating the potential for ignition of fuel vapors is achieved by eliminating possible ignition sources or reducing flammability via active inerting of the fuel system. Additional guidance is provided in FAA AC 20-53, Fuel System Lightning Protection section.

Standard:

MIL-STD-464, Paragraph 5.5.
TOP 01-2-511A
RTCA DO-160
SAE ARP 5412
SAE ARP 5416

SAE ARP 5577
FAA AC 20-53

Method of Compliance:
Compliance shall be verified by test, analysis or a combination thereof. Prior to entering flight test, verify the compliance by the following methods:

a. Lab test: Coupon testing to demonstrate no puncture of aircraft skin/structure using representative samples that include treatments, coatings, fasteners, etc., and,

b. Lab test: Fuel tanks: If fuel tanks are not inerted, verify that ignition sources have been eliminated via high current testing of fuel system representative components following ARP 5416 Ignitable Mixture (Flammable Gas) Test Method or equivalent test methods such as RTCA DO-160 Ignitable Mixture (Flammable Gas) Test Method. If fuel tanks are inerted, verify by measuring the oxygen content of the tanks and inerting is maintained throughout the flight envelope and ground operations.

The airworthiness substantiation shall include a Lightning Protection Test Plan and Procedure prepared IAW DI-EMCS-81541, and a Lightning Protection Test Report prepared IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.2.7.8. Indirect Effects
The external lightning environment will interact with an aircraft to induce voltage and current transients in conductors such as wiring inside the aircraft. The aircraft shall be subjected to a transient test through the application of high-level artificial lightning currents to selected attachment points on the exterior of the aircraft while the resulting responses are monitored on interior wiring. These points shall have been previously identified during an analysis. The effects of the artificial lightning strikes are generally observed through instrumentation. (Note: To minimize risk of damage to aircraft or test personnel, the test should be conducted in incremental steps, starting with a minimum discernible current level until the maximum applied threat level is attained).

Criteria:
The air system (aircraft) shall withstand the indirect effects of lightning. The indirect effect requirements are determined by an aircraft level analysis when the aircraft is exposed to the external lightning environment defined in MIL-STD-464, paragraph 5.5., Figures 1 and 2 and Table VII, or an equivalent environment such as in SAE ARP 5412, Sections 6 and 7, using the test methodologies of RTCA DO-160, Section 22, Lightning Induced Transient Susceptibility or an equivalent test method, such as SAE ARP 5416, Section 6, Indirect Effects Test Methods.

Standard:
MIL-STD-464, Paragraph 5.5.

MIL-STD-461
TOP 01-2-511A
RTCA DO-160
SAE ARP 5412
SAE ARP 5415
SAE ARP 5416

Method of Compliance:
Compliance shall be verified by test, analysis or a combination thereof. Prior to entering flight test, verify the compliance by the following methods:

a. Analysis. Determination of system-level lightning induced transient levels through: Air system level computational model and analysis utilizing validated models and methods with supporting documentation following guidance from SAE ARP 5415, Section 4.6.3., Verification by Analysis. In lieu of MOC Analysis (a.), MOC Test (c.) is acceptable, and,

b. Analysis. Margin analysis to verify that the air system components meet the established system-level lightning induced transient levels via equipment qualification testing MIL-STD-461 CS117 or RTCA DO-160, Section 22, Lightning Induced Transient Susceptibility.

c. Ground test: Determination of system-level lightning induced transient levels through: Air system tests using high level pulse or low-level continuous wave (CW) techniques.

The airworthiness substantiation shall include a Lightning Protection Test Plan and Procedure prepared IAW DI-EMCS-81541, and a Lightning Protection Test Report prepared IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.2.7.9. Lightning Protection Analysis

A Lightning Protection Analysis (LPA) of the air vehicle, its subsystems and equipment shall be made to determine potential lightning damage susceptibility. This analysis shall be performed early in the program to identify the potential lightning effects to the vehicle and to categorize them based upon the criticality of the lightning hazard and the zone or zones within which the subsystem is located. The potential effects of lightning (direct effects and indirect effects) shall be a part of the analysis. The analysis shall specify the portions of the air vehicle, its subsystems and equipment requiring protection consideration.

Criteria:
The Lightning Protection Analysis (LPA) shall address the following:

a. The LPA shall partition aircraft surfaces for the purposes of lightning zone identification IAW with the zone definitions of SAE ARP 5414.

b. The LPA shall identify the lightning environment for the above zones as well as for each aircraft subsystem and equipment. MIL-STD-464, paragraph 5.5., Figures 1 and 2 and Table VII defines the lightning environment. This environment shall be identified for both aircraft design and test purposes.

c. The LPA shall identify safety and flight critical systems, subsystems, and equipment as defined in Section 13.4., E3 Definitions.

d. The LPA shall define the prediction and analysis/test techniques to be used for assessing the safety and susceptibility to the lightning environment of the aircraft and its associated subsystems, including, as a minimum, the structure, mechanical subsystems, fuel/hydraulic subsystems, electrical/electronic subsystems, personnel, and external stores.

e. The LPA shall define the approach for direct-effects protection of the aircraft to include materials, fabrication, and assembly techniques. Protection verification methods to be used during the development and qualification phases shall be delineated, such as risk reduction testing conducted on representative panels or coupons of the aircraft skin, joints, and structural members. Potential problem areas shall be addressed along with plans for their resolution.

f. The LPA shall define the approach for protection of electrical and electronic subsystems against the indirect effects of a lightning strike to the aircraft. The LPA shall address the methods to be employed in integrating the lightning requirements with other E3 and aircraft performance requirements as applicable, i.e., whether lightning protection provisions will adversely affect static discharge control, antenna patterns, aerodynamics, and/or other factors related to aircraft performance. Protection of newly designed and existing equipment shall be addressed along with the protection verification methods to be used during the development and qualification phases. Potential problem areas shall be discussed along with the plans for their resolution.

g. The LPA shall address the cumulative effects of recurring strikes, potential problem areas, and plans for their resolution. The number of strikes to be tolerated beyond that required for flight safety depends upon life cycle considerations, e.g., subsystems and equipment which are likely to receive many lightning strikes during their lifetime should be designed to tolerate these effects.

h. The LPA shall identify how the lightning-related electrical bonding requirements are to be met without unacceptably degrading the corrosion control measures. The plan shall especially address how these measures are to be integrated with the E3, personnel protection, electrical bonding, and corrosion control measures which apply to other than lightning-protection related designs.

i. The LPA shall identify a comprehensive approach for analysis and testing to be performed during developmental phases. Test articles (e.g., breadboards, skin and joint

coupons, prototype systems), facilities, instrumentation, and voltage and current waveforms to be used shall be described.

j. The LPA shall identify all verification criteria that will be used to demonstrate that the aircraft, subsystem, or component has satisfied lightning protection requirements. Criteria shall include discussions of design margins and pass/fail rationale.

k. The LPA shall discuss life cycle aspects of the lightning protection design integrity such as repair, maintenance, integrity verification and inspection requirements. The following are some examples of life-cycle considerations:

(1) Whether the protection designs are accessible and maintainable or whether they are designed to survive the design lifetime of the aircraft without mandatory maintenance or inspection. Identify bonding, shielding, or other protection devices which can be disconnected, unplugged, or otherwise deactivated during maintenance.

(2) Whether protection design measures are repairable or replaceable without degradation of the initial level of protection.

(3) The LPA shall discuss manufacturing implementation of critical lightning protection designs, and control of changes. Change documentation shall be identified, and its traceability discussed.

l. The LPA shall discuss lightning protection measures implemented for redundant subsystems (e.g., flight and engine controls), especially in regard to flight safety.

m. The LPA shall develop design margins for indirect effects IAW FAA AC 20-136, especially for flight-critical electrical/electronic subsystems and equipment. A design margin is the difference between the voltage and/or current level at which a component begins to degrade in performance and the voltage and/or current level that is produced (induced/coupled) at the input of the component as a result of a 200,000-ampere lightning strike to the aircraft.

Standard:
MIL-STD-464
SAE ARP 5414
FAA AC 20-136

Method of Compliance:
Compliance shall be verified by analysis, test or a combination thereof. The airworthiness substantiation shall include a Lightning Protection Analysis prepared IAW DI-EMCS-81540, a Lightning Protection Test Plan and Procedure prepared IAW DI-EMCS-81541, and a Lightning Protection Test Report prepared IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.2.8. E3 Control Plan/Integration Analysis (E3IA)
This requirement is applicable for each new platform or prior to finalization of any major design work or major modification to existing platforms. This analysis shall clearly establish the contractor's approach for achieving compliance with the E3 requirements of Section 13 of this document.

Criteria:
The E3 Control Plan/E3IA shall address, as a minimum, the following:

a. Methods and requirements for ensuring that contractor developed, or furnished subsystems and equipment will not be affected by interference from sources internal or external to the aircraft, nor be sources of interference which might adversely affect the operation of other subsystems.

b. Predicted problem areas and proposed methods of resolution for those systems not in compliance with the Section 13 E3 requirements of this document, MIL-STD-461 and MIL-STD-464.

c. Identify the radiation characteristics from aircraft antennas, including fundamental and spurious energy, and antenna to antenna coupling.

d. Identify the detailed approach to cable design and installation, including wire categorization criteria, labeling, segregation of potentially interference generating or susceptible wires, shielding and termination techniques, as well as the criteria and methods for determining the amount of shielding required.

e. Define the impact of corrosion control to bonding requirements on meeting and maintaining E3 performance requirements and recommendations for resolution of problems areas.

f. Identify the design criteria and required tests for lightning protection and design impacts in individual subsystems and equipment.

g. Categorize the criticality for aircraft systems and the degradation criteria for each subsystem and equipment. Include safety margins, where required.

h. Identify the design criteria and required tests for electrostatic buildup, including precipitation static, propulsion and fuel system charging, and electrostatic discharge.

i. Identify the methods for spike protection and minimization for subsystems and equipment connected to the power bus.

j. Identify the bonding and grounding criteria and methodology for all subsystems and equipment.

k. Identify the E3 requirements and hardening allocations for off-the-shelf and government furnished equipment.

l. Identify the frequency spectrum utilization details.

m. The specific test and analysis methodology for verification of each of the E3 requirements.

n. Details of the life cycle provisions for ensuring that all E3 requirements are maintained over the life of the aircraft.

o. Radiation hazards analysis for personnel, fuel and ordnance.

Standard:
MIL-STD-464
MIL-STD-461

Method of Compliance:
Compliance shall be verified by analysis. This analysis is per platform type, and all components / subsystems shall be evaluated. The airworthiness substantiation shall include an Electromagnetic Environmental Effects (E3) Integration and Analysis Report prepared IAW DI-EMCS-81540.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.2.9. TEMPEST

Compromising emanations are unintentional intelligence bearing signals, which if intercepted and analyzed, would disclose national security information transmitted, received, handled, or otherwise processed by any classified information processing system.

Criteria:
National security information shall not be compromised by emanations from classified information processing equipment in accordance with MIL-STD-464, paragraph 5.13.

Standard:
MIL-STD-464 Paragraph 5.13

Method of Compliance:
The procuring activity is required to contact the Certified TEMPEST Technical Authority (CTTA). The CTTA will then determine the need to apply the TEMPEST requirement.

The US Army CTTA point of contact is:

Army TEMPEST Program Manager, 310th Military Intelligence Battalion, IAMG-C-TMP, 4552 Pike Road, Fort George G. Meade, MD 20755. Telephone: (301) 677-4440. By email: 902d310thTEMPEST@mi.army.mil.

TEMPEST requirements are typically imposed on: External communication equipment, internal communication equipment, navigation equipment that both transmit and receive, inertial systems if the inertial system is integrated into the system in such a way that position data become classified and are transmitted over the data bus and between other air vehicles or ground stations.

As directed by the CTTA, compliance shall be verified by test, analysis, inspections, or a combination thereof. NSTISSAM TEMPEST/1-92 and CNNS Advisory Memorandum TEMPEST 01-02 provide testing methodology for verifying compliance with TEMPEST requirements.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.2.10. Emission Control (EMCON)

If specified by the procuring authority, the aircraft shall control radiated fields necessary to limit threat capability to detect and track the system commensurate with its operational requirements.

Criteria:

When tactical EMCON conditions are imposed, the aircraft systems electromagnetic radiated emissions shall not exceed -110 dBm/m^2 (5.8 dBμV/m) at one nautical mile or -105 dBm/m^2 (10.8 dBμV/m) at one kilometer in any direction from the aircraft over the frequency range of 500 kHz to 40 GHz, when using the resolution bandwidths listed in MIL-STD-464, paragraph 5.14.1., Emissions Control, TABLE XI.

Standard:

MIL-STD-464, Paragraph 5.14.1.
TOP 01-2-511A

Method of Compliance:

Compliance shall be verified by test and inspection. EMCON testing is for each platform type. The airworthiness substantiation shall include an EMCON Test Plan and Procedure Report prepared IAW DI-EMCS-81541, and a EMCON Test Report prepared IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.2.11. High Power Microwave (HPM)

HPM is a radio frequency environment produced by microwave sources (i.e., a weapon) capable of emitting high power or high energy densities. The source may produce microwaves in the form of a single pulse, repetitive pulses, pulses of more complex modulation, or continuous wave (CW) emissions.

This requirement is applicable only if specifically invoked by the procuring activity.

Criteria:
The system shall meet its operational performance requirements after being subjected to the HPM environment. Applicable field levels and HPM pulse characteristics for a particular system shall be determined by the procuring activity based on operational scenarios, tactics, and mission profiles using authenticated threat and source data. Note: This data and the test results using this data may be Classified. Refer to the platform's Security Classification Guide (SCG) for appropriate classification.

Standard:
MIL-STD-464, paragraph 5.4.
MIL-HDBK-235, Part 8

Method of Compliance:
Compliance shall be verified by test. HPM testing is for each platform type. The airworthiness substantiation shall include a HPM Test Plan and Procedure Report prepared IAW DI-EMCS-81541, and a HPM Test Report prepared IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.2.12. Electromagnetic Spectrum Supportability

The availability of adequate spectrum to support military electronic systems and equipment is critical to maximizing mission effectiveness. Spectrum planning and frequency management must be given appropriate and timely consideration during the development, procurement, and deployment of military assets that utilize the electromagnetic spectrum. To ensure maximum compatibility among the various worldwide users of the electromagnetic spectrum, it is essential that spectrum-dependent equipment comply with spectrum usage and management requirements. The DoD’s use of the spectrum is constantly being challenged by the commercial sector. It is expected that the military’s control of the spectrum will diminish in favor of commercial use. As more and more spectrum is taken away, the available spectrum must be managed as efficiently as possible to ensure the success of all military operations.

Criteria:
Spectrum-dependent systems shall comply with the DoD, national, and international spectrum regulations for the use of the electromagnetic spectrum (see National Telecommunications and Information Administration (NTIA) “Manual of Regulations and Procedures for Radio Frequency Management” and DoDI 4650.01).

Standard:
MIL-STD-464, Paragraph 5.15
NTIA Manual of Regulations and Procedures for Radio Frequency Management

DoDI 4650.01

Method of Compliance:
Compliance shall be verified by test, analysis, or a combination thereof, as appropriate for the development stage of the system. A Spectrum Supportability Risk Assessment (SSRA) is an assessment performed by program managers (PMs) and materiel developers (MATDEVs) on all programs that are acquiring or incorporating spectrum-dependent systems (SDS). Prior to operating certified spectrum-dependent systems and equipment, a frequency assignment which authorizes the use of specified frequencies is required.

Additional Information

Comm Doc's	DoD/MIL Doc's	FAA/EASA	Def-Stan 970	STANAG

13.3. Ordnance E3 Requirements
Per MIL-HDBK-240, Part 1, ordnance is defined as "Explosives, chemicals, pyrotechnics, and similar stores (for example, bombs, guns, ammunitions, flares, smoke, and napalm) carried on an airborne, sea, space, or ground system." For Army aviation, the most common ordnance items include, but are not limited to, missiles, rockets, ammunition, chaff/flare cartridges, cable cutters, and engine fire bottles. Testing of ordnance items is conducted at both the component level and at the system (platform) level. Testing of ordnance items is applicable for new or modified items, to include launchers and control/firing boxes, or for new, modified, or re-located aircraft transmitters and antennas. Each phase of the item's Stockpile-to-Safe Separation Sequence (S4) shall be considered, as follows: Transportation/storage, Assembly/disassembly, Staged, Handling/loading, Platform-loaded, and Immediate post-launch/missile in-flight. Note that not all of the listed phases may be applicable for every ordnance item.

13.3.1. Ordnance Component/Subsystem Requirements

13.3.1.1. Ordnance EMI
The electronic components of ordnance systems shall be evaluated for EMI per Section 13.1.1. of this document. Ordnance electronic components include missile and rocket seekers, guidance sections, launchers / dispensers, and control/firing boxes.

Ordnance items are classified as safety critical equipment. First Flight requirements are CE101, CE102, CE106/RE103 (for RF Ordnance systems), RE102, CS101, CS114, CS115, and RS103.

Criteria:
All new and modified ordnance system electronics shall meet the emissions requirements of MIL-STD-461, in accordance with Section 13.1.1. of this document. All new and modified ordnance components shall meet their operational performance requirements when exposed to the susceptibility environments of MIL-STD-461, in accordance with Section 13.1.1. of this document. Testing shall be performed using

aircraft representative cables/wiring (type, size, length, and shielding), except power leads shall be unshielded, and launchers / dispensers. Component grounding and bonding shall be as in the aircraft installation. Ordnance items are classified as safety critical equipment, therefore, for RS103, the modulations defined in Table 13.1 shall be used and the full electric field strength limit shall apply. The ordnance system electronics will be operating during the test.

Standard:
MIL-STD-461
MIL-STD-464
MIL-HDBK-240

Method of Compliance:
Compliance shall be verified by test. The item under test shall be production representative. The airworthiness substantiation shall include an EMI test plan and procedure prepared IAW DI-EMCS-80201, and an EMI test report prepared IAW DI-EMCS-80200.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.3.1.2. Ordnance ESD

ESD testing on ordnance systems shall be evaluated to determine if a safety and/or operability hazard results due to either human contact (personnel ESD (PESD)) or by inflight helicopter operations (helicopter ESD (HESD)).

Ordnance items are classified as safety critical equipment. PESD and HESD with live ordnance are first flight requirements.

Criteria:
Ordnance systems and their electronic components shall meet their operational performance requirements after exposure to the PESD environment of +/- 25 kV, discharging a 500-pF capacitor through a 500-ohm and 5000-ohm resistors, per MIL-STD-464, para. 5.8.3.1., and MIL-HDBK-240, Part 3, section 4.

Ordnance systems shall survive and remain safe when exposed to the HESD environment defined in MIL-STD-464, paragraph 5.8.3.2., and MIL-HDBK-240, Part 3, section 5. The HESD level associated with a hovering helicopter is +/-300 kV, represented by a 1000 pF capacitor discharging through a 1-ohm resistor.

Standard:
MIL-STD-461, CS118
MIL-STD-464, Paragraph 5.8.3.
MIL-HDBK-240, Part 3
TOP 01-2-511A

Method of Compliance:
PESD testing shall be performed to any point on the all-up-round (AUR) that may be contacted by personnel or become charged during the transportation/ storage, assembly/disassembly, staged, handling/loading, and platform loaded configurations. The minimum sample size for AUR PESD testing should be 22 items (live electrically initiated devices (EIDs) or AURs) or, if fewer than 22 items are available for testing, the number of discharges delivered must be equivalent to 22 test sequences. A minimum of four devices of the 22 samples required for PESD testing (live EIDs or AURs) must receive incremental voltage testing per MIL-HDBK-240, Part 3, Table II. A test sequence is defined as a complete series of discharges applied to identified test points.

HESD testing shall be performed to test points which could make contact with a charged aircraft or become charged during the different configurations/modes of operation including: transportation/VERTREP/sling load, man-carry (internal to the aircraft, outside of its shipping container), platform loaded/external carry, and hot tube loading/unloading. The minimum sample size for AUR HESD testing should be 10 items (live EIDs or AURs) or, if fewer than 10 items are available for testing, the number of discharges delivered must be equivalent to 10 test sequences. A minimum of four devices of the 10 samples required for HESD testing in the tested configuration (bare/man-carry, hot tube loaded, external carry, or VERTREP/sling load) must receive incremental voltage testing per MIL-HDBK-240, Part 3, Table VIII. A test sequence is defined as a series of discharges to identified test points.

Compliance shall be verified by test. The item under test shall be production-representative.

The airworthiness substantiation shall include an electrostatic discharge test plan and procedure prepared IAW DI-EMCS-81541, and an electrostatic discharge test report prepared IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.3.1.3. Ordnance Lightning
Lightning test data is used to determine the susceptibility of ordnance and weapon systems to lightning effects from a direct-strike, near-strike, or the indirect effects of lightning.

Flights with ordnance systems that have not been evaluated for lightning shall remain 25 nm from a lightning capable weather system (DOT/FAA/TC-22/11 paragraph 3.3.4., Methods of avoidance). This shall be annotated in the AWR.

Criteria:
Direct-strike lightning (DSL) testing shall be conducted to determine if exposure of ordnance items results in a safety and/or operational performance hazard. Ordnance items shall remain operational when exposed to DSL in the transportation/storage

configuration. Ordnance items shall remain safe when exposed to DSL in the staged and platform loaded configurations. The DSL environment is defined in MIL-STD-464, paragraph 5.5,. Figure 1, and Table VII, and MIL-HDBK-240, Part 5, Section 5.

Near-strike lightning (NSL) testing shall be conducted to determine if exposure of ordnance items results in a safety and/or operational performance hazard. Ordnance items shall remain safe and operational when exposed to NSL in the transportation/storage, assembly/disassembly, staged, handling/loading, platform loaded, and immediate post launch configurations. The NSL environment is defined in MIL-STD-464, paragraph 5.5., Figure 2, Table VII, and MIL-HDBK-240, Part 5, Section 4.

Electronic components of ordnance systems shall meet their operational performance requirements after exposure to the indirect lightning effects environment of MIL-STD-461, Section 5.15, CS117.

Standard:
MIL-STD-461, CS117
MIL-STD-464, Paragraph 5.5.
MIL-HDBK-240, Part 5
TOP 01-2-511A

Method of Compliance:
Compliance shall be verified by test. The item under test shall be production-representative.

For live all-up-round (AUR) testing, one AUR at a minimum is needed. When testing a live AUR, one test sequence is required at all predetermined attachment points. For live EID testing of an inert AUR (no warhead or motor energetics), the minimum EID sample size should be 10 items. When testing live EIDs in an inert AUR, an equivalent of 10 test sequences should be conducted. A test sequence is defined as a series of discharges to the AUR at identified test Subsequent sequences may be conducted by using a different AUR or on the same AUR with a different set of EIDs and electronic/electrical subsystems.

For NSL testing, the item under test is located 10 m away from the lightning discharge. The ordnance items shall be tested with live EIDs in the AUR configuration; ten (10) sets of EIDs shall be tested for each test configuration. An equivalent of 10 test sequences should be conducted when testing to the NSL threat, where a test sequence is defined as three (3) discharges per test point per test aspect angle.

The airworthiness substantiation shall include a lightning test plan and procedure prepared IAW DI-EMCS-81541, and a lightning test report prepared IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.3.2. Ordnance - Aircraft Level Requirements

13.3.2.1. Ordnance EMC

Ordnance EIDs shall be evaluated as victims against aircraft transmitters as sources. This is required for new or modified ordnance systems, or for new or modified aircraft transmitters and antennas, to include relocated antennas. This test is also known as EID evaluation and is typically conducted as part of aircraft EMC testing.

Criteria:

Ordnance EIDs, when installed on the platform, shall not be susceptible to transmissions from the platform antennas. EIDs defined as having a safety function shall have a minimum of 16.5 dB safety margin. EIDs defined as having a reliability function shall have a minimum of 6 dB safety margin.

Standard:

MIL-STD-464
MIL-HDBK-240, Parts 2 and 6

Method of Compliance:

Compliance shall be verified by test. Testing is required for each platform type. The item under test shall be production-representative and the platform shall have all mission equipment installed.

EID testing shall be required due to changes to platform antennas (new, modified, re-located), transmitters, and for new or modified ordnance. This test is required for first flight with live ordnance. Test methodologies are in MIL-HDBK-240, Part 6, paragraph 4.2.10. Inert EIDs shall be instrumented in order to calculate the safety margin. EID instrumentation methodology is per MIL-HDBK-240, Part 2. If inert, instrumented EIDs cannot be used, a minimum sample size should be 10 items (live EIDs or AURs). Testing shall be conducted in the platform-loaded configuration. The platform and the ordnance item will be operating during the test.

The airworthiness substantiation shall include an EMC test plan and procedure prepared IAW DI-EMCS-81541, and an EMC test report prepared IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.3.2.2. Ordnance EMV

Ordnance system electronics shall be evaluated for operability during exposure to the external electromagnetic environment. This test may also be referred to the external radio frequency electromagnetic environment (external RF EME).

Criteria:
Ordnance system electronics shall meet their operational performance requirements during exposure to the external electromagnetic environment. This environment is defined in Table 13.1. The EMV environment may also be specified in the items or platform's performance specification.

Standard:
MIL-STD-464, Paragraph 5.3.
MIL-HDBK-240, Part 4
DoDI-6055.11

Method of Compliance:
The electronic components of ordnance systems may consist of launcher, dispenser, guidance section, seeker, control/firing boxes, etc. Testing is required for the platform loaded and immediate post-launch/ in-flight configurations. Radiating external antennas will be located at multiple aspect angles to the ordnance item to evaluate potential RF entry points into the item. The platform and the ordnance item will be operating during the test. Explosive components shall not be installed.

As the aircraft crew are being exposed to RF, the EMV test environment may be restricted by the HERP limitations of DoD-I 6055.11 and IEEE C95.1-2345 (see Section 13.2.6.).

Testing is required for each platform type. Compliance shall be verified by test. The data is typically classified either by the items or platform's Security Classification Guide (SCG). The item under test shall be production-representative and the platform shall have all mission equipment installed. The airworthiness substantiation shall include an EMV test plan and procedure prepared IAW DI-EMCS-81541, and an EMV test report prepared IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.3.2.3. Hazards of Electromagnetic Radiation to Ordnance (HERO)
Ordnance systems shall remain safe during, and shall operate after, exposure to an external electromagnetic environment.

Criteria:
Ordnance systems shall remain safe during, and shall meet its operational performance requirements after, exposure to the external EME of MIL-STD-464, paragraph 5.9.3. and Table 9.

Standard:
MIL-STD-464, Paragraph 5.9.3. and Table 9
MIL-HDBK-240, Part 2.
DoD-I 6055.11

Method of Compliance:
Compliance shall be verified by test. Testing is required for each platform type. The item under test shall be production-representative.

Ordnance systems shall meet the HERO requirements of MIL-STD-464 for their defined Stockpile-to-Safe Separation Sequence (S4) configurations (MIL-STD-464, Table X). Test methodologies are defined in MIL-HDBK-240, Part 2. EIDs defined as having a safety function shall have a minimum 16.5 dB safety margin. EIDs defined as having a reliability function shall have a minimum 6 dB safety margin. Ordnance EIDs shall be live and instrumented but other explosive components shall not be installed. The ordnance item is not powered during the test. For the platform loaded and loading/unloading configurations, the aircraft is not powered. Radiating external antennas will be located at multiple aspect angles to the ordnance item to evaluate potential RF entry points into the item.

As personnel are being exposed to RF for the loading/unloading configuration, the HERO test environment may be restricted by the HERP limitations of DoD-I 6055.11 and IEEE C95.1-2345 (see Section 13.2.6).

Depending upon the results of testing, ordnance will then be classified as HERO SAFE, HERO SUSCEPTIBLE, or HERO UNSAFE.

The airworthiness substantiation shall include a HERO test plan and procedure prepared IAW DI-EMCS-81541, and a HERO test report prepared IAW DI-EMCS-81542.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

13.4. E3 Definitions

This section provides definitions of common E3 related terms used throughout Section 13, E3. Other E3 related definitions are available from MIL-STD-464, para. 3, Definitions, MIL-STD-461, Section 3, Definitions and ANSI C63.14

a. E3 Flight Critical Equipment: E3 generated anomalies involving this equipment would cause immediate or almost immediate loss of aircraft control or unsafe situations with loss of life a likely occurrence.

b. E3 Flight Essential Equipment: E3 generated anomalies involving this equipment could cause an emergency landing with possible damage to the aircraft or would cause the pilot to take other emergency action. Injury or loss of life is possible.

c. E3 Flight Nonessential Equipment: E3 generated anomalies involving this equipment would cause reduced safety through lack of redundant systems. Aircraft damage and personnel injury or loss of life unlikely.

d. E3 Mission Critical Equipment: E3 generated anomalies involving this equipment would cause immediate or almost immediate mission abort. Injury or loss of life possible though unlikely unless the aircraft is involved in combat, in which case aircraft may not be able to return to base safely.

e. E3 Mission Essential Equipment: E3 generated anomalies involving this equipment would cause degraded, or lack of, mission success. During combat, aircraft and crew could be in jeopardy of loss.

f. E3 Mission Nonessential Equipment: E3 generated anomalies involving this equipment would create annoyances and minor discomfort with little impact on mission accomplishment.

g. E3 Safety Critical Equipment: E3 generated anomalies involving this equipment would cause a safety hazard to personnel or to the aircraft.

h. Subsystem: A subsystem is a major functional element of a system, usually consisting of several components that are essential to the operational completeness of the subsystem. Subsystem examples include airframe, propulsion, guidance, navigation, and communication with reference to the air vehicle as the overall system. The terms system and subsystem are often used interchangeably in defining a functional element (e.g., flight control system/subsystem, environmental control system/subsystem, etc.).

i. EUT: Equipment Under Test. Sometimes called Item Under Test (IUT).

j. EID: Electrically Initiated Device. Sometimes called Squib.

14. SYSTEM SAFETY

This section covers the implementation of a comprehensive and robust system safety program, which spans the system lifecycle. The aim of the system safety program is to identify any associated system hazards / risks, and to eliminate them where possible, or mitigate the risks such that the residual risks are at acceptable levels.

14.1. System Safety Program.

The purpose of the system safety program is to identify any associated system hazards/risks, and to eliminate them where possible, or mitigate the risks such that the residual risks are at acceptable levels.

Criteria:

The allocation of functional hazards from aircraft-level analyses shall be accomplished. Demonstration should be shown in lower-level analyses that the architecture supports those allocations. Identified risks, mitigations, and safety related requirements shall be documented during the development phase and updated, as needed, throughout the lifecycle. This task shall include system reliabilities rolled-up above the function level to the highest applicable system level. Military unique functions e.g. weapons, lasers, countermeasures, etc. should follow the MIL-STD-882 requirements

A system safety program shall be implemented which:

a. mitigates risks/hazards attributed to hardware, software, and human system integration;

b. documents and tracks identified risks/hazards and the corresponding mitigating design/modification;

c. ensures residual risks are at acceptable levels.

Standard:

SAE ARP4754
SAE ARP4761
RTCA/DO-178C
RTCA/DO-254
ADS-37A-PRF
ADS-71-SP
MIL-STD-882

Method of Compliance:

The basis of risk determination is rooted in the system safety process. System safety contains specific requirements for analyses of the human interfaces, causal factors related to the human, effects of human error, human factors engineering and human error analysis of operator functions, tasks, and requirements. While conducting these analyses, the human must be considered a component within a subsystem, receiving both inputs and initiating outputs. All in all, the human must be considered an element of the system of systems, receiving both inputs and initiating outputs within the analysis. It

is not sufficient to apply blanket probabilities that training will be sufficient, that the human will detect the failed or degraded mode, or that the human can or will initiate the appropriate response to an abnormal condition. The likelihood of those errors must be considered as part of the safety case for a specific configuration and the declared intended use of the system. The procedures for identifying and mitigating or eliminating risk shall be planned and implemented for the entire lifecycle of the system. Human performance and human engineering design criteria issues shall be identified, analyzed, and prioritized early in the process in order to coordinate with program management and establish requirements for eliminating or reducing the associated risks to acceptable levels. Such provisions are then implemented and monitored during the Human Engineering program. Note, all risk determinations shall be quantified such that varying programmatic risk matrices can be correlated and reconciled without confusion or error. Failed and degraded modes of operation for components, sub-systems and the system shall be described to include how individual failures and degraded modes of the system are identified, how they propagate through the system, how the failed and degraded modes affect available functions, how the failures and degraded modes are presented to the crew, as well as a description of the expected procedures necessary for mitigation, as appropriate. Also note, Hazardously Misleading Information (HMI), or the annunciated loss of function as a result of a system, subsystem or component failure, shall be initially considered a minimum of a major failure condition, until system safety documentation substantiates a higher or lower level of criticality.

The SAE ARP4754B defines the development of aircraft systems taking into account the overall aircraft. The hardware process must also evaluate categorization IAW ADS-37A-PRF and ADS-71-SP. The results of the process must be importable to the MIL-STD-882 process utilized for fielded military systems. Figure 1 below depicts the ARP4754 process sequence and relationship to the systems engineering process. Table 14-1 below depicts ARP 4761 Failure Condition Severity as Related to Probability Objectives and Assurance Levels as modified for PEO Aviation Policy Memorandum Number 18-20.

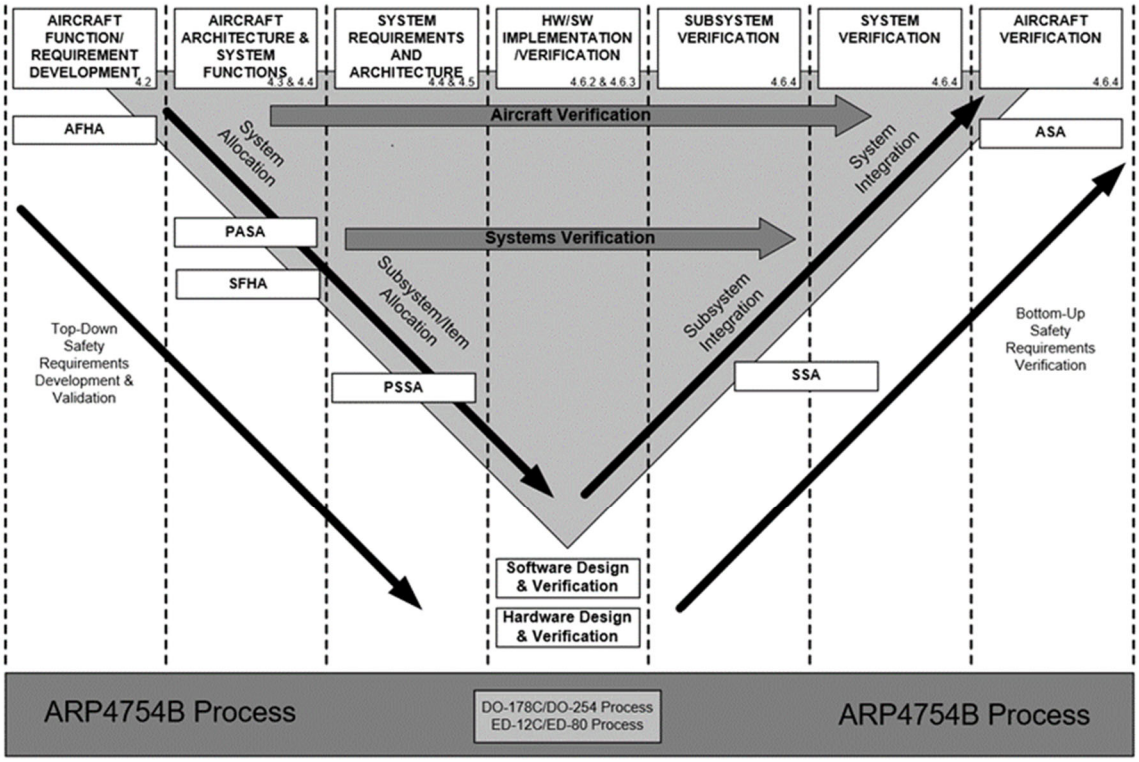

Figure 1. Interaction between Safety and Developmental/Systems Engineering processes.

Probability (Quantitative)		Per Flight Hour				
		1.0	1.0E-03	1.0E-05	1.0E-07	1.0E-09
Probability (Descriptive)	FAA	Probable		Improbable		Extremely Improbable
	JAA	Frequent	Reasonably Probable	Remote	Extremely Remote	Extremely Improbable
Failure Condition Severity Classification	FAA	Minor		Major	Severe Major	Catastrophic
	JAA	Minor		Major	Hazardous	Catastrophic
Failure Condition Effect	FAA & JAA	- slight reduction in safety margins - slight increase in crew workload - some inconvenience to occupants		- Significanat Reduction in Safety Margins or functional capabilities - significant increase in crew workload or in conditions impairing crew effeciency - some discomfort to occupants	- large reduction in safety margins or functional capabilities - higher workload or physical distress such that the crew could not be relied upon to perfoorm tasks accurately or completely -adverse effects upon occupants	- all failure conditions which prevent continued safe flight and landing
Development Assurance Level	ARP 4754	Level D		Level C	Level B	Level A

Note: A "No Safety Effect" Development Assurance Level E exists which may span any probability range.

Table 14-1 ARP 4761 Failure Condition Severity as Related to Probability Objectives and Assurance Levels

The probability and severity for hazard risks for military systems shall be based on the following as defined by Program Executive Officer, Aviation Policy Memorandum Number 18-20, System Safety Program Management Process:

Severity / Probability	Catastrophic 1	Critical 2	Marginal 3	Negligible 4
Frequent > 100 A	1A HIGH AAE	2A HIGH AAE	3A SERIOUS PEO	4A MEDIUM PM
Probable <=100 but > 10 B	1B HIGH AAE	2B HIGH AAE	3B SERIOUS PEO	4B MEDIUM PM
Occasional <= 10 but > 1 C	1C HIGH AAE	2C SERIOUS PEO	3C SERIOUS PEO	4C MEDIUM PM
Remote <= 1 but > 0.1 D	1D SERIOUS PEO	2D SERIOUS PEO	3D MEDIUM PM	4D MEDIUM PM
Improbable <= 0.1 but > 0.01 E	1E SERIOUS PEO	2E MEDIUM PM	3E MEDIUM PM	4E LOW PM
Very Improbable < =0.01 but >Baseline F	1F MEDIUM PM	2F LOW PM	3F LOW PM	4F LOW PM

SEVERITY*		
Description	**Category**	**Mishap Result Criteria**
Catastrophic	**1**	Death or permanent total disability; aircraft loss; irreversible significant environmental damage; or monetary loss equal to or exceeding $10M.
Critical	**2**	Severe injury or severe occupational illness (permanent partial disability) or hospitalization of 3 or more personnel, reversible significant environmental damage or monetary loss equal to or exceeding $1M but less than $10M.
Marginal	**3**	Minor injury or minor occupational illness (no permanent effect/1 or more lost work days), reversible moderate environmental damage, or monetary loss equal to or exceeding $100K but less than $1M.
Negligible	**4**	Less than minor injury or occupational illness (less than one lost workday), minimal environmental damage or monetary loss less than $100K.

PROBABILITY		
Description	Level	Per 100,000 flight hours
Frequent	A	Greater than 100
Probable	B	Less than or equal to 100 and greater than 10
Occasional	C	Less than or equal to 10 and greater than 1
Remote	D	Less than or equal to 1 and greater than 0.1
Improbable	E	Less than or equal to 0.1 and greater than 0.01
Very Improbable	F	Less than or equal to 0.01 but greater than baseline

For Standard Practices for System Safety, the most current version of MIL-STD-882 or ARP-4761 shall be used, unless more stringent practices or regulation is provided by the Program Executive Office (PEO) or Program Manager. All identified hazards or risks shall be eliminated or reduced to an acceptable level. Standard risk may be shown by compliance with applicable standards, specifications that support an engineering

judgment, risk inherent and typical to performing the task, or formal resolution through the hazard risk management process.

Any Army PEO-AVN system safety assessment or process that is part of an airworthiness assessment shall be IAW the most current version of AR 385-10 and current PEO-Aviation Safety Policy Memorandum (Currently 18-20).

The airworthiness substantiation shall use a system-level rollup of risks, mitigations, and safety-related concerns to establish and document the product during the development phase and updated, as needed, throughout the lifecycle. This task shall include system reliabilities rolled-up above the function level to the highest applicable system level.

The airworthiness substantiation shall identify the appropriate substantiation documents to satisfy the method of compliance of similarity, analysis, test, demonstration, modeling and simulation, or by combinations of these methods and report compliance to all requirements contained in the associated paragraphs for each requirement in the AQS. In addition, the follow documentation is required to be part of the AQS.

MIL-STD-882 specifies the Level of Rigor (LOR) process to assess the software's contribution to risk and is the means through the LOR tasks of implementing design assurance providing confidence in the software. The LOR process is the analogous military process to the civilian DO-178C process for software design assurance. Table IV below determines the software control category used in conjunction with the hazard severity to determine the Software Criticality Index/LOR and associated high level tasks in Table V. Table VI provides the relationship between the SwCI, the LOR tasks, and how not meeting the LOR task requirements affects software’s contribution to risk.

MIL-STD-882 TABLE IV. Software control categories SOFTWARE CONTROL CATEGORIES

Level	Name	Description
1	Autonomous (AT)	- Software functionality that exercises autonomous control authority over potentially safety-significant hardware systems, subsystems, or components without the possibility of predetermined safe detection and intervention by a control entity to preclude the occurrence of a mishap or hazard. (This definition includes complex system/software functionality with multiple subsystems, interacting parallel processors, multiple interfaces, and safety-critical functions that are time critical.)
2	Semi-Autonomous (SAT)	- Software functionality that exercises control authority over potentially safety-significant hardware systems, subsystems, or components, allowing time for predetermined safe detection and intervention by independent safety mechanisms to mitigate or control the mishap or hazard. (This definition includes the control of moderately complex system/software functionality, no parallel processing, or few interfaces, but other safety systems/mechanisms can partially mitigate. System and software fault detection and annunciation notifies the control entity of the need for required safety actions.) - Software item that displays safety-significant information requiring immediate operator entity to execute a predetermined action for mitigation or control over a mishap or hazard. Software exception, failure, fault, or delay will allow, or fail to prevent, mishap occurrence. (This definition assumes that the safety-critical display information may be time-critical, but the time available does not exceed the time required for adequate control entity response and hazard control.)
3	Redundant Fault Tolerant (RFT)	- Software functionality that issues commands over safety-significant hardware systems, subsystems, or components requiring a control entity to complete the command function. The system detection and functional reaction includes redundant, independent fault tolerant mechanisms for each defined hazardous condition.

		(This definition assumes that there is adequate fault detection, annunciation, tolerance, and system recovery to prevent the hazard occurrence if software fails, malfunctions, or degrades. There are redundant sources of safety-significant information, and mitigating functionality can respond within any time-critical period.) - Software that generates information of a safety-critical nature used to make critical decisions. The system includes several redundant, independent fault tolerant mechanisms for each hazardous condition, detection and display.
4	Influential	- Software generates information of a safety-related nature used to make decisions by the operator but does not require operator action to avoid a mishap.
5	No Safety Impact (NSI)	- Software functionality that does not possess command or control authority over safety-significant hardware systems, subsystems, or components and does not provide safety-significant information. Software does not provide safety-significant or time sensitive data or information that requires control entity interaction. Software does not transport or resolve communication of safety-significant or time sensitive data.

MIL-STD-882 TABLE V. Software safety criticality matrix SOFTWARE SAFETY CRITICALITY MATRIX

	SEVERITY CATEGORY			
SOFTWARE CONTROL CATEGORY	Catastrophic (1)	Critical (2)	Marginal (3)	Negligible (4)
1	SwCI 1	SwCI 1	SwCI 3	SwCI 4
2	SwCI 1	SwCI 2	SwCI 3	SwCI 4
3	SwCI 2	SwCI 3	SwCI 4	SwCI 4
4	SwCI 3	SwCI 4	SwCI 4	SwCI 4
5	SwCI 5	SwCI 5	SwCI 5	SwCI 5

SwCI	Level of Rigor Tasks
SwCI 1	Program shall perform analysis of requirements, architecture, design, and code; and conduct in-depth safety-specific testing.
SwCI 2	Program shall perform analysis of requirements, architecture, and design; and conduct in-depth safety-specific testing.
SwCI 3	Program shall perform analysis of requirements and architecture; and conduct in-depth safety-specific testing.
SwCI 4	Program shall conduct safety-specific testing.
SwCI 5	Once assessed by safety engineering as Not Safety, then no safety specific analysis or verification is required.

MIL-STD-882 TABLE VI. Relationship between SwCI, risk level, LOR tasks, and risk

Software Criticality Index (SwCI)	Risk Level	Software LOR Tasks and Risk Assessment/Acceptance
SwCI 1	High	- If SwCI 1 LOR tasks are unspecified or incomplete, the contributions to system risk will be documented as HIGH and provided to the PM for decision. The PM shall document the decision of whether to expend the resources required to implement SwCI 1 LOR tasks or prepare a formal risk assessment for acceptance of a HIGH risk.
SwCI 2	Serious	- If SwCI 2 LOR tasks are unspecified or incomplete, the contributions to system risk will be documented as SERIOUS and provided to the PM for decision. The PM shall document the decision of whether to expend the resources required to implement SwCI 2 LOR tasks or prepare a formal risk assessment for acceptance of a SERIOUS risk.
SwCI 3	Medium	- If SwCI 3 LOR tasks are unspecified or incomplete, the contributions to system risk will be documented as MEDIUM and provided to the PM for decision. The PM shall document the decision of whether to expend the resources required to implement SwCI 3 LOR tasks or prepare a formal risk assessment for acceptance of a MEDIUM risk.
SwCI 4	Low	- If SwCI 4 LOR tasks are unspecified or incomplete, the contributions to system risk will be documented as LOW and provided to the PM for decision. The PM shall document the decision of whether to expend the resources required to implement SwCI 4 LOR tasks or prepare a formal risk assessment for acceptance of a LOW risk.
SwCI 5	Not Safety	- No safety-specific analyses or testing is required.

Additional Information

Comm Docs	*DoD/MIL Docs*	*FAA/EASA*	*Def-Stan 970*	*STANAG*
		RTCA/DO-307A AC 20-164 ARTCA/DO-363		

14.2. System Safety Airworthiness Substantiation Documents

The following safety documents are necessary for execution of a robust safety and airworthiness program.

14.2.1. System Safety Program Plan (SSPP)

The purpose of the system safety program plan is to provide the details of the task and activities of system safety management and system safety engineering required to identify, evaluate, and eliminate or control hazards throughout the changes from the baseline configuration. The System Safety Program Plan describes fully the planned safety tasks and activities required to meet the System Safety Program requirements.

Criteria:
All tasks and activities of a Safety Program shall be defined in a SSPP.

Standard:
MIL-STD-882

Method of Compliance:
The airworthiness substantiation shall include a SSPP IAW DI-SAFT-81626 to ensure the airworthiness for the manned and unmanned aircraft systems, subsystems, components, allied equipment, and modifications to Army aircraft is attained and sustained throughout the life cycle (design, production, and continued). The process shall provide a systematic approach to the development and implementation of architecture, hardware, and software in complex systems and integrated aircraft level functions for the purpose of mitigating the risk of development error (requirements determination and design error) and undesirable intended effects. A structured systematic process is required, since it is not practical, and may not even be possible, to develop a finite test suite for highly-integrated and complex systems, which conclusively demonstrates that there are no residual development errors that could affect aircraft safety. A key feature of this process is the assignment of Developmental Assurance (Criticality) Levels (DALs) to aircraft level functions, which are then flowed into system architecture, subsystems, software, and hardware items as DALs. The SSPP shall describe in detail the tasks and activities of the system safety engineering and management program. The SSPP shall be in compliance with the government provided program System Safety Management Plan. The SSPP shall also describe the safety, systems, and software engineering processes to be employed to identify, document, evaluate, and eliminate and/or control system hazards to the levels of acceptable risk for the program. Software/firmware safety shall be addressed in this Plan. If software/ firmware safety is not addressed in the SSPP, prepare a separate

Software/Firmware Safety Program Plan IAW DI-MISC-80711, using IEEE 1228-1994 as a guide. Note: the JSSSEH, Section 4.2.1.4, page 65, Figure 4-11, compares MIL-STD-882 and RTCA/DO-178 level of rigor approaches, to determine hazard risk where software causal factors exist; RTCA/DO- 178C explains the software levels and Software Development Plan (SDP),, MIL-STD-882 provides mishap severity categories which can lead to establishment of software integrity levels.

The SSPP shall address the identification and evaluation of hazards at the system and subsystem levels to determine the criticality of the Multi-Core Processor (MCP), its critical configuration settings, and the associated software components hosted on the MCP.

The airworthiness substantiation shall include a SSPP prepared IAW DI-SAFT-81626.

Additional Information

Comm Docs	*DoD/MIL Docs*	*FAA/EASA*	*Def-Stan 970*	*STANAG*
IEEE 1228-1994				

14.2.2. Preliminary Hazard Analysis (PHA)

The purpose of the PHA is to determine initial risk assessments of identified hazards. Hazards associated with the proposed design or function shall be evaluated for severity and probability based on the best available data, including mishap data (as accessible) from similar systems, legacy systems, and other lessons learned. Provisions, alternatives, and mitigation measures to eliminate hazards or reduce associated risk shall be included.

Criteria:
All safety hazards of the design shall be defined in a PHA.

Standard:
MIL-STD-882

Method of Compliance:
The airworthiness substantiation shall include a PHA IAW MIL-STD-882 Tasks 201 and 202 and DI-SAFT-80101. The PHA shall include hazards that are associated with the design and operational concept of the installed software. The PHA shall identify the initial risk assessment for each hazard based on best available data. This provides the initial framework for a listing of hazards and associated risks that require tracking and resolution during program design and development. The PHA shall also be used to identify potential safety-critical issues in computing hardware and/or software. The PHA shall be maintained and updated throughout the development process. The airworthiness substantiation shall include a PHA prepared IAW MIL-STD-882 Tasks 201 and 202 and DI-SAFT-80101.

Additional Information

Comm Docs	*DoD/MIL Docs*	*FAA/EASA*	*Def-Stan 970*	*STANAG*
		FAA System Safety Handbook CH 7/8/9.		

14.2.3. Reserved

14.2.4. Aircraft Functional Hazard Assessment (AFHA)

The purpose of an aircraft level FHA is to identify and classify the failure conditions associated with the aircraft level functions. The classification of these failure conditions establishes the safety requirements that an aircraft must meet. The goal in conducting this AFHA is to clearly identify each failure condition along with the rationale for its severity classification.

Criteria:
All aircraft-level functions for consequence of failure shall be defined in an AFHA.

Standard:
SAE ARP 4761

Method of Compliance:
The airworthiness substantiation shall include an AFHA IAW SAE ARP 4761/ PEOAVN IAW DI-SAFT-80101. The AFHA shall identify and classify the failure conditions associated with the aircraft level functions. The classification of these failure conditions establishes the safety requirements that an aircraft must meet. For those aircraft functions related to systems to be modified or added under the new program a complete analysis IAW SAE ARP4761 shall be performed. For other systems the severity classification may be applied based upon previously developed supporting data. The AFHA shall include:

a. The methods for demonstrating compliance with aircraft level safety requirements.

b. Aircraft level functions.

c. Functions exchanged between internal aircraft systems.

d. Functions that interface with other aircraft or off-aircraft systems.

The airworthiness substantiation shall be developed IAW SAE ARP 4761 prepared IAW DI-SAFT-80101.

Additional Information

Comm Docs	*DoD/MIL Docs*	*FAA/EASA*	*Def-Stan 970*	*STANAG*
		FAA System Safety Handbook CH 7/8/9.		

14.2.5. System-Level Functional Hazard Assessment (FHA)
The purpose of the systems level FHA is to allocate aircraft level functions to systems through the design process.

Criteria:
All system-level functions for consequence of failure shall be defined in a System-Level FHA.

Standard:
SAE ARP 4761

Method of Compliance:
The airworthiness substantiation shall include a system-level FHA IAW SAE ARP 4761 prepared IAW DI-SAFT-80101. A system-level FHA is a qualitative assessment that considers a failure or combination of system failures that affect an aircraft function. After aircraft functions have been allocated to systems by the design process, each system which integrates multiple aircraft functions shall be re-examined using the FHA process. The FHA is updated to consider the failure of single or combinations of aircraft functions allocated to a system. The output of the FHA is used as the starting point for conducting the Preliminary System Safety Assessment (PSSA). The FHA maybe an addendum to the AFHA. If during the development phase aircraft or system architecture changes occur, the FHA(s) shall be resubmitted for review and approval. The FHA(s) shall include:

a. Internal functions of the system and functions exchanged between internal equipment of the system.

b. Functions provided by/to other aircraft-internal or off-aircraft systems.

c. The FHA shall identify the postulated functional failures or hazards for the MCP Platform at the system/subsystem level and the refinement of these hazards identified by the PHL and the PHA, by failure modes and failure conditions.

The airworthiness substantiation shall include a system-level FHA IAW SAE ARP 4761 and prepared IAW DI-SAFT-80101.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		FAA System Safety Handbook CH 7/8/9.		

14.2.6. Preliminary Aircraft / System Safety Assessment (PASA/PSSA).
The purpose of the PASA/PSSA is to conduct a systematic examination of the proposed system architecture(s) to determine how failures can cause the functional hazards identified by the FHA. The objective of the PASA/PSSA is to establish the safety requirements of the system and to determine that the proposed architecture can reasonably be expected to meet the safety objectives identified by the FHA.

Criteria:
All safety requirements shall be defined in a PASA/PSSA.

Standard:
SAE ARP 4761

Method of Compliance:
The airworthiness substantiation shall include a PASA/PSSA IAW SAE ARP 4761 and SAE ARP 4754 prepared IAW DI-SAFT-80102. A PASA/PSSA is a systematic examination of a proposed architecture(s) to determine how failures could cause the Failure Conditions identified by the AFHA/FHA. The PSSA process is interactive, associated with the design definition, and like the design process, is continuous and iterative throughout the design life cycle. The objectives of the PASA and PSSA are to complete the safety requirements of an aircraft, system or item and validate that the proposed architecture can reasonably be expected to meet the safety requirements. The PASA/PSSA may identify the need for alternative protective strategies (e.g., partitioning, built-in-test, monitoring, independence and safety maintenance task intervals, etc.). The PASA/PSSA outputs shall be used as an input to the Aircraft Safety Assessment (ASA)/System Safety Assessment (SSA) and other documents, including, but not limited to, system requirements, software requirements, and hardware requirements. The PASA/PSSA is conducted at multiple stages of system development including aircraft, system, and item design definitions. At the lowest level, the PSSA determines the safety related design requirements of hardware and software.

The PSSA shall identify failures contributing to the failure conditions from the system FHA. Possible contributing factors leading to failure conditions may be identified by using FTA, Dependence Diagram (DD), Markov Analysis (MA) or other analysis methods. A CCA shall also be included in the PSSA. The CCA shall support the development of the specific system architecture and related systems/subsystems by evaluating the overall architecture sensitivity to common cause events.

The FTA, DD, or MA is a top-down system evaluation procedure in which a qualitative model for a particular undesired event shall be formed and then evaluated. The FTAs

shall cover all catastrophic and critical hazards, shall be based on function, and shall be traced to specification requirements. An FTA (DD or MA) shall be used to derive the lower level requirements from those identified in the FHAs (aircraft fault trees for the aircraft FHA and PSSA fault trees for system FHA). These derived requirements shall be captured as requirements in aircraft and system specifications.

The CCA (Common Cause Analysis) shall include a Particular Risks Analysis (PRA), Common Mode Analysis (CMA), and Zonal Safety Analysis (ZSA). Successive iterations of the PSSA shall provide iteratively more detail in the CCA. The CCA shall be completed in sufficient detail to demonstrate independence between functions, systems, and items or conversely that such independence is not possible.

Hardware/Software failures (software errors, faults) arising from common causes shall be included in the PSSA to show the contribution to the system architecture, and to derive what system and item safety requirements are needed. Specific safety related requirements for software such as containment boundary definitions, partitioning strategies, and specific verification strategies shall be identified.

Design Assurance Levels, both Functional (FDAL) and Item (IDAL) shall be documented and justified by supporting analysis in the PSSA. The DAL of an aircraft function shall include the effects of failures or development errors of that function on the aircraft, crew, and/or occupants. The DAL of each item depends on both the system architecture and the resulting failure effects of the item on the functions performed by the system/subsystem.

The PSSA shall be updated throughout the development or sustainment process to address the analysis of the proposed system and software architectural environment, e.g. Symmetric Multi-Processing, for the MCP.

PSSA Delivery Sequence:

a. The PSSA development is an iterative process. Multiple deliverables of the document during the development process ensure complex programs are developed IAW user and airworthiness requirements. The level of PSSA development shall parallel the level of specification development.

b. All, post SRR PSSAs deliverables, shall be submitted.

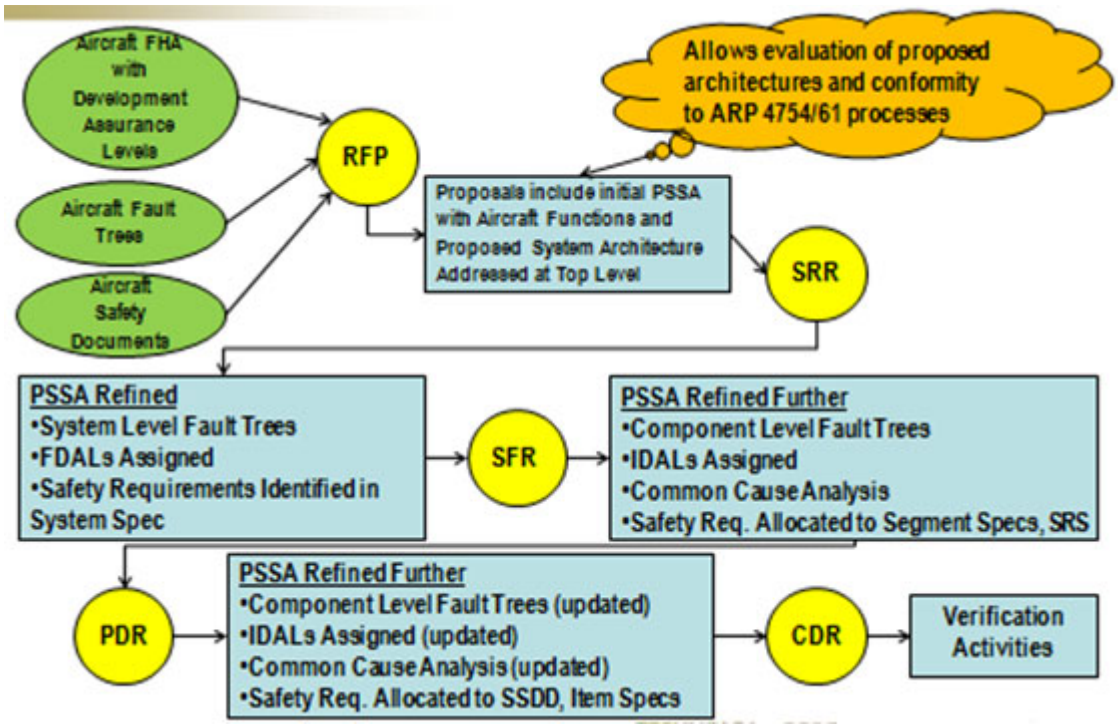

Figure 2. PSSA Development Flow

The airworthiness substantiation shall include a PASA/PSSA IAW SAE ARP 4761 and prepared IAW DI-SAFT-80102.

Additional Information

Comm Docs	*DoD/MIL Docs*	*FAA/EASA*	*Def-Stan 970*	*STANAG*
		FAA System Safety Handbook CH 7/8/9.		

14.2.7. Common Cause Analysis (CCA)

A purpose of the CCA is to determine if there are combined multiple failures of components and operator errors which result in degradation or disablement of the system and are set up by a common event or causative mechanism. A CCA should support the development of the specific system architecture and that of related systems by evaluating the overall architecture sensitivity to common cause events.

Criteria:

All common cause failures evaluated during the design shall be identified in a CCA.

Standard:

SAE ARP 4761

Method of Compliance:
The airworthiness substantiation shall include a CCA IAW SAE ARP 4761, Paragraph 4.4. and shall be prepared IAW DI-MISC-80711.

The System Architecture shall establish the structure and boundaries that the specific system design has implemented. A CCA shall support the development of the specific system architecture and related systems/subsystems by evaluating the overall architecture sensitivity to common cause events.

The PSSA must contain, or have provided simultaneously, the CCA that establishes requirements for redundancy, separation and independence of functions to limit or mitigate failure conditions. The CCA shall consist of the following items:

a. PRA: An analysis of events or influences, which are outside the system(s) and items(s) concerned, but which may violate failure independence claims. Particular risks may influence several zones at the same time.

b. CMA: Verifies that “And” events in the fault trees are actually independent in implementation. The effects of design, manufacturing, maintenance errors, and system component failures that defeat independence shall be analyzed.

c. ZSA: A qualitative analysis to ensure that the equipment installation meets the safety requirements with respect to: Basic Installation, Interference Between Systems, and Maintenance Errors.

The airworthiness substantiation shall include a CCA IAW SAE ARP 4761, Paragraph 4.4. and prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

14.2.8. Fault Tree Analysis

The purpose of an FTA is to recognize hazards that may occur, documenting their unwanted consequences and analyzing their potential causes.

Criteria:
All hazards shall be identified and described in an FTA.

Standard:
SAE ARP 4761

Method of Compliance:
The airworthiness substantiation shall include an FTA IAW SAE ARP 4761, Paragraph 4.1. and Appendix D and shall be prepared IAW DI-MISC-80711.

The FTA is a top-down system evaluation procedure in which a qualitative and/or quantitative model for a particular undesired event shall be formed and then evaluated.

The quantitative FTA shall calculate average probability of occurrence per flight hour for the failure condition, assuming a typical flight of average duration, and considering the appropriate exposure and at risk times. If a quantitative Fault Tree Analysis (FTA) is utilized as a method to understand the design logic, the failure probability of software functionality should be set to “one (1)” to understand the control of the software within the system context and impact to top-level event failure probability and cut sets. The process of determining minimal branches for a quantitative FTA evaluation is exactly the same as the process used for qualitative evaluation.

The FTA shall include the results for MCP common modes and shared resources and those hazards associated with the hardware and software components of the MCP Platform, including the shared resources, such as the real-time operating systems, interconnects, cache, and the partitioning mechanisms for both detected and undetected loss of functions and malfunctions of the MCP.

The analysis shall begin with an undesired top-level hazard event and systematically determine all credible single faults and failure conditions of the system functional blocks at the next lower level which causes this event.

The analysis shall proceed down through more detailed, successive levels of the design until a Primary Event is uncovered or until a top-level hazard event requirement has been satisfied.

The FTA should consist of the following items:

a. Facilitation of technical/certification authority assessments and reviews.

b. Assessment of a design modification with regards to its impact on safety.

c. Quantification of the top event probability of occurrence.

d. Allocation of probability budgets to lower-level events.

e. Visibility into the contribution of development errors by providing a format for mixed quantitative and qualitative assessment.

f. Assessment of single and multiple-fault effects.

g. Assessment of exposure intervals, latency, and "at risk" intervals with regard to their overall impact on the system.

h. Visibility of potential common-cause boundaries.

i. Assessment of common-cause fault sources.

j. Assessment of fail-safe design attributes (fault-tolerant and error-tolerant).

k. Assessment of code-level failures that contribute to defined system, equipment, or software CSCI failures.

The airworthiness substantiation shall include an FTA (Qualitative FTA) IAW SAE ARP 4761, Paragraph 4.1. and Appendix D and prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		FAA System Safety Handbook CH 7/8/9.		

14.2.9. System Safety Assessment (SSA)

The purpose of the System Safety Assessment is to provide a systematic, comprehensive evaluation of the implemented system to show that relevant safety requirements are met and is a verification that the design meets the safety requirements in the FHA and PSSA.

Criteria:
All safety requirements shall be assessed in an SSA.

Standard:
SAE ARP 4761, Paragraph 3.4.
SAE ARP 4761, Appendix C

Method of Compliance:
The airworthiness substantiation shall include an ASA/SSA IAW SAE ARP 4761, paragraph 3.4/ PEO AVN Policy Memorandum Number 18-20 and Appendix C, and SAE ARP 4754, and shall be prepared IAW DI-SAFT-80101.

An Aircraft/System Safety Assessment (ASA/SSA) is a systematic, comprehensive evaluation of the implemented aircraft and system(s) to show that relevant safety requirements are satisfied. The difference between the PASA/PSSA and an ASA/SSA is that the PASA/PSSA are methods to evaluate proposed architectures and derive system/item safety requirements; whereas the ASA/SSA are methods to verify that the implemented design meets the safety requirements as defined in the PASA and PSSA.

The ASA/SSA integrates the results of the various analyses to verify the safety of the overall aircraft/systems and to cover all of the specific safety considerations identified in the PASA/PSSA. The ASA/SSA process data includes results of the relevant analyses and substantiation.

This shall include the following information:

a. List of previously agreed upon external event probabilities.

b. System description including functions and interfaces.

c. List of Failure Conditions (FHA, PASA, PSSA).

d. Failure Condition classification (FHA, PASA, PSSA).

e. Qualitative analyses for Failure Conditions (e.g. FTA, FMES, MA, DD).

f. Quantitative analyses for Failure Conditions (e.g. FTA, FMES, MA, DD).

g. The results obtained from the CCA.

h. Safety related tasks and intervals (FTA, FMES, MA, DD).

i. Design Assurance Levels for aircraft functions and systems (FDAL) (PASA, PSSA).

j. Design Assurance Levels for electronic hardware and software items (IDAL) (PSSA).

k. Verification that safety requirements from the PASA, PSSA are incorporated into the design and/or testing process.

l. The results of the non-analytic verification processes (i.e. test, demonstration and inspection).

m. The SSA shall address the verification analysis of the selected system/software architecture, and MCP environment, e.g. SMP.

The airworthiness substantiation shall include an SSA IAW SAE ARP 4761, paragraph 3.4/ PEO AVN Policy Memorandum Number 18-20 and Appendix C, and prepared IAW DI-SAFT-80101.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	AR 40-10 AR 700–142	FAA System Safety Handbook CH 8.		

14.2.10. Failure Mode, Effects Analysis (FMEA)

The purpose of the FMEA Report is to provide an analysis of independent single item failures and the resulting potential impact on mission success, performance, safety, and maintainability. This analysis is intended to promote design corrective actions by identifying potential failure risk and maintainability issues in order that appropriate corrective actions may be taken early to eliminate or control high risk items to improve operational readiness and reduce life cycle cost.

Criteria:

All failures and the impact to safe operation shall be described in a FMEA.

Standard:
SAE ARP 5580

Method of Compliance:
The airworthiness substantiation shall include a FMEA IAW SAE ARP 5580. The FMEA report shall be prepared IAW DI-SESS-81495.

The program shall utilize the FMEA as the basis for the development of fault isolation procedures, Reliability Centered Maintenance analyses, and cross-correlation with the FHA and PSSA during the system safety assessment verification process.

a. As part of the FMEA, the program shall identify flight-safety-critical hardware and software established by the system safety process.

b. The program shall identify paths that could result in unintended functional behavior or inhibit desired functions.

c. The program shall identify existing design criteria or other procedures to mitigate identified Category I, IR (Remote), II, and IIR failure modes.

d. Where such criteria and/or procedures are not in place, the program shall develop and implement corrective actions to eliminate or mitigate these conditions.

The airworthiness substantiation shall include a FMEA IAW SAE ARP 5580 and prepared IAW DI-SESS-81495.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		FAA System Safety Handbook CH 9 AC 20-157		

14.2.11. Safety Assessment Report (SAR)
The purpose of the SAR is to identify all safety features of the system, design and procedural hazards that may be present in the system and specific procedural controls and precautions that should be followed. The SAR is a comprehensive evaluation of the safety risks being assumed prior to test or operation of the system.

Criteria:
All safety and procedural controls in the system shall be described in a SAR.

Standard:
MIL-STD-882, Task 301

Method of Compliance:
The airworthiness substantiation shall include a SAR IAW MIL-STD-882, Task 301 and shall be prepared IAW DI-SAFT-80102.

a. The SAR shall provide a comprehensive evaluation of the implemented system functions to ensure relevant safety requirements are met.

b. The SAR shall include supporting analysis and activities such as: system FHA, system FTA, Software Safety Critical Function Analysis (SSCFA), developmental testing, operational testing, live fire tests (if applicable), field testing, supportability, transportability, and maintenance.

c. For software the SAR shall:

(1) include the final analysis of the software and hardware related hazards to ensure all hazards are controlled;

(2) provide evidence that the software and hardware meet the safety related requirements, within the selected software architecture;

(3) provide evidence that the necessary system safety nets are in place to respond to MCP failures; and

(4) include an assessment of the residual risk.

The airworthiness substantiation shall include a SAR IAW MIL-STD-882, Task 301 and prepared IAW DI-SAFT-80102.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
SAE ARP 4761				

14.2.12. System Safety Hazard Analysis (SSHA)

The purpose of the SSHA is to verify subsystem compliance with requirements to eliminate hazards or reduce the associated risks; to identify previously unidentified hazards associated with the design of subsystems; and, to recommend actions necessary to eliminate identified hazards or mitigate their associated risks.

Criteria:
All safety hazards of the design shall be defined in a SSHA.

Standard:
MIL-STD-882, Task 205

Method of Compliance:
The airworthiness substantiation shall include a SSHA IAW MIL-STD-882 Task 205 and prepared IAW DI-SAFT-80101. The SSHA identifies hazards and mitigation measures in the integrated system design, including software, subsystem, and human interfaces. The SSHA assesses the entire system as a unit, identifying hazards and failure modes that could be introduced as a result of the physical and functional integration of the subsystems, to include the human as a component of the system.

The airworthiness substantiation shall include a SSHA IAW MIL-STD-882 Task 205 and prepared IAW DI-SAFT-80101

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	JSSC Software System Safety Handbook			

14.2.13. Health Hazard Assessment (HHA)

The purpose of the HHA is to identify human health hazards, to evaluate proposed hazardous materials and processes using such materials, and to propose measures to eliminate the hazards or reduce the associated risks when the hazards cannot be eliminated.

Criteria:
All human health hazards shall be identified and tracked in an HHA.

Standard:
MIL-STD-882, Task 207

Method of Compliance:
The airworthiness substantiation shall include an HHA IAW MIL-STD-882, Task 207 and IAW DI-SAFT-80106 and is required IAW AR 40-10. Airworthiness substantiation shall include the report that contains assessments made by the U.S. Army Public Health Center. A Health Hazard Assessment Report (HHAR) shall be provided by the U.S. Army Public Health Center and updated or revised as changes to the configuration are made. The HHAR shall be integrated and coordinated with the program's system safety assessment for decision milestones.

The airworthiness substantiation shall include an HHA IAW MIL-STD-882, Task 207 and as required IAW AR 40-10, IAW DI-SAFT-80106.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

14.2.14. Hazard Tracking System (HTS)

The purpose of having a closed-loop HTS is to establish, identify, maintain, and manage hazards.

Criteria:
All safety hazards shall be identified and tracked in a HTS.

Standard:
MIL-STD-882, Task 106

Method of Compliance:
The airworthiness substantiation shall include HTS and Reports IAW MIL-STD-882, Task 106 and IAW DI-SAFT-80105.

To support management of the fielded system within the U.S. Army's safety program, an HTS shall be provided at completion of the program. A process should also be in place to generate the Hazard Tracking Matrix at any point during the program. The HTS shall include the following data elements:

a. Identified hazards.

b. Associated mishaps.

c. Risk assessments.

d. Identified risk mitigation measures.

e. Selected mitigation measures.

f. Hazard status.

g. Verification of risk reductions.

h. Risk acceptances.

The airworthiness substantiation shall include an HTS and Reports IAW MIL-STD-882, Task 106 and prepared IAW DI-SAFT-80105.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

14.3. Software Safety
Ssoftware system safety optimizes system safety in the design, development, use, and maintenance of software systems and their integration with safety-critical hardware systems in an operational environment.

14.3.1. Software Safety Program.
System safety processes must include software functionality to maximize system safety. Safety processes must encompass the design, development, use, and maintenance of software systems and their integration with safety-critical hardware systems in an operational environment. The Software Safety Program encompasses all software in the system.
Criteria:
A software safety program shall be implemented.

Standard:
MIL-STD-882

ARP-4761
AMCOMR 385-17

Method of Compliance:
The airworthiness substantiation shall include a software safety program IAW MIL-STD-882 and or ARP 4761 which shall be integrated in the system safety process and documented in the SSPP. The contractor's system safety program shall determine the contribution of software to potential failure conditions, including the software component's relationship to failure conditions and the severity of the failure conditions. The results of this determination enable each CSCI to be assigned a software level (Software Criticality Index (SwCI), DALs, LORs, tool qualification levels, as applicable), for use in applying the guidance in RTCA/DO-178C. Additional guidance is found in SAE ARP-4754A and the JSSSH IG. Key software safety issues shall be addressed as part of the system safety program in the software safety plan, including:

a. Software levels are established for the program for use in applying MIL-STD-882 and DO-178C.

b. Safety-related software functions are identified and analyzed, and their defining requirements are traced.

c. No single point failure caused by software results in loss of aircraft or system.

d. Designs have the necessary provisions to restart and/or reset the system safely while in flight.

e. Safety-related software functions are physically and functionally separated from non-safety functions.

f. Executive/operating system is developed at the highest software level.

g. Safety-related software functions do not use single-source data.

h. Failure in non-safety functions cannot cause safety-related failures.

i. Separate independent power sources are provided for redundant operations.

For Aviation systems that incorporate artificial intelligence technologies, machine learning algorithms, adaptive software/systems, image classification, and other non-deterministic software or technologies, the airworthiness substantiation shall address such applications in engineering cognizance documentation for purposes of compliance with the terms of this Airworthiness Qualification Plan, and shall address the airworthiness effects of these applications in the Airworthiness Qualification Specification. The Safety significance of these aspects of the product shall be incorporated into the program's Safety Analysis/Case, including evaluation of associated hazards and mitigations engineered to address risk. The airworthiness substantiation shall include a software safety program IAW MIL-STD-882 and/or

ARP-4761 and shall be integrated in the system safety process and documented IAW the SSPP.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
ASTM F3269-17 IEC 61508 RTCA/DO-178C SAE ARP-4754A	AMCOM 385-17	FAA System Safety Handbook CH 10		

14.3.2. Built-In Test (BIT)

The purpose of the BIT is t monitor the system, detect failures, record detected failures, and notify the operator when necessary. The BIT will also provide the results of maintainability and BIT demonstrations and tests, or test from which maintainability/BIT evaluation is a byproduct.

Criteria:

The BIT functionality shall be designed and implemented to detect all flight critical failures.

Standard:

MIL-STD-1591

Method of Compliance:

The airworthiness substantiation shall include a BIT Demonstration Report IAW MIL-STD-1591 and prepared IAW DI-SESS-81603. For each subsystem's first failure instance, BIT shall be designed to detect, and the subsystem isolates and accommodates, 100% of the safety critical failures.

For subsystems supporting safety critical functions that have been determined to require (3) or more channels of redundancy, the subsystem shall be designed to detect and accommodate 95% of second like safety critical failures. BIT proper functioning shall be verified as part of the Functional Qualification Testing (FQT) and documented in the Software Test Report (STR). The airworthiness substantiation shall include a BIT Demonstration Report IAW MIL-STD-1591 and prepared IAW DI-SESS-81603.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	JSSG 2008 JSSG-2009 MIL-STD-1591	FAA System Safety Handbook CH 10		

14.3.3. Failure Detection Latency

The purpose of an appropriate failure detection latency is to ensure that the operator is notified in time to react safely.

Criteria:
Flight critical information shall be displayed within 100ms of a detected failure.

Standard:
GAMA

Method of Compliance:
The operator shall be alerted to the loss of flight critical processing or the loss of redundancy in a flight critical processing system within 100ms. Failure Detection Latency is verified by test.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

14.3.4. Software Safety Critical Function Analysis (SSCFA)
The purpose of the SSCFA is to identify all safety critical functions performed by software.

Criteria:
The SSCFA shall identify all software safety critical functions.

Standard:
JSSSEH

Method of Compliance:
The airworthiness substantiation shall include a SSCFA IAW Joint Services Software Safety Committee, Software Systems Safety Engineering Handbook (JSSSEH) and prepared IAW DI-MISC-80508A or DI-MISC-80711. All hardware and software safety/flight-critical items shall be identified, and their safety critical functions verified.

a. Each software safety/flight-critical function of the system shall be assigned a DAL.

b. All software safety/flight-critical tasks of the system must be allocated to processor cores at boot time and should only execute in that core. The processing hardware used for all software safety/flight-critical tasks of the system shall be identified.

The SSCFA report shall address the evaluation of critical functions that are implemented in software that executes on the MCP Platform.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

14.4. Software Safety Airworthiness Substantiation Documents

14.4.1. Hazard Causal Factor Analysis.

The purpose of the HCFA is to identify the specific cause(s) of each identified hazard for new software development and integration with other new or existing software to enable mitigation techniques to be identified.

Criteria:
All causes of software hazards shall be defined.

Standard:
JSSSEH

Method of Compliance:
The airworthiness substantiation shall include a software Hazard Causal Factor Analysis (HCFA) IAW DI-MISC-80711 for new software development and integration with other new or existing software. The Joint System Safety Committee (JSSC) Software System Safety Analysis Handbook (SSS-SSAH-1997) may be used as a guide in performing the analysis and preparation of the HCFA. The HCFA shall contain the following:

Identify each specific cause which contributes to the hazard, including computing hardware, software, human error, and software influenced error potential causes.

a. Identify which hazard causes(s) are contributors to the hazard from across interface boundaries (across subsystem interfaces and between Contractors).

b. Identify specific functional requirements to mitigate each causal factor to a level of acceptable risk. This includes computing hardware, software, and associated Warnings and Cautions, Notes, and technical manual requirements.

c. Identify specific design, test, and verification requirements to provide evidence that the original design requirements have been successfully implemented in the design and code.

d. The airworthiness substantiation shall include a software Hazard Causal Factor Analysis (HCFA) prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

14.4.2. Software Failure Modes and Effects Analysis (SWFMEA)

The purpose of the SW FMEA is to provide an analysis of single item failures and the resulting impact on mission, performance safety and maintainability. The analysis is intended to promote design corrective actions by identifying appropriate corrective actions to eliminate or control high risk items.

Criteria:
All software failure modes shall be identified and described in a SWFMEA.

Standard:
SAE ARP 5580
DOT/FAA/TC-15/62

Method of Compliance:
The Software Failure Modes and Effects Analysis (SWFMEA) shall be prepared [DAL A and DAL B only]. The SWFMEA report shall be prepared, using SAE ARP 5580 and MIL-STD-1629 as guides, and the delivery requirements of DI-SESS-81495B. The SWFMEA report shall identify MCP failure modes associated with interference channels in the MCP chip fabric, shared resources, the MCP critical configuration settings, and any other MCP unique failures that could result in anomalous, i.e., non-deterministic, behavior of the MCP; and identify the operational impacts these failures could have on the software and the software's response(s) to the failures. The airworthiness substantiation shall include a SWFMEA report IAW SAE ARP 5580 and prepared IAW DI-SESS-81495B.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
SAE ARP 5580		AC 20-193		

14.4.3. Software Safety Critical Function Analysis Report
The purpose of the software safety critical function analysis report is to identify which CSCI or Computer Software Unit (CSU) are safety critical.

Criteria:
All software critical safety functions shall be defined in a Software Safety Critical Function Analysis Report.

Standard:
JSSSEH

Method of Compliance:
The airworthiness substantiation shall include a software Safety Critical Function Analysis Report IAW Joint Services Software Safety Committee (JSSSEH) Software Systems Safety Handbook and prepared IAW DI-MISC-80508A or DI-MISC-80711. This report shall identify which CSCI or CSU is safety critical. The report shall illustrate the relationship each CSCI or CSU has with the safety critical functions and show traceability to the software requirements. All hardware and software safety/flight-critical items shall be identified, and their safety critical functions verified.

a. Each software safety/flight-critical function shall be assigned a DAL.

b. Each software safety/flight-critical function shall be fully allocated to hardware.

The airworthiness substantiation shall include a software Safety Critical Function Analysis Report IAW JSSSEH and prepared IAW DI-MISC-80508A or DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

14.4.4. Software Hazard Analysis Tracking Report (SHATR)

The purpose of the SHATR is to provide an update of the SSHA and a periodic review of safety activities to monitor the progress of the system safety program.

Criteria:
All software hazards shall be identified and tracked in a SHATR.

Standard:
MIL-STD-882, Task 106

Method of Compliance:
The airworthiness substantiation shall include a SHATR IAW MIL-STD-882, Task 205 and prepared IAW DI-SAFT-80105. The SHATR provides an update of the SSHA and a periodic review of safety activities to monitor the progress of the system safety program. New software contribution to hazards are identified and existing software contribution to hazards are tracked and their status is updated based upon recent safety activities. The airworthiness substantiation shall include a SHATR IAW MIL-STD-882, Task 106 and prepared IAW DI-SAFT-80105.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

14.4.5. Machine Learning Data Hazard Analysis

The Machine Learning Data Hazard Analysis identifies and classifies the failure conditions associated with the Machine Learning data sets; to identify previously unidentified hazards associated with the data set, signals, sources, features and attributes; and, to recommend data sets, sources, attributes and features that should be collected in order to ensure the Machine Learning model is properly trained on those signals, sources, features and attributes identified in the hazards analysis in order to mitigate their associated risks.

Criteria:
All Machine Learning data set sources, signals, attributes, and features safety hazards shall be defined in a Machine Learning Data Hazard Analysis.

Standard:
Pending: Joint Software Safety Working Group Data Hazard Analysis.

Method of Compliance:
Substantiation shall include a Machine Learning Data Hazard Analysis. The Machine Learning Data Hazard Analysis shall identify, qualify, and classify the hazards associated with the data, data sources, data signals, data attributes, and data features, and include the following:

a. Conduct a data safety assessment of data sources, signals, features, and attributes anticipated to drive the AI/ML model generalization.

b. Conduct a data sources, signals, features, and attributes Failure Modes & Effects Analysis (e.g., Oliver Zendel, 2017), or equivalent.

c. Establish traceability from data sources, signals, features, and attributes to data safety hazard assessment.

d. Determine the criticality of data set sources, signals, features, and attributes based on safety assessment.

e. Identify those data sources, signals, features, and attributes with safety critical consequences, and the safety consequence of those data sources, signals, features, and attributes.

f. Identify all data sources signals, features, and attributes having the same safety consequence.

The safety assessments on data sources, signals, features, and attributes shall be conducted before collecting and processing the data set. This approach allows prioritization of the collection and processing of the safety-critical elements of the data set over those that are less critical.

Substantiation shall include Machine Learning Data Hazard Analysis as described above and IAW DI-SAFT-80101.

Additional Information

Comm Docs	DOD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
Oliver Zendel, K. H. (2017). Analyzing Computer Vision Data — The Good, the Bad and the Ugly. 2017 IEEE Conference on Computer, Vision and Pattern Recognition (CVPR). doi:10.1109/CVPR.2017.706.				

15. SOFTWARE AIRWORTHINESS

The following criteria, standards and methods of compliance define the guidelines to be used by the software developers to provide airworthiness approval recommendations for aviation systems and equipment that contain software and/or provide data to airborne systems such as ground control stations and flight planning systems. The criteria may also be used by the software developers to understand the lifecycle processes and products that are required for airworthiness approval. These criteria are intended for software and airborne electronic hardware that must achieve software airworthiness qualification. Any development or acquisition program that contains software and requires a SAQ should tailor the process in this document. This also includes systems that support aviation components such as ground control stations and flight planning systems. The degree of required application of the criteria is determined by the system safety process which defines the criticality of the software based on the functions it performs, supports, or contributes.

All of the analyses, activities, and products apply to new developments as well as to enhancements, modifications, COTS software, reuse of existing software, foreign airworthiness recognition and legacy system acquisitions. Whenever the word “development” is utilized in this document, it represents one of these system acquisition approaches.

It is recognized that these system acquisition approaches include traditional and “Modern Software development and Acquisition Practices” (Army Directive 2024-02) such as continuous integration/continuous delivery (CI/CD), agile-based, model-based development, DevSecOps, spiral development methodology, waterfall development methodology, or incremental development methodology. The acquisition approaches may or may not have the traditional CDRL delivery schedules of artifacts and documents during the development phase. While the deliverables and artifacts identified in this section are characteristic of a traditional waterfall methodology, with deliveries tied to a milestone review (i.e. SRR, PDR, CDR, TRR, etc.), they can be tailored to support any acquisition approach. This tailoring is accomplished as a part of the AQS development process and details of the basis for certification is documented in the Plan for Software Accomplishments of Certification (PSAC) which should be completed soon after program initiation and prior to development of the software. The deliverables and artifacts identified in this section identify specific information or data that is required, by SRD as the certification authority, to demonstrate compliance with the required objectives and activities of a robust development process as defined in DO-178C, DO-278, and DO-254. It is the responsibility of the acquisition authority and the developer to develop a plan (PSAC, SDP, SQAP, SCMP, and SVP) for generating, creating, curating, and maintaining that data of objective qualification evidence and making that data readily available to SRD, as the airworthiness certification stakeholder, via digital repositories, remote access, deliverable documentation, etc. That plan should also be consistent, compatible, and commensurate with the program development schedule and budget (i.e. rapid development and release of software requires near real time access to objective qualification evidence).

The system safety process should be an early and parallel effort with the establishment of the requirements that continues through the lifecycle of a program.

Software and Programmable Hardware Airworthiness Process.

Software and programmable hardware airworthiness activities shall be performed IAW RTCA/DO-178C, RTCA/DO-330, RTCA/DO-331, RTCA/DO-332, RTCA/DO-333, and RTCA/DO-254, and their applicable annexes. All software and programmable hardware, whether new, modified, legacy, COTS, or otherwise sourced, shall be evaluated under these requirements. Requirements identified to be IAW RTCA/DO-178C process are to be completed using the RTCA/DO-178C process in its entirety as completely applicable to the requirement. The CCDC AvMC will consider the contents of RTCA/DO178C as “shall” requirements regardless of the language used (e.g. “should”) unless otherwise agreed to on a case-by-case basis and documented in the Plan for Software Aspects of Certification (PSAC). All failure conditions which occur during testing shall have root cause analysis and corrective action.

15.1. Software Artifacts

The airworthiness substantiation shall include the following software engineering artifacts identified in the following subsections. The contractor may propose the delivery of alternative documentation, standards or methods of compliance, provided they meet the intent of the objectives identified. Specific acquisition requirements for each software artifact have been identified under each Method of Compliance paragraph.

In addition to the requirements identified in the Method of Compliance subsections of Sections 15.1.1.1. thru 15.1.5.11., the Supplier and Integrator shall meet the requirements identified in Table 15.1-1 for Reusable Software Component (RSC).

TABLE 15.1-1 Airworthiness Qualification Requirements for the Reusable Software Components (RSC)

Section Number	Deliverable/ Artifact	Supplier Requirements	Integrator Requirements
15.1.1.1.	**Plan for Software Aspects of Certification (PSAC)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.1., the PSAC shall: a. provide a high-level description of the Supplier's planned methods, practices, software lifecycle processes, and means of compliance for the RSC in meeting the objectives of RTCA/DO-178C and the planned level of credit sought for each of these objectives, based on the RSC's software level of rigor. b. include an identification and mapping of the substantiation evidence (such as software life cycle data) that will be used to document the compliance to these objectives. c. Identify and include the supporting rationale for the amount of full credit, partial credit, or no credit for each objective of RTCA/DO-178C. d. include an identification of those DO-178C objectives that will require additional substantiation data by the system, platform, or aircraft Integrator. e. contain the planned approach for the analysis of all interfaces and	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.1., the PSAC shall: a. provide a summary description of the Integrator's planned methods, practices, software lifecycle processes, and means of compliance for the integration of the RSC in meeting the objectives of RTCA/DO-178C and the level of credit sought for each of these objectives for the delivered software baseline, including the integrated RSCs. b. address the amount of partial qualification credit ascribed to the integrated RSCs, based on the RSC's software level of rigor, the evidence provided by the Supplier, and the assigned level of rigor for the delivered software baseline. c. Include as identification and mapping of the substantiation evidence (such as software life cycle data) that shall be used to document the compliance to these objectives for the delivered software baseline, including the integrated RSCs. d. include the identification and rationale for selection of all RSCs planned to be integrated into the delivered software.

Section Number	Deliverable/ Artifact	Supplier Requirements	Integrator Requirements
		parameter settings for the RSC and documenting a description of the effects of these interfaces and parameters on the proper operation of the RSC in its integrated environment. f. include the plan for documenting the architectural and design features of the RSC, which address its safe operation, partitioning requirements, vulnerabilities, limitations, or protection strategies in supporting the safety and cybersecurity analyses. g. include the plan for documenting the performance characteristics of the RSC, which is required to ensure the proper use and integration of the RSC.	e. address the impact of open problem reports against the RSCs, proposed modifications to the RSCs, including software requirements changes, software architecture changes, and the impacts these changes have on the verification evidence provided for these RSCs. f. include the supporting rationale for the achievement of partial or no credit for each objective of RTCA/DO-178C provided by the RSC Supplier. g. include an identification of those DO-178C objectives that shall require additional substantiation data by the system, platform, or aircraft Integrator for the integration of the third party RSCs. h. contain the planned approach for the analysis of all interfaces and parameter settings for the RSC and documenting a description of the effects of these interfaces and parameters on the proper operation of the RSC in the proposed integrated environment. i. include the plan for documenting the architectural and design features of the delivered software baseline, which addresses the safe operation, partitioning requirements, vulnerabilities, or protection strategies in supporting the safety and cybersecurity analyses for the integrated RSC.

Section Number	Deliverable/ Artifact	Supplier Requirements	Integrator Requirements
			j. Include the plan for addressing the integration of the RSC within the limitations of its functions, potential interface safety concerns, configuration, performance characteristics (e.g. worst-case timing, memory and throughput utilization), and other supporting data.
15.1.1.2.	**Software Development Plan (SDP)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.2., the SDP for the RSC shall: a. include a description of the Supplier's software lifecycle processes with particular emphasis on the planned processes that will be utilized in addressing the development, verification, and delivery of the RSCs and ensuring their portability. b. include the identification and definition of the software development environment, computer programming language, software standards, any tools, e.g. development or verification tools, configuration management tools, and defect management tools, required to address or support reuse. c. describe any new or novel concepts, methods, and technologies for developing the RSC.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15..11.2., the SDP for the RSC shall: a. include a description of the software lifecycle processes that shall be utilized in addressing the modification, integration, and verification of the RSCs with the delivered software baseline. b. include the identification and definition of the software development environment, computer programming language, software standards, any tools, e.g. development or verification tools, configuration management tools, and defect management tools, required to address or support the integration of RSCs. c. describe any new or novel concepts, methods, and technologies for integrating the RSC. d. describe the approach for managing the integration of RSCs. e. include the plan for assessment of

Section Number	Deliverable/ Artifact	Supplier Requirements	Integrator Requirements
		d. describe the approach for managing the development of RSCs. e. include a description of the detailed engineering and management tasks for each RSC and a corresponding schedule for each of these tasks. f. describe how RSCs are identified for development, selected, and tracked for delivery. g. identify the planned software architectural reuse framework, design pattern, etc. used for the development of the RSC. h. include a description of the software metrics such as those associated with the maturity, requirements stability, computing resource utilization, problem reporting/defect tracking and quality of the RSC. i. include the assumptions regarding the integrator's planned use of the RSC, such as the amount of changes to source code, compiler options, and parameter settings. j. Include the plan for the documentation of the RSC's functions, limitations, potential interface safety concerns, configuration, performance	changes to the RSC and its development environment, target processor other hardware, or integration with other software than that used for the original application of the RSC. f. include a description of the detailed engineering and management tasks for the integration of each RSC and a corresponding schedule for each of these tasks. g. describe how RSCs are identified and selected for integration as well as any reuse criteria used in their selection. h. identify the planned approach for assessing the impacts of the planned software architecture versus the software architectural framework, design pattern, etc. proposed by the Supplier for the integration of the RSC. i. include a description of the software metrics such as those associated with the maturity, requirements stability, computing resource utilization, problem reporting/defect tracking and quality for the integration of the RSC. j. include the Integrator's planned use of the RSC, such as the number of changes to source code, compiler options, and parameter settings. k. include the plan for documenting change impact analysis for the integration

Section Number	Deliverable/ Artifact	Supplier Requirements	Integrator Requirements
		characteristics (e.g. worst-case timing, memory and throughput utilization), and other supporting data.	of the RSCs due to deviations to the assumptions made by the RSC Supplier.
15.1.1.3.	**Software Qualification Assurance Plan (SQAP)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.3., the SQAP shall identify the processes, activities, artifacts, and products for the assigned software level of rigor for each RSC.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.3., the SQAP shall identify the processes, activities, artifacts, and products for assessing the quality characteristics, such as the problem reporting/defect history and the inspection results of the reuse artifacts for each candidate/selected RSC and its integration within the delivered software baseline.
15.1.1.4.	**Software Configuration Management Plan (SCMP)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.4., the SCMP shall address the software configuration management processes, activities, artifacts, and products for the assigned software level of rigor for each RSC.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.4., the SCMP shall address the software configuration management processes, activities, artifacts, and products for each RSC integrated into the delivered software baseline.
15.1.1.5.	**Software Verification Plan (SVP)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.5., the SVP shall: a. define the test environment, including verification tools, test cases, scripts, and methodologies	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.5., the SVP shall: a. define the test environment, including verification tools, test cases, scripts, and methodologies that shall be used to

Section Number	Deliverable/ Artifact	Supplier Requirements	Integrator Requirements
		that will be used to address the verification of the RSCs based on their assigned software level(s) of rigor. b. provide the approach for ensuring the RSCs satisfy the airworthiness requirements and meet the verification objectives identified in RTCA/DO-178C Section 11.3. for the delivered software baseline's assigned level(s) of rigor.	address the verification and/or reverification of the integrated RSCs based on their assigned software level(s) of rigor and the level of rigor required for the delivered software baseline. b. provide the approach for ensuring the integrated RSCs satisfy the airworthiness requirements and meet the verification objectives identified in RTCA/DO-178C Section 11.3. for the delivered software baseline's assigned level(s) of rigor.
15.1.1.6.	**Software Transition Plan (STrP)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.6, the STrP will identify the hardware, software, and other resources, such as the architectural reuse framework, required to support third party sustainment of the RSCs.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.6., the STrP shall identify the hardware, software, and other resources, such as the architectural reuse framework, required to support third party sustainment of the delivered software including the integrated RSCs.
15.1.1.7.	**Software Requirements Standards**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.7, the Software Requirements Standards will define the methods, rules, and tools to be used to develop the high-level requirements which enable or increase the reusability of the RSCs.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.7., the Software Requirements Standards shall define the methods, rules, and tools to be used to develop the high-level requirements, which enable the integration of third party RSCs.
15.1.1.8.	**Software Design Standards**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.8., the

Section Number	Deliverable/ Artifact	Supplier Requirements	Integrator Requirements
		15.1.1.8., the Software Design Standards will define the methods, rules, and tools to develop the software architectural reuse framework, detailed design, and low-level requirements for the RSCs.	Software Design Standards shall define the methods, rules, and tools to develop the software architectural reuse framework, detailed design, and low-level requirements for the integration of third party RSCs.
15.1.1.9.	**Software Code Standards**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.9., the Software Code Standards provide the guidance for implementation of the RSC design into source code for the assigned software level of rigor	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.9., the Software Code Standards provide the guidance for the integration of third party RSCs source code for the assigned software level of rigor of the delivered software baseline.
15.1.1.10.	**Software Model Standards**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.10., the Software Model Standards shall include a definition of the modeling language used and any limitations on the use of modeling language and tools used in the development of the RSCs.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.10. the Software Model Standards includes a definition of the modeling language used and any limitations on the use of modeling language and tools used in the integration of the third party RSCs within the delivered software baseline.
N/A	**Software Reuse Standards**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1. the Supplier shall identify the software development standards, which specifically apply to software reuse and the reuse processes that will be used.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1., the Integrator shall identify the software reuse standards and processes, which specifically apply to the integration of the RSC.

Section Number	Deliverable/ Artifact	Supplier Requirements	Integrator Requirements
15.1.2.	**Software Development Process Artifacts**	In addition to the airworthiness substantiation identified in AMACC paragraph 15.1.2. for each of the software development process artifacts the specific acquisition requirements for the reuse of component-level are identified in each of the following subsections.	In addition to the airworthiness substantiation identified in AMACC paragraph 15.1.2. for each of the software development process artifacts the specific acquisition requirements for the reuse of the component-level RSCs are identified in each of the following subsections.
15.1.2.3.	**Software Requirements Specification (SRS)**	There are no additional airworthiness requirements and substantiation evidence required for the RSC than those identified in AMACC paragraph 15.1.2.3.	In addition to the airworthiness substantiation identified in AMACC paragraph 15.1.2.3., the SRS shall include the software high level or derived requirements and the identification of those requirements associated with the integration of the component-level RSCs.
15.1.2.4.	**Interface Requirements Specification (IRS)**	In addition to the airworthiness requirements and substantiation evidence identified in AMACC paragraph 15.1.2.4., the IRS shall define the requirements for the RSC to interface with other software components and external hardware items	In addition to the airworthiness substantiation identified in AMACC paragraph 15.1.2.4., the IRS shall include the software high-level and/or derived requirements and the identification of those requirements associated with the integration of the component-level RSCs.
15.1.2.5.	**Software Design Description (SDD)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.5., the SDD shall describe the architectural reuse frameworks that can accommodate the RSC.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.5., the SDD shall define the architectural reuse framework as well as the low-level requirements and detailed design that shall be used to integrate the RSCs.

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15.1.2.6.	**Interface Design Description (IDD)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.6., the IDD shall define the interface characteristics for the RSC, if it is not already included in the SDD for the RSC. The IDD shall document the external interfaces to the RSC as well as those interfaces which permit the RSC to comply with the architectural reuse framework.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.6., the IDD shall define the interface characteristics required for the integration of the RSCs. The IDD shall document the external interfaces to the RSC as well as those interfaces, which permit the RSC to comply with the architectural reuse framework.
15.1.2.7.	**Data Base Design Description (DBDD)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.7., the DBDD shall describe the design of an RSC that is used as a database, used to access or manipulate the data in the database.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.7., the DBDD shall describe the design of the delivered software baseline including the integration of an RSC that is used as a database, used to access or manipulate the data in the database.
15.1.2.8.	**Software Integration Test Procedure (SITPr)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.8., the SITPr shall include test cases and procedures, which are used to verify the successful qualification and integration of the RSC.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.8., the SITPr shall include test cases and procedures, which are used to verify the successful integration of the RSCs within the delivered software baseline.
15.1.2.9.	**Software Test Description (STD)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.9., the STD shall include test	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.9., the STD shall include test cases and procedures

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		cases and procedures necessary to perform qualification testing of the RSCs. The STD shall include test cases that address appropriate functional, safety, security, performance, configuration, resource usage and robustness and airworthiness requirements. The STD shall also include test cases that address likely reuse scenarios for the RSCs.	necessary to perform qualification testing of the delivered software baseline with the integrated RSCs. The STD shall include test cases that address the functional, safety, security, performance, configuration, resource usage, robustness, and airworthiness requirements, as well as the test cases associated with the reuse scenarios for the RSCs.
15.1.2.10.	**Software Traceability Data**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.10., the bi-directional software traceability data for the RSCs shall be established for the software high-level requirements, low level requirements, implementation, and verification data.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.10., the bi-directional software traceability data for the delivered software baseline, with integrated RSCs, is established for the software high-level requirements, architectural and detail design, low-level requirements, implementation, and verification data.
15.1.3.	**Software Verification Process Artifacts**	In addition to the airworthiness substantiation identified in AMACC paragraph 15.1.3. for each of the software verification process artifacts the specific acquisition requirements for the reuse of component level RSCs are identified in each of the following subsections.	In addition to the airworthiness substantiation identified in AMACC paragraph 15.1.3. for each of the software verification process artifacts the specific acquisition requirements for the integration of component-level RSCs are identified in each of the following subsections.
15.1.3.1.	**Formal Qualification Test (FQT)**	In addition to the airworthiness requirements and substantiation	In addition to the airworthiness requirements and substantiation identified

Section Number	Deliverable/ Artifact	Supplier Requirements	Integrator Requirements
		identified in AMACC paragraph 15.1.3.1., the FQT will be used to demonstrate that the RSC meets its specified requirements, including compliance with the software reuse standards, compliance with the software architectural reuse framework and database design, as well as demonstration of likely reuse scenarios, as appropriate.	in AMACC paragraph 15.1.3.1., the FQT shall be used to demonstrate that the delivered software baseline, with integrated RSCs, meets its specified requirements, including compliance with the software reuse standards, software architectural reuse framework, database design, and verification cases and procedures for the RSCs reuse scenarios, as appropriate.
15.1.3.2.	**Change Impact Analysis (CIA)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.3.2., the software CIA is used to determine the scope of regression verification required for the RSC.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.3.2., the software CIA is used to determine the scope of regression verification required for the integration of the RSCs within the delivered software baseline.
15.1.3.3.	**Software Integration Test Report (SITR)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.3.3., the SITR documents the results of a formally executed SIT for the software elements of the RSC, which is, conducted IAW the SITPr.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.3.3., the SITR documents the results of a formally executed SIT, which is conducted IAW the SITPr.
15.1.3.4.	**System Integration Test (SIT)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.3.4., the SIT will be conducted to verify the correct integration of the elements within the RSC with the target hardware	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.3.4., the SIL Test shall be conducted to verify correct integration of the RSC within the delivered software baseline and the target hardware.

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15.1.3.5.	**Software Test Report (STR)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.3.5., the STR documents the results and analyses for the formally executed qualification test of the RSC, conducted IAW the approved SVP and STD.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.3.5., the STR documents the results and analyses for the formally executed qualification test of the delivered software baseline, with the integrated RSCs, conducted IAW the approved SVP and STD.
15.1.3.6.	**Structural Coverage Analysis (SCA)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.3.6., the SCA is performed for the RSC, based on requirement-based testing and the approved assigned software level of rigor for the RSC.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.3.6., the SCA is performed for the delivered software baseline, with the integrated RSCs, based on requirement-based testing and the approved assigned software level of rigor for the integrated RSCs.
15.1.4.	**Software Delivery Process Artifacts**	In addition to the airworthiness substantiation identified in AMACC paragraph 15.1.4. for each of the software delivery process artifacts the specific acquisition requirements for the reuse of component level RSCs are identified in each of the following subsections.	In addition to the airworthiness substantiation identified in AMACC paragraph 15.1.4. for each of the software delivery process artifacts the specific acquisition requirements for the reuse of component level RSCs are identified in each of the following subsections.
15.1.4.1.	**Software Version Description (SVD)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.1., the SVD shall be produced for the RSC or collection of related RSCs.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.1., the SVD shall be produced for the delivered software baseline, which includes the integrated RSC or collection of related RSCs.

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15.1.4.2.	**Software Product Specification (SPS)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.2., the SPS shall be produced for the RSC or collection of related RSCs.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.2., the SPS shall be produced for the delivered software baseline, which includes the integrated RSC or collection of related RSCs.
15.1.4.3.	**Software Source Code**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.3., the source code and related artifacts for the RSCs are tracked using configuration control measures for all releases provided to third party users and Integrators.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.3., the source code and related artifacts for the delivered software baseline, which includes the integrated RSCs, are tracked using configuration control measures for all releases.
15.1.4.4.	**Problem Report (PR)/Change Request (CR)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.4., the software PRs/CRs for each RSC version is tracked using configuration control measures for all releases provided to third party users and Integrators.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.4., the software PRs/CRs for the delivered software baseline, which includes the integrated RSCs are tracked using configuration control measures for all releases
15.1.4.5.	**Software Metrics (SM) Report**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.5., the SM Report for each RSC version, shall be maintained and tracked using configuration control measures for all releases	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.5., the SM Report shall be maintained for each version of the delivered software including the integrated RSC(s) and is tracked using approved configuration control measures for all releases.

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		provided to third party users and Integrators.	
15.1.4.6.	**Software Configuration Management (SCM) Records**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.6., the SCM records for each RSC version, shall be maintained and tracked (s) using configuration control measures for all releases provided to third party users and Integrators.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.145 6., the SCM records are maintained for each release of the delivered software baseline, which includes the integrated RSC(s) and is tracked using configuration control measures for all releases.
15.1.4.7.	**Software Quality Assurance (SQA) Records**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.7., the SQA records are maintained for each release of the RSC(s) and is tracked using configuration control measures for all releases provided to third party users and Integrators.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.7., the SQA records are maintained for each release of the delivered software baseline, which includes the integrated RSC(s) and is tracked using configuration control measures for all releases.
15.1.4.8.	**Software Installation Plan (SIP)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.8., the SIP is maintained for each release of the RSC and is tracked using configuration control measures for all releases provided to third party users and Integrators.	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.8., the SIP is maintained for each release of the delivered software baseline, which includes the integrated RSCs and is tracked using configuration control measures for all releases.
15.1.4.9.	**Software Conformity Review**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.9., the

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		15.1.4.9., the Software Conformity Review is performed and documented for each RSC. Evidence of this review are maintained for each RSC and is included in the release package or Software Accomplishment Summary for each RSC provided to third party users and Integrators.	Software Conformity Review is performed and documented for each delivered software baseline, which includes the integrated RSCs. Evidence of this review are maintained for each delivered software baseline, which includes the integrated RSCs and is included in the release package or Software Accomplishment Summary.
15.1.4.10.	**Software User Manual (SUM)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.10., the SUM is required for each RSC or collection of RSCs that will be delivered as a standalone executable(s).	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.10., the SUM is required for each delivered software baseline executable, which includes the integrated RSC or collection of RSCs.
15.1.4.11.	**Software Accomplishment Summary (SAS)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.11., the SAS shall: a. Be prepared for each RSC or collection of RSCs that will be delivered. b. Provide a high-level description of the Supplier's methods, practices, software lifecycle processes, and means of compliance for the RSC in meeting the objectives of RTCA/DO-178C. c. Document the planned level of credit sought for each of these	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.11., the SAS shall: a. Be prepared for each delivered software baseline, which includes the integrated RSC or collection of RSCs. b. Provide a high-level description of the Integrator's methods, practices, software lifecycle processes, and means of compliance for the delivered software baseline, including the integrated RSCs in meeting the objectives of RTCA/DO-178C, based on the RSC's required software level of rigor in the integrated target

Section Number	Deliverable/ Artifact	Supplier Requirements	Integrator Requirements
		objectives, based on the RSC's software level of rigor. d. Include an identification and mapping of the substantiation evidence that is being used to document the compliance to these objectives. e. Include the supporting rationale for the achievement of partial or no credit for each objective of RTCA/DO-178C. f. Include an identification of those DO-178C objectives that will require additional substantiation data be provided by the system, platform, or aircraft Integrator. g. Include an identification of those activities that an integrator must perform to ensure full airworthiness qualification of the RSC is achieved in each integration. h. Contain an analysis of all interfaces and parameter settings for the RSC. i. Provide a description of the effects of these interfaces and parameters on the proper operation of the RSC in its integrated environment. j. Include the architectural and design features of the RSC that address its safe operation, partitioning	environment. c. Include an identification and mapping of the substantiation evidence that is being used to document the compliance to these objectives for the delivered software baseline, including the integrated RSCs. d. Include the supporting rationale for the achievement of full credit for each objective of RTCA/DO-178C identified in the approved PSAC. e. Include an identification of those DO-178C objectives that required additional substantiation data that is provided by the system, platform, or aircraft Integrator. f. Include an identification of those activities that the integrator performed to ensure full airworthiness qualification of the delivered software baseline, including the integrated RSCs, is achieved. g. Contain an analysis of all interfaces and parameter settings for the delivered software baseline, including the integrated RSCs and describe the effects of these interfaces and parameters on the proper operation of the delivered software baseline in its integrated environment. h. Include a description of how the architectural and design features of the delivered software baseline, including the RSCs, address its safe operation,

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		requirements, vulnerabilities, or protection strategies.	partitioning requirements, vulnerabilities, or protection strategies.

In addition to the requirements identified in the Method of Compliance subsections of Sections 15.1.1.1. thru 15.1.5.11., the Applicant shall meet the requirements identified in Table 15.1-2 for systems utilizing Multi-Core Processors (MCPs).

TABLE 15.1-2 Software Requirements for MCP

Section Number	Deliverable/ Artifact	Description
15.1.1.1.	**Plan for Software Aspects of Certification (PSAC)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.1., the PSAC shall include: a. Identification of the specific MCP processor with the unique manufacturer's identifier and the identification of the number of active MCP cores to be used. b. Identification of all MCP chip resources (including shared resources, such as cache, I/O, memory, etc.) and a description of the methodology used for: allocating the resources to the various software applications and analyzing the interferences associated with the resource allocation, based on the results of the safety analysis. c. Identification of the approach for the verification of the demands of the resources when executing on the target processor under worst-case scenarios. Worst-case should be defined and a requirement for how it is determined. Assumptions should also be documented. d. Identification and description of the MCP software architecture to be used and all of the software components, including guest operating systems and hypervisors that will be hosted on the MCP. e. Identification of the dynamic features provided in software hosted on the MCP and a description of how these dynamic features will be utilized or bounded. f. Identification of whether or not the MCP device will be used in an IMA platform to host software applications from more than one system. g. Identification of whether or not the MCP Platform will provide robust resource and/or robust time partitioning as defined by AC 20-193. h. The approach for determining the MCP configuration settings, documenting the requirements for the MCP critical configuration settings,

Section Number	Deliverable/ Artifact	Description
		the management of the MCP critical configuration settings, the integration of the MCP configuration settings, and the verification of the MCP critical configuration settings. i. The identification and description of the methods and tools to be used to develop and demonstrate all of the individual software components hosted on the MCP so as to meet the software airworthiness qualification requirements of the AQP. j. The identification and description of the methods and tools to be used to comply with the applicable airworthiness qualification requirements of the AQP, including any methods or tools needed due to the use of an MCP or the selected MCP architecture. k. The identification of the verification approach that will be used to show that all software components hosted by the MCP Platform meet their software requirements and design requirements, functions correctly, and have sufficient time to complete their safety critical execution deadlines when hosted on the MCP Platforms with Robust Partitioning. l. The identification of the verification approach that will be used to show that all software components hosted on an MCP Platform that does not have Robust Partitioning or for which both robust resource and time partitioning have not been verified, meet their software requirements, design requirements, function correctly, and have sufficient time to complete their execution while all of the software components hosted on that MCP Platform are executing in the final intended configuration. m. A description of the approach for the use, allocations, and verification of MCP shared resources, including, shared cache. n. Identification and justification of any hardware dynamic features of the MCP that will be active and a summary description of how these features will be used. o. The identification of the verification approach that will be used to show that the data and control coupling between all of the individual software components hosted on the same core or on different cores of the MCP has

Section Number	Deliverable/ Artifact	Description
		been exercised during the software requirement- based testing, including exercising any interfaces between the applications via shared memory and any mechanisms to control access to shared memory. p. The approach for determining the appropriate means of mitigation that satisfies the functional, performance, and timing requirements of the system in the event of inadvertent alteration of the critical configuration settings of the MCP. q. The verification approach for the chosen means of mitigation for the occurrence of inadvertent alteration of the critical configuration settings of the MCP. r. The approach for identification of the interference channels that could permit interference to affect the software applications hosted on the MCP cores. s. The verification approach for the chosen means of mitigation for each interference channel which may include analysis to show that the interference was mitigated through the design of the hardware or software architecture, e.g., the memory is configured such that one core cannot modify another core's memory (hardware implements memory access in such a way that direct memory access is not possible) [DALs A and B only]. t. Identification of the approach for analyzing worst-case execution paths and the WCET of the executable software. u. Approach for planning and managing the available resources of the MCP; including interconnects, busses, and interfaces in the final configuration; and the allocation of the resources of the MCP to the software applications hosted on the MCP. v. Approach for planning and managing the identification of failures and their potential associated effects, based on the use of the MCP Platforms, including the selected MCP software architecture, and their associated mechanisms, such as shared resources, and the identification of

Section Number	Deliverable/ Artifact	Description
		requirements, design, implementation and verification of the selected mitigations to detect and handle these failures [DALs A and B only]. w. Approach for the verification of the partitioning integrity of the MCP Platform that is utilizing Robust Partitioning. x. Approach for determining the appropriate means of identifying and mitigating any MCP errata that negatively impact the behavior of the MCP in the defined usage domain.
15.1.1.2.	**Software Development Plan (SDP)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.2., the SDP shall: h. The SDP shall also include a detailed description of the plan for addressing each of the software considerations for MCP identified in paragraphs 15.1.1.1. a through x.
15.1.1.3.	**Software Qualification Assurance Plan (SQAP)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.3., the SQAP shall include a description of the plan for assuring the MCP Configuration settings are established, maintained, verified, and comply with the approved software life cycle plans and standards. a. The SQAP shall include consideration for the verification of the correctness and completeness of the critical configuration settings, the traceability of these critical configuration settings to requirements, the compatibility of these critical configuration settings with the executable object code, and the qualification of any tools used to check for consistency of the configuration settings.
15.1.1.4.	**Software Configuration Management Plan (SCMP)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.4., the SCMP shall include a description of how the MCP Configuration settings will be managed throughout the software life cycle. The SCMP shall include consideration for the way the critical configuration settings are utilized, the assignment of software levels (DALs) for the critical configuration settings, and the processes for establishing, demonstrating and maintaining the critical configuration

Section Number	Deliverable/ Artifact	Description
		settings. This information may be included in the Configuration Management Plan in lieu of the SCMP.
15.1.1.5.	**Software Verification Plan (SVP)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.1.5., the SVP shall include: (1) A description of the detail plan for the verification of all software components hosted by the MCP Platform to meet their software requirements and design requirements; and have sufficient time to complete their execution. (2) Identification and description of any methods or tools needed, as well as their qualification requirements, due to the use of an MCP or the selected MCP architecture. (3) The plan for conducting the verification of the software component's adherence to the time budgets allocated to the MCP (e.g., memory, I/O, cache). (4) The plan for conducting the verification of the demands of the resources when executing on the target processor under worst-case scenarios. (5) The plan for verification of the use and allocations of the MCP shared resources, including shared cache. (6) The plan for verification that the data and control coupling between all of the individual software components hosted on the same core or on different cores of the MCP has been exercised during the software requirement-based testing, including exercising any interfaces between the applications via shared memory and any mechanisms to control access to shared memory. (7) The plan for verification of the MCP configuration parameters of the final system design. (8) The plan for verification of the Worst-Case Execution Time (WCET) against the performance of the system to provide evidence that the WCET Analysis reflects the final system.

Section Number	Deliverable/ Artifact	Description
		(9) A plan for validation of the interference analysis against the performance of the system interference channels to provide evidence that the interference analysis accurately reflects the final system design. (10) The plan for the verification of all software components hosted on an MCP Platform that does not have Robust Partitioning, or for which both robust resource and time partitioning has not been verified, showing that the software components meet their software requirements and design requirements, function correctly, and have sufficient time to complete their execution while all of the software components hosted on that MCP Platform are executing in the final intended configuration. (11) Identification and description of the methods and tools to be used to demonstrate the performance requirements of all of the individual software components hosted on an MCP Platform that does not have Robust Partitioning, or for which both robust resource and time partitioning have not been verified, so as to meet the software airworthiness qualification requirements of the AQP. (12) The plan for verification of the appropriate means of mitigation that satisfies the functional, performance, and timing requirements of the system in the event of inadvertent alteration of the critical configuration settings of the MCP. (13) The plan for verification of the chosen means of mitigation, as appropriate, for each interference channel that could potentially affect the software applications hosted on the MCP cores [DALs A and B only]. (14) The plan for verification of the allocation of the resources of the MCP to the software applications hosted on the MCP, and the plan for the analysis and collection of measurement results used to demonstrate the demands of the resources when executing on the target processor under worst-case scenarios. (15) Identification of the level of testing that will be performed for the MCP, including the levels of integration for multiple CSCIs.

Section Number	Deliverable/ Artifact	Description
		(16) Identification of any unique requirements for the test environment utilized for the MCP platform. (17) The plan for the verification of the partitioning integrity of the MCP Platform that is utilizing Robust Partitioning. (18) The plan for the verification that the software components meet their timing requirements (deadlines) when the selected hardware dynamic features (e.g. inter-core interrupts) are activated for the MCP. (19) The plan for verification of the WCET against the performance of the system to provide evidence that the WCET analysis reflects the final system design, including WCET measured while the MCP is operating in an environment at the extremes of operational temperature, IAW the SSS.
15.1.2.1.	**System/Subsystem Specification (SSS)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.1., the SSS shall include: (1) Specification of the computer hardware requirements for the MCP, including the minimum number of cores and the MCP Platform software architecture. (2) Specification of the MCP resource utilization requirements, including processor capacity, memory capacity, cache utilization, and input/output capacity. (3) Specification of the MCP Platform software requirements regarding the use of operating systems, communications networks, and shared resources.
15.1.2.2.	**System/Subsystem Design Document (SSDD)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.2., the SSDD shall include: (1) The MCP platform (processor and avionics box level) design decisions, constraints, and considerations associated with the MCP configuration settings for the MCP interconnect and shared resources (such as cache, I/O, memory, etc.) that may result in an interference channel. (2) The MCP configuration settings that enable the hardware and software hosted on the MCP platform to satisfy the functional, performance and timing requirements of the system.

Section Number	Deliverable/ Artifact	Description
		(3) The MCP SSDD shall clearly and unambiguously define all interfaces between CSCIs, particularly those between the IMA platform software and the hosted IMA applications. (4) The SSDD shall identify the MCP's key interfaces and application program interfaces (APIs) in accordance with RTCA/DO-297 Section 2. (5) The allocation of the software components, e.g., CSCIs to the MCP cores. (6) The allocation of the software components to the MCP resource utilization including processor capacity, memory capacity, cache utilization, input/output capacity.
15.1.2.3.	**Software Requirements Specification (SRS)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.3., the SRS shall: (1) The SRS shall include derived safety requirements to address failure conditions and failure effects from hazard analyses, such as the SFMEA, based on the use of the MCP Platforms and their associated shared resources; [DAL A and DAL B only]. (2) The SRS shall include the requirements for the chosen means of mitigation for the interference channels [DAL A and DAL B only] (3) The SRS shall include the requirements for the MCP critical configuration settings which enable the software to satisfy the functional, performance, and timing requirements of the system [DAL A and DAL B only].
15.1.2.4.	**Interface Requirements Specification (IRS)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.4., the IRS shall: e. The IRS shall include requirements for Software interfaces between CSCIs or interfaces across partition boundary that are designed to ensure robust resource and time partitioning and to address mitigation of interference channels associated with the MCP platform.
15.1.2.5.	**Software Design Description (SDD)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.5., the SDD shall include:

Section Number	Deliverable/ Artifact	Description
		(1) The selected MCP Configuration Settings along with a detailed description of the analysis and justification of the design decisions supporting the selection of these critical configuration settings that will enable the hardware and the software hosted on the MCP to satisfy the functional, performance, and timing requirements of the system. (2) The identification of all the interference channels that could permit interference to affect the software applications hosted on the MCP cores and a detailed analysis of whether or not these interference channels require mitigation in the final intended configuration. (3) The identification of the classes of all interference channels, including those that do not require mitigation, for the selected final design configuration. (4) The design description for the chosen means of mitigation for the interference channels. (5) The detailed design description of how the MCP shared resources, such as shared cache, will be used and allocated. (6) The identification and documentation of the hardware dynamic features of the MCP device that will be active and a detailed description of how these features will be used. (7) The appropriate means of mitigation (e.g. secure boot or configuration confirmation) that satisfies the functional, performance, and timing requirements of the system in the event of inadvertent alteration (e.g., via single event upset) of the critical configuration settings of the MCP occurs and the design decisions and analysis that support the selected means of mitigation. (8) The failure modes analysis used to support the determination of the appropriate means of mitigation that satisfies the functional, performance, and timing requirements of the system in the event of inadvertent alteration of the critical configuration settings of the MCP. (9) The allocation of the resources of the MCP to the software applications hosted on the MCP, and the analysis and measurement results of the

Section Number	Deliverable/ Artifact	Description
		verification of the demands of the resources when executing on the target processor under worst-case scenarios for the selected final design configuration. (10) A description of the overall robustness aspects of the software design considerations that address failure effects, based on the use of the MCPs and their associated shared resources. (11) Identification of those failures that are contained within the Line Replaceable Unit (LRU) in which the MCP is hosted. (12) Identification of those failure effects that are not contained within the LRU in which the MCP is hosted, such that a 'safety net' external to the MCP may have to be utilized.
15.1.2.6.	**Interface Design Description (IDD)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.6., the IDD shall: a. The IDD shall include interface characteristics for the software interface design between CSCIs, board support packages, operating system(s) or interfaces across partition and/or core boundaries to ensure robust resource and time partitioning and to mitigate interference channels associated with the MCP platform.
15.1.2.8.	**Software Integration Test (SIT) Procedures (SITPr)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.8., the SITPr shall include: (1) Test cases and procedures that demonstrate all software components hosted by the MCP meet their software requirements and design requirements; functions correctly; and have sufficient time to complete their execution when hosted on the MCP Platforms with Robust Partitioning. (2) Test cases and procedures that demonstrate the software components compliance with the time allocations of the resources of the MCP for the software applications hosted on the MCP. (3) Test cases and procedures that demonstrate the demands of the resources when executing on the target processor under worst case scenarios.

Section Number	Deliverable/ Artifact	Description
		(4) Test cases and procedures that demonstrate the allocations of the MCP shared resources, including shared cache. (5) Test cases and procedures that demonstrate all software components hosted by MCP Platforms, that do not have Robust Partitioning or those where both robust resource and time partitioning has not been verified, meet their software requirements, design requirements function correctly and have sufficient time to complete their execution. (6) Test cases and procedures that demonstrate the MCP configuration parameters of the final system design. (7) Test cases and procedures for verification of the WCET against the performance of the system to provide evidence that the WCET Analysis reflects the final system design. (8) Test cases and procedures for verification of the interference analysis against the performance of the system interference channels to provide evidence that the interference analysis accurately reflects the final system design. (9) Test cases and procedures that demonstrate the chosen means of mitigation, as appropriate, for each interference channel that could potentially affect the software applications hosted on the MCP cores include configuration settings, interference channels and WCET. (10) Test cases that demonstrate the allocation of the resources of the MCP to the software applications hosted on the MCP, and the analysis and measurement results of the verification of the demands of the resources when executing on the target processor under worst case scenarios. (11) Robustness test cases that demonstrate the correct operation of the MCP in response to failure conditions, including the detection and proper selection of the mitigations, e.g. error and exception handlers. (12) Test cases and procedures for each level of testing required to demonstrate the associated MCP requirements. (13) Test cases and procedures for the verification of the partitioning integrity of the MCP Platform that is utilizing Robust Partitioning.

Section Number	Deliverable/ Artifact	Description
		(14) Test cases and procedures for the verification that the software components meet their timing requirements (deadlines) when the selected hardware dynamic features are activated for the MCP.
15.1.2.9.	**Software Test Description (STD)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.9., the STD shall include: (1) Test cases and procedures that demonstrate all software components hosted by the MCP meet their software requirements and design requirements; functions correctly; and have sufficient time to complete their execution when hosted on the MCP Platforms with Robust Partitioning. (2) Test cases and procedures that demonstrate the software components compliance with the time allocations of the resources of the MCP for the software applications hosted on the MCP. (3) Test cases and procedures that demonstrate the demands of the resources when executing on the target processor under worst case scenarios. (4) Test cases and procedures that demonstrate the allocations of the MCP shared resources, such as shared cache. (6) Test cases and procedures that demonstrate the MCP configuration parameters of the final system design. 7) Test cases and procedures for verification of the WCET against the performance of the system to provide evidence that the WCET Analysis reflects the final system design. (8) Test cases and procedures for verification of the interference analysis against the performance of the system interference channels to provide evidence that the interference analysis accurately reflects the final system design. (9) Test cases and procedures that demonstrate the chosen means of mitigation, as appropriate, for each interference channel that could potentially affect the software applications hosted on the MCP cores include configuration settings, interference channels and WCET.

Section Number	Deliverable/ Artifact	Description
		(10) Test cases that demonstrate the allocation of the resources of the MCP to the software applications hosted on the MCP, and the analysis and measurement results of the verification of the demands of the resources when executing on the target processor under worst case scenarios. (11) Test cases and procedures that demonstrate the correct operation of the MCP in response to failure conditions, including the detection and proper selection of the mitigations, e.g., error and exception handlers. (12) Test cases and procedures for each level of testing required to demonstrate the associated MCP requirements. (13) Test cases and procedures for the verification of the partitioning integrity of the MCP Platform that is utilizing Robust Partitioning. (14) Test cases and procedures for the verification that the software components meet their timing requirements (deadlines) when the selected hardware dynamic features (e.g. inter-core interrupts) are activated for the MCP.
15.1.2.10.	**Software Traceability Data**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.2.10., the Requirements Traceability Matrix (RTM) or Database shall include a. the verification of each MCP software requirement with the STD test case identification number and summary of the test results that verify each MCP software requirement, including those associated with robustness.
15.1.3.1.	**Formal Qualification Test (FQT)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.3.1., the FQTs shall be performed on the target hardware, including the MCP Platform.
15.1.3.2.	**Software Change Impact Analysis (CIA)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.3.2., the software CIA shall ensure all impacts associated with changes to the MCP critical configuration settings and associated software changes are evaluated, mitigated and documented. Furthermore, the SCIA should be evaluated by systems engineering and systems safety to determine if there are any changes in the safety-related information, such as previously identified hazards, failure conditions,

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		allocation of DALs, and safety-related requirements. The SCIA will be used to establish the level of re-testing and qualification of the MCP software requirements.
15.1.3.3.	**Software Integration Test Report (SITR)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.3.3., the SITR shall include: (1) The summary results of data and control coupling analyses between all the individual software components hosted on the same core or on different cores of the MCP which were exercised during software requirement-based testing and/or system level testing as appropriate, including exercising any interfaces between the applications via shared memory and any mechanisms to control the access to shared memory, and that the data and control coupling is correct. (2) The detailed data and control coupling analyses, which may be either included in an Appendix or as a reference document in the SITR. (3) The analysis and/or measurement results of the verification of the demands of the resources when executing on the target processor under worst case scenarios including the WCET of the system. (4) The verification results of the MCP configuration settings of the final system design. (5) The verification results showing that all software components hosted by the MCP meet their software requirements and design requirements; functions correctly; and have sufficient time to complete their execution when hosted on the MCP Platforms with Robust Partitioning. (6) The verification results showing that the demands of the resources when executing on the target processor under worst case scenarios are in compliance with the specified allocations of the MCP shared resources, including shared cache. (7) The verification results showing that all software components hosted by MCP Platforms, that do not have Robust Partitioning or those where both robust resource and time partitioning has not been verified, meet their

Section Number	Deliverable/ Artifact	Description
		software requirements and design requirements, function correctly, and have sufficient time to complete their execution. (8) The verification results showing that validation of the WCET against the performance of the system to provide evidence that the WCET Analysis reflects the final system design. (9) The verification results showing that the interference analysis against the performance of the system interference channels accurately reflects the final system design. (10) the verification results showing how the software behaves in response to the identified failures and robustness test cases; (11) the verification results for those failure effects that are contained within the LRU in which the MCP is hosted; (12) the verification results showing the appropriate means of mitigation that satisfies the functional, performance, and timing requirements (including WCET) of the system in the event of inadvertent alteration of the critical configuration settings of the MCP; (13) the verification results showing the proper allocation of the resources of the MCP to the software applications hosted on the MCP, and the analysis and measurement results of the verification of the demands of the resources when executing on the target processor under worst-case scenarios; (14) the verification results showing the correct operation of the MCP in response to failure conditions; including the detection and proper selection of the mitigations, e.g. error and exception handlers and proper system safety nets response; (15) the verification results showing the software components meet their timing requirements (deadlines) when the selected hardware dynamic features are activated for the MCP; and (16) the verification results for those MCP failure effects within the LRU that are not contained within the LRU, such that an external ‘safety net’ may have to be utilized.

Section Number	Deliverable/ Artifact	Description
15.1.3.5.	**Software Test Report (STR)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.3.5., the STR shall include: (1) The summary results of data and control coupling analyses between all the individual software components hosted on the same core or on different cores of the MCP which were exercised during software requirement-based testing and/or system level testing as appropriate, including exercising any interfaces between the applications via shared memory and any mechanisms to control the access to shared memory, and that the data and control coupling is correct. (2) The detailed data and control coupling analyses, which may be either included in an Appendix of or as a reference document in the STR. (3) The analysis and/or measurement results of the verification of the demands of the resources when executing on the target processor under worst case scenarios. (4) The verification results of the MCP configuration settings of the final system design. (5) The verification results showing that all software components hosted by the MCP meet their software requirements and design requirements; function correctly; and have sufficient time to complete their execution when hosted on the MCP Platforms with Robust Partitioning. (6) The verification results showing that the demands of the resources when executing on the target processor under worst case scenarios are in compliance with the specified allocations of the MCP shared resources, including shared cache. (7) The verification results showing that all software components hosted by non- partitioned MCP Platforms meet their software requirements and design requirements function correctly and have sufficient time to complete their execution. (8) The verification results showing that analysis of the WCET against the performance of the system to provide evidence that the WCET Analysis reflects the final system design.

Section Number	Deliverable/ Artifact	Description
		(9) The verification results showing that the interference analysis against the performance of the system interference channels accurately reflects the final system design. (10) The verification results showing how the software behaves in response to the identified failures and robustness test cases. (11) The verification results for those failure effects that are contained within the LRU in which the MCP is hosted [DAL A and DAL B only]. (12) The verification results showing the appropriate means of mitigation that satisfies the functional, performance, and timing requirements (including WCET) of the system in the event of inadvertent alteration of the critical configuration settings of the MCP occurs. (13) The verification results showing the proper allocation of the resources of the MCP to the software applications hosted on the MCP, and the analysis and measurement results of the verification of the demands of the resources when executing on the target processor under worst case scenarios. (14) The verification results showing the correct operation of the MCP in response to failure conditions; including the detection and proper selection of the mitigations, e.g. error and exception handlers and proper system safety nets response [DAL A and DAL B only]. (15) The verification results showing the software components meet their timing requirements (deadlines) when the selected hardware dynamic features (e.g. inter-core interrupts) are activated for the MCP. (16) the verification results for those MCP failure effects within the LRU that are not contained within the LRU, such that an external 'safety net' may have to be utilized.
15.1.4.1.	**Software Version Description (SVD)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.1., the SVD shall: e. The SVD shall identify the final MCP Configuration settings for the final Design.

Section Number	Deliverable/ Artifact	Description
		f. The SVD shall identify any known or potential problems with the mitigation of interference channels. g. The SVD shall include the identification of all data used to produce the final software for the MCP, including tools used: to demonstrate the software, maintain the software, manage the MCP device hardware requirements, and the development environment. i. The SVD shall identify any unique software installation instructions for ensuring compatibility and interoperability with the MCP Platform.
15.1.4.2.	**Software Product Specification (SPS)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.2., the SPS shall include: (1) The selected MCP parameter data items, including critical configuration settings along with a detailed description of the analysis and justification of the design decisions supporting the selection of these parameter data items and critical configuration settings for the final MCP design. (2) The identification of all the interference channels that could permit interference to affect the software applications hosted on the MCP cores and a detailed analysis of whether or not these interference channels require mitigation in the final MCP design configuration. (3) The identification of all interference channels, including those that do not require mitigation, for the final MCP design configuration. (4) The final detailed design description of how MCP shared resources, such as shared cache are used and allocated. (5) The allocations for the MCP shared resources for the final MCP design. (6) The identification and documentation of the hardware dynamic features of the MCP device that will be active and a detailed description of how these features are used for the final MCP design. (7) A description of the overall robustness characteristics or considerations of the software design that address failure effects, the use of the MCP Platforms and their associated shared resources for the final MCP design. (8) The appropriate means of mitigation that satisfies the functional, performance, and timing requirements of the system in the event of

Section Number	Deliverable/ Artifact	Description
		inadvertent alteration of the critical configuration settings of the MCP and the design decisions and analysis that support the selected means of mitigation for the final MCP design. (9) The failure modes analysis used to support the determination of the appropriate means of mitigation that satisfies the functional, performance, and timing requirements of the system in the event of inadvertent alteration of the critical configuration settings of the MCP for the final MCP design. (10) The design description for the chosen means of mitigation for the interference channels for the final MCP design. (11) The allocation of the resources of the MCP to the software applications hosted on the MCP, and the analysis results of the verification of the demands of the resources when executing on the target processor under worst-case scenarios for the final MCP design configuration. (12) An analysis of the current errata for the MCP, including documentation on how all existing errata may or may not influence behavior of the MCP, and evidence that any errata that negatively impacts the behavior of the MCP in the defined usage domain are mitigated.
15.1.4.11.	**Software Accomplishment Summary (SAS)**	In addition to the airworthiness requirements and substantiation identified in AMACC paragraph 15.1.4.11., the SAS shall include: d. The SAS shall communicate to potential users any limitations for re-use of the MCP and/or limitations of the MCP as an IMA platform to host third party applications in a manner consistent with the objectives of RTCA/DO-297. (1) The timing and memory margin analysis summary for the available resources, including cache, main memory, and input/output of the MCP and its interconnect in the final configuration, the allocation of the resources of the MCP to the software applications hosted on the MCP, and the analysis and measurement results of the verification of the demands of the resources, when executing on the target processor under routine, interrupt, and WCET scenarios, or based on the worst-case execution path(s) through the software.

Section Number	Deliverable/ Artifact	Description
		(2) The WCET analysis summary based on the utilization of the available resources e.g. cache, main memory, and interconnects of the MCP for the final design configuration, the allocation of the resources of the MCP to the software applications hosted on the MCP, and the analysis and measurement results of the verification of the demands of the resources when executing on the target processor under worst-case scenarios or based on the worst-case execution path(s) through the software. (3) A summary description of how the software airworthiness qualification requirements of this AQP have been satisfied; including those that relate to incremental acceptance. (4) A summary description of the MCP critical configuration settings and the verification of the MCP critical configuration settings with appropriate reference to the detailed description of the MCP critical configuration settings and their verification analysis. (5) The final analysis of the software related hazards for the MCP, the evidence that the hazards associated with the MCP are controlled, that the MCP meets the safety related requirements, and that the residual risks associated with the MCP are acceptable.

15.1.1. Software Planning Process Artifacts

15.1.1.1. Plan for Software Aspects of Certification (PSAC)

The purpose of the PSAC is to provide a high-level description of the overall project and describe how the software level(s) proposed are consistent with the outputs of the system safety assessment process and how other life cycle data will satisfy the objectives of DO-178C and applicable supplements. It also provides a summary of the other plans which address the development, verification, configuration management, and quality assurance of the software.

Criteria:
The PSAC provides a high-level description of the overall project and a summary of the plans for the development, configuration management, verification, and software quality assurance of the software for the approved level of rigor assigned to the software, based on its architecture considerations and utilization within the equipment, systems, and aircraft operating requirements. A PSAC is developed, documented, placed under configuration control, and implemented.

Standard:
RTCA/DO-178C Section 11.1.
RTCA/DO-255

Method of Compliance:
Provide and demonstrate the PSAC is complete and consistent in addressing a software lifecycle that identifies the processes, activities, artifacts, and products for the assigned software level(s) for each computer software configuration item (CSCI) IAW RTCA/DO-178C, Section 11.1.

A PSAC shall be prepared IAW DI-SESS-82336 and RTCA/DO-178C Section 11.1. The PSAC shall include: an overview of the system, an overview of the software, the software airworthiness qualification considerations, a summary of the software lifecycle processes, the planned software products and artifacts/data, the planned schedule, and any additional considerations that may affect the airworthiness qualification process. The PSAC shall address the summary plan for providing access to all artifacts, data required to support the use of digital engineering and the selected or approved system/software development processes, including model-based systems engineering, agile development methodology.

The PSAC shall include processes and activities performed and data produced in accordance with any RTCA/DO-178C supplement (RTCA/DO-330, RTCA/DO-331, RTCA/DO-332, and RTCA/DO-333).

For IMA systems, the PSAC shall identify the overall approach to the assignment of objectives to the responsible stakeholder(s) per the guidance of DO-297 and AC 20-148. The PSAC shall identify when airworthiness objectives and/or AQP requirements will be partially satisfied as described in AC 20-148 Section 5(a). The PSAC shall document any test requirements or DO-178C objectives that ‘partial’ or ‘no

credit' will be sought by the IMA platform developer or the IMA application developer. The PSAC shall also include a summary/high level description of the plan for addressing the following additional considerations for MCP, which are further addressed in the Advisory Circular (AC) 20-193, Use of Multi-core Processors, and using considerations of DO-255 Requirements Specification for Avionics Computer Resource (ACR) that go along with the AC 20-193 Paper for Multi-Core Processors (MCP). The objectives of DO-178C for airborne systems and DO-278 for ground control stations and flight planning systems shall be met. The CCDC AvMC Airworthiness Authority requires the developer to meet all of the software process objectives, related activities, outputs and equivalent life cycle data of RTCA/DO-178C or DO-278, as applicable and their related supplements or annexes, with approved tailoring by the Airworthiness Authority.

The airworthiness substantiation shall include a PSAC prepared IAW DI-SESS-82336 and RTCA/DO-178C Section 11.1.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-255 RTCA/DO-297 RTCA/DO-278 RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115 AC 20-170 AC 20-193 AC 20-148		

15.1.1.2. Software Development Plan (SDP)

The purpose of the SCMP is to provide the acquirer/developer insight into, and a tool for monitoring, the processes to be followed for software development including requirements, design, code and integration phases (DO-178C Table A-2), the methods to be used, the approach to be followed for each activity, the project schedules, organizational structure, and resource requirements. Additionally, the SDP briefly describes the verification requirements, design, code, and integration (DO-178C Tables A-3 through A-5).

Criteria:

The SDP includes a description of the contractor's management organization, work plan for the software development effort, processes, procedures, development environment, and standards to be followed in its implementation, as well as the identification of artifacts and products for the approved level of rigor assigned to the software, based on its architecture considerations and utilization within the equipment, systems, and aircraft operating requirements. An SDP is developed, documented, placed under configuration control, and implemented.

Standard:

RTCA/DO-178C Section 11.2.

Method of Compliance:
Provide and demonstrate the SDP is complete and consistent in addressing a software lifecycle that identifies the processes, activities, artifacts, and products for the assigned software level(s) for each CSCI IAW DI-IPSC-81427 and RTCA/DO-178C Section 11.2.

The SDP shall address the detailed plan for providing access to all artifacts, data required to support the use of digital engineering and the selected or approved system/software development processes, including model-based systems engineering, agile development methodology.

An SDP shall be prepared IAW DI-IPSC-81427 and shall address all items in RTCA/DO-178C Section 11.2.

a. The SDP shall describe how the Developer will develop, conduct, manage, and monitor all software related activities.

b. The SDP shall address the handling of any safety critical software to include the documentation, the flow down of all identified hazards mitigated by software to software safety requirements, safety requirements to the source code, up through system level testing.

c. The SDP shall address the developer software safety program.

d. The safety program described in the SDP shall address the software hazards analysis and tracking system to be used on the program.

e. The SDP shall include references to the Software Standards that will be utilized.

f. The SDP shall address standards, tools, and methods used to meet the identified cybersecurity requirements in paragraph 20.1. of the AMACC.

g. The SDP shall address the modeling method(s), modeling language(s), and modeling tool(s) to be used.

The airworthiness substantiation shall include an SDP prepared IAW DI-IPSC-81427 and RTCA/DO-178C Section 11.2.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.1.3. Software Quality Assurance Plan (SQAP)
The purpose of the SQAP is to provide the software quality team's plan complete coverage of all the information, instructions and documentation necessary for assuring that the software complies with the approved plans and standards as well as the DO-178C objectives. The SQAP is to identify the project's quality-related objectives, to describe how achievement of these objectives will be measured and to describe the quality-related processes that will be used to assure that the objectives are achieved. The SQAP includes the organization of the software quality assurance team within the overall company and emphasizes their independence.

Criteria:
The SQAP includes a description of the contractor's quality team's organization and the level of the team's independence within the company organization, the team's plan for complete coverage of all the information, instructions and documentation necessary for assuring that the software complies with the approved level of rigor assigned to the software, based on its architecture considerations and utilization within the equipment, systems, and aircraft operating requirements. A SQAP is developed, documented, placed under configuration control, and implemented.

Standard:
RTCA/DO-178C Section 11.5.

Method of Compliance:
Provide and demonstrate the SQAP is complete and consistent in addressing a software lifecycle that identifies the processes, activities, artifacts, and products for the assigned software level(s) for each CSCI IAW RTCA/DO-178C Section 11.5.

A SQAP IAW DI-MISC-80508 and RTCA/DO-178C Section 11.5. shall be developed.

a. The software quality assurance process and lifecycle objective evidence shall be recorded and made available to the government to support contractual requirements and be available for review during all phases of the developer's performance.

b. Provisions shall be made to permit Government representatives to review procedures and data during all phases of the developer's performance.

c. Software quality metrics shall be provided in the quality assurance artifacts.

d. Existing software quality data collection and reporting formats shall be made available to the Government for evaluation.

e. The status of problem reports (open and closed) shall be provided electronically every two weeks through the IPT. All software problems shall be tracked from identification to correction.

The airworthiness substantiation shall include a SQAP prepared IAW DI-MISC-80508 and RTCA/DO-178C Section 11.5.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115 AC 20-193		

15.1.1.4. Software Configuration Management Plan (SCMP)

The purpose of the SCMP is to describe the organization, procedures, and controls of the Developer's CM program and how to manage the configuration of the life cycle data throughout the software development and verification effort. Software configuration management begins during the planning phase and continues throughout the entire software life cycle – all the way through deployment, maintenance, and retirement of the system.

Criteria:

The SCMP includes a description of the contractor's CM organization, procedures, and controls of the contractor's CM program and how the contractor will manage the configuration of the life cycle data throughout the software development and verification effort for the approved level of rigor assigned to the software, based on its architecture considerations and utilization within the equipment, systems, and aircraft operating requirements. A SCMP is developed, documented, placed under configuration control, and implemented.

Standard:

RTCA/DO-178C Section 11.4.
RTCA/DO-331 Section MB.11.4.

Method of Compliance:

Provide and demonstrate the SCMP is complete and consistent in addressing the software configuration management processes, activities, artifacts, and products for the assigned software level(s) for each CSCI IAW RTCA/DO-178C Section 11.4. and RTCA/DO-331 Section MB.11.4., as appropriate.

A SCMP IAW RTCA/DO-178C Section 11.4. and RTCA/DO-331 Section MB.11.4. shall be developed. The software configuration management process and lifecycle objective evidence shall be recorded and be available for review during all phases of the developer's performance. This information may be included in the Configuration Management Plan in lieu of the SCMP.

The airworthiness substantiation shall include a SCMP prepared IAW DI-SESS-80858, RTCA/DO-178C Section 11.4. and RTCA/DO-331 Section MB.11.4., as appropriate.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.1.5. Software Test Plan (STP)
The purpose of the STP is to provide a description of the verification procedures to be used to satisfy the software verification process objectives for qualification testing of CSCIs and software systems. It describes the software test environment to be used for the testing, identifies the tests to be performed, and provides schedules for test activities.

Criteria:
The STP includes a description of the verification procedures, and test environment(s) that will be used to satisfy the software verification process objectives for qualification testing of CSCIs and software systems for the approved level of rigor assigned to the software, based on its architecture considerations and utilization within the equipment, systems, and aircraft operating requirements. A STP is developed, documented, placed under configuration control, and implemented.

Standard:
RTCA/DO-178C Section 11.3.

Method of Compliance:
Provide and demonstrate the STP is complete and consistent in addressing the verification of the software products for the assigned software level for each CSCI IAW RTCA/DO-178C Section 11.3 and DI-IPSC-81438.

The airworthiness substantiation shall include a STP IAW DI-IPSC-81438 and DO-178C paragraph 11.3.

a. The STP shall describe the plans for qualification testing of the software.

b. The STP shall also describe the software test environment to be used for the testing; identify the test to be performed, including traces necessary to ensure all software requirements, including security requirements, will be functionally tested, and provide schedules for test activities.

c. The STP shall address the method(s) that will be used to perform software regression testing, if required, for the safety requirements identified in the Software Requirements Specification (SRS). The scope of the regression test shall be justified by a formal Change Impact Analysis.

d. An STP is required for each CSCI to be integrated into the platform and each platform CSCI that was modified for the integration.

e. The STP shall address describe the procedures for achieving requirements-based test coverage analysis, requirements-based structural coverage analysis, including data and control coupling analyses.

f. The STP shall address model traceability analysis, model coverage criteria, and model coverage analysis

g. The STP shall address model simulation methods, including the method for selecting simulation cases, simulation procedures to be used, and simulation data to be produced.

h. The STP shall include a description of the model simulation environment and tools, and the guidance for applying these tools.

i. The STP shall include the following additional verification considerations for MCP:

(1) A description of the detail plan for the verification of all software components hosted by the MCP Platform to meet their software requirements and design requirements; and have sufficient time to complete their execution.

(2) Identification and description of any methods or tools needed, as well as their qualification requirements, due to the use of an MCP or the selected MCP architecture.

(3) The plan for conducting the verification of the software component's adherence to the time budgets allocated to the MCP (e.g., memory, I/O, cache).

(4) The plan for conducting the verification of the demands of the resources when executing on the target processor under worst-case scenarios.

(5) The plan for verification of the use and allocations of the MCP shared resources, including shared cache.

(6) The plan for verification that the data and control coupling between all of the individual software components (1) A hosted on the same core or on different cores of the MCP has been exercised during the software requirement-based testing, including exercising any interfaces between the applications via shared memory and any mechanisms to control access to shared memory.

(7) The plan for verification of the MCP configuration parameters of the final system design.

(8) The plan for verification of the Worst-Case Execution Time (WCET) against the performance of the system to provide evidence that the WCET Analysis reflects the final system.

(9) A plan for validation of the interference analysis against the performance of the system interference channels to provide evidence that the interference analysis accurately reflects the final system design.

(10) The plan for the verification of all software components hosted on an MCP Platform that does not have Robust Partitioning, or for which both robust resource and time partitioning has not been verified, showing that the software components meet their software requirements and design requirements, function correctly, and have sufficient time to complete their execution while all of the software components hosted on that MCP Platform are executing in the final intended configuration.

(11) Identification and description of the methods and tools to be used to demonstrate the performance requirements of all of the individual software components hosted on an MCP Platform that does not have Robust Partitioning, or for which both robust resource and time partitioning have not been verified, so as to meet the software airworthiness qualification requirements of the AQP.

(12) The plan for verification of the appropriate means of mitigation that satisfies the functional, performance, and timing requirements of the system in the event of inadvertent alteration of the critical configuration settings of the MCP.

(13) The plan for verification of the chosen means of mitigation, as appropriate, for each interference channel that could potentially affect the software applications hosted on the MCP cores [DALs A and B only].

(14) The plan for verification of the allocation of the resources of the MCP to the software applications hosted on the MCP, and the plan for the analysis and collection of measurement results used to demonstrate the demands of the resources when executing on the target processor under worst-case scenarios.

(15) Identification of the level of testing that will be performed for the MCP, including the levels of integration for multiple CSCIs.

(16) Identification of any unique requirements for the test environment utilized for the MCP platform.

(17) The plan for the verification of the partitioning integrity of the MCP Platform that is utilizing Robust Partitioning.

(18) The plan for the verification that the software components meet their timing requirements (deadlines) when the selected hardware dynamic features (e.g. inter-core interrupts) are activated for the MCP.

(19) The plan for verification of the WCET against the performance of the system to provide evidence that the WCET analysis reflects the final system design, including WCET measured while the MCP is operating in an environment at the extremes of operational temperature, IAW the SSS.

The airworthiness substantiation shall include a STP prepared IAW DI-IPSC-81438 and RTCA/DO-178C Section 11.3.

Additional Information

Comm Doc's	DoD/MIL Doc's	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		CAST-32A AC 20-115 AC20-148		

15.1.1.6. Software Verification Plan (SVP)
The purpose of the SVP is to provide a description of the verification procedures to be used to satisfy the software verification process objectives for qualification testing of CSCIs and software systems. It describes the software test environment to be used for the testing, identifies the tests to be performed, and provides schedules for test activities.

Criteria:
The SVP includes a description of the verification procedures, and test environment(s) that will be used to satisfy the software verification process objectives for qualification testing of CSCIs and software systems for the approved level of rigor assigned to the software, based on its architecture considerations and utilization within the equipment, systems, and aircraft operating requirements. An SVP is developed, documented, placed under configuration control, and implemented.

Standard:
RTCA/DO-178C Section 11.3.

Method of Compliance:
Provide and demonstrate the SVP is complete and consistent in addressing the verification of the software products for the assigned software level for each CSCI IAW RTCA/DO-178C Section 11.3. and DI-MISC-80508.

An SVP IAW DI-MISC-80508 and DO-178C paragraph 11.3. shall be developed.

a. The SVP shall describe the plans for qualification testing of the software.

b. The SVP shall also describe the software test environment to be used for the testing; identify the test to be performed, including traces necessary to ensure all software requirements, including security requirements, will be functionally tested, and provide schedules for test activities.

c. The SVP shall address the method(s) that will be used to perform software regression testing, if required, for the safety requirements identified in the Software

Requirements Specification (SRS). The scope of the regression test shall be justified by a formal Change Impact Analysis.

d. The SVP shall address each CSCI to be integrated into the platform and each platform CSCI that was modified for the integration.

e. The SVP shall address describe the procedures for achieving requirements-based test coverage analysis, requirements-based structural coverage analysis, including data and control coupling analyses.

f. The S SVP TP shall address model traceability analysis, model coverage criteria, and model coverage analysis.

g. The SVP shall address model simulation methods, including the method for selecting simulation cases, simulation procedures to be used, and simulation data to be produced.

h. The SVP shall include a description of the model simulation environment and tools, and the guidance for applying these tools.

The airworthiness substantiation shall include an SVP prepared IAW DI-IPSC-81438 and RTCA/DO-178C Section 11.3.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-193AC 20-115		

15.1.1.7. Software Transition Plan (STrP)

The purpose of the STrP is to identify the hardware, software, and other resources needed for life cycle support of deliverable software and to describe the developer's plans for transitioning deliverable items to the support agency.

Criteria:

The STrP will identify the hardware, software, and other resources needed for life cycle support of deliverable software and to describe the developer's plans for transitioning deliverable items to the support agency for the approved level of rigor assigned to the software, based on its architecture considerations and utilization within the equipment, systems, and aircraft operating requirements. A STrP is developed, documented, placed under configuration control, and implemented.

Standard:

IEEE 12207:2017

Method of Compliance:
Provide and demonstrate the STrP is complete and consistent in addressing the hardware, software, and other resources needed for transitioning the lifecycle support of the delivered software, artifacts, and products for the assigned software level(s) for each CSCI IAW DI-IPSC-81429.

A STrP IAW IEEE 12207:2017 Section 6.4.10. and DI-IPSC-81429 shall be developed. The STrP shall identify the hardware, software, and other resources needed for life cycle support of deliverable software.

The airworthiness substantiation shall include a STrP prepared IAW DI-IPSC-81429 and IEEE 12207:2017 Section 6.4.10.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
IEEE 15288:2023 or latest				

15.1.1.8. Software Requirements Standards
The purpose of the Software Requirements Standards is to provide a guide for the development team how to write effective and implementable high-level requirements, use the requirements management tool, perform traceability, handle derived requirements, and create requirements that meet the DO-178C and/or DO-331 criteria as appropriate. Note: If high-level requirements are expressed by a model, additional standards will be addressed in the Software Model Standards (see MB.11.23).

Criteria:
The Software Requirements Standards provides guidance for the development team in developing effective and implementable high-level requirements, using the requirements management tool, performing requirements traceability, and handling derived requirements that meet the DO-178C and/or DO-331 criteria as appropriate. A Software Requirements Standard is developed, placed under configuration control, and implemented.

Standard:
RTCA/DO-178C Section 11.6. and RTCA/DO-331 Section MB 11.23, if high-level requirements are expressed by a model.

Method of Compliance:
Provide and demonstrate the Software Requirements Standards are complete and consistent in addressing the rules, guidelines, and tools in the development and documentation of the high-level requirements of the software for each CSCI IAW RTCA/DO-178C Section 11.6. and if high-level requirements are expressed by a model, additional standards will be addressed in the Software Model Standards (See RTCA/DO-331 Section MB.11.23).

The Software Requirements Standards IAW DI-MISC-80508 and RTCA/DO-178C Section 11.6. shall be developed. These standards define the methods, rules, and tools to be used to develop the high-level requirements. The Software Requirements Standards may be included in the SDP.

The airworthiness substantiation shall include Software Requirements Standards prepared IAW DI-MISC-80508 and RTCA/DO-178C Section 11.6. and/or RTCA/DO-331 Section MB 11.23.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.1.9. Software Design Standards

The purpose of the Software Design Standards is to provide a guide for the team developing the design how to write effective and implementable design, use the design tools, perform traceability, handle derived low-level requirements, and create design data that meets the DO-178C criteria. Note: If low-level requirements and/or software architecture are expressed by a model, additional standards will be addressed in the Software Model Standards (see MB.11.23).

Criteria:

The Software Design Standards provide guidance for the development team in developing the design, documenting an effective and implementable design, using the design tools, performing traceability, handling derived low-level requirements, and creating design data that meets the DO-178C Section 11.7. and/or RTCA/DO-331 Section MB 11.23 criteria, as appropriate. A Software Design Standard is developed, placed under configuration control, and implemented.

Standard:

RTCA/DO-178C Section 11.7. and RTCA/DO-331 Section MB 11.23, if low-level requirements are expressed by a model.

Method of Compliance:

Provide and demonstrate the Software Design Standards are complete and consistent in addressing the rules, guidelines, and tools in the development and documentation of the architecture, detailed design, and low-level requirements of the software for each CSCI IAW RTCA/DO-178C Section 11.7. and if high-level or low-level requirements are expressed by a model, additional standards will be addressed in the Software Model Standards (See RTCA/DO-331 Section MB.11.23).

The Software Design Standards shall be developed IAW DI-MISC-80508, RTCA/DO-178C Section 11.7. and/or RTCA/DO-331 Section MB 11.23 criteria, as appropriate. These standards define the methods, rules, and tools to be used to develop the software architecture and low-level requirements. The Software Design Standards may be included in the SDP.

The airworthiness substantiation shall include Software Design Standards prepared IAW DI-MISC-80508, RTCA/DO-178C Section 11.7. and/or RTCA/DO-331 Section MB 11.23 criteria.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.1.10. Software Code Standards

The purpose of the Software Code Standard is to provide guidelines to the coders and to describe how to use the specific language properly, restrict parts of the language that might not be advisable to use in safety-critical domain, identify naming conventions, describe the use of global data, and develop readable and maintainable code.

Criteria:

The Software Code Standards provide guidance for the development team in implementing the design into source code, defining the programming language(s) used and acceptable subsets of the languages to use in safety-critical domain, identifying naming conventions, and identifications of conditions and constraints in coding conventions for the approved level of rigor assigned to the software. The Software Code Standards are developed, placed under configuration control, and implemented.

Standard:

RTCA/DO-178C Section 11.8.

Method of Compliance:

Provide and demonstrate the Software Code Standards are complete and consistent in addressing the programming languages, rules, guidelines, and tools in the implementation of the software for each CSCI IAW RTCA/DO-178C Section 11.8.

The Software Code Standards IAW DI-MISC-80508 and RTCA/DO-178C Section 11.8. shall be developed. These standards define the programming languages, methods, rules, and tools to be used to code the software. The software code standards shall include secure coding standards, practices and guidelines, and static code analysis methodology. The Software Code Standards may be included in the SDP.

The airworthiness substantiation shall include Software Code Standards prepared IAW DI-MISC-80508 and RTCA/DO-178C Section 11.8.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.1.11. Software Model Standards

The purpose of the Software Model Standards is to provide the guide for the developers to enable them to produce high quality and compliant models in a safety-critical domain ensuring that the software, generated using the model, performs as intended.

Criteria:

The Software Model Standards provide a description of the modeling techniques and tools that are used by the contractor for each type of model planned to be used for the project. The Software Model Standards include a definition of the modeling language used and any limitations on the use of the modeling language and the modeling tools IAW RTCA/DO-331 MB.11.23. The Software Model Standards are developed, placed under configuration control, and implemented.

Standard:

RTCA/DO-331 Section MB.11.23

Method of Compliance:

Provide and demonstrate the Software Model Standards are complete and consistent in addressing the modeling techniques and tools used in the model-based generation of the software and associated artifacts for each CSCI IAW RTCA/DO-331 Section MB.11.23.

The Software Model Standards IAW RTCA/DO-331 Section MB.11.23 shall be developed. The Software Model Standards may be included in the SDP.

The airworthiness substantiation shall include a Software Model Standards prepared IAW DI-MISC-80508 and RTCA/DO-331 Section MB.11.23. The Software Model Standards may be included in the SDP.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.2. Software Development Process Artifacts

15.1.2.1. System/Subsystem Specification (SSS)

The purpose of the SSS is to provide a description of what is to be produced by system given the inputs and constraints. The SSS is developed from analysis of higher-level system requirements, safety-related requirements, and system architecture. The SSS specifies the methods to be used to ensure that each requirement has been met.

Criteria:

The SSS is developed, baselined, placed under configuration control, and utilized. The SSS contains system/subsystem requirements that are verifiable and consistent with the documented system/subsystem architecture, properly allocated to the subordinate elements, and contain the appropriate bi-directional traceability, and also contains tagging for the system safety attributes.

Standard:

IEEE 12207:2017

Method of Compliance:

Provide and demonstrate the SSS is complete, consistent with the system/subsystem architecture and contain requirements that are verifiable, have been properly allocated to the subordinate elements and contain the appropriate bi-directional traceability.

A SSS IAW IEEE 12207:2017 and DI-IPSC-81431shall be developed.

a. The SSS shall specify the requirements for the system or subsystem, and the methods used to assure that each requirement has been met. The SSS shall specify the subsystem-level requirements. An SSS is required for each Integrated Modular Avionics (IMA) configuration.

b. The SSS shall distinguish all system safety requirements from the other system requirements.

The airworthiness substantiation shall include an SSS prepared IAW IEEE 12207:2017 and DI-IPSC-81431.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
IEEE 15288:2023 or latest				

15.1.2.2. System/Subsystem Design Document (SSDD)

The purpose of the SSDD is to define the system architecture and to serve as the blueprint for the software implementation phase. It describes both how the system will be put together and how it will perform the desired functionality, including the delegation of functions to software and/or hardware.

Criteria:
The SSDD is developed, baselined, placed under configuration control, and utilized; contains system/subsystem requirements that are verifiable and consistent with the documented system/subsystem architecture, properly allocated to the software and/or hardware and contain the appropriate bi-directional traceability; and tagging for the system safety attributes.

Standard:
IEEE 12207:2017

Method of Compliance:
Provide and demonstrate the SSDD is complete, consistent with the system/subsystem architecture and contains verifiable requirements, which are properly allocated to the software and /or hardware and contain the appropriate bi-directional traceability.

A SSDD IAW IEEE 12207:2017and DI-IPSC-81432 shall be developed.

a. The SSDD shall include the design of the system and its operational and support environments and describe the organization of the system as composed of Subsystems such as Hardware Configuration Items, CSCIs, and manual operations.

b. The SSDD shall include allocation of the system requirements to Subsystems that include computing hardware, software, and operations elements that comprise the system. When one system requirement is allocated to more than one of the system elements, the specific function must be specified that each of the system elements is required to perform (if applicable).

The airworthiness substantiation shall include a SSDD prepared IAW IEEE 12207:2017and DI-IPSC-81432.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
IEEE 15288:2023 or latest	JSSG 2008 JSSSEH			

15.1.2.3. Software Requirements Specification (SRS)
The purpose of the SRS is to provide a description of what is to be produced by software given the inputs and constraints. The SRS is developed from analysis of system requirements, safety-related requirements, and system architecture. The SRS specifies the high-level requirements, including derived requirements, for a CSCI and the methods to be used to ensure that each requirement has been met.

Criteria:
The System requirements allocated to software are identified, developed, placed under configuration control, and documented as software requirements for each CSCI in an SRS. All functional software requirements are accurate, consistent, documented, placed under configuration control, and utilized.

Standard:
RTCA/DO-178C Section 11.9.

Method of Compliance:
Provide and demonstrate the SRS for each CSCI is complete, consistent, and contains verifiable software requirements, with appropriate safety tagging, bi-directional traceability, and identification of the verification method.

An SRS IAW DI-IPSC-81433 and RTCA/DO-178C Section 11.9. shall be developed. High level requirements may be contained in a Specification Model, if used.

a. The SRS shall distinguish all software safety requirements from the other software requirements.

b. The SRS shall identify all derived requirements and provide justification for each.

c. The SRS shall specify the requirements the software performs and the methods to be used to ensure that each requirement has been met.

d. The SRS shall include a matrix that shows requirements traceability between the SRS and the higher-level specification, e.g. SSSs.

e. An SRS is required for each CSCI in the system.

f. All requirements that are planned to be tested shall be in the SRS or shall be submitted in updates to other SRSs.

g. The SRS shall identify and describe security controls implemented in order to address security risks identified as part of the software safety assessment. See NIST SP 800-53 for guidance on security control implementation based on FIPS 199 risk categorization.

Airworthiness substantiation shall include an SRS prepared IAW DI-IPSC-81433 and RTCA/DO-178C Section 11.9.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-297 RTCA/DO-278 RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115 AC 20-170 AC 20-193		

15.1.2.4. Interface Requirements Specification (IRS)
The purpose of the IRS is to provide required software interfaces between or among systems and components for given software items in the allocated baseline. The IRS

specifies the requirements, including derived requirements, imposed on one or more systems, subsystems, Hardware Configuration Items (HWCIs), CSCIs, manual operations, or other system components to achieve one or more interfaces among these entities.

Criteria:
The IRS specifies the high-level interface requirements, including derived requirements, imposed on one or more systems, subsystems, HWCIs, CSCIs, manual operations, or other system components to achieve one or more interfaces among these entities. All airworthiness-related hardware and software interfaces are defined, accurate, consistent, documented, placed under configuration control with their associated control and information flows established.

Standard:
RTCA/DO-178C Section 11.9.

Method of Compliance:
Provide and demonstrate the IRS for each specified interface is complete, consistent, and contains verifiable software requirements, with appropriate safety tagging, bi-directional traceability, and identification of the verification method.

An IRS IAW DI-IPSC-81434 and RTCA/DO-178C, paragraph 11.9. shall be developed.

a. The IRS shall distinguish all software safety requirements from the other software requirements.

b. The IRS shall provide justification for each derived requirement.

c. The software IRS shall specify the requirements imposed on the Hardware/Software Interface, and the interfaces between software.

d. An IRS is required for each CSCI that is part of the system.

The airworthiness substantiation shall include an IRS prepared IAW DI-IPSC-81434 and RTCA/DO-178C, paragraph 11.9.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.2.5. Software Design Description (SDD)
The purpose of the SDD is to define the software architecture and detailed low-level requirements (LLRs), including derived requirements, needed to serve as the blueprint

for the software implementation phase. It describes both how the software will be put together (architecture) and how it will perform the desired functionality (LLRs).

Criteria:
The SDD describes the design of the software, the software design decisions, the architectural design, the detailed design, and detailed LLRs. The SDD contains a complete, accurate, and consistent documentation of the software architecture. Detailed LLRs are defined, complete, accurate, consistent, and documented with a description of how the software will satisfy the high-level software requirements and how the requirements are allocated to processors and tasks in the SDD. The SDD is established, placed under configuration control, and utilized.

Standard:
RTCA/DO-178C Section 11.10.

Method of Compliance:
Provide and demonstrate the SDD for each CSCI is complete, consistent, and contains verifiable software LLRs and detailed design, with appropriate safety tagging, bi-directional traceability, and identification of the verification method.

A SDD IAW DI-IPSC-81435 and RTCA/DO-178C Section 11.10. shall be developed. The SDD shall describe the design of the software. The software architecture and low-level requirements may be contained in a Design Model which, if used, will be IAW RTCA/DO-331 Section MB.11.10.

a. The SDD shall trace to the SRS with special flags for the implementation of any safety software requirements.

b. The SDD shall identify all derived requirements and provide justification for each.

c. The SDD shall also describe software design decisions, the architectural design and detailed design (defined as the lowest software components that make up the CSCIs (e.g., Computer Software Units, Packages)) needed to implement the software.

d. The SDD shall include a matrix that shows where requirements from the corresponding SRS are designed into the software code.

e. An SDD is required for each CSCI in the system.

f. The SDD shall include an analysis to ensure no deactivated code can be executed on the target environment.

g. The SDD shall include a trace from higher level to lower levels of requirements where applicable, input/output description, resource limitations, design methods, and descriptions of the software components.

h. Auto generated graphical representations of software, (e.g., Simulink® or UML diagrams) shall be accompanied by written requirements or design description text. Graphical diagrams will be considered equal to the direct submittal of software code.

(1) Graphical control law diagrams shall be accompanied by textual requirements at a level of detail appropriate to define hand coded sections of the software. The graphical output is considered to be the design itself, and therefore, cannot be a requirement or a description/explanation of the design.

(2) Software containing cases (decision branches), signals, variables, states, and logic shall be described at an appropriate level of detail.

The airworthiness substantiation shall include an SDD prepared IAW DI-IPSC-81435 and RTCA/DO-178C Section 11.10.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254 RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115 AC 20-152 AC 20-193		

15.1.2.6. Interface Design Description (IDD)
The purpose of the IDD is to provide a full identification of both interface characteristics among the components and their interfaces with external entities such as other systems, hardware items, software items, and users.

Criteria:
The IDD specifies the detailed design for one or more interfaces between one or more CSCIs and other configuration items or critical items. All airworthiness-related hardware and software interfaces are defined and documented, and the associated control and information flows are established. The IDD is established, placed under configuration control, and utilized.
Standard:
RTCA/DO-178C, paragraph 11.10.

Method of Compliance:
Provide and demonstrate the IDD for each CSCI is complete, consistent, and contains verifiable software design requirements, with appropriate safety tagging, bi-directional traceability, and identification of the verification method.

An IDD IAW DI-IPSC-81436 and RTCA/DO-178C, paragraph 11.10. shall be developed. The IDD shall include interface design requirements to ensure mechanisms to mitigate interference channels associated with the MCP platform are included. The IDD describes the interface characteristics of one or more systems, subsystems, HWCIs,

CSCIs, manual operations, or other system components. If it is not included in the SDD, an IDD is required for each CSCI to be integrated into the platform, and each platform CSCI that was modified for the integration.

a. The IDD shall trace to the SRS/IRS with special flags for the implementation of any safety software requirements.

b. The IDD shall provide justification for each derived requirement.

The airworthiness substantiation shall include an IDD prepared IAW DI-IPSC-81436 and RTCA/DO-178C, paragraph 11.10.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.2.7. Database Design Description (DBDD)

The purpose of the DBDD is to provide the number of levels of database design and the names of those levels based on the design methodology including conceptual, internal, logical, and physical. The DBDD is a collection of related data elements and data element assemblies stored in one or more computerized files in a manner that can be accessed by users or computer programs via a database management system.

Criteria:

The DBDD specifies a collection of related data elements and data element assemblies stored in one or more computerized files in a manner that can be accessed by users or computer programs via a database management system. The DBDD is established, placed under configuration control, and utilized.

Standard:

IEEE 12207:2017

Method of Compliance:

Provide and demonstrate the DBDD is complete, consistent, correct, and contains verifiable software LLRs and database design elements, with appropriate safety tagging and bi-directional traceability.

The airworthiness substantiation shall include a DBDD IAW DI-IPSC-81437 and IEEE-12207:2017. The DBDD describes the design of a database and the software units used to access or manipulate the data in the database.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.2.8. Software Integration Test (SIT) Procedures (SITPr)
The purpose of the SITPr is to provide documentation as to how the software integration verification process activities are implemented. The SITPr includes test cases and procedures appropriately linked to their associated requirements. The SITPr also documents the minimum set of test cases necessary to test all safety-related requirements as part of the process of establishing a regression test baseline.

Criteria:
The SITPr includes test cases and procedures appropriately linked to their associated requirements and identifies the minimum set of test cases necessary to test all safety-related requirements as part of the process of establishing a regression test baseline. The SITPr is produced, placed under configuration control, and utilized during or as a result of the conduct of the SIT.

Standard:
RTCA/DO-178C section 11.13

Method of Compliance:
Provide and demonstrate the SITPr is complete, consistent, and correct.

The SITPr IAW DI-IPSC-81439 and RTCA/DO-178C Section 11.13. shall be developed.

a. The SITPr is used to demonstrate the requirements of the SSS according to specific plans for qualification, integration, and regression testing described in the SVP. The SITPr shall include all necessary test preparation to complete a successful Formal Qualification Test (FQT), which includes the analysis, test procedures, and test cases. The test procedures shall be detailed down to step-by-step instructions for how each test case is to be set up and executed, how the test results are evaluated, and the test environment to be used. The SIT shall describe the FQT environment, which shall be completed on the system representative/target/flight configuration. The SIT shall include a matrix that shows requirements traceability between the SSS and SITPr, pairing the requirement with the test case identification number and its associated test procedure.

b. A Software Safety Regression test shall be developed that includes test cases for each safety requirement identified in the SRS, in addition to tests that cover all changed software and any software affected by the change. The scope of the regression test shall be justified by a formal Change Impact Analysis (CIA). The Software Safety Regression Test shall be documented in the SITPr.

c. Computer scripts or other electronic forms of test procedures necessary for the execution of the SIT shall be delivered as part of the SITPr. Such data shall be accompanied by written descriptions of the procedures to permit government evaluation of the data.

Airworthiness substantiation shall include a SIT prepared IAW DI-IPSC-81439 and RTCA/DO-178C Section 11.13.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.2.9. Software Test Description (STD)

The purpose of the STD is to provide documentation as to how the software verification process activities are implemented. The STD includes test cases and procedures appropriately linked to their associated requirements. The STD also documents the minimum set of test cases necessary to test all safety-related requirements as part of the process of establishing a regression test baseline.

Criteria:

The STD includes the test preparations, test cases, and test procedures to be used to perform the qualification testing of the software. The STD includes test cases and procedures appropriately linked to their associated requirements and identifies the minimum set of test cases necessary to test all safety-related requirements as part of the process of establishing a regression test baseline for the qualification testing. The STD for each CSCI is produced, placed under configuration control, and utilized.

Standard:

RTCA/DO-178C section 11.13. and RTCA/DO-331 section MB.11.13

Method of Compliance:

Provide and demonstrate the STD for each CSCI is complete, consistent and correct and includes bi-directional traceability to the high-level requirements identified in the SRS, as well as a software safety regression tests for each safety tagged requirement in the SRS.

A STD IAW DI-IPSC-81439, RTCA/DO-178C Section 11.13. and RTCA/DO-331 Section MB.11.13. shall be developed. To implement the software testing objectives, two categories of test cases shall be included: normal range test cases and robustness (abnormal range) test cases.

a. The STD shall include the test preparations, test cases and test procedures with expected values and demonstrate statements to be used to perform qualification testing of the software.

b. A Software Test Description is required for each CSCI to be integrated into the platform and each platform CSCI that was modified for the integration.

c. The STD shall include a matrix that shows bi-directional requirements traceability between the SRS and the STD.

d. The STD shall distinguish (e.g., flag) all software safety tests from the other software tests.

e. A Software Safety Regression test shall be developed that includes test cases for each safety requirement identified in the Software Requirement Specification, in addition to tests that cover all changed software and any software affected by the change.

f. Computer scripts or other electronic forms of test procedures necessary for the execution of the STD shall be delivered as part of the STD. Such data shall be accompanied by written descriptions of the procedures to permit government evaluation of the data.

g. Simulation cases: The purpose of each simulation case, set of inputs, conditions, expected results, and pass/fail criteria.

h. Simulation procedures: The step-by-step instructions for how each simulation case is to be set up and executed, how the simulation results are evaluated, and the simulation environment to be used.

The airworthiness substantiation shall include a STD prepared IAW DI-IPSC-81439, RTCA/DO-178C Section 11.13. and/or RTCA/DO-331 Section MB.11.13. Items d and e, as appropriate.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.2.10. Software Traceability Data

The purpose of the Software Traceability Data is to provide trace data associations between life cycle data items contents to ensure that only the system requirements allocated to software and appropriate derived software requirements are documented in the SRS and are implemented and verified.

Criteria:
All software safety requirements for each CSCI have sufficient bi-directional traceability established for the software high-level requirements, low-level requirements (design), implementation (source code), and verification data. The Software Traceability Data is developed, documented, and placed under configuration control.

Standard:
RTCA/DO-178C Sections 5.5., 6.5., and 11.21 and RTCA/DO-331 Section MB.11.21 if utilizing a model representing high-level requirements or low-level requirements, and/or software architecture, traceability with the model.

Method of Compliance:
Provide and demonstrate that full requirements bi-directional traceability data is complete and consistent from the system level to the software requirements, design, source code, and verification data for all software levels.

The Software Traceability Data IAW RTCA/DO-178C Sections 5.5., 6.5., and 11.21 and DI-MISC-80508 shall be developed. The resulting data shall include the documentation showing requirements have been satisfied, and the tracing of re-used components has been completed by providing a Requirements Traceability Matrix (RTM). Note: If utilizing a model representing high-level requirements or low-level requirements, and/or software architecture, traceability with the model should provide the granularity to demonstrate System Requirements allocated to software and high level requirements, High-level requirements and low-level requirements, Low-level requirements and Source Code, Software Requirements and Test Cases, Test Cases and Test procedures, Test Procedures and test results the above IAW RTCA/DO-331 Section MB.11.21.

a. Each overridden or overloaded operation shall be traced to its corresponding requirement.

b. A complete trace of the software must be achieved. A rigorous process shall be in place to translate functional requirements to design.

c. A complete requirements verification of the software shall be achieved. A testing strategy shall be implemented to show testing robustness of the software being demonstrated.

d. Safety-related requirements and derived requirements shall be flagged throughout the traceability data.

The airworthiness substantiation shall include Software Traceability Data and a Report prepared IAW RTCA/DO-178C Sections 5.5., 6.5., and 11.21, RTCA/DO-331 Section MB.11.21, and DI-MISC-80508.

Note: If utilizing a model representing high-level requirements or low-level requirements, and/or software architecture, traceability with the model should provide the granularity to demonstrate the above.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254 RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115 AC 20-152		

15.1.3. Software Verification Process Artifacts

15.1.3.1. Formal Qualification Test (FQT)

The purpose of the FQT is to provide the test execution to demonstrate to the acquirer that a CSCI or a system meets its specified requirements by executing test cases and procedures, observing the responses, and recording the results. In addition to the functional run-for-record, the FQT includes testing used to establish structural coverage of the software.

Criteria:
All CSCIs are baselined prior to their release for FQT. The FQT is performed on the approved representative target/flight hardware, utilizing the approved STD for each CSCI. The FQT will be witnessed by representatives of the airworthiness authority, with requirements-based verification and analysis results documented in the STR.

Standard:
RTCA/DO-178C Section 11.14

Method of Compliance:
Provide and demonstrate that the final configuration of each CSCI that is integrated in the operational flight program has been fully qualified and that all of their software requirements have been verified. Provide and demonstrate that all associated deliverables and artifacts associated with each CSCI and required for FQT are complete and baselined prior to FQT.

An FQT of the software utilizing the STD shall be performed.

a. The FQT shall provide data results that document all high-level and low-level software requirements have been verified.

b. The FQT shall provide data results that document the software structural coverage analysis objective, required for the assigned DAL, and has been achieved.

c. The test results shall be documented in a Software Test Report (STR) for each software item IAW DI-IPSC-81440 and RTCA/DO-178C Section 11.14.

d. If the FQT is for software that has been changed, at a minimum, regression testing shall be performed which includes at least one test case for each safety

requirement identified in the SRS, and verifies all software, test case or requirement changes. Results of the regression test shall be included in the STR.

e. The FQTs shall be performed on the target hardware, including the MCP Platform.

f. Test Readiness Reviews (TRR) shall be held prior to the start of formal qualification testing.

The airworthiness substantiation shall include a STR prepared IAW DI-IPSC-81440 and RTCA/DO-178C Section 11.14.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.3.2. Software Change Impact Analysis (CIA)
The purpose of the software CIA is to provide the approach for documenting the software life cycle data changed and affected by the change , the impact of these changes, and the verification activities needed to ensure that no adverse effects on the system, including system/software safety, are introduced during the change. The software CIA additionally substantiates the scope of change to an established software product baseline to permit partial (i.e. regression) verification of a new revision of the software product. The approval of the software CIA requires a review by systems engineering and system/software safety personnel.

Criteria:
The software CIA is produced and utilized in determining the scope of regression verification for revisions to the software CSCI , including the verification of the impacts/changes affecting systems engineering, systems safety/or software safety. The software CIA is performed and documented and placed under configuration control.

Standard:
RTCA/DO-178C Section 12.1.

Method of Compliance:
Provide and demonstrate the software CIA is complete, consistent and correct for the software CSCI approved changes.

In the event of software changes, a software CIA shall be developed IAW DI-MISC-80508 and RTCA/DO-178C Sections 12.1.1., 12.1.2., and 12.1.3. to ensure all impacts associated with the change are evaluated, mitigated and documented and that the changes are flowed to affected requirements, design, architecture, code and testing artifacts. The CIA shall assess if changes to the system affect security and if additional

security measures should be implemented. Furthermore, the SCIA should be evaluated by systems engineering and systems safety to determine if there are any changes in the safety-related information, such as previously identified hazards, failure conditions, allocation of DALs, and safety-related requirements. The airworthiness substantiation shall include a software CIA prepared IAW DI-MISC-80508 and RTCA/DO-178C Sections 12.1.1., 12.1.2., and 12.1.3.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115D AC 00-69 Section 3.1		

15.1.3.3. Software Integration Test Report (SITR)

The purpose of the SITR is to provide documentation of the results of a formal executed test event IAW documented and approved software integration test procedures, including all identified failures, re-tests, and test procedure alterations (i.e. redlines). Any discrepancies found should be recorded and tracked via problem reporting.

Criteria:

The SITR provides documentation of the results of a formally executed SIT IAW the approved SITPr. A SITR is produced and placed under configuration control.

Standard:

RTCA/DO-178C Section 6.4.
RTCA/DO-178C Section 11.14.

Method of Compliance:

Provide and demonstrate the SITR is complete, consistent and correct IAW RTCA/DO-178C Sections 6.4. and 11.14.

A SITR IAW DI-IPSC-81440 and RTCA/DO-178C Section 6.4. and 11.14. shall be developed.

a. The SITR shall be the record of the software qualification, integration, and regression testing performed. The SITR shall include the results of each test, the procedure used for the test, and a listing of the personnel that witnessed the test. The SITR shall include the configuration item or software version reviewed. The SITR shall include all structural coverage results and traceability analyses with test result.

The airworthiness substantiation shall include a SITR prepared IAW DI-IPSC-81440 and RTCA/DO-178C Section 6.4. and 11.14.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.3.4. System Integration Laboratory (SIL) Test

The purpose of the SIL Test is to verify correct integration of the software with the target hardware.

Criteria:

The SIL Test Report provides documentation of the results of a formally executed SIL Test, which is performed utilizing approved SIL Test Plan. The SIL Test Plan and SIL Test Report are produced and placed under configuration control.

Standard:

RTCA/DO-178C Section 6.4. and 11.14

Method of Compliance:

Provide and demonstrate the SIL Test Plan and SIL Test Report are complete, consistent, and correct.

The airworthiness substantiation shall include System Integration Laboratory testing. A System Integration Laboratory (SIL) Test Plan IAW DI-NDTI-80566 and a SIL Test Report IAW DI-NDTI-80809 shall be developed. The functionality of newly designed or modified equipment shall be tested, qualified and demonstrated in a qualified SIL. The airworthiness substantiation shall include comprehensive integration testing to ensure compliance with the newly designed or modified equipment design requirements. The system integration testing shall include, as a minimum, software, hardware interfaces, display and control functionality, man-in-the-loop demonstrations, and power interrupt testing. SIL integration testing for all safety-critical systems shall be performed prior to line pilot operational testing or fielding. Functional, laboratory, and system testing shall be required on all safety-critical systems.

The airworthiness substantiation shall include a SIL Test Plan prepared IAW DI-NDTI-80566 and a SIL Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.3.5. Software Test Report (STR)
The purpose of the STR is to provide documentation of the results of a formally executed test event IAW documented and approved software test procedures, including all identified failures, re-tests, and test procedure alterations (i.e. redlines). Any discrepancies found should be recorded and tracked via problem reporting.

Criteria:
The STR provides documentation of the results of a formally executed qualification test IAW the approved SVP. The STR is developed, documented, and placed under configuration control.

Standard:
RTCA/DO-178C Section 11.14.

Method of Compliance:
Provide and demonstrate the STR is complete, consistent and correct IAW RTCA/DO-178C Section 11.14.

A Software Test Report IAW DI-IPSC-81440 and RTCA/DO-178C Section 11.14. shall be developed. The STR shall be developed, maintained and provided as part of software laboratory out-briefs. The STR shall provide a summary of the results of all software test scripts that were run in support of the baseline testing. This should include total test points run, passed and failed as well as identification of the cause of each failure. The STR shall also include a cross reference matrix that correlates each software requirement tested with the manner it was tested. The provided STR shall include the following information:

a. The STR shall include the personnel that witnessed the test.

b. A STR is required for each CSCI that is developed or modified.

c. The STR shall include the PR/CRs derived from failed test cases, to include traceability of the PR/CR to the failed test case.

d. The STR shall include all structural coverage results, traceability analyses, type consistency analyses, and dynamic memory management verification.

e. The STR shall include the configuration of all models used.

The airworthiness substantiation shall include a STR prepared IAW DI-IPSC-81440 and RTCA/DO-178C Section 11.14.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115 AC 20-193		

15.1.3.6. Structural Coverage Analysis (SCA)
The purpose of the SCA is to provide an evaluation of the code structure, including interfaces, and to identify any code structure that was not exercised during the requirements-based testing. The SCA additionally documents that the requirements and tests used to evaluate code coverage are appropriate for the intended function of the system under evaluation.

Criteria:
SCA is performed for the requirements-based testing and the results are documented in the STR.

Standard:
RTCA/DO-178C Section 6.4.

Method of Compliance:
Provide and demonstrate that the SCA results from requirements-based testing are documented in the STR and that this report is complete, consistent and accurate for the approved software level for each CSCI.

The Test Coverage Analysis (TCA) of the software including SCA and model coverage in the STR IAW RTCA/DO-178C Sections 6.4.4., 6.4.4.1., 6.4.4.2., 6.4.4.3., and RTCA/DO-331 Section MB.6.7., and DI-IPSC-81440 shall be developed.

a. The Requirements-Based TCA shall be performed IAW RTCA/DO-178C Section 6.4.4.1. for the approved criticality level of that CSCI or software partition, as identified by the System Safety Assessment process.

b. The SCA for Requirements-Based Testing, e.g., FQT, shall be performed IAW RTCA/DO-178C Section 6.4.4.2. for the assigned criticality level of each CSCI or software partition, as identified by the System Safety Assessment process. The achieved level (percentage) of structural coverage shall be documented in the FQT STR for each CSCI along with any additional analyses and justifications for any identified gaps in the structural coverage. The selected method for demonstrating the SCA of the software shall be documented in the SDP or in the PSAC.

c. The SCA Resolution shall address all the items in RTCA/DO-178C Section 6.4.4.3.

The airworthiness substantiation shall include the TCA and SCA, which are documented in the STR IAW RTCA/DO-178C Section 6.4.4., 6.4.4.1., 6.4.4.2., 6.4.4.3., RTCA/DO-331 Section MB.6.7. and DI-IPSC-81440.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
NASA/TM-2001-210876 RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.4. Software Delivery Process Artifacts

15.1.4.1. Software Version Description (SVD)

The purpose of the SVD is to provide an identification and a description of the software product version in the life cycle environment for supporting software regeneration, reverification, or software modification. It is used to release, track, and control software version.

Criteria:

The SVD provides an identification and a description of the software product version, including a description of the problem reports, change proposals, and change notices associated with each change, and the effects of each change on the system operation, and on interfaces with other hardware and software. The SVD is produced for each CSCI, placed under configuration control, and is utilized IAW the software lifecycle.

Standard:

RTCA/DO-178C Section 11.15.
RTCA/DO-178C Section 11.16.
RTCA/DO-331 Sections MB.2.2.1.i through MB.2.2.1. o, MB.11.15, and MB.11.16

Method of Compliance:

Provide and demonstrate the SVD for each CSCI is complete, consistent, correct, and under configuration control.

An SVD IAW DI-IPSC-81442, RTCA/DO-178C Sections 11.15. and 11.16, and RTCA/DO-331 Sections MB.11.15. and MB.11.16. shall be developed. The SVD shall identify and describe a software version. The SVD identifies the problem reports, change proposals, and change notices associated with each change and the effects of each change on the system operation, and on interfaces with other hardware and software. An SVD is required for one or more CSCIs such that all CSCIs are under configuration control.

a. The SVD shall include the Software Lifecycle Environment Configuration Index IAW RTCA/DO-178C Section 11.15. and RTCA/DO-331 Section MB.11.15, and the Software Configuration Index IAW RTCA/DO-178C Section 11.16. requirements.

b. The SVD shall identify and describe a software version and shall be developed for any version of the system released for formal testing/production/fielding.

c. The SVD shall provide a plan for retaining the tools and artifacts related to the software, and for documenting the software development environment, such that software can be maintained across the lifecycle.

d. The SVD shall contain a list of all changes incorporated into the software version since the previous version.

e. The SVD shall address the software lifecycle data identified in section items MB.2.2.1.i through MB.2.2.1.o. If a software configuration index (SCI) exists and includes that data, a reference to this SCI in the SVD is considered sufficient.

The airworthiness substantiation shall include an SVD prepared IAW DI-IPSC-81442, RTCA/DO-178C Sections 11.15. and 11.16, and RTCA/DO-331 Sections MB.11.15. and MB.11.16.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115 AC 20-170 AC 20-193		

15.1.4.2. Software Product Specification (SPS)

The purpose of the SPS is to contain or provide references to the executable software, source files, and software support information, including “as built” design information and compilation, build, and modification procedures, for a CSCI.

Criteria:

The SPS contains the final version of the SDD and IDD ("As Built Design") the source code listings and the electronic source and executable code files. The SPS is produced for each CSCI, placed under configuration control, and is utilized IAW the software lifecycle. The SPS is developed and documented.

Standard:

RTCA/DO-178C Section 11.10.
RTCA/DO-178C Section 11.11
RTCA/DO-178C Section 11.12
RTCA/DO-178C Section 11.16
RTCA/DO-178C Section 11.22

Method of Compliance:
Provide and demonstrate the SPS for each CSCI is complete, consistent, correct, and under configuration control.

A SPS IAW DI-IPSC-81441 and RTCA/DO-178C Sections 11.10. thru 11.12., 11.16. and 11.22 shall be developed.

a. The SPS shall include executable software, parameter data files, source files, and software support information, including final design information and compilation, build, and modification procedures, for all CSCIs.

The airworthiness substantiation shall include a SPS prepared IAW DI-IPSC-81441 and RTCA/DO-178C Sections 11.10. thru 11.12., 11.16. and 11.22.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.4.3. Software Source Code
The purpose of Source Code is to prove that the software implementation correctly traces to and implements the design, properly implements the proposed software development standards.

Criteria:
The source code is produced, placed under configuration control, and utilized IAW the software lifecycle.

Standard:
RTCA/DO-178 Section 11.11

Method of Compliance:
Provide and demonstrate the source code is complete, consistent, and correct and under configuration control.

Software Source Code shall be documented IAW DI-IPSC-81488 and RTCA/DO-178C Section 11.11.

The airworthiness substantiation shall include Software Source Code prepared IAW DI-IPSC-81488 and RTCA/DO-178C Section 11.11.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.4.4. Software Problem/Change Report (PR/CR)
The purpose of the Software PR/CR is to identify and record the resolution to software product anomalous behavior, process non-compliance with software plans and standards, and deficiencies in software life cycle data.

Criteria:
The Software PR/CR contains an identification and record of the resolution to software product anomalous behavior, process non-compliance with software plans and standards, and deficiencies in software life cycle data. The Software PR/CR is produced, placed under configuration control, and utilized.

Standard:
RTCA/DO-178C Sections 7.2.3. & 11.17

Method of Compliance:
Provide and demonstrate Software PR/CR is complete, consistent, accurate, and contain the required information in regard to issues identified in the software lifecycle phases for the software, artifacts, tools and hardware IAW RTCA/DO-178C Sections 7.2.3. and 11.17.

A Software PR/CR IAW RTCA/DO-178C Section 7.2.3. and 11.17. and DI-MISC-80508 shall be prepared and maintained. The PR/CR shall be maintained through a software/change tracking database that addresses software problems and software safety issues.

a. A software defect management approach shall be documented in the SDP.

b. The defect history of any software delivered at any time shall be provided with that product.

The airworthiness substantiation shall include a Software PR/CR prepared IAW RTCA/DO-178C Section 7.2.3. and 11.17. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.4.5. Software Metrics (SM) Report

The purpose of the SM Report is to quantify various characteristics of the software. These metrics may be used to understand software maintainability, reliability, and/or performance.

Criteria:

The SM Report is produced and utilized to assess the memory, throughput margins for all processors, data channels, and storage devices. Sufficient capacity and design margin shall exist for all processors, data channels (I/O, buses, etc.), and data storage devices. For first fielding, 50% capacity shall exist for all processors, data channels (e.g. I/O, buses, etc.), and data storage devices.

Standard:

Processing rates and margins do not reach the peak/worst case, full loading rates and margins specified for the life cycle phase. At no time during the life cycle do the processing rates and margins degrade to an unacceptable level.

Method of Compliance:

Provide and demonstrate the SM Report is complete, consistent, and contains the required margins for all required metrics, including the memory, throughput margins for all processors, data channels, and storage devices.

The SM Report IAW DI-MISC-80508 and RTCA/DO-178C Section 11.10. shall be developed and maintained. The airworthiness substantiation shall collect, interpret and use software metrics to report: new, modified and total lines of code at the function allocation level; memory allocation, processor throughput, utilized and remaining processing resources for maximum system loading.

The airworthiness substantiation shall include a SM Report prepared IAW DI-MISC-80508 and RTCA/DO-178C Section 11.10.

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-255 RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333	JSSG 2008 JSSSEH	AC 20-115		

15.1.4.6. Software Configuration Management (SCM) Records

The purpose of the SCM Records is to provide the results of the software configuration management process activities including additional data used in the process, such as status accounting reports, release records, software library records, and baseline records. Examples of SCM Records for models include baseline records and model element library records.

Criteria:
SCM Records are developed, placed under configuration control, and documented.

Standard:
RTCA/DO-178C Section 11.18. and RTCA/DO-331 Section MB.11.18.

Method of Compliance:
Provide and demonstrate that the SCM Records are correct, complete, consistent, and verifiable.

The SCM Records IAW RTCA/DO-178C Section 11.18, RTCA/DO-331 Section MB.11.18. shall be developed and maintained, and if models are used, examples of SCM Records for models shall include baseline records and model element library records IAW RTCA/DO-331 Section MB.11.18.

The airworthiness substantiation shall include Software Configuration Management Records prepared IAW RTCA/DO-178C Section 11.18. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.4.7. Software Quality Assurance (SQA) Records

The purpose of the SQA Records is to provide evidence of software quality assurance involvement throughout the software development and verification effort. These may include software quality assurance review or audit reports, meeting minutes, records of authorized process deviations, or software conformity review records.

Criteria:
The SQA Records are developed, documented, maintained, placed under configuration control, and include completed checklists and/or audit reports for each software lifecycle phase.

Standard:
RTCA/DO-178C Section 11.19

Method of Compliance:
Provide and demonstrate the SQA Records are complete and contain checklists and/or audit reports for process reviews, compliance with lifecycle transition criteria, and all developed artifacts.

The SQA Records shall be developed and maintained IAW DI-MISC-80508 and RTCA/DO-178C Section 11.19.

The airworthiness substantiation shall include SQA Records prepared IAW DI-MISC-80508 and RTCA/DO-178C Section 11.19.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.4.8. Software Installation Plan (SIP)
The purpose of the SIP is to provide a plan for installing software at user sites, including preparations, user training, and conversion from existing systems.

Criteria:
The SIP provides a plan for installing software at user sites. The SIP is developed, documented, and placed under configuration control.

Standard:
IEEE 12207:2017

Method of Compliance:
Provide and demonstrate the SIP is complete and consistent in addressing the hardware, software, and other resources needed for installation of each CSCI IAW DI-IPSC-81428.

A SIP IAW IEEE 12207:2017 and DI-IPSC-81428 shall be developed.

The airworthiness substantiation shall include a SIP prepared IAW IEEE 12207:2017 and DI-IPSC-81428.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.4.9. Software Conformity Review

The purpose of the software conformity review is to provide assurance to the government that all software lifecycle processes have been completed.

Criteria:
The Software Conformity Review is held and evidence containing the results of the review are developed and documented.

Standard:
RTCA/DO-178C, Section 8.3.

Method of Compliance:
Provide and demonstrate the Software Conformity Review was held, conducted IAW RTCA/DO-178C Section 8.3. and documented.

A Software Conformity Review IAW RTCA/DO-178C Section 8.3. shall be conducted to obtain assurance that software life cycle processes are complete and shall document the results of the Software Conformity Review in the Software Accomplishment Summary (SAS).

The airworthiness substantiation shall include the results of the Software Conformity Review in the SAS prepared IAW RTCA/DO-178C Sections 8.3. and 11.20, and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.4.10. Software User Manual (SUM)

The purpose of the SUM is to provide documentation of the end-user operation of the software product to achieve the correct function of the software product as integrated and deployed to its use condition(s).

Criteria:
The SUM is produced and contains the appropriate information for the installation and operation of the software in the equipment, systems, and aircraft specified operating requirements. The SUM is developed, documented, and placed under configuration control.

Standard:
IEEE 1063-2001

Method of Compliance:
Provide and demonstrate the SUM is complete and consistent in addressing the end-user operation of the software product IAW DI-IPSC-81443.

A SUM shall be prepared IAW IEEE Std 1063-2001 and DI-IPSC-81443. The SUM shall provide all instructions and data required for a hands-on user to install, configure and operate a CSCI. The SUM for each CSCI shall define all configuration files and input parameters necessary to configure the software.

The airworthiness substantiation shall include a SUM prepared IAW IEEE Std-1063-2001 and DI-IPSC-81443.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115		

15.1.4.11. Software Accomplishment Summary (SAS)
The purpose of the SAS is to provide a summary of data items to show compliance to the plans and processes set forth in the PSAC. The SAS demonstrates to the Certification Authority that the objectives set forth in the planning documents have been achieved. Any deviation from the plans that has not been approved by the Certification Authority needs to be clearly described in the SAS.

Criteria:
The SAS contains a summary of all of the software lifecycle activities, artifacts, and compliance to the approved software plans, which address the acquisition, development, management, and verification of the software for the approved level of rigor assigned to the software, based on its architecture considerations and utilization within the equipment, systems, and aircraft operating requirements. The SAS is developed, documented, and placed under configuration control.

Standard:
RTCA/DO-178C Section 11.20

Method of Compliance:
Provide and demonstrate the SAS is complete and consistent in addressing the compliance of the software development processes with the approved software plans and standards and the completeness of the lifecycle processes, software, artifacts, and products for the assigned software level(s) for each CSCI IAW RTCA/DO-178C Section 11.20.

The airworthiness substantiation shall include a SAS IAW RTCA/DO-178C Section 11.20 and DI-SESS-82337.

a. The SAS shall show compliance of the software to the airworthiness requirements.

b. The SAS shall address all software aspects of the AQS to demonstrate how the software data and process show compliance to the AQS.

c. The SAS shall describe the degree of compliance with the PSAC and identify any differences from the PSAC.

d. The SAS shall summarize the work performed by all stakeholders to meet airworthiness objectives including those related to IMA incremental acceptance and define any remaining activities which much be satisfied.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254 RTCA/DO-297 RTCA/DO-278 RTCA/DO-178C RTCA/DO-330 RTCA/DO-331 RTCA/DO-332 RTCA/DO-333		AC 20-115 AC 20-152 AC 20-170 AC 20-193		

15.2. Programmable Hardware Artifacts

The airworthiness substantiation shall include the following programmable hardware engineering artifacts.

NOTE: References to “hardware” in Paragraph 15.2. relate to “Programmable Hardware” such as ASICs, FPGAs, and other Complex Hardware silicon devices as addressed in the RTCA/DO-254 and the FAA AC20-152 in which it is endorsed.

15.2.1. Programmable Hardware Planning Process Artifacts.

15.2.1.1. Plan for Hardware Aspects of Certification (PHAC)

The purpose of the PHAC is to provide a high-level description of the overall project, and to describe how the programmable hardware design assurance level of each function associated with the hardware item will be satisfied with the DO-254 (and applicable supplements) objectives.

Criteria:

The PHAC provides a high-level description of the overall project and a summary of the plans for the development, management, and verification of the programmable hardware for the approved level of rigor assigned to the programmable hardware, and aircraft operating requirements. A PHAC is developed and implemented.

Standard:
RTCA/DO-254 Section 10.1.1.

Method of Compliance:
Provide and demonstrate the PHAC is complete and consistent in addressing the programmable hardware lifecycle that identifies the processes, activities, artifacts, and products for the assigned programmable hardware level(s) for each programmable hardware configuration item (HWCI) IAW RTCA/DO-254 Section 10.1.1.

The PHAC shall address the summary plan for providing access to all artifacts, data required to support the use of digital engineering and the selected or approved system/programmable hardware development processes, including model-based systems engineering, agile development methodology.

A PHAC IAW DI-MISC-80508 and RTCA/DO-254 Section 10.1.1. shall be prepared.

The airworthiness substantiation shall include a PHAC prepared IAW DI-MISC-80508 and RTCA/DO-254 Section 10.1.1.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.1.2. Programmable Hardware Design Plan (PHDP)

The purpose of the PHDP is to provide the acquirer/developer information for the evaluation and monitoring of the processes and activities to be conducted for the design of the hardware item including requirements, design, code and integration phases, the methods to be used, the approach to be followed for each activity, and project schedules, organization, and resources.

Criteria:
The PHDP includes a description of the contractor’s management organization, work plan for the software development effort, processes, procedures, development environment, and standards to be followed in its implementation, as well as the identification of artifacts and products for the approved level of rigor assigned to the programmable hardware, and aircraft operating requirements. A PHDP is developed and implemented.

Standard:
RTCA/DO-254 Section 10.1.2.

Method of Compliance:
Provide and demonstrate the PHDP is complete and consistent in addressing the programmable hardware lifecycle that identifies the processes, activities, artifacts, and products for the assigned programmable hardware level(s) for each programmable hardware configuration item (HWCI) IAW RTCA/DO-254 Section 10.1.2.

The PHDP shall address the detailed plan for providing access to all artifacts, data required to support the use of digital engineering and the selected or approved system/programmable hardware development processes, including model-based systems engineering, agile development methodology.

The airworthiness substantiation shall include a PHDP prepared IAW DI-IPSC-81427 and RTCA/DO-254 Section 10.1.2.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.1.3. Programmable Hardware Process Assurance Plan (PHPAP)
The purpose of the PHPAP is to document the assurance plan describing the procedures, methods and standards to be applied, and the activities to be conducted for achieving the process assurance objectives of DO-254.

Criteria:
The PHPAP includes a description of the contractor's quality team's organization and the level of the team's independence within the company organization, the team’s plan for complete coverage of all the information, instructions and documentation necessary for assuring that the programmable hardware complies with the approved level of rigor assigned to the programmable hardware, and aircraft operating requirements. A PHPAP is developed and implemented.

Standard:
RTCA/DO-254 Section 10.1.6.

Method of Compliance:
Provide and demonstrate the PHPAP is complete and consistent in addressing the programmable hardware lifecycle that identifies the processes, activities, artifacts, and products for the assigned design level for each programmable HWCI IAW RTCA/DO-254 Section 10.1.6.

The airworthiness substantiation shall include a PHPAP prepared IAW DI-MISC-80508 and RTCA/DO-254 Section 10.1.6.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.1.4. Programmable Hardware Configuration Management Plan (PHCMP).
The purpose of the PHCMP is to document the configuration/change control management process and to ensure it is followed and is suitable to control programmable hardware supporting SCFs.

Criteria:
The PHCMP includes a description of the contractor's CM organization, procedures, and controls of the contractor’s CM program and how the contractor will manage the configuration of the life cycle data throughout the programmable hardware development and verification effort for the approved level of rigor assigned to the programmable hardware, and aircraft operating requirements. A PHCMP is developed and implemented.

Standard:
RTCA/DO-254 Section 10.1.5.

Method of Compliance:
Provide and demonstrate the PHCMP is complete and consistent in addressing the programmable hardware lifecycle that identifies the processes, activities, artifacts, and products for the assigned design level for each programmable HWCI IAW RTCA/DO-254 Section 10.1.5.

The airworthiness substantiation shall include a PHCMP prepared IAW DI-SESS-80858B and RTCA/DO-254 Section 10.1.5.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.1.5. Programmable Hardware Validation Plan (PHValP)
The purpose of the PHValP is to document the validation plan by describing the procedures, methods and standards to be applied and the activities to be conducted for the validation of the hardware item derived requirements to achieve the validation objectives of this document. This plan may be included in the PHAC and may reference validation standards to be applied.

Criteria:
The PHValP includes a description of the verification procedures, and test environment(s) that will be used to satisfy the programmable hardware verification process objectives for qualification testing of HWCIs and programmable hardware systems for the approved level of rigor assigned to the programmable hardware, and aircraft operating requirements. A PHValP is developed and implemented.

Standard:
RTCA/DO-254 Section 10.1.3.

Method of Compliance:
Provide and demonstrate the PHValP is complete and consistent in addressing the programmable hardware lifecycle that identifies the processes, activities, artifacts, and products for the assigned design level for each programmable HWCI IAW RTCA/DO-254 Section 10.1.3.

The airworthiness substantiation shall include a PHValP prepared IAW DI-IPSC-81438 and RTCA/DO-254 Section 10.1.3.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.1.6. Programmable Hardware Verification Plan (PHVerP)

The purpose of the PHVerP is to provide the verification plan describing the procedures, methods and standards to be applied and the processes and activities to be conducted for the verification of the programmable hardware items to achieve the verification objectives of DO-254. This plan may be included in the PHAC and may reference verification policies and standards to be applied.

Criteria:

The PHVerP includes a description of the procedures, methods, and standards to be applied and the processes and activities to be conducted for the verification of the programmable hardware items to meet the verification objectives of RTCA/DO-254 for the approved level of rigor assigned to the programmable hardware, and aircraft operating requirements. A PHVerP is developed and implemented.

Standard:

RTCA/DO-254 Section 10.1.4.

Method of Compliance:

Provide and demonstrate the PHVerP is complete and consistent in addressing the programmable hardware lifecycle that identifies the processes, activities, artifacts, and products for the assigned design level for each programmable HWCI IAW RTCA/DO-254 Section 10.1.4.

The airworthiness substantiation shall include a PHVerP prepared IAW DI-IPSC-81438 and RTCA/DO-254 Section 10.1.4.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.1.7. Programmable Hardware Transition Plan (PHTrP)

The purpose of the PHTrP is to identify the set of activities, the hardware and other resources needed for lifecycle support of deliverable programmable hardware and describe the developer’s plans for transitioning deliverable items to the support agency that enables responsibility for programmable hardware development to pass from one organization to another, usually the organization that will perform programmable hardware maintenance.

Criteria:
The PHTrP will identify the hardware, software, and other resources needed for life cycle support of deliverable programmable hardware and to describe the contractor's plans for transitioning deliverable items to the support agency for the approved level of rigor assigned to the programmable hardware, and aircraft operating requirements. A PHTrP is developed and implemented.

Standard:
IEEE 12207:2017

Method of Compliance:
Provide and demonstrate the PHTrP is complete and consistent in addressing the programmable hardware lifecycle that identifies the processes, activities, artifacts, and products for the assigned design level for each programmable HWCI.

A PHTrP IAW IEEE 12207:2017 and DI-IPSC-81429 shall be prepared. The PHTrP shall identify the hardware, software, and other resources needed for life cycle support of deliverable programmable hardware.

The airworthiness substantiation shall include a PHTrP IAW IEEE 12207:2017 and prepared IAW DI-IPSC-81429.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
IEEE 15288:2023 or latest RTCA/DO-254		AC 20-152		

15.2.1.8. Programmable Hardware Requirements Standards
The purpose of the Programmable Hardware Requirements Standards is to define the criteria for writing effective and implementable high-level requirements, use the requirements management tool, perform traceability, and to handle derived requirements.

Criteria:
The Programmable Hardware Requirements Standards provides guidance for the development team in developing effective and implementable high-level requirements, using the requirements management tool, performing requirements traceability, and handling derived requirements that meet the RTCA/DO-254 criteria. The Programmable Hardware Requirements Standards are developed and implemented.

Standard:
RTCA/DO-254 Section 10.2.1.

Method of Compliance:
Provide and demonstrate the Programmable Hardware Requirements Standards are complete and consistent in addressing the programmable hardware lifecycle that

identifies the processes, activities, artifacts, and products for the assigned design level for each programmable HWCI IAW RTCA/DO-254 Section 10.2.1.

The Programmable Hardware Requirements Standards IAW DI-MISC-80508 and RTCA/DO-254 Section 10.2.1. shall be prepared. These standards define the methods, rules, and tools to be used to develop the requirements. The Programmable Hardware Requirements Standards may be included in the PHDP.

The airworthiness substantiation shall include the Programmable Hardware Requirements Standards prepared IAW DI-MISC-80508 and RTCA/DO-254 Section 10.2.1.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.1.9. Programmable Hardware Design Standards

The purpose of the Programmable Hardware Design Standards is to provide a guide for the team to developing the design how to write effective and implementable design, use the design tools, perform traceability, handle derived low-level requirements, and create design data that meets the DO-254 criteria.

Criteria:

The Programmable Hardware Design Standards provides guidance for the development team in developing the design, documenting an effective and implementable design, using the design tools, performing traceability, handling derived low-level requirements, and creating design data that meets the RTCA/DO-254 Section 10.2.2. criteria. Programmable Hardware Design Standards are developed and implemented.

Standard:

RTCA/DO-254 Section 10.2.2.

Method of Compliance:

Provide and demonstrate the Programmable Hardware Design Standards are complete and consistent in addressing the programmable hardware lifecycle that identifies the processes, activities, artifacts, and products for the assigned design level for each programmable HWCI IAW RTCA/DO-254 Section 10.2.2.

The Programmable Hardware Design Standards IAW RTCA/DO-254 Section 10.2.2. and DI-MISC-80508 shall be prepared. These standards define the methods, rules, and tools to be used to develop the hardware design. The Programmable Hardware Design Standard may be included in the PHDP.

The airworthiness substantiation shall include Programmable Hardware Design Standards prepared IAW RTCA/DO-254 Section 10.2.2. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.1.10. Programmable Hardware Validation and Verification Standards

The purpose of the Programmable Hardware Validation and Verification Standards is to provide selected standard(s) to be used and defined rules, procedures, methods, guidance and criteria for validating and verifying the programmable hardware design and implementation.

Criteria:

The Programmable Hardware Validation and Verification Standards provide the rules, procedures, methods, guidance and criteria for validating and verifying the programmable hardware design and implementation for the approved level of rigor assigned to the programmable hardware, and aircraft operating requirements. Programmable Hardware Validation and Verification Standards are developed and implemented.

Standard:

RTCA/DO-254 Section 10.2.3.

Method of Compliance:

Provide and demonstrate the Programmable Hardware Validation and Verification Standards are complete and consistent in addressing the programmable hardware lifecycle that identifies the processes, activities, artifacts, and products for the assigned design assurance level for each programmable HWCI IAW RTCA/DO-254 Section 10.2.3.

The Programmable Hardware Validation and Verification Standards IAW DI-MISC-80508 and RTCA/DO-254 Section 10.2.3. shall be prepared. These standards define the methods, rules, and tools to be used to validate and verify the programmable hardware design and implementation. The Programmable Hardware Validation and Verification Standards may be included in the PHDP.

The airworthiness substantiation shall include Programmable Hardware Validation and Verification Standards prepared IAW DI-MISC-80508 and RTCA/DO-254 Section 10.2.3.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.1.11. Programmable Hardware Archive Standards

The purpose of the Programmable Hardware Archive Standards is to provide standards to be used to define the procedures, methods and criteria used to retain and archive product data and develop and maintain program and project archives. Programmable

Hardware Archive Standards may include archive content, format, and medium standards, rules, methods and criteria.

Criteria:
The Programmable Hardware Archive Standards provide a description of the procedures, methods and criteria used to retain and archive product data and develop and maintain program and project archives. Programmable Hardware Archive Standards are developed and implemented.

Standard:
RTCA/DO-254 Section 10.2.4.

Method of Compliance:
Provide and demonstrate the Programmable Hardware Archive Standard are complete and consistent in addressing the programmable hardware lifecycle that identifies the processes, activities, artifacts, and products for the assigned design level for each programmable HWCI IAW RTCA/DO-254 Section 10.2.4.

The Programmable Hardware Archive Standards IAW RTCA/DO-254 Section 10.2.4. and DI-MISC-80508 shall be prepared. The Programmable Hardware Archive Standards shall address all items in RTCA/DO-254 Section 10.2.4. These standards define the procedures, methods, and criteria used to retain and archive project data. The Programmable Hardware Archive Standards may be included in the PHDP.

The airworthiness substantiation shall include Programmable Hardware Archive Standards prepared IAW RTCA/DO-254 Section 10.2.4. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.2. Programmable Hardware Development Process Artifacts

15.2.2.1. Programmable Hardware Requirements Specification (PHRS)
The purpose of the PHRS is to define the hardware to be produced. The PHRS represents a decomposition of system requirements, safety-related requirements, and system architecture. The PHRS also specifies the verification methods to be used to ensure that each requirement has been met and identifies the safety critical requirements.

Criteria:
The PHRS specifies the high-level requirements, including derived requirements, for a programmable hardware item and the methods to be used to ensure that each requirement has been met. The System requirements allocated to a programmable hardware item are identified, developed, and documented. The PHRS is established, under configuration control and is utilized. A PHRS is developed and implemented.

Standard:
RTCA/DO-254 Section 10.3.1.

Method of Compliance:
Provide and demonstrate the PHRS is complete, consistent and correct IAW RTCA/DO-254 Section 10.3.1.

a. A PHRS IAW RTCA/DO-254 Section 10.3.1. and DI-IPSC-81433 shall be developed. The PHRS shall specify the functional, performance, safety, quality, maintainability, and reliability requirements for the hardware item being developed.

b. The PHRS shall distinguish all safety requirements from the other requirements.

c. The PHRS shall distinguish all derived requirements from the other requirements. The PHRS shall provide justification for each derived requirement.

The airworthiness substantiation shall include a PHRS prepared IAW RTCA/DO-254 Section 10.3.1. and DI-IPSC-81433.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.2.2. Programmable Hardware Design Description (PHDD)
The purpose of the PHDD is to provide a description of the programmable hardware design. It describes the architecture and the detailed design expressed as LLRs that define the programmable hardware implementation. It describes requirements for functionality (e.g., LLRs) as well as performance requirements.

Criteria:
The PHDD describes the design of the programmable hardware, the programmable hardware design decisions, the architectural design, the detailed design, and detailed LLRs. The PHDD contains a complete, accurate, consistent, and documentation of the hardware architecture and detailed LLRs, with a description of how the programmable hardware will satisfy the high-level requirements and how the requirements are allocated to the programmable hardware. The PHDD is established, under configuration control and is utilized. A PHDD is developed and implemented.

Standard:
RTCA/DO-254 Section 10.3.2.

Method of Compliance:
Provide and demonstrate the PHDD is complete, consistent and correct IAW RTCA/DO-254 Section 10.3.2.

a. A PHDD IAW RTCA/DO-254 Section 10.3.2. and DI-IPSC-81435 shall be developed. The PHDD shall describe the design of the programmable hardware.

b. The PHDD shall distinguish all safety requirements from the other requirements.

c. The PHDD shall distinguish all derived requirements from the other requirements. The PHDD shall provide justification for each derived requirement.

d. The PHDD shall include a matrix that shows requirements traceability between the PHDD and the higher-level specification, e.g. PHRS. This traceability shall verify that PHDD-level safety requirements trace to PHRS-level safety requirements.

The airworthiness substantiation shall include a PHDD prepared IAW RTCA/DO-254 Section 10.3.2. and DI-IPSC-81435.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.2.3. Programmable Hardware Interface Description (PHID)
The purpose of the PHID is to describe interface characteristics between components, and their interfaces to external systems, hardware items, software items, and users.

Criteria:
The PHID specifies the detailed design for one or more interfaces between one or more programmable HWCIs and other configuration items or critical items. All airworthiness-related hardware and software interfaces are defined and documented, and the associated control and information flows are established. The PHID is established, under configuration control and is utilized. A PHID is developed and implemented.

Standard:
RTCA/DO-254 Section 10.3.2.2.4.

Method of Compliance:
Provide and demonstrate the PHID is complete, consistent and correct IAW RTCA/DO-254 Section 10.3.2.2.4.

a. A PHID IAW RTCA/DO-254 Section 10.3.2.2.4. and DI-IPSC-81436 shall be developed. The PHID shall describe the requirements for interfaces between the programmable hardware and applicable software.

b. The PHID shall distinguish all safety requirements from the other requirements.

c. The PHID shall distinguish all derived requirements from the other requirements. The PHID shall provide justification for each derived requirement.

d. The PHID shall include a matrix that shows requirements traceability between the PHID and the higher-level specification, e.g. PHRS. This traceability shall verify that PHID-level safety requirements trace to PHRS-level safety requirements.

The airworthiness substantiation shall include a PHID prepared IAW RTCA/DO-254 Section 10.3.2.2.4. and DI-IPSC-81436.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.2.4. Programmable Hardware Review and Analysis Procedures (PHRAP)

The purpose of the PHRAP is to provide the approach for documenting the process and criteria for conducting reviews and analyses.

Criteria:

The PHRAP provides the approach for documenting the process and criteria for conducting reviews and analyses. The PHRAP is developed, placed under configuration control, and is utilized. A PHRAP is developed and implemented.

Standard:

RTCA/DO-254 Section 10.4.2.

Method of Compliance:

Provide and demonstrate the PHRAP is complete, consistent and correct IAW RTCA/DO-254 Section 10.4.2.

A PHRAP IAW RTCA/DO-254 Section 10.4.2. and DI-MISC-80508 shall be developed.

The airworthiness substantiation shall include a PHRAP prepared IAW RTCA/DO-254 Section 10.4.2. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.2.5. Programmable Hardware Test Procedures (PHTP)

The purpose of the PHTP is to provide the methods, environment and step-by-step instructions for conducting both functional and environmental qualification testing used for the verification of the programmable hardware item. It identifies items to be tested, the test equipment and support required, the test conditions to be imposed, the parameters to be measured, and the pass/fail criteria against which the test results will be measured. The document is a compilation of individual test procedures for related elements of a system, subsystem, or equipment.

Criteria:

The PHTP includes the test preparations, test cases, and test procedures to be used to perform the qualification testing of the programmable hardware. The PHTP includes test cases and procedures appropriately linked to their associated requirements and identifies the minimum set of test cases necessary to test all safety-related requirements as part of the process of establishing a regression test baseline for the

qualification testing. The PHTP for each programmable hardware item is produced, placed under configuration control, and utilized.

Standard:
RTCA/DO-254 Section 10.4.4.

Method of Compliance:
Provide and demonstrate the PHTP is complete, consistent and correct IAW RTCA/DO-254 Section 10.4.4.

A PHTP IAW RTCA/DO-254 Section 10.4.4. and DI-MISC-80508 shall be developed.

The airworthiness substantiation shall include a PHTP prepared IAW RTCA/DO-254 Section 10.4.4. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.2.6. Requirements Verification Matrix (RVM)
The purpose of the RVM is to provide trace data associations between the requirements, detailed design, implementation and verification data that facilitates configuration control, modification and verification of the hardware item.

Criteria:
The RVM is established, under configuration control and is utilized. An RVM is developed and implemented.

Standard:
RTCA/DO-254 Section 10.4.1.

Method of Compliance:
Provide and demonstrate the RVM is complete, consistent and correct IAW RTCA/DO-254 Section 10.4.1.

a. An RVM IAW RTCA/DO-254 Section 10.4.1. and DI-MISC-80508 for each FQT event shall be developed. The RVM shall demonstrate bi-directional tracing between system requirements and high-level hardware requirements; high-level requirements and low-level requirements; hardware requirements and test cases, reviews, and analyses; test cases and test procedures; test procedures, reviews, and analyses and test results.

b. Safety-related requirements and derived requirements shall be flagged (tagged) throughout the trace.

The airworthiness substantiation shall include an RVM prepared IAW RTCA/DO-254 Section 10.4.1. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.3. Programmable Hardware Validation and Verification Process Artifacts

15.2.3.1. Programmable Hardware Acceptance Test Criteria (PHATC)

The purpose of the PHATC is to provide the criteria and assessment data that the test and associated test results are capable of ensuring that an item is manufactured or repaired correctly.

Criteria:
The PHATC is established, under configuration control and utilized. A PHATC is developed and implemented.

Standard:
RTCA/DO-254 Section 10.5.

Method of Compliance:
Provide and demonstrate the PHATC is complete, consistent and correct IAW RTCA/DO-254 Section 10.5.

A PHATC IAW RTCA/DO-254 Section 10.5. and DI-MISC-80508 shall be developed.

The airworthiness substantiation shall include a PHATC prepared IAW RTCA/DO-254 Section 10.5. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.3.2. Programmable Hardware Review and Analysis Results (PHRAR)

The PHRAR provides a quantitative assessment of the item being analyzed, and any corrective actions generated as a result of review or analysis, to supply evidence that the reviews and analyses have been completed according to approved procedures and criteria.

Criteria:
The PHRAR report is established, placed under configuration control and utilized. A PHRAR is developed and implemented.

Standard:
RTCA/DO-254 Section 10.4.3.

Method of Compliance:
Provide and demonstrate the PHRAR is complete, consistent and correct IAW RTCA/DO-254 Section 10.4.3.

a. A PHRAR report IAW RTCA/DO-254 Section 10.4.3. and IAW DI-IPSC-81440 shall be developed.

b. The PHRAR report shall include the personnel that witnessed and/or audited the reviews and analyses.

c. The PHRAR report shall include the PR/CRs derived from failed reviews and/or analyses, to include traceability of the PR/CR to the failed review and/or analysis.

The airworthiness substantiation shall include a PHRAR report prepared IAW RTCA/DO-254 Section 10.4.3. and DI-IPSC-81440.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.3.3. Programmable Hardware Test Results (PHTR)
The purpose of the PHTR report is to provide the objective evidence that the tests have been completed to approved procedures in support of the verification of the programmable hardware item. The PHTR report summarizes all verification activities, including reviews, analyses, and actual test coverage achieved. Any discrepancies found should be recorded and tracked via problem reporting.

Criteria:
The PHTR report provides documentation of the results of a formally executed qualification test IAW the approved PHTP. The PHTR report is developed, documented, and placed under configuration control.

Standard:
RTCA/DO-254 Section 10.4.5.

Method of Compliance:
Provide and demonstrate the PHTR report is complete, consistent and correct IAW RTCA/DO-254 Section 10.4.5.

a. A PHTR report IAW RTCA/DO-254 Section 10.4.5. and DI-IPSC-81440 shall be developed.

b. The PHTR report shall include the personnel that witnessed the test.

c. The PHTR report shall include the PR/CRs derived from failed tests, to include traceability of the PR/CR to the failed test.

d. If the PHRAP report and the PHTP have been combined into a common airworthiness substantiation document, the PHTR report shall be incorporated into the PHRAR report in lieu of a separate document.

The airworthiness substantiation shall include Programmable Hardware Test Results report prepared IAW
RTCA/DO-254 Section 10.4.5. and DI-IPSC-81440.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.4. Programmable Hardware Delivery Process Artifacts.
The following programmable hardware record artifacts shall be prepared and provided to the airworthiness authority.

15.2.4.1. Programmable Hardware Problem Reports / Change Requests (PR/CR).
The purpose of the Programmable Hardware PR/CR is to identify and record the resolution to programmable hardware design problems, process non-compliance with programmable hardware plans and standards, and deficiencies in programmable hardware life cycle data.

Criteria:
The programmable hardware PR/CR contains an identification and record of the resolution to the programmable hardware anomalous behavior, process non-compliance with programmable hardware plans and standards, and deficiencies in programmable hardware life cycle data. The programmable hardware PR/CR is produced, placed under configuration control, and utilized.

Standard:
RTCA/DO-254 Section 10.6.

Method of Compliance:
Provide and demonstrate the programmable hardware PR/CR is complete, consistent, accurate, and contain the required information in regard to issues identified in the lifecycle phases for the programmable hardware, artifacts, and tools IAW RTCA/DO-254 Sections 10.6.

The programmable hardware PR/CR records IAW RTCA/DO-254 Section 10.6. and DI-MISC-80508 shall be prepared and maintained.

a. The records shall be maintained through a programmable hardware/change tracking database that addresses programmable hardware problems and programmable hardware safety issues.

b. A programmable hardware defect management approach shall be documented in the PHDP.

c. The defect history of any programmable hardware delivered at any time shall be provided with that product.

The airworthiness substantiation shall include programmable hardware PR/CR prepared IAW RTCA/DO-254 Section 10.6. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.4.2. Programmable Hardware Configuration Management (PHCM) Records

The purpose of the PHCM Records is to provide the results of the PHCM process activities including additional data used in the PHCM process, such as configuration identification lists, baseline or electronic records, change history reports, problem report summaries, tool identification data, archive records and release records.

Criteria:
The PHCM Records provide the results of the PHCM process activities, including additional data used in the PHCM process. Programmable HCM records are maintained and utilized.

Standard:
RTCA/254 Section 10.7.

Method of Compliance:
Provide and demonstrate that the Programmable HCM records are correct, complete, consistent, and verifiable.

The PHCM records shall be prepared IAW RTCA/254 Section 10.7. and DI-MISC-80508.

The airworthiness substantiation shall include PHCM Records prepared IAW RTCA/254 Section 10.7. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.2.4.3. Programmable Hardware Process Assurance (PHPA) Records

The purpose of the PHPA Records is to provide evidence of PHPA involvement throughout the hardware development and verification effort. These may include review or audit reports, meeting minutes, records of authorized process deviations, or conformity review records.

Criteria:
The PHPA Records provide evidence of PHPA involvement throughout the hardware development and verification effort. Programmable HPA records are produced, maintained, and utilized.

Standard:
RTCA/254 Section 10.8.

Method of Compliance:
Provide and demonstrate that the Programmable HPA records are correct, complete, consistent, and verifiable.

The PHPA records shall be prepared IAW RTCA/254 Section 10.8. and DI-MISC-80508.

The airworthiness substantiation shall include PHPA Records prepared IAW RTCA/254 Section 10.8. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152C		

15.2.4.4. Programmable Hardware Accomplishment Summary (PHAS)
The purpose of the PHAS is to provide a summary of data items to show compliance to the plans and processes set forth in the PHAC. The PHAS substantiates that the objectives set forth in the planning documents have been achieved. Any deviation from the plans must be clearly described in the PHAS.

Criteria:
The PHAS contains a summary of all of the programmable hardware lifecycle activities, artifacts, and compliance to the approved programmable hardware plans, which address the acquisition, development, management, and verification of the programmable hardware and the approved design assurance level assigned to each programmable HWCI, based on its architecture considerations and utilization within the equipment, systems, and aircraft operating requirements.

Standard:
RTCA/DO-254 Section 10.9.

Method of Compliance:
Provide and demonstrate the PHAS is complete and consistent in addressing the compliance of the programmable hardware design processes with the approved plans and standards and the completeness of the lifecycle processes, hardware, artifacts, and products for the approved design assurance level(s) for each programmable HWCI IAW RTCA/DO-254 Section 10.9.

a. Provide a PHAS which shall be prepared and provided IAW DI-MISC-80508 and shall address all items in RTCA/DO-254 Section 10.9. The PHAS shall show compliance of the programmable hardware to the airworthiness requirements.

b. The PHAS shall address all programmable hardware aspects of the AQS to demonstrate how the programmable hardware data and process show compliance to the AQS.

c. The PHAS shall describe the degree of compliance with the PHAC and identify any differences from the PHAC.

The airworthiness substantiation shall include a PHAS prepared IAW DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-254		AC 20-152		

15.3. Tool Qualification Artifacts

15.3.1. Tool Planning Process Artifacts

15.3.1.1. Tool Qualification Plan (TQP)

The purpose of the TQP is to provide a high-level description of the overall Tool Qualification Process, consideration of proposed Tool Qualification Level(s) (TQL), functional overview, operational environment(s), and the activities of tool life cycle processes including tool qualification data producing and additional considerations.

Criteria:
The TQP provides a high-level description of the overall Tool Qualification Process, including the proposed TQL, functional overview, operational environment(s), and the activities of tool life cycle processes including tool qualification data. The TQP is produced, placed under configuration control, and utilized for the defined tool development lifecycle processes.

Standard:
RTCA/DO-330 Section 10.1.2.

Method of Compliance:
Provide and demonstrate the TQP is complete and consistent with the tool's intended usage and TQL IAW RTCA/DO-330 Section 10.1.2.

Develop a Tool Qualification Plan IAW RTCA/DO-330 Section 10.1.2. and DI-MISC-80508 for each software tool used in the development, verification, or validation of software.

The airworthiness substantiation shall include a Tool Qualification Plan prepared IAW RTCA/DO-330 Section 10.1.2. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.1.2. Tool Development Plan (TDP).
The purpose of the TDP is to provide the detailed objectives, standards, and tool life cycle(s) to be used in the tool development processes in terms of the hardware and software.

Criteria:
The TDP provides the detailed objectives, standards, and tool life cycle(s) to be used in the tool development processes. The TDP is produced, placed under configuration control, and utilized.

Standard:
RTCA/DO-330 Section 10.1.3.

Method of Compliance:
Provide and demonstrate the TDP is complete and consistent with the tool's intended usage IAW RTCA/DO-330 Section 10.1.3.

Develop a TDP IAW RTCA/DO-330 Section 10.1.3. and DI-IPSC-81427. The TDP includes the objectives, standards, and tool life cycle(s) to be used in the tool development process.

The airworthiness substantiation shall include a TDP prepared IAW RTCA/DO-330 Section 10.1.3. and DI-IPSC-81427.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.1.3. Tool Configuration Management Plan (TCMP)
The purpose of the TCMP is to provide a description of the methods to be used to satisfy the objectives of the Tool Configuration Management (TCM) process throughout the tool software development and tool verification effort. TCM begins during the planning phase and continues throughout the entire software life cycle – all the way through deployment, maintenance, and retirement of the system.

Criteria:
The TCMP is produced and utilized.

Standard:
RTCA/DO-330 Section 10.1.5.

Method of Compliance:
Provide and demonstrate the TCMP is complete and consistent with the tool's intended usage and that processes are documented for the configuration management of configuration items, baselining these items and establishing requirements traceability throughout the tool's lifecycle IAW RTCA/DO-330 Section 10.1.5.

Develop a TCMP IAW RTCA/DO-330 Section 10.1.5. and DI-SESS-80858. The TCMP establishes the methods to be used to satisfy the objectives of the TCM process throughout the tool life cycle.

The airworthiness substantiation shall include a TCMP prepared RTCA/DO-330 Section 10.1.5. and DI-SESS-80858.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.1.4. Tool Quality Assurance Plan (TQAP)
The purpose of the TQAP is to provide a description of the methods to be used to satisfy the objectives of the Tool Quality Assurance (TQA) process throughout the tool software development and tool verification effort. The TQAP may include descriptions of process improvement, metrics, and progressive management methods.

Criteria:
The TQAP provides a description of methods to be used to satisfy the objectives of the TQA process throughout the tool software development and tool verification effort. A TQAP shall be developed, placed under configuration control, and utilized.

Standard:
RTCA/DO-330 Section 10.1.6.

Method of Compliance:
Provide and demonstrate the TQAP is complete and consistent with the tool's intended usage and that assurance is obtained that the tool's lifecycle processes are being followed IAW RTCA/DO-330 Section 10.1.6.

A TQAP IAW RTCA/DO-330 Section 10.1.6. and DI-MISC-80508 shall be developed. The TQAP establishes the methods to be used to satisfy the objectives of the TQA process.

The airworthiness substantiation shall include a TQAP prepared IAW RTCA/DO-330 Section 10.1.6. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.1.5. Tool Verification Plan (TVP)
The purpose of the TVP is to provide descriptions of the verification activities required to satisfy the tool verification process objectives. These procedures may vary based on the TQL. This plan should include the verification methods for establishing verification

independence, integrity of the protection, reverification, and compliance baseline of developed components.

Criteria:
The TVP provides descriptions of the verification activities required to satisfy the tool verification process objectives. The TVP is produced, placed under configuration control, and utilized.

Standard:
RTCA/DO-330 Section 10.1.4.

Method of Compliance:
Provide and demonstrate the TVP is complete and consistent with the tool's intended usage IAW RTCA/DO-330 Section 10.1.4.

A TVP IAW RTCA/DO-330 Section 10.1.4. and DI-IPSC-81438 shall be developed. The TVP is a description of the verification activities to satisfy the tool verification process objectives.

The airworthiness substantiation shall include a TVP prepared IAW RTCA/DO-330 Section 10.1.4. and DI-IPSC-81438.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.1.6. Tool Requirements (TR) Standards

The purpose of the TR Standards is to provide criteria for the development of effective and implementable tool requirements by defining the methods, rules, and tools to be used. Criteria are also defined for handling derived high-level requirements.

Criteria:
The TR Standards provide guidance for the development team in developing effective and implementable high-level requirements, using the requirements management tool, performing requirements traceability, and handling derived requirements that meet the RTCA/DO-330 criteria. The TR Standards are produced, placed under configuration control, and utilized.

Standard:
RTCA/DO-330 Section 10.1.7.

Method of Compliance:
Provide and demonstrate the TR Standards are complete, correct, and consistent with the TDP IAW RTCA/DO-330 Section 10.1.7.

TR Standards IAW RTCA/DO-330 Section 10.1.7. and DI-MISC-80508 shall be developed. The TR Standards define the method, rules, and tools to be used to develop the tool requirements.

The airworthiness substantiation shall include TR Standards prepared IAW RTCA/DO-330 Section 10.1.7. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.1.7. Tool Design (TD) Standards

The purpose of the TD Standards is to provide a guide for the team developing the design, to define the methods, rules, and tools to be used to develop the tool architecture, to handle derived low-level requirements, and create design data that meets the DO-330 criteria.

Criteria:

The TD Standards provide guidance for the development team in developing the design, documenting an effective and implementable design, using the design tools, performing traceability, handling derived low-level requirements, and creating design data that meets the DO-330 criteria. The TD Standards are produced, placed under configuration control, and utilized.

Standard:

RTCA/DO-330 Section 10.1.8.

Method of Compliance:

Provide and demonstrate the TD Standards are complete, correct, and consistent with the TD Plan IAW RTCA/DO-330 Section 10.1.8.

TD Standards IAW RTCA/DO-330 Section 10.1.8. and DI-MISC-80508 shall be developed. The TD Standards define the methods, rules, and tools to be used to develop the tool architecture and low-level requirements.

The airworthiness substantiation shall include Tool Design Standards prepared IAW RTCA/DO-330 Section 10.1.8. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.1.8. Tool Code (TC) Standards

The purpose of the TC Standards is to provide guidelines to the coders defining the methods, rules, and tools to be used to develop Tool Source Code. TC Standards

describe how to use the specific language properly, restrict parts of the language that might not be advisable to use in safety-critical domain, identify naming conventions, describe the use of global data, and develop readable and maintainable code.

Criteria:
The TC Standards provide guidance for the development team in implementing the design into source code, defining the programming language(s) used and acceptable subsets of the languages to use in safety-critical domain, identifying naming conventions, and identifications of conditions and constraints in coding conventions for the approved level of rigor assigned to the software. The TC Standards are produced, placed under configuration control, and utilized.

Standard:
RTCA/DO-330 Section 10.1.9.

Method of Compliance:
Provide and demonstrate the TC Standards are complete, correct, and consistent with its intended usage IAW RTCA/DO-330 Section 10.1.9.

Tool Code Standards IAW RTCA/DO-330 Section 10.1.9. and DI-MISC-80508 shall be developed. The Tool Code Standards define the programming languages, methods, rules, and tools to be used to produce the tool source code.

The airworthiness substantiation shall include Tool Code Standards prepared IAW RTCA/DO-330 Section 10.1.9. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.2. Tool Development Process Artifacts.

15.3.2.1. Tool Operational Requirements (TOR).
The purpose of the TOR is to define the tool's functionality and interface from a software life cycle process perspective (the process which uses the tool). The TOR includes descriptions of tool use context, environment(s), functions and technical features, applicable user information, and operational use of the tool.

Criteria:
The TOR define the tool's functionality and interface from a software life cycle process perspective and include descriptions of tool use context, environment(s), functions and technical features. The TOR is produced, placed under configuration control, and utilized.

Standard:
RTCA/DO-330 Section 10.3.1.

Method of Compliance:
Provide and demonstrate the TOR is complete, correct, and consistent with the intended usage of the tool IAW RTCA/DO-330 Section 10.3.1.

A TOR IAW RTCA/DO-330 Section 10.3.1. and DI-MISC-80508 shall be developed. The TOR define the tool's functionality and interface from a software life cycle process perspective.

The airworthiness substantiation shall include Tool Operational Requirements prepared IAW RTCA/DO-330 Section 10.3.1. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.2.2. Tool Requirements (TR).
The purpose of the TR is to provide descriptions of all the tool functionality, technical features, and tool requirements including interface requirements, functional requirements, and specific requirements for compliance with operational environment, and expected responses of tools under abnormal operating conditions.

Criteria:
The TR provides descriptions of all the tool functionality, technical features, and tool requirements including interface requirements, functional requirements, and specific requirements for compliance with the tool's operational environment and expected responses of the tool under abnormal operating conditions. The TR is produced, placed under configuration control, and utilized.

Standard:
RTCA/DO-330 Section 10.2.1.

Method of Compliance:
Provide and demonstrate the TR is complete, correct, and consistent with the TOR, the TDP, and the TR Standard IAW RTCA/DO-330 Section 10.2.1.

TR IAW RTCA/DO-330 Section 10.2.1. and DI-MISC-80508 shall be developed.

The airworthiness substantiation shall include a TR prepared IAW RTCA/DO-330 Section 10.2.1. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.2.3. Tool Design Description (TDD)

The purpose of the TDD is to provide descriptions of the tool architecture, tool structure, and low-level tool requirements allocated into tool architecture. The TDD should also include descriptions of the software components and specify references to the baseline which implement and are traceable to the Tool Requirements.

Criteria:
The TDD provides descriptions of the tool architecture, tool structure, and low-level tool requirements allocated to the tool architecture. The TDD is produced, placed under configuration control, and utilized.

Standard:
RTCA/DO-330 Section 10.2.2.

Method of Compliance:
Provide and demonstrate the TDD is complete and consistent with the TR, the TDP, and the TD Standards IAW RTCA/DO-330 Section 10.2.2.

A TDD IAW RTCA/DO-330 Section 10.2.2. and DI-IPSC-81435 shall be developed. The TDD is a definition of the tool architecture and low-level tool requirements that will refine the tool requirements.

The airworthiness substantiation shall include a Tool Design Description prepared IAW RTCA/DO-330 Section 10.2.2. and DI-IPSC-81435.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.2.4. Tool Operational Verification and Validation Cases and Procedures (TOVVCP)

The purpose of the TOVVCP is to provide details of how the TOVVCP activities are implemented. This data includes the review/analysis procedures, test cases, and test procedures in addition to the description in the TVP.

Criteria:
The TOVVCP provides details of how the activities are implemented, including the review/analysis procedures, test cases, and test procedures in addition to the description in the TVP. The TOVVCP is produced, placed under configuration control, and utilized.

Standard:
RTCA/DO-330 Section 10.3.3.

Method of Compliance:
Provide and demonstrate the TOVVCP is complete and consistent with the TVP, the TOR, the TR, and the requirements verification bi-directional traceability IAW RTCA/DO-330 Section 10.3.3.

A TOVVCP IAW RTCA/DO-330 Section 10.3.3. and DI-IPSC-81439 shall be developed.

The airworthiness substantiation shall include a TOVVCP report prepared IAW RTCA/DO-330 Section 10.3.3. and DI-IPSC-81439.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.2.5. Tool Verification Cases and Procedures (TVCP)
The purpose of the TVCP is to define the step-by-step details of the verification and validation process for the tool necessary to verify the implementation of the tool software requirements.

Criteria:
The TVCP defines the step-by-step details of the verification and validation process for the tool. The TVCP is produced, placed under configuration control, and utilized.

Standard:
RTCA/DO-330 Section 10.2.5.
RTCA/DO-330 Section 10.2.7.

Method of Compliance:
Provide and demonstrate the TVCP is complete, correct, and consistent with the TVP, the TR, and the requirements verification bi-directional traceability IAW RTCA/DO-330 Sections 10.2.5. and 10.2.7.

A TVCP IAW RTCA/DO-330 Section 10.2.5. and DI-IPSC-81439 shall be developed. The TVCP shall document the means of executing and evaluating the verification of the tool requirements. The TVCP shall provide traceability to the tool requirements IAW RTCA/DO-330 Section 10.2.7.

The airworthiness substantiation shall include a TVCP prepared IAW RTCA/DO-330 Section 10.2.5. and DI-IPSC-81439.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.3. Tool Verification Process Artifacts

15.3.3.1. Tool Operational Verification and Validation Results (TOVVR)

The purpose of the TOVVR is to provide detailed results of tool operational verification and validation process activities. This data provides final pass/fail results, software configuration items under test, results of tests/reviews/analyses (including coverage and traceability analyses) and tracking record of any discrepancies found using the problem reporting process.

Criteria:
The TOVVR shall be developed and documented.

Standard:
RTCA/DO-330 Section 10.3.4.

Method of Compliance:
Provide and demonstrate the TOVVR is complete and correct IAW RTCA/DO-330 Section 10.1.4.

A TOVVR IAW RTCA/DO-330 Section 10.3.4. and DI-IPSC-81440 shall be developed.

The airworthiness substantiation shall include a TOVVR prepared IAW RTCA/DO-330 Section 10.3.4. and DI-IPSC-81440.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.3.2. Tool Verification Results (TVR)

The purpose of the TVR is to document the results of the tool verification activities as defined in the Tool Verification Cases and Procedures. This activity substantiates that the tool's software requirements have been fully and properly implemented in the tool software.

Criteria:
The TVR shall be developed and documented.

Standard:
RTCA/DO-330 Section 10.2.6.

Method of Compliance:
Provide and demonstrate the TVR is complete and consistent with the execution of the TVCP IAW RTCA/DO-330 Section 10.2.6.

A TVR IAW RTCA/DO-330 Section 10.2.6. and DI-IPSC-81440 shall be developed for each formal test event. The TVR shall provide traceability to the TVCP.

The airworthiness substantiation shall include a TVR prepared IAW RTCA/DO-330 Section 10.2.6. and DI-IPSC-81440.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.4. Tool Delivery Process Artifacts

15.3.4.1. Tool Configuration Index (TCI)

The purpose of the TCI is to provide identification of tool product configuration, Tool Executable Object Code, tool Source Code components, tool life cycle data, references to the Tool Life Cycle Environment Index, archive and release media, Tool Executable Object Code build instruction, and procedures to recover the tool for regeneration, testing, and modification.

Criteria:

The TCI provides identification of tool product configuration, Tool Executable Object Code, tool Source Code components, tool life cycle data, references to the Tool Life Cycle Environment Index, archive and release media, Tool Executable Object Code build instruction, and procedures to recover the tool for regeneration, testing, and modification. The TCI shall be produced and placed under configuration control.

Standard:

RTCA/DO-330 Section 10.1.11

Method of Compliance:

Provide and demonstrate the TCI is complete and correct IAW RTCA/DO-330 Section 10.1.11.

A TCI IAW RTCA/DO-330 Section 10.1.11. and DI-MISC-80508 shall be developed. The TCI identifies the configuration of the tool product.

The airworthiness substantiation shall include a TCI prepared IAW RTCA/DO-330 Section 10.1.11. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.4.2. Tool Life Cycle Environment Configuration Index (TLCEI)

The purpose of the TLCEI is to provide identification of tool life cycle environment configuration. The TLCEI provides information to help reproduction of the development and verification environment, reproduction of tool executable code, and for reverification or modification.

Criteria:
The TLCEI provides identification of the tool life cycle environment configuration. The TLCEI shall be produced and placed under configuration control.

Standard:
RTCA/DO-330 Section 10.1.10.

Method of Compliance:
Provide and demonstrate the TLCEI is complete and correct IAW RTCA/DO-330 Section 10.1.10.

A TLCEI IAW RTCA/DO-330 Section 10.1.10. and DI-MISC-80508 shall be developed. The TLCEI identifies the configuration of the tool life cycle environment.

The airworthiness substantiation shall include a TLCEI prepared IAW RTCA/DO-330 Section 10.1.10. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.4.3. Tool Software Product Specification (TSPS)
The purpose of the TSPS is to provide references to the executable tool software, tool source files, and all associated files including parameter and configuration files required to execute the tool. Various tool configurations may be generated if the tool is intended to be used in multiple tool operational environments.

Criteria:
The TSPS includes the final tool design information, source code files, executable software, and software support information, including the compilation, build, and modification procedures for each tool CSCI. The TSPS shall be produced and placed under configuration control.

Standard:
RTCA/DO-330 Section 10.2.3.
RTCA/DO-330 Section10.2.4.
Method of Compliance:
Provide and demonstrate the TSPS is complete, accurate, and consistent with its intended usage IAW RTCA/DO-330 Sections 10.2.3. and 10.2.4.

A TSPS IAW RTCA/DO-330 Sections 10.2.3., and 10.2.4. and DI-IPSC-81441 shall be developed. The TSPS shall include executable software, source files, and software support information, including final design information and compilation, build, and modification procedures, for all tool CSCIs.

The airworthiness substantiation shall include a TSPS prepared IAW RTCA/DO-330 Sections 10.2.3., and 10.2.4. and DI-IPSC-81441.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.4.4. Tool Problem Report (TPR)
The purpose of the TPR is to provide a record of the resolution to tool products anomalous behavior, process non-compliance with tool plans and standards, and deficiencies in tool life cycle data.

Criteria:
The TPR provides a record of the resolution to tool products anomalous behavior, process non-compliance with tool plans and standards, and deficiencies in tool life cycle data. The TPR shall be produced and placed under configuration control.

Standard:
RTCA/DO-330 Section 10.1.12

Method of Compliance:
Provide and demonstrate the TPR is complete and correct IAW RTCA/DO-330 Section 10.1.12.

A TPR IAW RTCA/DO-330 Section 10.1.12. and DI-MISC-80508 shall be developed.

The airworthiness substantiation shall include a TPR prepared IAW RTCA/DO-330 Section 10.1.12. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.4.5. Tool Configuration Management (TCM) Records
The purpose of the TCM Records is to provide the results of the TCM process activities including additional data used in the TCM process, such as configuration identification list, baseline, change history reports, archive and release records.

Criteria:
The TCM Records provide the results of the TCM process activities including, configuration identification list, baseline, change history reports, archive and release records.

Standard:
RTCA/DO-330 Section 10.1.13

Method of Compliance:
Provide and demonstrate the TCM Records are complete and consistent with the TCMP IAW RTCA/DO-330 Section 10.1.13.

TCM Records IAW RTCA/DO-330 Section 10.1.13. and DI-MISC-80508 shall be developed.

The airworthiness substantiation shall include TCM Records prepared IAW RTCA/DO-330 Section 10.1.13. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.4.6. Tool Quality Assurance (TQA) Records
The purpose of the TQA Records is to provide evidence of software quality assurance involvement throughout the tool development and verification effort. These may include software quality assurance review or audit reports, meeting minutes, records of authorized process deviations, and tool conformity review records.

Criteria:
The TQA Records provide evidence of software quality assurance involvement throughout the tool development and verification effort. TQA Records shall be prepared, maintained, and provided.

Standard:
RTCA/DO-330 Section 10.1.14

Method of Compliance:
Provide and demonstrate the TQA Records are complete and consistent with the TQAP IAW RTCA/DO-330 Section 10.1.14.

TQA Records IAW RTCA/DO-330 Section 10.1.14. and DI-MISC-80508 shall be developed.

The airworthiness substantiation shall include TQA prepared IAW RTCA/DO-330 Section 10.1.14. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.4.7. Tool Installation Report (TIR)

The purpose of the Tool Installation Report is to provide identification of tool operational environment, executable object code, external components, and references of all support information including user manual.

Criteria:

The TIR provides identification of tool operational environment, executable object code, external components, and references to all support information including user manual. The TIR shall be produced and placed under configuration control.

Standard:

RTCA/DO-330 Section 10.3.2.

Method of Compliance:

Provide and demonstrate the TIR is complete and consistent with the tool's intended usage IAW RTCA/DO-330 Section 10.3.2. and the TQP.

A TIR IAW RTCA/DO-330 Section 10.3.2. and DI-MISC-80508 shall be developed.

The airworthiness substantiation shall include a Tool Installation Report prepared IAW RTCA/DO-330 Section 10.3.2. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.3.4.8. Tool Accomplishment Summary (TAS)

The purpose of the TAS is to provide a summary of primary data items to show compliance to the plans and processes set forth in the TQP. The TAS demonstrates to the Certification Authority that the objectives set forth in the TQP have been achieved. Any deviation from the plan that has not been approved by the Certification Authority needs to be clearly described in the Tool Accomplishment Summary.

Criteria:

The TAS provides a summary of primary data items to show compliance to the plans and processes set forth in the TQP. The TAS demonstrates to the Airworthiness Authority that the objectives set forth in the TQP have been achieved. The TAS shall be produced and placed under configuration control.

Standard:

RTCA/DO-330 Section 10.1.15

Method of Compliance:

Provide and demonstrate the TAS is complete and consistent with the tool's intended usage IAW RTCA/DO-330 Section 10.1.15. and the approved TQP.

The airworthiness substantiation shall include a TAS prepared IAW RTCA/DO-330 Section 10.1.15. and DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
RTCA/DO-248 RTCA/DO-330		AC 20-115		

15.4. MACHINE LEARNING ARTIFACTS.

Should software include Machine Learning (ML) techniques, substantiation should include ML related artifacts identified in the following sections. ML is defined as software developed using design and development techniques where an algorithm is trained using an engineered data set to produce a model that can be used to predict future values.

Current policy focuses on Machine Learning for which the training remains static after fielding. Applications where algorithms adapt during operation are not currently addressed in airworthiness policy and are not recommended at this time.

Airworthiness evaluation of ML software includes traditional AMACC Section 15.1. Software Artifacts, and the criteria in Section 15.4. to address the unique aspects of assurance for the Machine Learning Lifecycle Products. Criteria for ML are to be evaluated using the Machine Learning Certification Supplement in its entirety.

The Machine Learning Development Strategy is likely to include two Lifecycles:

1. the Machine Learning Development Lifecycle (MLDL)

2. the Machine Learning Implementation Lifecycle (MLIL)

The MLDL is a preliminary development lifecycle in which an input data set and model development processes are used to develop an ML model, which comprises a trained coefficient data matrix and an ML model design description. Software developed during MLDL might use software libraries or languages that cannot be qualified for flight, but which provide the most effective and efficient means of producing the artifacts necessary to inform the follow-on MLIL.

The products of the MLDL transition to the second lifecycle, the MLIL, during which the ML Model design depiction is used to code qualifiable ML software that uses the trained coefficient data matrix to provide the intended ML functionality for deployment.

15.4.1. Machine Learning Planning Process Artifacts.

The artifacts that are needed to transition from the MLDL to the MLIL are the following: ML requirements, MLDL verification results, test data set, ML data processing description, and ML model description. The ML Model Description serves as low-level software requirements.

The MLIL receives the MLDL transition artifacts and implements them in software as an ML Inference Model. MLIL qualification directly uses DO-178C software lifecycle processes, using the ML Requirements as the high-level requirements and the ML model design description as the low-level requirements. The vendor's unique approach to the execution of the MLDL and MLIL is provided in the planning process artifacts, with particular attention to the transition from the MLDL to the MLIL.

Substantiation includes Machine Learning planning artifacts identified in the following subsections. The developer may propose the delivery of alternative documentation, Standards, or Methods of Compliance, provided they meet the intent of the objectives identified and the approach is approved during planning activities (PSAC). Standard acquisition requirements for each software artifact have been identified under each Method of Compliance paragraph.

Machine Learning planning artifacts supplement the AMACC Section 15.1.1. Software Planning Process Artifacts by adding the unique aspects necessary to guarantee assurance of the Machine Learning item, the fielded Inference Model. The Sections that follow, while describing data and documentation requirements for ML software individually, are not intended to prescribe how deliverable artifacts are packaged, but rather to define the required content. Packaging of that content should be described in the relevant Planning Documentation.

15.4.1.1. Plan For Machine Learning Aspects of Certification.
The Plan for Machine Learning Aspects of Certification describes the lifecycle approach for the Machine Learning item. This approach details the MLDL and MLIL as well as the transition criteria between the two.

Criteria:
The Plan for Machine Learning Aspects of Certification shall supplement the criteria established in DO-178C Section 11.1. and AMACC Section 15.1.1.1. Plan for Software Aspects of Certification (PSAC) by addressing concerns unique to ML, such as data assurance, ML model development, and the MLDL to MLIL transition. The PSAC also addresses augmentation of traditional software development concerns such as configuration management, quality assurance, and certification authority coordination.

Standard:
Machine Learning Certification Supplement Section 11.1.

Method of Compliance:
The Plan for Machine Learning Aspects of Certification shall provide a plan to establish complete and consistent artifacts. The Plan for Machine Learning Aspects of Certification shall identify the Machine Learning processes, objectives, activities, artifacts, and products for the assigned software criticality levels ("DAL") for each Machine Learning computer software configuration item (CSCI) IAW Machine Learning Certification Supplement Section 11.1.

At a minimum, the Plan for Machine Learning Aspects of Certification shall include: a system overview, an ML-based software item overview, the ML Certification considerations, a summary of the MLDL and MLIL processes, an overview of the ML lifecycle output data, the planned schedule, any additional considerations that may affect the airworthiness qualification process and supplier oversight. The additional considerations shall address the approach to tool qualification, including tool selection criteria. For example, Criteria 1 should be assigned to any tool capable of inserting errors into the final deployed ML inference model, such as synthetic dataset generation tools.

The Plan for Machine Learning Aspects of Certification may be included in a broader PSAC established for the overall code base.

Substantiation shall include a Plan for Machine Learning Aspects of Certification IAW DI-MISC-80508 and Machine Learning Certification Supplement Section 11.1.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement	DO-178C Section 11.1		

15.4.1.2. Machine Learning Development Plan

The Machine Learning Development Plan describes the processes, objectives, and activities the ML developer plans to follow to be fully detailed and described.

Criteria:

The Machine Learning Development Plan shall include the ML Data Development Plan and the ML Model Development Plan, and supplements the criteria established in AMACC Section 15.1.1.2. Software Development Plan (SDP).

Standard:

Machine Learning Certification Supplement Section 11.2.

Method of Compliance:

The ML Data Development Plan shall describe the ML data development procedures and data governance processes used to satisfy the ML data governance processes, objectives, and activities.

Where tools are used, tool qualification shall be appropriately addressed.

The ML Development Plan may be included in an overall Software Development Plan.

Otherwise, substantiation shall include Machine Learning Development Plan IAW DI-MISC-81427B and Machine Learning Certification Supplement Section 11.2.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement			

15.4.1.2.1. Machine Learning Data Development Plan
The Machine Learning Data Development Plan details the environment, processes, objectives, and activities for the acquisition, processing, and development of the data set used to train, validate, and test the ML model.

Criteria:
The Machine Learning Data Development Plan shall include the identification of standards, plans, processes, objectives, and activities to establish and satisfy the data requirements, acquire, and process the data, and tools used for acquisition and processing of the data, and supplements the criteria established in AMACC Section 15.1.1.2. Software Development Plan (SDP) with respect to ML data set development.

Standard:
Machine Learning Certification Supplement Section 11.2.1.

Method of Compliance:
The Machine Learning Data Development Plan shall be a part of the ML Development Plan (Section 15.4.1.2) and shall supplement the approach established in the Machine Learning Certification Supplement Section 11.2.1.

The ML Data Development Plan shall describe the ML data development procedures and data governance processes used to satisfy the ML data governance processes, objectives, and activities.

Where tools are used, tool qualification shall be appropriately addressed.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement			

15.4.1.2.2. Machine Learning Model Development Plan.
The Machine Learning Model Development Plan details the environment, processes, objectives, and activities for designing, building, training, validating, and testing the ML model.

Criteria:
The Machine Learning Model Development Plan shall include a description of the Machine Learning Model development strategy with plans, standards, processes, objectives, and activities for the training, validation, and testing of the ML model, and supplements the criteria established AMACC Section 15.1.1.2. Software Development Plan (SDP) with respect to Model Development.

Standard:
Machine Learning Certification Supplement Section 11.2.2.

Method of Compliance:
The ML Model Development Plan shall be a part of the ML Development Plan (Section 15.4.1.2.1) and shall describe the ML model development procedures, techniques, transition criteria, and software environments (e.g., tools, programming languages) used to satisfy the ML model development processes, objectives, and activities.

The ML Model Development Plan shall include design, programming, training strategies, including optimization strategies and other relevant techniques. The ML Model Development Plan shall address model explainability, model performance assurance, and development assurance, and, where necessary, mitigations such as continuous integrity monitoring and intervention.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement			

15.4.1.3. Machine Learning Verification Plan.
The overall purpose of the ML Verification Plan is to provide the plan for the verification and testing of the ML requirements, data set, and model. Primarily the ML Verification Plan consists of two components: (1) ML Data Verification Plan, and (2) ML Model Verification Plan.

Criteria:
The ML Verification Plan shall include a description of the ML test procedures and test environment for the ML requirements, the ML data set, and the ML model, and supplements the criteria established in DO-178C Section 11.3. and AMACC Section 15.1.1.5. Software Test Plan (STP).

Standard:
Machine Learning Certification Supplement Section 11.3.

Method of Compliance:
The ML Verification Plan shall describe the verification procedures to be used to satisfy the ML verification process objectives for ML requirements, ML data set, and ML model verification. These procedures may vary by assurance level as defined by Annex A of DO-178C.

The ML Verification Plan shall include organization responsibilities, independence of action, verification methods, verification environment, verification criteria, partitioning considerations, ML programming language assumptions, reverification considerations, and previously developed ML data set or ML model reuse considerations.

Substantiation shall include ML Verification Plan IAW DI-IPSC-81438A and Machine Learning Certification Supplement, Section 11.3.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement	DO-178C Section 11.3		

15.4.1.3.2. Machine Learning Data Verification Plan
The ML Data Verification Plan provides verification procedures to satisfy the ML data verification process objectives. These procedures ensure that the datasets are compliant with standards and requirements, including the relevant operational design domain.

Criteria:
The ML Data Verification Plan shall include a description of the ML data set verification process. This process confirms that the MLDL data standards and ML data requirements, including the definition of the ML-based item's operational design domain, are fulfilled by the ML data sets. The ML Data Verification Plan supplements the criteria established in DO-178C Section 11.3. and AMACC Section 15.1.1.5. Software Test Plan (STP).

Standard:
Machine Learning Certification Supplement Section 11.3.1.

Method of Compliance:
The ML Data Verification Plan shall describe the verification procedures to be used to satisfy the ML data verification process objectives. The ML Data Verification Plan verification procedures shall establish the approach to confirm that the ML data standards and requirements are fulfilled by the data sets. The Data Verification Plan shall ensure all data quality requirements are achieved. The Data Verification Plan shall ensure the ML data set provides adequate and representative coverage of the operational design domain, including nominal cases, boundary cases, edge cases and adverse cases.

Substantiation shall include ML Data Verification Plan IAW DI-MISC-80508 and Machine Learning Certification Supplement Section 11.3.1.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement	DO-178C Section 11.3		

15.4.1.3.3. Machine Learning Model Verification Plan
The ML Model Verification Plan describes the verification procedures used to satisfy the ML model verification process objectives. The ML Model Verification Plan procedures

ensure that the ML model is compliant with ML model standards and ML model requirements.

Criteria:
The ML Model Verification Plan shall include a description of the verification procedures to confirm that the ML Model Standard and ML Model requirements are fulfilled by the ML model.

Standard:
Machine Learning Certification Supplement Section 11.3.2.

Method of Compliance:
The ML Model Verification Plan supplements the criteria established in DO-178C Section 11.3. and AMACC Section 15.1.1.5. Software Test Plan (STP).

The ML Model Verification Plan shall confirm the ML model generalization, stability, and robustness is appropriately maintained over the entire operational design domain.

Substantiation shall include ML Model Verification Plan IAW DI-MISC-80508 and Machine Learning Certification Supplement Section 11.3.2.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement	DO-178C Section 11.3		

15.4.1.4. Machine Learning Development Lifecycle Configuration Management Plans

The Machine Learning Development Lifecycle (MLDL) Configuration Management Plan describes the configuration management process for the ML data set and ML model.

Criteria:
The MLDL Configuration Management Plan shall include a description of the configuration management approach for the ML data set and ML model.

Standard:
Machine Learning Certification Supplement Section 11.4.

Method of Compliance:
The Machine Learning Configuration Management Plan shall describe the approach for establishing a baseline, traceability, and change control of the ML data set and ML model. The ML Configuration Management Plan shall describe the approach for configuration management of and reproducibility approach for the ML data set and ML model development environment, and supplements the criteria established in DO-178C Section 11.4. and AMACC Section 15.1.2.2. Software Configuration Management Plan (SCMP).

The MLDL Configuration Management Plan may be incorporated in a SCMP.

Substantiation shall include MLDL Configuration Management Plan IAW DI-SESS-80858 and Machine Learning Certification Supplement Section 11.4.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement	DO-178C Section 11.4		

15.4.1.5. Machine Learning Development Lifecycle Quality Assurance Plan
The Machine Learning Development Lifecycle (MLDL) Quality Assurance Plan ensures quality assurance for the design, development, and verification of the ML dataset and ML model. Also, the MLDL Quality Assurance Plan ensures the quality of the processes, objectives, and activities outlined in the Machine Learning Certification Supplement.

Criteria:
The MLDL Learning Quality Assurance Plan shall include a description of the quality assurance artifacts to be produced and followed to ensure that the Machine Learning Certification Supplement processes and objectives are adhered to. The MLDL Quality Assurance Plan supplements the criteria established in DO-178C Section 11.5. and AMACC Section 15.1.1.3. Software Quality Assurance Plan (SQAP) for the execution of the ML assurance process.

Standard:
Machine Learning Certification Supplement Section 11.5.

Method of Compliance:
The MLDL Quality Assurance Plan shall describe the methods used to achieve the ML assurance processes, objectives, and activities from the Machine Learning Certification Supplement.

The MLDL Quality Assurance Plan shall describe the processes to ensure all ML plans, standards, process, objectives, activities, and output data items are developed appropriately.

This material can be like that for AMACC Section 15.1.2.1.. Software Quality Assurance Plan (SQAP). The MLDL Quality Assurance Plan may be included in the Software Quality Assurance Plan.

Substantiation shall include MLDL Quality Assurance Plan IAW DI-MISC-80508 and Machine Learning Certification Supplement Section 11.5.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement	DO-178C Section 11.5		

15.4.1.6. Machine Learning Data Standard

The Machine Learning Data Standard defines the descriptions, methods, rules, and tools used to develop the data sets.

Criteria:

The Machine Learning Data Standard shall provide standards guidance for developing datasets. The Machine Learning Data Standard documents the approach for data set identification, collection, creation, processing, allocation, and curation of a representative and complete dataset for ML model training, validation, and testing.

Standard:

Machine Learning Certification Supplement Section 11.6.

Method of Compliance:

The Machine Learning Data Standard shall define the data quality expectations, format/type, methods, rules, and tools to be used to develop the data sets using guidance from Machine Learning Certification Supplement Section 11.6.

The Machine Learning Data Standard shall be tailored based on the use of real, synthesized, synthetic, or combinations thereof, as well as the types of signals, sources, features, and attributes that should be present in the ML dataset. Machine Learning Data Standard shall include guidance for collection, processing, and dividing the data set (e.g., a training data set, validation data set, and test data set). The Machine Learning Data Standard processing details shall address sampling, translation, modification, normalization, labeling, and other augmentation processes for the ML data set. The Machine Learning Data Standard shall list guidance for achieving the necessary Data Quality Requirements, such as balance, correctness, completeness, and representativeness of the operational design domain. The Machine Learning Data Standard shall establish the methodology for ensuring data set integrity and traceability through the whole data governance pipeline, including that assurance there is no data leakage.

Substantiation shall include the Machine Learning Data Standard IAW DI-MISC-80508 and Machine Learning Certification Supplement Section 11.6.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement			

15.4.1.7. Machine Learning Model Standard

The Machine Learning Model Standard provides a model development standard for the team developing the ML model. The Machine Learning Model Standard describes design techniques and activities, indicates the proper use of specific ML languages, restricts ML modeling techniques, and identifies training techniques and activities. The Machine Learning Model Standard also describes the use of training and validation data sets and helps develop robust and reliable ML models. The Machine Learning Model

Standard is unique from AMACC 15.1.2.8. Software Model Standards, and only under unique conditions where Model Based Development (DO-331) techniques are combined with Machine Learning techniques would the two standards and approaches need to be considered together.

Criteria:
The Machine Learning Model Standard shall provide guidance for developing the ML model, and documents the approach for setting the learning rate, drop out, activation function, loss function, number of training epochs, and other hyperparameters.

Standard:
Machine Learning Certification Supplement Section 11.7.

Method of Compliance:
The Machine Learning Model Standard shall describe the ML languages, methods, rules, and tools to be used to develop the ML model. The Machine Learning Model Standard shall describe the characteristics of the ML model using guidance from Machine Learning Certification Supplement Section 11.7. The Machine Learning Model Standard shall address ensuring generalization, stability, and robustness of the ML model for the full operational design domain through adequate design, training, and testing.

Substantiation shall include Machine Learning Model Standard IAW DI-MISC-80508 and Machine Learning Certification Supplement Section 11.7.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement	DO-331		

15.4.1.8. Machine Learning Requirements Standard
The Machine Learning Requirements Standard provides a guide for the development team of how to effectively write implementable high-level ML requirements, where the ML requirements consist of the ML data requirements and the ML model requirements.

Criteria:
The Machine Learning Requirements Standard shall include a description of the requirement expectations for the development of the ML model, ML data set, and ML model requirements.

Standard:
Machine Learning Certification Supplement Section 11.8.

Method of Compliance:
The ML Requirements Standard shall define the methods, rules, and tools for the development of the ML-based item, ML data set, and ML model requirements. The ML

Requirements Standard shall include notations to be used, constraints, and methods for identifying derived requirements.

The ML Requirements Standard shall include guidance for the development of requirements that address ML performance assurance, ML development assurance, and ML mitigation considerations, and supplements the criteria established in DO-178C Section 11.6. and AMACC Section 15.1.2.5. Software Requirements Standard to address ML requirements development.

The ML Requirement Standard shall include guidance for the development of the definition of the ML-based item operational design domain. The ML Requirement Standard shall include guidance for the development of nominal, boundary, edge case, adverse cases, and robustness expectations for the ML-based item across the entire ML-based item operational design domain.

Substantiation shall include Machine Learning Requirements Standard IAW DI-MISC-80508 and Machine Learning Certification Supplement Section 11.8.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement	DO-178C Section 11.6		

15.4.1.8.1. Machine Learning Data Requirements Standard
The Machine Learning Data Requirements Standard provides methods, rules, and tools to be used to develop the ML data requirements.

Criteria:
The Machine Learning Data Requirements Standard shall include a description of those attributes unique to establish ML data set requirements, and supplements the criteria established in DO-178C Section 11.6. and AMACC Section 15.1.2.5. Software Requirements Standard.

Standard:
Machine Learning Certification Supplement Section 11.8.1.

Method of Compliance:
The ML Data Requirements Standard shall define the methods, rules, and tools to be used to develop the ML data requirements. The ML Data Requirements Standard shall address the following: intended use, format, type, signals, sources, features, attributes, data quality requirements, accuracy, correctness, representativeness, completeness, labelling, and sufficiency.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement	DO-178C Section 11.6		

15.4.1.8.2. Machine Learning Model Requirements Standard
The Machine Learning Model Requirements Standard provides methods, rules, and tools used to develop the ML model requirements.

Criteria:
The Machine Learning Model Requirements Standard shall include a description of those attributes unique to establish ML model requirements.

Standard:
Machine Learning Certification Supplement Section 11.8.2.

Method of Compliance:
The ML Model Requirements Standards shall define standards for the methods, rules, and tools to be used to develop the ML model requirements, and supplements the criteria established in DO-178C Section 11.6. and AMACC Section 15.1.2.5. Software Requirements Standard.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement	DO-178C Section 11.6		

15.4.2. Machine Learning Development Process Artifacts
Substantiation includes the following Machine Learning development artifacts identified in the following subsections. The contractor may propose the delivery of alternative documentation, Standards, or Methods of Compliance, provided they meet the intent of the objectives identified. Specific acquisition requirements for each ML artifact have been identified under each Method of Compliance paragraph.

15.4.2.1. Machine Learning Requirements
The Machine Learning Requirements provide the high-level requirements for the MLDL and MLIL Lifecycles.

Criteria:
The Machine Learning Requirements shall include ML-Model requirements, derived ML-safety requirements, the ML data requirements, as defined below as supplementary to the criteria in DO-178C Section 11.9. and AMACC Section 15.1.2.3. Software Requirements Specification (SRS).

Standard:
Machine Learning Certification Supplement Section 11.9.

Method of Compliance:
The Machine Learning Requirements shall include the necessary performance assurance, development assurance, and mitigation requirements for the ML-based item. The Machine Learning Requirements shall detail the ML-based item operational design domain (see Annex A for definitions).

The ML Requirements shall include the ML Data Requirements and the ML Model Requirements and may be included in a Software Requirements Specification. Substantiation shall include Machine Learning Requirements IAW DI-IPSC-81433 and Machine Learning Certification Supplement Section 11.9.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement	DO-178C Sec 11.9		

15.4.2.1.1. Machine Learning Data Set Requirements

The Machine Learning Data Set Requirements provides is a definition of the ML data set requirements including the derived ML data set requirements. In general, the approach to discuss this material can be like that taken for AMACC Section 15.1.2.3. Software Requirements Specification (SRS).

Criteria:

The Machine Learning Data Set Requirements shall be included in the Machine Learning Requirements (Section 15.4.2.1) and shall include system, subsystem, and ML model requirements allocated to the ML data set.

Standard:

Machine Learning Certification Supplement Section 11.9.1.

Method of Compliance:

The Machine Learning Data Set Requirements shall define the ML data set requirements, including derived safety Requirements. The ML Data Set Requirements shall satisfy the ML Data Standard, safety requirements and hazard assessments, including the data hazard assessment. The ML Data Set Requirements shall define the Data Quality Requirements (e.g., completeness, representativeness, accuracy) required by the operational design domain, including nominal, boundary, edge, and adverse cases.

Substantiation shall include Machine Learning Data Requirements IAW DI-IPSC-81433 and Machine Learning Certification Supplement Section 11.9.1.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement			

15.4.2.1.2. Machine Learning Model Requirements

The Machine Learning Model Requirements provides a description of the Machine Learning model produced, using the inputs and constraints. The Machine Learning Model Requirements should be part of the Machine Learning requirements (Section 15.4.2.1). The Machine Learning Model Requirements are developed from analysis of system requirements, safety-related requirements, and system architecture.

Criteria:
The Machine Learning Model Requirements shall include system, subsystem, and ML-based item requirements allocated to the ML model.

Standard:
Machine Learning Certification Supplement Section 11.9.2.

Method of Compliance:
The Machine Learning Model Requirements shall be included in the Machine Learning Requirements (Section 15.4.2.1) and shall define the ML model requirements, including all derived ML model requirements.

The ML Model Requirements shall satisfy the ML model standard, safety requirements and hazard assessments, and supplements the criteria established in DO-178C Section 11.9. and AMACC Section 15.1.2.3. Software Requirements Specification (SRS). The ML Model Requirements shall specify that the ML model performance assurance, development assurance and mitigations for the ML model are appropriate for the operational design domain nominal cases, boundary conditions, edge cases, and adverse cases.

Substantiation shall include Machine Learning Model Requirements IAW DI-IPSC-81433 and Machine Learning Certification Supplement Section 11.9.2.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement	DO-178C Section 11.9		

15.4.2.2. Machine Learning Data Set Processing Description

The Machine Learning Data Set Processing Description describes the data set processing approach, including the collection, generation, normalization, labeling/annotating, division, and coverage of the data set.

Criteria:
The Machine Learning Data Set Processing Description shall define processing of the Machine Learning data set. This includes sourcing of the data set, whether real, synthesized, synthetic, or combined, the normalization approach, cleaning (e.g., cropping annotating/labeling), and augmentation of the data set, and all other relevant steps. The Machine Learning Data Set Processing Description contains a complete, accurate, and consistent documentation of data set processing. It includes the tools, techniques, and procedures necessary to allow the data processing approach to be verified and validated.

Standard:
Machine Learning Certification Supplement Section 11.10.

Method of Compliance:
The Machine Learning Data Processing Description shall define the processing used to produce the ML data set. The Machine Learning Data Processing Description shall include a retrospective description of the data set processing activities that occurred during the ML data development process. The Machine Learning Data Processing Description shall guarantee reproducibility of the data set used during MLDL model training and validation processes, should the need arise due to incident or mishap investigation. The Machine Learning Data Processing Description shall comply with the ML Data Standard.

Substantiation shall include Machine Learning Data Processing Description IAW DI-IPSC-81435 and Machine Learning Certification Supplement Section 11.10.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement			

15.4.2.3. Machine Learning Model Description
The Machine Learning Model Description defines the Machine Learning model algorithm, parameters, and other necessary details, so that the Model Description can serve as the detailed low-level requirements (LLRs) for the Machine Learning Model Implementation Lifecycle (MLIL). The Machine Learning Model Description describes both how the model is put together (architecture) and how it will provide the desired funcionality (LLRs).

Criteria:
The Machine Learning Model Description shall describe the design of the Machine Learning model, the Machine Learning model parameters, the Machine Learning model architectural design, and the Machine Learning model detailed design. The Machine Learning Model Description contains complete, accurate, and consistent documentation of the Machine Learning model algorithm and is sufficiently detailed to satisfy the ML data and model requirements and ML model standard.

Standard:
Machine Learning Certification Supplement Section 11.11

Method of Compliance:
The ML Model Description shall define the ML model architecture and the low-level requirements that satisfy the high-level ML requirements and ML model requirements. The ML Model Description shall include sufficient documentation of the ML Model to facilitate the implementation of the ML Inference Model during the MLIL. At a minimum, the ML Model Description shall detail the ML model low-level requirements characteristics, as defined in DO-178C, ensuring that source code can be directly implemented from the ML Model Description without further information. The ML Model Description shall be bi-directionally traceable to the ML-based item and ML model

requirements. The ML Model Description contents shall be compliant with the ML model standard.

Substantiation shall include Machine Learning Model Description IAW DI-IPSC-81435 and Machine Learning Certification Supplement Section 11.11.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement			

15.4.2.4. Machine Learning Data Sets
The purpose of Machine Learning Data Sets, including Training, Validation, and Test Data Sets, is to provide the Machine Learning model with data that correctly traces to and implements the Machine Learning data set requirements.

Criteria:
The Machine Learning Data Sets, including Training, Validation, and Test Data Sets shall be accurate, representative, and complete with respect to the ML data set requirements.

Standard:
Machine Learning Certification Supplement Section 11.12

Method of Compliance:
ML data sets (including training, validation, and test data sets) shall be used to train, validate, and test the ML model. The ML data sets shall satisfy the ML data standard, ML data requirements, safety requirements and hazard analysis, and representativeness of the operational design domain. The ML data sets development shall be reflected in the ML Data Processing Description Document.

Substantiation shall include Machine Learning Data Sets in a machine-readable file format that is usable and readily accessible by the Government. The Machine Learning Data Sets shall be organized with a unique naming convention with appropriately annotated labels, features, attributes, and metadata, as outlined in Machine Learning Certification Supplement Section 11.12.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement			

15.4.3. Machine Learning Verification Process Artifacts
Machine Learning verification artifacts identified in the following subsections comprise the verification process artifacts. The contractor may propose the delivery of alternative documentation, Standards, or Methods of Compliance, provided they meet the intent of

the objectives identified. Specific acquisition requirements for each software artifact have been identified under each Method of Compliance paragraph.

15.4.3.1. Machine Learning Environment Configuration Index
The Machine Learning Environment Configuration Index provides identification of Machine Learning lifecycle environment configuration. The Machine Learning Environment Configuration Index provides information to help reproduction of the ML development and verification environment, reproduction of Machine Learning data set and model, and for reverification or modification.

Criteria:
The ML Environment Configuration Index shall identify the version of tools used for data processing and model development.

Standard:
Machine Learning Certification Supplement Section 11.13

Method of Compliance:
The Machine Learning Environment Configuration Index shall provide identification of the Machine Learning lifecycle environment configuration and shall be part of the Machine Learning Configuration Index (See Section 15.4.3.2).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement			

15.4.3.2. Machine Learning Configuration Index
The Machine Learning Configuration Index provides configuration identification of Machine Learning development lifecycle items. The Machine Learning Configuration Index includes the Machine Learning inference model object code build instruction and procedures to recover the data set and Machine Learning inference model for regeneration, testing, and modification.

Criteria:
The Machine Learning Configuration Index shall identify the configuration of the ML model. The ML Configuration Index shall consist of the ML data set, ML inference model, ML model design description, ML requirements, ML data processing description, and other ML assurance output data items used to substantiate the ML-based item assurance case.

Standard:
Machine Learning Certification Supplement Sections 11.13. and 11.14

Method of Compliance:
The Machine Learning Configuration Index shall provide identification of Machine Learning product configuration, Machine Learning output data items, Machine Learning

data sets and model configuration, Machine Learning lifecycle data, references to the Machine Learning lifecycle environment index, archive and release media, Machine Learning inference model executable object code build instruction, and procedures to recover the Machine Learning data sets and model for regeneration, testing, and modification. The Machine Learning Environment Configuration Index shall identify the configuration of the ML-based item development and verification environment. The ML Environment Configuration Index shall identify the version of tools used for data processing and model development.

Substantiation shall include Machine Learning Configuration Index IAW DI-IPSC-81442 and Machine Learning Certification Supplement Section 11.14.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement			

15.4.3.3. Machine Learning Verification Cases and Procedures
The ML Verification Cases and Procedures provide the steps and approaches for executing the ML verification program in accordance with the ML Verification Plan. This includes verifying the ML requirements, which encompass the ML data requirements and the ML model requirements.

Criteria:
The Machine Learning Verification Cases and Procedures shall provide a detailed description of the test steps and approach for verifying the ML requirements, ML data set, and ML model.

Standard:
Machine Learning Certification Supplement Section 11.15

Method of Compliance:
The Machine Learning Verification Cases and Procedures shall describe the cases and procedures used to verify the ML requirements, which consist of the ML-based item requirements, ML data requirements, and ML model requirements.

The ML Verification Cases and Procedures shall demonstrate that the ML requirements comply with and are traceable to system requirements, ML data sets comply with and are traceable to ML data requirements, and ML model complies with and is traceable to ML model requirements.

The ML Verification Cases and Procedures shall describe and detail the approach to verify the ML data training set is in compliance with the ML Data Standard, ML data set requirements, and provides coverage of the operational design domain.

The ML Verification Cases and Procedures shall cover the ML model performance requirements, development assurance requirements, and mitigations for the operational

design domain for nominal cases, boundary cases, edge cases, and adverse cases in accordance with the ML model requirements.

The Machine Learning Verification Cases and Procedures supplement the criteria established in AMACC Section 15.1.2.9. Software Test Description (STD).

Substantiation shall include Machine Learning Verification Cases and Procedures IAW DI-IPSC-81439 and Machine Learning Certification Supplement Section 11.15.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement			

15.4.3.4. Machine Learning Verification Results
The Machine Learning Verification Results provides the results of the verification of the ML requirements, ML data set, and ML model.

Criteria:
The Machine Learning Verification Results shall provide a description of the verification results of the ML requirements, ML data set, and ML model, and supplements the criteria established in AMACC Section 15.1.3.5. Software Test Report (STR).

Standard:
Machine Learning Certification Supplement Section 11.16

Method of Compliance:
The Machine Learning Verification Results shall describe the verification results of evaluating the ML requirements, ML data set, and ML model, and augments the content of the AMACC Section 15.1.3.5. Software Test Report (STR) .

The Machine Learning Verification Results shall describe in detail the verification of the ML data set against the ML data set requirements, including compliance against the data set safety requirements and data set hazard analysis.

Coverage: The Machine Learning Verification Results shall describe in detail the verification of the ML data set coverage of the operational design domain using nominal cases, boundary cases, edge cases, and adverse cases, all of which shall be specified in the ML data set requirements.

Results: The Machine Learning Verification Results shall describe in detail the verification results of the ML model performance requirements, development assurance requirements, and mitigations for the operational design domain nominal cases, boundary cases, edge cases, and adverse cases, which shall be specified in the ML model requirements.

ML Verification Results may be included in a Software Test Report.

Substantiation shall include Machine Learning Verification Results IAW DI-IPSC-81440 and Machine Learning Certification Supplement Section 11.16.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement			

15.4.3.5. Machine Learning Problem Reports
The Machine Learning Problem Reports document the issues encountered during the MLDL, and may include necessary ML requirement changes, data set issues, and model updates.

Criteria:
The Machine Learning Problem Reports shall contain the necessary unique identification, configuration control, and detailed documentation to ensure they can be properly tracked and resolved through the MLDL to closure.

Standard:
Machine Learning Certification Supplement Section 11.17. and AMACC Section 15.1.4.4.

Method of Compliance:
Substantiation shall include Machine Learning Problem Reports IAW DI-MISC-80508 and Machine Learning Certification Supplement Section 11.17.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement			

15.4.3.6. Machine Learning Inference Model.
The Machine Learning Inference Model also termed “ML-based item”, is an executable object directly usable on the target computer. As the fielded software product, all criteria in Section 15.4. apply to establishing airworthiness for the ML-based item.

Criteria:
The Machine Learning Inference Model shall be produced, and utilized IAW the Machine Learning lifecycle, including the Machine Learning Development Lifecycle and Machine Learning Implementation Lifecycle. The Machine Learning inference model shall implement the Machine Learning model requirements and conform to the model development standards. The Machine Learning model is correct and complete.

Standard:
Machine Learning Certification Supplement Section 11.18

Method of Compliance:
The Machine Learning Inference Model shall be object code that is directly executable by the target computer. The Machine Learning Inference Model shall be developed from the ML Model description during the MLIL using exact semantic replication. The Machine Learning Inference Model shall be verified during the MLIL against the ML-based item requirements and ML model description using the ML test data set. Machine Learning Inference Model performance deviations from the ML-based item requirements shall be documented.

Substantiation shall include Machine Learning Inference Model IAW DI-IPSC-81488 and Machine Learning Certification Supplement Section 11.18.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement			

15.4.4. Machine Learning Delivery Process Artifacts
Substantiation should include the Machine Learning delivery process artifacts identified in the following subsections. The contractor may propose the delivery of alternative documentation, Standards, or Methods of Compliance, provided they meet the intent of the objectives identified, and subject to airworthiness approval in advance. Specific acquisition requirements for each software artifact have been identified under each Method of Compliance paragraph.

15.4.4.1. Machine Learning Configuration Management Records.
Machine Learning Configuration Management Records provide substantiation evidence that the ML Configuration Management Plan is being properly executed.

Criteria:
The Machine Learning Configuration Management Records shall include configuration records for the MLDL output data items, including ML requirements, ML data sets, and ML model.

Standard:
Machine Learning Certification Supplement Section 11.19

Method of Compliance:
The ML Configuration Management Records shall provide baseline and configuration evidence for the MLDL output data items, including ML requirements, ML data set, Data Processing Description and ML Model Description IAW AMACC Section 15.1.4.6. Software Configuration Management Records.

The ML Configuration Management Records shall provide evidence that MLDL environment is under control and is retrievable.ML Configuration Management Records may be included in the Software Configuration Management Records; otherwise,

substantiation shall include Machine Learning Configuration Management Records IAW DI-MISC-80508 and Machine Learning Certification Supplement Section 11.19.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement			

15.4.4.2. Machine Learning Quality Assurance Records
Machine Learning Quality Assurance Records provide the quality assurance substantiation artifacts that the MLDL processes, objectives, activities, and output data items were adequately and completely developed.

Criteria:
The Machine Learning Quality Assurance Records shall be subject to Software Quality Assurance.

Standard:
Machine Learning Certification Supplement Section 11.20 and AMACC Section 15.1.4.7. Software Quality Assurance (SQA) Records.

Method of Compliance:
The Machine Learning Quality Assurance Records shall provide evidence that the MLDL plans, standards, process, objectives, activities, and output data items are developed appropriately.

ML Quality Assurance Records may be included in the Software Quality Assurance Records.

Substantiation shall include Machine Learning Quality Assurance Records IAW DI-MISC-80508 and Machine Learning Certification Supplement Section 11.20.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement			

15.4.4.3. Machine Learning Accomplishment Summary
The Machine Learning Accomplishment Summary provides summary compliance substantiation that the ML lifecycle processes, objectives, and activities were executed accurately and completely.

Criteria:
The Machine Learning Accomplishment Summary shall provide the substantiation of the ML lifecycle processes, objectives, and activities, and supplements the criteria established in AMACC Section 15.1.4.11. Software Accomplishment Summary (SAS).

Standard:
Machine Learning Certification Supplement Section 11.21

Method of Compliance:
The Machine Learning Accomplishment Summary shall provide a description indicating the ML-based item is adequate for the requirements. This includes substantiating that the ML-based item is adequate for the intended operational design domain, including nominal cases, boundary cases, edge cases and adverse cases. The Machine Learning Accomplishment Summary shall provide a description that the ML-based items achieve the necessary performance assurance, development assurance, and mitigation considerations. Any deviations to any ML lifecycle plans, standards, processes, objectives, or activities shall be captured in the Machine Learning Accomplishment Summary.

The Machine Learning Accomplishment Summary supplements the criteria in AMACC Section 15.1.4.11. Software Accomplishment Summary (SAS).

The ML Accomplishment Summary may be part of a broader Software Accomplishment Summary; otherwise, substantiation shall include Machine Learning Accomplishment Summary IAW DI-MISC-80508 and Machine Learning Certification Supplement Section 11.21.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement			

15.4.4.4. Machine Learning Trace Data

The Machine Learning Trace Data provides substantiation artifacts showing bi-directional traceability for the evaluation of verification coverage.

Criteria:
The Machine Learning Trace Data shall provide substantiation for the appropriate bi-directional traceability for the appropriate ML artifacts.

Standard:
Machine Learning Certification Supplement Section 11.22 and AMACC Section 15.1.2.10. Software Traceability Data.

Method of Compliance:
The ML Trace Data shall establish the bi-directional traceability associations between ML lifecycle output data items. The ML Trace Data may be included in a broader Software Traceability Data artifact.

Substantiation shall include Machine Learning Trace Data IAW DI-MISC-80508 and Machine Learning Certification Supplement Section 11.22.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	ML Cert Supplement			

15.4.5. Definitions

Term	Definition
Adaptive ML	A class of ML where the inference model is allowed to update the weights of the ML model while fielded/deployed. Within this document, locked is synonymous with frozen and non-adaptive, while antonyms are online, continuous, unlocked, and adaptive.
Generalization	Refers to the Machine Learning inference model's ability to make correct predictions on new, previously unseen data as opposed to the data used to train the Machine Learning model.
Hyperparameter	A setting that is used to control the behavior of a learning algorithm (e.g., number of hidden layers, learning rate, number of neurons per layer).
Inference Model	The trained Machine Learning software that is delivered as an ML-based item for fielding/deployment after the Machine Learning Implementation Lifecycle (MLIL) phase.
ML Model	A Machine Learning algorithm usually implemented in Python or an un-qualifiable programming language that is trained on a data set during the Machine Learning Development Lifecycle (MLDL) and implements the Machine Learning model requirements. A Machine Learning model is unique from a “model” as referenced in RTCA Model Based Development (DO-331).
Operational Design Domain (ODD)	Documented description of the specific operating domain(s) in which an automated function or system is designed to properly operate, including but not limited to operational aspects, environmental conditions, and other domain constraints.
Reinforcement Learning (RL)	An ML learning approach that optimizes a reward function, which indicates the quality of an action taken at each iterative step.

16. SUSTAINMENT OF AIRWORTHINESS

This section considers criteria for servicing and maintenance activity and oversight.

The AvMC requires the contractor to ensure operating and maintenance manuals are integrated in the airworthiness process.

16.1. Critical Safety Items (CSI) Management

The purpose of the CSI management is to ensure compliance with U.S. law, DoD policy, and Army Regulations requiring an aircraft CSI Program for control of parts critical to the safe operation, mission capability, and mission readiness of the aircraft.

16.1.1. Critical Safety Items (CSIs)

The purpose of the CSIs is to identify parts, assemblies, installation equipment, launch equipment, recovery equipment, or support equipment for an aircraft or aviation weapons system that contains a critical characteristic (CC). The failure, malfunction, or absence of a CC could cause a catastrophic or critical failure resulting in the loss of, or serious damage to the aircraft or weapons system, an unacceptable risk of personal injury or loss of life, or an uncommanded engine shutdown that jeopardizes safety.

Criteria:
CSIs of the system shall be identified.

Standard:
AMCOM Regulation 702-7
Appendix B
MIL-STD-31000
Appendix Q

Method of Compliance:
The airworthiness substantiation shall identify, provide the design criteria, and critical characteristics of CSIs. They shall be documented the Technical Data Package drawings, reports and associated lists, in sufficient detail for "form, fit, function and interface" replacement without degrading system airworthiness IAW AMCOM Regulation 702-7, Appendix B and prepared IAW MIL-STD-31000 and DI-SESS-81000. Inspection of documentation will identify a process is in place that adequately identify CSIs, and associated design criteria and critical characteristics at the component, subsystem and system levels. The airworthiness substantiation shall substantiate the CSI identification and management ensures:

a. CSIs are a subset of Critical Application Items (CAIs). All CSIs are CAIs but not all CAIs are CSIs. An item shall be designated as a CAI if the item is essential to weapon system performance or operation, or the preservation of life or safety of operating personnel, as determined by the Military Airworthiness Authority.

b. The determining factor in CSIs is the consequence of failure. CSIs must contain a characteristic whose failure would lead to a failure of the item in a way that would lead to a catastrophic or critical failure resulting in the loss of or serious damage to the

weapon system, an unacceptable risk of personal injury, or loss of life (as defined by MIL-STD-882), an uncommanded engine shutdown, and/or an uncontained engine failure that jeopardizes safety. The characteristics that would lead to a catastrophic or critical failure shall be classified as CCs. The foundation for criticality determination is based on a FMECA prepared IAW DI-SESS-81495. Critical Characteristics (CCs) shall also be derived for each CSI from the FMECA results.

The airworthiness substantiation shall include a CSI Component List prepared IAW DI-SFT-81932.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
SAE AS9017 SAE AS6081 SAE AS6174	DA Pam 95-9 Joint Aeronautical Commanders Group (JACG) Aviation Critical Safety Item Management Handbook JACG Aviation Source Approval and Management Handbook			

16.1.2. CSI Program

The purpose of the Contractor's CSI program is to identify and manage CSIs as intended to control parts critical to the safe operation, mission capability, and mission readiness of the aircraft.

Criteria:
CSIs shall be managed according to a CSI Program Plan

Standard:
AMCOM Regulation 702-7
Appendix B

Method of Compliance:
The airworthiness substantiation shall implement a CSI Program IAW AMCOM Regulation 702-7, Appendix B. The process shall provide oversight of its CSI program utilizing the appropriate personnel from the various Contractor departments including at a minimum quality, manufacturing, customer service, engineering, and safety. The airworthiness substantiation shall substantiate all Prime, sub-vendor, OEM aircraft and engine manufacturers establish and continuously maintain a CSI program. The prime contractor's CSI program will be applicable to all end items, spare parts manufacture,

and repair contracts. The airworthiness substantiation shall include a CSI Program Plan and a CSI Control Plan prepared IAW DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
SAE AS9017	DA Pam 95-9 Joint Aeronautical Commanders Group (JACG) Aviation Critical Safety Item Management Handbook JACG Aviation Source Approval and Management Handbook			

16.1.3. Technical Data Requirements

The purpose of the CSI technical data requirements is to document the engineering, operational, and maintenance specifications, parameters, processes, procedures and materials data of the critical characteristics (CCs) to sustain the system.

Criteria:

Critical parts shall be classified as CAIs or CSIs.

Standard:

AMCOM Regulation 702-7, Appendix B

Method of Compliance:

The airworthiness substantiation shall institute a classification system that establishes whether a part is considered a CAI, or in addition, a CSI. The classification of an item as a CSI shall be based solely on its influence on flight safety. Any OEM subcontractor that supplies a CSI item to the Contractor to identify on their drawing the Contractor's critical characteristic(s) IAW DA Pam 95-9 and AMCOM Regulation 702-7shall be required.

a. The airworthiness substantiation shall clearly identify on part or assembly drawings its CSI status and the critical characteristics for each CSI IAW MIL-STD-31000. The airworthiness substantiation shall prepare the critical characteristic identification

b. (Appendix Q) and applicable control procedures to facilitate inclusion in related maintenance and overhaul documents, including applicable preservation, packaging, and handling, and shipping instructions IAW DI-SESS-81000.

c. The airworthiness substantiation shall validate each CSI to ensure that all aspects of the design are thoroughly considered, parts/materials operate within design constraints, and the design allows for assessment by non-destructive evaluation (NDE), where possible. The Contractor's validation shall be documented and include engineering analysis of the item's critical characteristics, and shall consider changes/deterioration through time, use, fatigue life, and operating conditions. This data shall be prepared IAW DI-MISC-80508.

d. A CAI list that identifies which CAIs are CSIs shall be developed, maintained, and updated. The airworthiness substantiation shall include data to identify and document each part on the CAI list by part number, part name, drawing numbers with revision, vendor name, serial number prefix (if applicable); and, for CSIs, the critical characteristics. The part numbers and/or critical characteristics for any part on the CAI list shall not be revised without Military Airworthiness Authority approval. The airworthiness substantiation shall include a CSI Component List and a Critical Application Item List prepared IAW DI-SAFT-81932.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
ASME Y14.5	DA Pam 95-9 Joint Aeronautical Commanders Group (JACG) Aviation Critical Safety Item Management Handbook MIL-STD-31000			

16.1.4. Marking/Identification

The purpose of the marking/identification is to provide positive designation, identification, tracking and management for engineering configuration control of CSIs.

Criteria:

A plan for CSI serialization and marking shall be defined. CSIs shall be serialized and marked.

Standard:

AMCOM Regulation 702-7
Appendix B
MIL-STD-130

Method of Compliance:

All CSIs, and depot repairable CAIs shall be marked and identified. Locations and methods of markings must be IAW drawings, technical data packages, contract quality assurance provisions, or through other contract requirements/clauses. Data format shall

be IAW MIL-STD-130. All CSIs require individual serialization or identification by lot number for traceability. Serial number requirements may be identified on drawings in the technical data packages IAW MIL-STD-31000, and in contract quality assurance provisions, or through other contract requirements/clauses. An internal system for assigning serial numbers shall be developed. Serialization shall occur so that any individualized inspection/process that involves a critical characteristic is traceable to a specific serial number. All serial numbers approved for issue or provided by the Government shall be accounted for; this includes material scrapped during manufacturing (if item/product serialization has been assigned prior to final marking). Serial numbers used in this program shall not be used on any other part with the same basic part number (i.e., only a dash number or revision letter difference) manufactured by that contractor. The airworthiness substantiation shall include a Marking and Identification Plan developed IAW AMCOM Regulation 702-7, Appendix B, and MIL-STD-130 and prepared IAW DI-MISC-80508."

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	DA Pam 95-9 Joint Aeronautical Commanders Group (JACG) Aviation Critical Safety Item Management Handbook MIL-STD-31000 AMCOM Regulation 700-39, Serialization Requirement for Aviation and Missile Equipment			

16.1.5. Manufacturing/Repair Planning

The purpose of the manufacturing/repair planning is to ensure CSI manufacturing processes and inspection criteria produce consistent compliance with engineering specifications.

Criteria:

CSIs shall be manufactured and repaired according to manufacturing plans.

Standard:

AMCOM Regulation 702-7, Appendix B
QE-STD-1
QE-STD-2

Method of Compliance:
CSI Manufacturing Planning shall be developed IAW AMCOM Regulation 702-7, Appendix B, QE-STD-1, and QE-STD-2. All manufacturing, assembly, and inspection points for CSIs shall be controlled by detailed procedures outlining each step or parameter of the manufacturing/repair process along with any materials, tooling, equipment, environmental control, and operator certification required that leads to the specific production/repair of an end item. Plans shall clearly identify their applicability to a CSI, all critical characteristics (CC), and will include identification, IAW contractor procedures, as to its particular revision. All process plans shall clearly define sequence of operation, machine type, and accept/reject limits for the specific process or operation. Critical processes not easily verified by subsequent inspection shall clearly define process-operating parameters with tolerances. All operations producing CCs shall be clearly defined and provide for documentation of acceptance by the operator/inspector on the approximate date and the method of verification by which the operation was inspected. For Frozen plans, the following apply:

a. Frozen planning is required for CSIs as part of the source approval process. Once frozen, plans shall remain frozen throughout the existing contract and all subsequent contracts for the item unless changes to the planning are made in accordance with AMCOM Reg 702-7 and submitted in accordance with DI-SESS-81012.

b. All changes to CSI frozen planning affecting the method of manufacturing or sources will be submitted to the Government for review in accordance with DI-SESS-81012.

c. A CSI frozen planning list shall be prepared, maintained, and updated. The frozen planning documentation shall be identified and documented. The shall be provided part number, part name, title, revision number, and date of last revision for each CSI shall be provided. The airworthiness substantiation shall include a CSI Manufacturing Plan(s) developed IAW AMCOM Regulation 702-7, Appendix B, QE-STD-1, and QE-STD-2 and prepared IAW DI-MISC-80508."

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
SAE AS9017	DA Pam 95-9 Joint Aeronautical Commanders Group (JACG) Aviation Critical Safety Item Management Handbook JACG Aviation Source Approval and Management Handbook CAST-STD-1 FORG-STD-1 AMRDEC Policy 06-04, Product Verification Audit.			

16.1.6. Audits

The purpose of the CSI Program audits is to verify that manufacturing planning and quality controls are being implemented and documented properly for CSI parts.

Criteria:

Audits shall be conducted by contractors of CSIs, to include subcontractors and vendors.

Standard:

AMCOM Regulation 702-7, Appendix B

Method of Compliance:

The airworthiness substantiation shall be provided to ensure that the Contractor performs self-audits of their frozen planning when that planning applies to a CSI or critical characteristics produced or verified in house IAW AMCOM Regulation 702-7, Appendix B. At a minimum, audits will be performed at the start of each production contract, annually, and when process changes (including production line relocation) occur. The airworthiness substantiation shall be provided to ensure that subcontractors/suppliers accomplish self-audits. The airworthiness substantiation shall be provided to ensure that the contractor maintain records verifying that their vendors are in full compliance with the audit requirement. All audit findings will be recorded, and corrective action will be documented.

a. The airworthiness substantiation shall be provided to ensure that the Contractor performs periodic audits of each subcontractor or supplier’s CSI Program to assure that adequate program controls are in place and that the supplier’s CSI program is in compliance with the Contractor’s CSI program.

b. The Contractor shall support Government audits of the Contractor's implementation of CSI requirements, to include subcontractors and suppliers. The airworthiness substantiation shall include and ensure the following CSI documentation is available to the Government audit team: CSI program documents, Critical Item Management database, frozen planning list, frozen planning, technical data, minutes and records of Contractor's Control Board (CCB) meetings, and existing supporting documentation.

c. The airworthiness substantiation shall include a CSI Audit Plan developed IAW AMCOM Regulation 702-7, Appendix B and prepared IAW DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	DA Pam 95-9 Joint Aeronautical Commanders Group (JACG) Aviation Critical Safety Item Management Handbook JACG Aviation Source Approval and Management Handbook			

16.1.7. Critical Characteristics

The purpose of critical characteristic (see Appendix Q) is to identify any feature or material attribute throughout the life cycle of a CSI, which if nonconforming, missing or degraded could cause the failure or malfunction of the CSI.

Criteria:

Critical Characteristics (CCs) of CSIs that can be non-destructively inspected and/or tested shall be subjected to 100 percent inspection by the contractor, subcontractor or supplier.

Standard:

AMCOM Regulation 702-7, Appendix B

Method of Compliance:

The airworthiness substantiation shall be provided to ensure all critical characteristics (CCs) that can be non-destructively inspected and/or tested shall be subjected to 100 percent inspection by the contractor or subcontractor/supplier IAW AMCOM Regulation 702-7, Appendix B unless specific approval is received from the cognizant ESA. The airworthiness substantiation shall ensure the Contractor exercises a level of control that ensures product and process compliance to the Contractor's documented procedures. The Contractor inspection personnel shall be trained and certified for critical processes/inspections. All inspection records shall identify part number, serial number, CCs inspected with the exact reading or dimension, date of inspection, identity of inspector, inspector certification and method of inspection to include specific inspection

tools. If a CC consists of variable data, the specific value shall be recorded. Measurements shall not be recorded as pass/fail, unless the inspection does not result in a discrete value. CCs shall be identified on the inspection records in such a manner as to draw attention to them. The airworthiness substantiation shall ensure Contractor implements variability reduction methods. Once the manufacturing program demonstrates that the critical processes are statistically in control, stable, and capable, the contractor may submit a request to implement a Statistical Process Control program in lieu of 100 percent inspection for CCs to the Military Airworthiness Authority for approval IAW DI-MISC-80508. The airworthiness substantiation shall include a CC Inspection Plan developed IAW AMCOM Regulation 702-7, Appendix B and prepared IAW DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
ANSI/ASQC Z1.4	DA Pam 95-9 Joint Aeronautical Commanders Group (JACG) Aviation Critical Safety Item Management Handbook			

16.1.8. Quality Requirements

The purpose of the CSI program quality requirements is to define the manufacturing process controls, quality assurance checks, and provide documentation for CSI compliance.

Criteria:

A Quality Program shall be maintained for manufacture and repair of each CSI that is certified or approved by the Government to meet the intent of one of SAE AS9100, SAE AS9110, or ISO 9001.

Standard:

AMCOM Regulation 702-7, Appendix B
QE-STD-1
QE-STD-2
SAE AS9100
SAE AS9110
ISO 9001

Method of Compliance:

The airworthiness substantiation shall be provided to ensure that the Contractor establishes and maintains a Quality Program that is certified or approved by the Government to meet the intent of one of the following quality systems: SAE AS9100,

SAE AS9110, or ISO 9001. The airworthiness substantiation shall include a Quality Program Plan prepared IAW DI-MGMT-82184 and DI-QCIC-81722.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	DA Pam 95-9 Joint Aeronautical Commanders Group (JACG) Aviation Critical Safety Item Management Handbook JACG Aviation Source Approval and Management Handbook CAST-STD-1 FORG-STD-1			

16.1.9. Test Measurement and Diagnostic Equipment (TMDE)

The purpose of the TMDE is to provide accurate, calibrated, and verified CSI manufacturing inspection results to ensure consistent compliance with engineering specifications.

Criteria:
A plan for verifying manufacturing inspection results with TMDE shall be defined.

Standard:
AMCOM Regulation 702-7, Appendix B

Method of Compliance:
The Contractor's TMDE used shall be IAW AMCOM Regulation 702-7, Appendix B. The equipment to inspect CSIs shall discriminate to within ten percent of the total tolerance spread for the feature being inspected except as follows: for total tolerance spreads of less than .001, TMDE shall be discriminate to 20 percent of the spread. The test system/measurement uncertainty must not exceed 25 percent as compared with the tolerance range (4:1 Ratio). Test system uncertainty is determined via a Gage Repeatability & Reproducibility study. The airworthiness substantiation shall include a TMDE Program Plan prepared IAW DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
ANSI Z540.3. ASME Y14.5	DA Pam 95-9 Joint Aeronautical Commanders Group (JACG) Aviation Critical Safety Item Management Handbook JACG Aviation Source Approval and Management Handbook			

16.1.10. Nonconforming Material Control

The purpose of the CSI program nonconforming material control is to provide manufacturing controls and documentation to identify, segregate and eliminate nonconforming material or process results.

Criteria:

Non-conformities of manufactured or repaired CSIs shall be investigated.

Standard:

AMCOM Regulation 702-7, Appendix B

Method of Compliance:

The airworthiness substantiation shall be provided to ensure the Contractor investigates deficiencies identified against CSIs IAW AMCOM Regulation 702-7, Appendix B. If a nonconformity is identified on a CSI subsequent to all manufacturing, assembly and inspection requirements, the Contractor initiates an investigation to determine cause and effect and implement closed-loop corrective action to prevent recurrence. The Contractor's plan shall include disposition of nonconforming CSIs and disposal of nonconforming parts. Product dispositioned for scrap shall be conspicuously and permanently marked, or positively controlled, until physically rendered unusable. The airworthiness substantiation shall be contained in Nonconforming Material Control Plan developed IAW AMCOM Regulation 702-7 Appendix B and prepared IAW DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	DA Pam 95-9 JACG Aviation Critical Safety Item Management Handbook JACG Aviation Source Approval and Management Handbook			

16.1.11. Records

The purpose of the CSI program records is to provide manufacturing process and quality assurance inspection documentation to ensure CSI compliance.

Criteria:

Technical and quality records relating to manufacture and repair of CSIs shall be maintained and traceable by lot number and/or serial number to the date and location that they were produced.

Standard:

AMCOM Regulation 702-7, Appendix B

Method of Compliance:

The airworthiness substantiation shall be provided to ensure technical/quality requirements relating to CSIs are traceable by lot number and/or serial number to the date and location that they were produced IAW AMCOM Regulation 702-7, Appendix B. Records shall provide the degree of traceability required to enable subsequent verification of all aspects of material, manufacture, special process, personnel certification, variability control charts (if applicable), assembly, and inspection of CCs. The Contractor personnel performing work or having inspection responsibilities pertaining to critical characteristics, shall be certified to the appropriate professional level as outlined in the applicable national standards, best commercial practices, or as contractually required. The Contractor's purchase orders for subcontracted products or processes that contain CCs shall clearly identify the CSI status of the part(s)/assemblies and their CCs. All purchase orders shall flow down appropriate CSI program requirements for compliance. The airworthiness substantiation shall be provided to ensure the Contractor retain copies of all records generated pursuant to the CSI Program. The airworthiness substantiation shall include a CSI Records Management Plan developed IAW AMCOM Regulation 702-7 Appendix B and prepared IAW DI-MISC-80508.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

16.1.12. Sourcing

The purpose of the CSI program sourcing is to ensure that vendor or material source qualification, manufacturing process controls, and documentation are controlled and managed to ensure CSI compliance.

Criteria:

Sourcing of CSIs shall be controlled by a Source Change Board.

Standard:

AMCOM Regulation 702-7, Appendix B
QE-STD-1

QE-STD-2

Method of Compliance:
The airworthiness substantiation shall be provided to ensure the Contractor has a process to qualify all new CSI suppliers under a Source Change Board IAW AMCOM Regulation 702-7, Appendix B, QE-STD-1, and QE-STD-2. When a new source of supply for a CSI is required, the airworthiness substantiation shall be provided to ensure complete all original qualification testing as was required during the original qualification of the approved source(s) is completed. The Contractor's CAGE code shall be clearly identified on each CSI. The airworthiness substantiation shall be provided to ensure prepared, maintained, and updated source qualification data. The airworthiness substantiation data shall identify and document the qualification data for current and new sources for parts to be delivered with a manufacturer's CAGE code different from that of the Contractor. The airworthiness substantiation shall provide the source qualification data that identifies the supplier and CAGE code, the part number, and the serial number prefix in a CSI Vendor List. The airworthiness substantiation shall include a CSI Sourcing Plan prepared IAW DI-QCIC-80809 and a CSI Vendor List prepared IAW DI-MISC-80508."

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	DA Pam 95-9 JACG Aviation Critical Safety Item Management Handbook JACG Aviation Source Approval and Management Handbook CAST-STD-1 FORG-STD-1 AMRDEC Policy 06-04, Product Verification Audit.			

16.1.13. Configuration Management
The purpose of the CSI program configuration management is to provide control of engineering data, CSI identification, manufacturing process and inspection documentation to ensure CSI compliance.

Criteria:
CSIs shall be configuration controlled by a configuration management process.

Standard:
AMCOM Regulation 702-7, Appendix B

Method of Compliance:
The airworthiness substantiation shall be provided to ensure that implementation of a Configuration Management (CM) program for CSIs IAW AMCOM Regulation 702-7, Appendix B. The CM Plan will include requirements and definitions for Class I and Class

II ECPs and Critical, Major, and Minor Deviations. The Government will maintain configuration control and change authority for all modifications or changes affecting form, fit, function, or interface parameters of the contract items and sub-assemblies or software. Class I ECPs shall be submitted to the Army for approval/disapproval. A Class I change will not be implemented until authorized by the Army. Class II ECPs shall be submitted to the Army for approval/disapproval unless approval authority has been delegated to DCMA. A Class II change will not be implemented until authorized by the Army/DCMA. The airworthiness substantiation shall be provided to ensure that the Contractor will not manufacture any item for acceptance by the Government that incorporates a known departure from technical or contractual requirements unless a request for a deviation has been approved. Authorized deviations are a temporary departure from the requirements only and do not authorize a change to the item's configuration baseline. Delivery and/or shipment of items with Critical or Major Deviations is not permitted without authorization from the Army. Delivery and/or shipment of items Minor Deviations is not permitted without authorization from the Army, unless approval authority is delegated to DCMA. The airworthiness substantiation shall include a Configuration Management Plan developed using MIL-HDBK-61 as a guide and prepared IAW DI-SESS-80508."

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
ANSI/EIA-649	DA Pam 95-9 JACG Aviation Critical Safety Item Management Handbook JACG Aviation Source Approval and Management Handbook RDMR Form 532 DD Form 1693 MIL-HDBK-61			

16.2. Continuing Airworthiness

The property of an air system to safely attain, sustain, and complete flight in accordance with approved usage limits. Instructions for Continuing Airworthiness.

Criteria:

All maintenance instructions necessary to maintain airworthiness shall be defined in the ICA.

Standard:

MIL-STD-40051-1C
MIL-STD-40051-2

Method of Compliance:
The airworthiness substantiation shall provide Technical Data essential for the instructions for continuing airworthiness of the aircraft, engine, ground control/support components, major dynamic and flight control components IAW MIL-STD-40051-1 and MIL-STD-40051-2. The technical data shall be prepared IAW DI-TMSS-81676.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	Army Pamphlet 738–751			

16.2.1. Field Level Technical Data
The purpose of the field level technical data is to provide field level maintainers instruction for maintaining the aircraft and its components to ensure it is airworthy. The technical data provides general information pertaining to the use and identification of hardware and materials and provide instructions for preventative maintenance and field level repairs.

Criteria:
All field level maintenance and repair instructions shall be as defined in the ICA.

Standard:
MIL-STD-40051-1C
MIL-STD-40051-2
MIL-DTL-87268
MIL-STD-38784
MIL-STD-3031
MIL-HDBK-523
S1000D

Method of Compliance:
The airworthiness substantiation shall provide Field (User) level maintenance manuals IAW MIL-STD-40051-1C or MIL-STD-40051-2, MIL-DTL-87268, S1000D, MIL-STD-3031, MIL-HDBK-523, and MIL-STD-38784 and include:

a. Explanation of features and data necessary for field level maintenance and/or preventive maintenance.

b. Detail description of the components, systems and installations.

c. Installation instructions, including paper procedures for necessary task.

d. Basic control and operating information including any special procedures and limitations that apply.

e. Servicing information detailing servicing points and equipment required for servicing.

f. Scheduling information for each part of the aircraft or component, including recommended periods at which it should be cleaned, inspected, adjusted, tested, lubricated, and/or overhauled with the degree of inspection, the applicable wear tolerances, and work recommended at these periods.

g. Testing and troubleshooting information describing probable malfunctions and remedial action for those malfunctions.

h. Order and method of removing and replacing the component and its parts.

i. List of the tools and equipment necessary for maintenance and directions for their use and calibration requirements.

j. Procedures for corrosion prevention and control.

k. Procedures for packaging, preservation, and storage.

l. Identify CSI and associated Critical Characteristics pertaining to field level removal, repair and installation.

The airworthiness substantiation shall include the manuals prepared IAW MIL-STD-40051-2 in Army IADS format, and IAW DI-TMSS-81814, DI-TMSS-81675, DI-TMSS-81676, DI-TMSS-81677, DI-TMSS-81818, DI-TMSS-81819, DI-TMSS-81820, and DI-TMSS-81821.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
ANSI Z540.3. ASME Y14.5	MIL-HDBK-1222 MIL-STD-3008			

16.2.1.1. Cautions and warnings
Warning and Caution notes are used when alternative design approaches cannot eliminate a hazard per MIL-STD-882. All required Cautions and Warnings are prominently displayed in the pilot or operator’s checklist and the maintenance personnel's manuals and technical orders.

Criteria:
Verify that cautions and warnings are included in maintenance manuals, aircrew checklists, and ground crew checklists.

Standard:
JSSG-2000: 3.6.1., 3.6.2.
MIL-STD-882: A.4.3.3.i
MIL-STD-38784: 3.2., A.3.2., A.3.3., A.3.4, A.3.5.
MIL-DTL-85025
14 CFR 23.1501, 23.1529, 25.1501, 25.1503-25.1533, 25.1529, 25.1541, 25.1543, 25.1557, 25.1563

Method of Compliance:
Operator and maintenance actions requiring Cautions and Warnings are verified by review of the Failure Modes Effects Criticality Analysis (FMECA) and from the System Safety Hazard Analysis. The proper wording and placement of Cautions and Warnings per MIL-STD-38784 and MIL-DTL-85025 is verified by a review of the checklists and maintenance manuals.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

16.2.1.2. Maintenance checklists

Maintenance checklists are developed in accordance with applicable service's procedures for preparing maintenance publications.

Criteria:
Verify that maintenance checklists are available for critical maintenance tasks, such as fuel and oxygen servicing procedures, towing procedures and restrictions, jacking procedures, engine operation during maintenance, lifting procedures, integrated combat turn procedures, etc.

Standard:
JSSG-2000: 3.6.1., 3.6.2.
JSSG-2001: 3.1.5.
USAF TO 00-5-1, Air Force Technical Order System, 2.4.3., 2.4.3.1., 2.4.3.1.1., 2.4.3.2.
COMNAVAIRFORINST 4790.2.
14 CFR 23.1501, 23.1529, 25.1501, 25.1503-25.1533, 25.1529, 25.1541, 25.1543, 25.1557, 25.1563

Method of Compliance:
The maintenance checklists developed are verified by showing traceability from the support analysis and are verified by the Government.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

16.2.1.3. Support equipment

The support equipment used to perform maintenance functions on the air vehicle system is safe to operate and cannot adversely affect the safety of the air vehicle system.

Criteria:
Verify that support equipment does not adversely affect the safety of the air vehicle system.

Standard:
JSSG-2000: 3.6.1., 3.6.2.
JSSG-2001: 3.1.5.
14 CFR 23.1501, 23.1529, 25.1501, 25.1503-25.1533, 25.1529, 25.1541, 25.1543, 25.1557, 25.1563

Method of Compliance:
The safety of the support equipment is verified by review of the System Safety Hazard Analysis and through individual testing of the support equipment and compatibility testing with the air vehicle system.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

16.2.1.4. Removal procedures

For each level of maintenance, procedures for authorized system/subsystem/ component removal and installation are adequately covered in the appropriate maintenance manuals

Criteria:
Verify that maintenance manuals incorporate procedures for system/component removal.

Standard:
JSSG-2000: 3.6.1., 3.6.2.
JSSG-2001: 3.1.5.
14 CFR Part 23, Appendix G; Part 25, Appendix H

Method of Compliance:
The removal and installation instructions have undergone a quality assurance check, and the check and the content of removal and installation instructions have been verified by the Government.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

16.2.1.5. Operational testing

Operational tests are performed to ensure system performance when components are removed/replaced that are critical to the operation of the air vehicle system. The maintenance manuals detail the operational tests required to ensure safe system performance following removal/replacement of air vehicle system components.

Criteria:
Verify that maintenance manuals require system operational testing for normal/emergency system operation when systems are affected by removal/replacement of components.

Standard:
JSSG-2000: 3.6.1., 3.6.2.
JSSG-2001: 3.1.5.
14 CFR Part 23 Appendix G; Part 25, Appendix H

Method of Compliance:
Verify by analysis, test, and demonstration that the maintenance manuals contain the operational test(s) required to ensure safe system performance following the removal/replacement of air vehicle system components. Testing instructions have undergone a quality assurance check, and the check and the content of operational testing instructions have been verified by the Government.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

16.2.1.6. Checklists
Preflight checklists that are used by the ground crew and the aircrew or operator are consistent and well-coordinated with operators' manuals.

Criteria:
Verify that ground crew work cards for preflight inspection are coordinated with the aircrew checklists.

Standard:
JSSG-2000: 3.6.1., 3.6.2.
JSSG-2001: 3.1.5.
MIL-DTL-85025
14 CFR 23.1501, 23.1529

Method of Compliance:
Preflight checklists are verified by analysis, test and demonstration for consistency of content and continuity between the air and ground crew documentation.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

16.2.1.7. Special inspection procedures
Special inspection procedures have defined exceedance parameters (e.g., temperatures, speeds, G loads, vibration) and corresponding durations. Acceptable damage criteria are established which clearly delineate serviceability or repair

requirements. Maintenance levels and personnel authorized to perform the required inspections are identified. Special inspection procedures provide troubleshooting instructions and identify items (e.g., support equipment, supplies, tools) needed to perform the inspections.

Criteria:
Verify that special inspection procedures are available for unusual or specified conditions (e.g., exceeding operating limits; severe vibration; engine stall; foreign object damage (FOD) to engine or structure; excessive loss of fluid; conditions requiring fluid sampling and analysis; severe braking action, hard landing, and running off runway; air vehicle subject to excessive G loads or maneuvers outside the specified flight envelope; lost tools; emergency procedures implemented; dropped objects or parts; sudden stoppage inspection in event of compressor stall).

Standard:
JSSG-2000: 3.6.1., 3.6.2.
JSSG-2001: 3.1.5.
MIL-PRF-5096: 3.2.2.3.1. gives guidance regarding special inspections after a specific occurrence
14 CFR 23.1501, 23.1529

Method of Compliance:
Verify by analysis, test, and demonstration that instructions are documented for special inspections. Special inspection procedures have undergone quality assurance checks, and the checks and the content of the special inspection procedures have been verified by the Government.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

16.2.1.8. Life-limited parts
All known life-limited parts and their replacement intervals are identified in maintenance documentation. Replacements intervals are based on operational data whenever possible. Prior to fielding, replacement intervals are based on available analyses and test data.

Criteria:
Verify that life-limited parts and replacement intervals are identified using relevant operational data.

Standard:
JSSG-2000: 3.6.1., 3.6.2.
JSSG-2001: 3.1.5.
MIL-PRF-5096: 3.2.2.4. gives guidance regarding flying time related or time change items
14 CFR 23.1501, 23.1529

Method of Compliance:
The identification of life-limited parts is verified by the review of maintenance documentation. Replacement intervals are traceable to appropriate source data such as the FMECA, reliability and maintainability predictions, and reliability/fatigue testing results, and the life-limited parts are identified in the appropriate technical data.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

16.2.2. Sustainment Level Technical Data
The purpose of the sustainment level technical data is for aircraft, power plant, drive train and component operation, maintenance, and repair at each applicable MRO level above the field unit through depot overhaul in order to maintain airworthiness, manage component life cycle, and control of parts critical to the safe operation, mission capability, and mission readiness of the aircraft systems.

Criteria:
All depot level maintenance and repair instructions shall be as defined in the ICA.

Standard:
MIL-STD-40051-1C
MIL-STD-40051-2
MIL-DTL-87268
MIL-STD-38784
QE-STD-2

Method of Compliance:
The airworthiness substantiation shall ensure that a Sustainment (MRO/Depot) level manuals is provided IAWMIL-STD-40051-1C or MIL-STD-40051-2, MIL-DTL-87268, MIL-STD-38784, and QE-STD-2 to include:

a. Facility, incoming inspection and pre-shop analysis requirements for maintenance, overhaul, and repair at each sustainment level.

b. Disassembly information, including the order and method of disassembly, complete Repair Bill of Materials, illustration of the parts breakdown structure, consumable parts, expendable items, shop tools, special tools, equipment and test equipment.

c. Cleaning and inspection instructions that include the materials and apparatus to be used and methods and precautions to be taken.

d. Inspection methods with details of all fits and clearances, dimensional range, measurement tolerances and inspection acceptance criteria. Develop and provide all non-destructive testing/inspection process control, technique sheets and specifications.

e. Repair methods with all necessary details for worn or otherwise substandard parts and components including acceptance criteria to determine when replacement is necessary. Develop and provide all process control sheets and specifications, including but not limited to shot peen, plating, grinding, special coatings, etc.

f. Assembly instructions specifying proper order, method, torque values, consumable parts, expendable items, shop tools, special tools, equipment and test equipment.

g. Testing instructions for all components and subcomponents after assembly including test equipment, calibration requirements, correlation requirements, troubleshooting procedures and test equipment correlation standards. Procedures for corrosion prevention and control.

h. Procedures for packaging, preservation, and storage with applicable shelf life.

i. Descriptions and drawings of all tools, fixtures and test equipment needed for overhaul.

j. Major part and component substrate material composition – metal alloys, composite, per either MMPDS or CMH-17.

k. Illustrations of parts and components including all geometrical dimensioning and tolerance.

l. Identify CSIs and associated manufacturing, installation, or depot level Critical Characteristics pertaining to each MRO sustainment level.

The airworthiness substantiation shall include the manuals prepared IAW MIL-STD-40051-2 and prepared IAW DI-TMSS-81814, DI-TMSS-81818, DI-TMSS-81819, DI-TMSS-81820, DI-TMSS-81821, and future Army DID(s) to be developed per specific project requirements.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-1222 MIL-STD-3008			

16.2.3. Non-destructive inspections

Non-destructive inspection (NDI) techniques and repair procedures address damage that occurs during normal operations (e.g., erosion, delamination, corrosion, as well as battle damage). Inspection intervals are identified in accordance with 16.2.4. Damage limits are documented in maintenance and technical documentation. Repair procedures identify all materials, processes, tools, equipment, facilities, and training necessary to complete the repairs. Structural substantiation is provided demonstrating that completed repairs maintain structural integrity and return the system to a positive margin of safety for strength and fatigue life.

Criteria:
To ensure continuing airworthiness, verify that in-service, non-destructive inspection techniques, inspection intervals, damage limits and detailed repair procedures have been developed and documented in the technical manuals.

Standard:

Method of Compliance:
Verification methods include inspection and review of NDI documentation, repair procedures, and relevant structural substantiation. Documentation is reviewed to verify that damage limits, inspection intervals, and necessary materials, processes, tools, equipment, facilities, and training are identified. Structural substantiation is reviewed to verify that positive margins of safety for strength and fatigue life are maintained.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
ASTM E1417				

16.2.4. Inspections and intervals
All features of the air vehicle system requiring periodic inspection (to include NDI) are identified in maintenance documentation. Inspection intervals are based on operational data whenever possible. Prior to fielding, inspection intervals are based on available analyses and test data.

Criteria:
Verify that all required inspection intervals are identified using relevant operational data.

Standard:
JSSG-2000: 3.6.1., 3.6.2.
JSSG-2001: 3.1.5.
MIL-PRF-5096: 3.2.1.1.1. gives guidance regarding frequency of maintenance items.
14 CFR 23.1501, 23.1529
Method of Compliance:
All required inspections and corresponding intervals are verified by the review of maintenance documentation. Inspection intervals are traceable to appropriate source data such as the FMECA, reliability and maintainability predictions, and reliability/fatigue testing results.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17. ARMAMENT AND STORES INTEGRATION

This section covers the installation, integration, interface and operation of the aircraft armament system and store systems on the aircraft.

Included with the scope of this section are:

- Weapon Systems (guns, rockets, missiles).
- Radar Systems
- Laser and designator Systems
- Aircraft Survivability Systems
- Expendables

Where necessary specific aircraft system integration criteria are included. However, more general system integration issues (e.g. EMC, Electrical) are covered elsewhere in the AMACC.

When designing store equipment, the general airworthiness criteria for aircraft equipment and systems, as well as the overall aircraft flight control and flight performance should always be considered.

The following criteria, standards and methods of compliance apply to all air systems and represent the minimum requirements necessary to establish, verify, and maintain an airworthy design.

17.1. Radar System

The purpose of the radar system is detect objects and provide range information in distance and direction.

17.1.1. Radar System Safety

The purpose of radar system safety is to provide safe flight and ensure safe operation during maintenance and testing on the ground.

Criteria:
The aircraft radar system shall function safely to ensure safe flight.

Standard:
Aircraft System Specification
MIL-STD-882

Method of Compliance:
The aircraft radar system shall have an analysis and test to include detection and action/response functionality which includes the number of sensors and types, data processors, processor throughput, data busses, controls and displays, and communication devices are capable of meeting safe flight performance, including integrity, continuity of service, relative positioning, trajectory, timing and intent information IAW aircraft system specification. Testing shall be used to verify that the radar system operates in as designed/intended including degraded visual environment.

This shall include verification of controls, displays, audio alerts and proper system response to inputs. Threat stimulators shall be used as appropriate to cause the radar system to respond so that the proper response (displays, countermeasures) can be observed. Ground testing is recommended to be used to the extent it is safe and feasible to do so, to allow a more controlled testing environment. All modes of operation (normal and test/maintenance) shall be exercised. The Weight-on-Wheels inhibit may be disabled during this test to allow for representative airborne system operation while on the ground. The airworthiness substantiation shall include a Radar System Functional Analysis Report prepared IAW DI-MISC-80711, a Radar System Functional Test Plan IAW DI-NDTI-80566, and Radar System Functional Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.1.2. Hazards of Electromagnetic Radiation (HERP) to Personnel

The purpose of HERP is to ensure that ground personnel and the air crew are a safe distance from radar system emissions.

Criteria:

The aircraft radar emission shall not impose a hazard to air crew and ground personnel.

Standard:

The U.S. Army PHC shall evaluate the radar for safe operations. The test data and report shall be utilizing IEEE C95.1-2005.

Method of Compliance:

For the aircraft radar system, personnel maximum safe exposure times and minimum safe stand-off distances from RF and microwave transmitters installed on the aircraft shall tested IAW Paragraph 13. The radar system shall be evaluated by the U.S. Army Public Health Command utilizing IEEE C95.1-2005 for safety. The analysis shall evaluate system design control measures and potential hazards. The results of the analysis will be used to determine additional testing either component level or on-aircraft.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 20-182 AC 20-68		

17.1.3. Hazardous of Electromagnetic Radiation Fuel (HERF)

The purpose of the HERF is to provide safe operation of the radar due to system emissions near aircraft fuel system, and fuel that may be near radar maintenance and testing on the ground.

Criteria:
The aircraft radar system emissions shall not cause a hazard to aircraft fuel system.

Standard:
ADS-37 paragraph 3.6.2.
MIL-STD-464 paragraph 5.9.2.

Method of Compliance:
The aircraft radar system emissions shall not imposed a hazard to the aircraft fuel system and tested IAW EMI/EMC requirements in paragraph 13 of this document.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 20-68, AC 20-182.		

17.1.4. Hazardous of Electromagnetic Radiation Ordnance (HERO)
Ordnance will include weapons, ammunition, combat vehicles, and maintenance tools and equipment. The purpose of HERO is to prevent detonation and damage to any ordnance while the radar is emitting electromagnetic radiation.

Criteria:
During the operation of the aircraft radar system, ordnance shall remain safe.

Standard:
ADS-37 paragraph 3.6.1.
MIL-STD-464 paragraph 5.9.3.

Method of Compliance:
The aircraft radar system emissions shall not imposed a hazard to ordnance and tested IAW EMI/EMC requirements in paragraph 13 of this document.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.1.5. Thermal Integration
The purpose of thermal integration is to ensure that the radar system will operate and not be degraded during ground and flight environments in both hot and cold temperature extremes, and to consider radar temperature effects on other aircraft components.

Criteria:
The aircraft radar system shall not be degraded in all aircraft temperature extremes to include the radar not effecting other components on the aircraft.

Standard:
Aircraft System Specification
ADS-63 paragraph 4.4.2.

Method of Compliance:
The aircraft radar thermal analysis shall be IAW aircraft system specification and ADS-63 paragraph 4.4.2. and include worst case operating conditions to include ground and flight environments in both hot day and cold weather start-up conditions. Thermal analysis shall include the thermal loading effects of adjacent equipment installed in the same avionics compartments or areas. Thermal analysis for environmentally cooled radar shall address hot day and cold weather startup conditions, hot day flight operations shall address emergency and or supplemental backup forced air cooling. The airworthiness substantiation shall include a Radar Thermal Analysis Report prepared IAW DI-MISC-80711 and a Radar Thermal Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 20-182		

17.1.6. Inoperability
The purpose of inoperability is to show the addition of the radar system will cause either no blockage or interference with other systems and demonstrate that any negative effects on performance and integration of surrounding equipment are minimized.

Criteria:
The aircraft radar system shall not have external RF Electromagnetic Environment (EME) that impacts safe flight.

Standard:
Aircraft System Specification
ADS-63 paragraph 4.4.8.

Method of Compliance:
The aircraft radar system shall have an analysis and test IAW aircraft system specification and ADS-63 paragraph 4.4.8. to show it will not cause either no blockage or interference with other systems, and that any negative effects on performance and integration of surrounding equipment are minimized. The airworthiness substantiation shall include a Radar Inoperability Analysis Report prepared IAW DI-MISC-80711, a Radar Inoperability Test Plan IAW DI-NDTI-80566, and Radar Inoperability Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.1.7. Weapons Firing

The purpose of weapons firing is to determine the effects of weapons firing on radar system performance, including effects from vibration, smoke, and debris.

Criteria:
The aircraft radar system shall not be degraded and/or cause unsafe condition during weapon firing.

Standard:
Aircraft System Specification
ADS-63 paragraph 5.3.2.2.C

Method of Compliance:
The aircraft radar system shall have an analysis and test IAW aircraft system specification and ADS-63 paragraph 5.3.2.2.C to determine the functional performance and effects during weapons firing, including effects from vibration, smoke, and debris. The airworthiness substantiation shall include a Radar System Functional Analysis Report prepared IAW DI-MISC-80711, Radar System Functional Test Plan IAW DI-NDTI-80566, and Radar System Functional Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.1.8. Safety Interlocks

The purpose of safety interlocks is to determine by analysis, testing, or demonstration that the safety interlocks have been designed to provide the required level of protection from inadvertent dispensing and/or emitting.

Criteria:
The aircraft radar system shall incorporate safety interlocks to prevent inadvertent emissions.

Standard:
IEEE C95.1-2005
MIL-STD-882

Method of Compliance:
The aircraft radar system shall incorporate safety interlocks to prevent inadvertent emissions by utilizing IEEE C95.1-2005 and MIL-STD-882. The safety inhibits shall ensure safety of Air Crew, Maintenance Personnel, and ground crew. The interlocks shall ensure that any single interlock is sufficient to place the system into a safe (inhibited) state. It is recommended that the interlocks be implemented in hardware. In addition, a Weight-on-Wheels inhibit shall be incorporated to prevent emitting while on the ground. The design may incorporate a method to manually override this inhibit to conduct ground maintenance/test activities, provided that this override cannot be accidentally bumped/activated. Analysis shall be performed to determine that the safety

interlocks have been designed to provide the required level of protection from inadvertent dispensing and/or emitting. Test and demonstration shall be conducted to ensure safe operations of the radar interlocks. The airworthiness substantiation shall include a Radar Safety Demo Interlock Analysis Report prepared IAW DI-MISC-80711, a Radar Safety Interlock Demo Test Plan IAW DI-NDTI-80566, and a Radar Safety Demo Interlock Analysis Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.1.9. Boresighting

The purpose of boresighting is to demonstrate that the radar boresighting procedures, boresight retention and boresight accuracy are functionally acceptable as related to the elements of the target acquisition/designation subsystem.

Criteria:

The aircraft radar system shall have capabilities to boresight and maintain boresight retention.

Standard:

ADS-63 paragraph 5.3.1.10.

Method of Compliance:

The aircraft radar system shall have an analysis and test IAW ADS-63 paragraph 5.3.1.10. to demonstrate boresighting procedures and boresight retention. Particular attention should be paid to the elements of the target acquisition/designation subsystem and boresight accuracy. The airworthiness substantiation shall include a Radar Boresighting Analysis Report prepared IAW DI-MISC-80711, a Radar Boresighting Test Plan IAW DI-NDTI-80566, and a Radar Boresighting Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.1.10. Reliability

The purpose of reliability is to demonstrate the radar start up and status BIT capabilities operate and function normally during ground and flight testing.

Criteria:

Characterize the reliability of radar BIT to isolate radar system failures.

Standard:

Aircraft System Specification
ADS-63 paragraph 5.5.5.

Method of Compliance:
An aircraft radar system BIT demonstration during ground and flight testing shall be conducted IAW aircraft system specification and ADS-63 paragraph 5.5.5. with faults inserted to ensure reliable determination of system failures and alert the flight crew of flight-critical equipment status. If the radar system has multiple BIT modes (e.g. startup BIT, pilot-initiated BIT, background/continuous BIT) they shall all be exercised to the maximum extent possible. The airworthiness substantiation shall include a Radar BIT Demo Test Plan shall be prepared IAW DI-NDTI-80566 and Radar BIT Demo Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.1.11. Operation
The purpose of operation is to demonstrate by ground and flight testing that the operator can control all modes of the radar operation in accordance with the aircraft system specification and MIL-STD-1472.

Criteria:
The aircraft radar controls and displays shall not cause unsafe flight.

Standard:
Aircraft System Specification
MIL-STD-1472

Method of Compliance:
The aircraft shall be tested during ground and flight testing to demonstrate that the operator can control all modes of the radar operation IAW the aircraft system specification and MIL-STD-1472. Testing shall be used to verify that all radar symbology is correctly shown on the aircraft displays (including for example threat symbology, BIT status, expendable inventories) and that all switches, lights, and controls operate and function satisfactorily on the radar control panels. A test plan shall be prepared IAW DI-NDTI-80566 and test report IAW DI-NDTI-80809.

a. Weather radars - When used as navigational aids, the following parameters shall be tested IAW the aircraft system specification:

(1) Maximum range, azimuth, and elevation.

(2) Ability to identify precipitation, both type and severity, along with the associated accuracies.

(3) Ability to identify severe climatic activity, such as high winds or other dangerous conditions, along with associated accuracies.

b. Weather radars shall be tested during flight to verify detection of hazardous weather for the specified range.

c. Radar ground mapping shall be tested during flight to verify the ability to display terrain type, and to locate specified size targets at the specified range.

The airworthiness substantiation shall include a Radar Operation Test Plan prepared IAW DI-NDTI-80566 and a Radar Operation Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
		AC 27-1 AC 29-2		

17.2. Electro-Optical, Infrared Sensor Systems and Laser Systems

The primary purpose of electro-optical/infrared (EO/IR) sensor systems is to detect objects and potential targets. The primary purpose of laser pointers is to indicate points of interest and potential targets. Laser rangefinders are used to measure the distance to objects. Laser designators guide weapons, such as missiles and laser-guided bombs, to targets. Lasers are often integrated into EO/IR sensor systems.

17.2.1. General Requirements for EO/IR Sensor Systems and Laser Systems

17.2.1.1. Boresight Retention of EO/IR Sensor Systems and Laser Systems

The purpose of boresight retention is to ensure that EO/IR sensor systems and laser systems are aligned to their designated direction and hold that position for the time provided in the system specification. Boresight retention is critical for accurate pointing and designating for the weapons systems. If the EO/IR sensor system is used for navigation, accurate boresight retention of the sensor system is a safety feature.

Criteria:
The aircraft's EO/IR sensor system and laser systems shall retain boresight for the specified time.

Standard:
Aircraft System Specification
ADS-65A-HDBK paragraph 5.6.2.5.
MIL-STD-1425A paragraph 4.4.6.

Method of Compliance:
The EO/IR sensor systems and laser systems shall be tested for boresight retention and accuracy. Laser boresight alignment and retention are safety-critical, according to MIL-STD-1425A. The airworthiness substantiation of the test shall be IAW the aircraft's system specification and ADS-65A-HDBK paragraph 5.6.2.5. The airworthiness substantiation shall include an EO/IR Boresight Retention and Accuracy Test Plan prepared IAW DI-NDTI-80566 and EO/IR Boresight Retention and Accuracy Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.2.1.2. Clearance for EO/IR Sensor Systems and Laser Systems

The purpose of having adequate clearance for the electro-optical and laser systems is to ensure these systems are protected during aircraft landings, weapons fire, and aircraft rotor operation.

Criteria:

The aircraft's EO/IR and laser systems shall be located to have adequate clearance to avoid damage during aircraft landings, weapons firing, and rotor operation.

Standard:

Aircraft System Specification
ADS-65A-HDBK paragraph 4.8.3.12

Method of Compliance:

An analysis and test of the EO/IR system's clearance shall be performed. The analysis and test shall identify the clearance of the sensor relative to the aircraft, ground, and aircraft components to ensure there is sufficient clearance between the sensor packages, rotors, and the weapon’s trajectories IAW the aircraft system specification and ADS-65A-HDBK paragraph 4.8.3.12. The airworthiness substantiation shall include an EO/IR Clearance Analysis Report prepared IAW DI-MISC-80711, an EO/IR Clearance Test Plan prepared IAW DI-NDTI-80566 and EO/IR Clearance Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.2.2. EO/IR Sensor Systems

17.2.2.1. Built-In Tests in EO/IR Sensor Systems

The purpose of built-in tests (BITs) containing fault detection and fault isolation functions is to alert the flight crew of the health status of the EO/IR sensor systems. BITs should correctly detect failures of the sensor system. When then EO/IR sensor systems are used for navigation, proper operation of these BITs is flight critical.

Criteria:

Built-in tests shall correctly identify failures in the EO/IR sensor system.

Standard:

ADS-65A-HDBK paragraph 5.1.

Method of Compliance:
The aircraft EO/IR system's and laser system's BIT functionality shall be demonstrated IAW the aircraft system specification during ground and flight testing. Testing the BIT function demonstrates it shall alert the flight crew of flight-critical equipment status and conduct failure detection and failure isolation. A BIT may be continuous, automatic, or initiated as required. The airworthiness substantiation shall include an EO/IR BIT Demo Test Plane prepared IAW DI-NDTI-80566 and EO/IR BIT Demo Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.2.2.2. Degraded Visual Environment EO/IR Sensor Systems

Degraded Visual Environment (DVE) systems can provide situational awareness to aid flight and landing in less-than-ideal, or "degraded," environments. DVE systems that are qualified to more stringent standards can also be used for pilotage. The degraded environments (can include but are not limited to smoke, smog, fog, dust, snow, rain, darkness, blowing sand and haze. Many DVE systems rely upon EO/IR sensor systems for input.

Criteria:
The EO/IR sensor systems utilized by the aircraft's DVE system shall be able to detect obstacles in the specified degraded environments at the specified ranges.

Standard:
Aircraft System Specification

Method of Compliance:
The DVE EO/IR sensor shall provide timely and accurate data to the DVE system. The DVE system shall be evaluated in the different types of degraded environments as defined by the system specification. The DVE system shall be assessed in each degraded environment using a standardized obstacle set and resolution targets. The assessment shall include determining the maximum distance the DVE system can detect obstacles in each degraded environment.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.2.2.3. Pilotage EO/IR Sensor Systems

When EO/IR sensor systems provide input for aircraft pilotage, their performance is safety critical. All criteria for sensor performance relate to the sensor's ability to provide accurate information to the aircraft systems and the aircrew.

Criteria:
The EO/IR sensor systems utilized for aircraft pilotage shall meet their specified performance requirements.

Standard:
Aircraft System Specification
ADS-65A-HDBK paragraphs 5.5.5. – 5.5.7.

Method of Compliance:
The EO/IR sensor(s) used for pilotage shall provide timely and accurate data to the aircraft pilotage system.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.2.2.4. Pilotage EO/IR Sensor System Optical Components
The optical components in EO/IR sensor systems must be suited to perform in the specified environmental conditions. This is critical if the sensor systems are used for pilotage. Of particular concern are the scratching and damage of optical-quality surfaces.

Criteria:
The EO/IR sensor systems utilized for aircraft pilotage shall contain components and surfaces that can perform in the specified environmental conditions.

Standard:
MIL-C-675 paragraphs 3.4-3.8.5.
ADS-65A-HDBK paragraphs 5.5.5. – 5.5.7.

Method of Compliance:
The EO/IR system's optical components' shall be tested IAW MIL-C-675 paragraph 3.4-3.8.5. The durability testing shall be conducted to show optical components' have not been degraded by environmental testing. The optical components' coating, transmission, film thickness, and reflectance shall also be tested. The airworthiness substantiation shall include an EO/IR Optical Components Environmental Test Plan prepared IAW DI-NDTI-80566 and an EO/IR Optical Components Environmental Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.2.3. Laser Systems

17.2.3.1. Laser Hazard Evaluation

The purpose of the laser hazard evaluation is to identify hazards and potential hazards of lasers systems installed onboard Army aircraft to ensure the laser systems operate safely. Control measures to eliminate or mitigate the hazards should be analyzed and presented.

Criteria:
System tests and analysis shall be performed by an independent Army agency such as the Defense Health Agency to assess each laser system's operating parameters and to determine control measures to protect the aircrew from laser hazards.

Standard:
Aircraft System Specification
ADS-65A-HDBK paragraph 4.8.3.3. – 4.8. 3.4.

Method of Compliance:
A laser safety assessment must be performed by the Defense Health Agency for all laser systems on aircraft whose airworthiness is under the authority of the U.S. Army Aviation and Missile Command. The Defense Health Agency (DHA) will verify operational parameters of the laser and determine potential hazards and appropriate control measures to mitigate or eliminate those hazards. The DHA's Laser Hazard Evaluation includes the nominal ocular hazard distance, nominal skin hazard distance and laser eye protection requirements. The Laser Hazard Evaluation shall be submitted to SRD for review. Preliminary reports may be submitted for testing AWRs, but final reports are required for fielding or operational AWRs.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.2.3.2. Built-In Tests in Laser Systems

The purpose of built-in tests (BITs) containing fault detection and fault isolation functions is to alert the flight crew of the health status of the laser systems. BITs should correctly detect failures of the laser systems to prevent uncommanded laser fire, which presents a safety hazard to the aircrew. Built-in tests can also detect errors in the laser arming and firing functions and the laser firing direction (boresight).

Criteria:
Built-in tests shall correctly identify faults in the laser system.

Standard:
ADS-65A-HDBK paragraph 5.1.

Method of Compliance:
The laser system's BIT functionality shall be demonstrated IAW the aircraft system specification during ground and flight testing. No laser radiation should be emitted when the laser system is not being intentionally fired. Testing the BIT function demonstrates it shall alert the flight crew of flight-critical equipment status and conduct failure detection and failure isolation. A BIT may be continuous, automatic, or initiated as required. The airworthiness substantiation shall include an EO/IR BIT Demo Test Plane prepared IAW DI-NDTI-80566 and EO/IR BIT Demo Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.2.3.3. Laser System Location and Clearances

The purpose of analyzing the location of the installed laser system is to ensure there is adequate clearance for firing the lasers. The lasers shall not be able to fire directly into the cockpit or crew areas of the aircraft. The lasers shall not fire directly onto any part of the aircraft on which it is installed. Physical and/or software inhibits may be used to ensure the laser system does not fire in unsafe directions.

Criteria:
The location of the laser system on the aircraft shall be selected and the system designed so the lasers cannot fire directly into the aircraft nor onto any part of the aircraft itself.

Standard:
ADS-51-HDBK paragraph 103.2.6 (4) b.
ADS-65A-HDBK paragraphs 4.8.1., 4.8.3.12., 5.6.1.d.

Method of Compliance:
The laser system equipment location as installed on the aircraft shall be described by drawings and schematics. This information should be used to assess the laser clearance and laser cutout regions (masking). The airworthiness substantiation of the documentation showing location of sensor system as installed on the aircraft shall be provided. The airworthiness substantiation shall include an EO/IR/Laser System Location Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.2.3.4. Laser Armed Indicator

The purpose of a laser armed indicator is to inform the aircrew when lasers are active and ready to fire.

Criteria:
The laser system shall have an indicator to show the aircrew when the laser is armed.

Standard:
MIL-STD-1425 paragraph 4.4.8.

Method of Compliance:
The EO/IR system shall have a laser status switch installed to inform the pilot/Air Vehicle Operator (AVO) or ground personnel that the laser is in active mode. An indicator light or other display symbology shall be provided to indicate when the laser is armed. The airworthiness substantiation shall include an EO/IR Laser Status Switch Test Plan prepared IAW DI-NDTI-80566 and EO/IR Laser Status Switch Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.2.3.5. Laser Firing Indicator

The purpose of laser firing indicators is to provide the aircrew an indication of when the laser is firing.

Criteria:
The aircraft's EO/IR system's laser shall have a firing indicator light or other display symbology.

Standard:
MIL-STD-1425 paragraph 4.4.7. (The details of the displays shall conform to Human-Systems Interface requirements.)

Method of Compliance:
The EO/IR system shall have a laser firing indicator light or other display symbology to indicate when the laser is firing. The airworthiness substantiation shall include an EO/IR Laser Firing Indicator Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.2.3.6. Laser System—Two Actions to Prevent Inadvertent Firing

The purpose of two actions to fire the laser is to prevent inadvertent laser firing. Typically, two separate actions are required—an “arming” action and then a “firing” action. The two actions need to be in close temporal proximity to qualify as the two required actions. These two deliberate steps prevent inadvertent firing, which can occur if the laser is constantly “armed.”

Criteria:
Two separate sequential actions (within close temporal proximity) shall be required to fire the laser to prevent inadvertent fire.

Standard:
Aircraft System Specification
MIL-STD-1425 paragraphs 4.4.3. and 5.4.4.
Method of Compliance:
The EO/IR system shall require continuous operator interaction to fire the laser IAW the aircraft's system specification and MIL-STD-1425 paragraph 4.4.3. The airworthiness substantiation shall include an EO/IR Continuous Operator Interaction Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.2.3.7. Laser Cease Fire

The purpose of laser cease fire protocols is to prevent inadvertent long-term lasing.

Criteria:
The laser shall immediately cease firing without positive operator input (releasing the “laser fire” button) and/or shall cease firing by design (i.e., a time-out, or pulse count) to prevent inadvertent long-term lasing.

Standard:
Aircraft Specification

Method of Compliance:
Verify the system design ceases laser firing without positive operator input and/or by design constraint.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.2.3.8. Laser Systems—Ground Interlock

The purpose of laser ground interlock is to prevent the laser from firing while the aircraft is on the ground to protect the aircrew from laser fire. The ground interlock may be overridden (for example in a maintenance or training mode) as long as safe operation can be ensured.

Criteria:
The laser system shall not fire when the ground interlock is active.

Standard:
Aircraft Specification
MIL-STD-1425 paragraph 4.4.8.

Method of Compliance:
The system design showing how the laser cannot fire while the ground interlock is active shall be submitted to the Government for review. Analysis and/or ground tests can be used to verify this requirement.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.2.3.9. Laser Systems—Landing Interlock

Laser systems shall cease firing when the aircraft lands (when the landing gear first contacts the ground or landing surface).

Criteria:
If a laser is firing during the aircraft's approach to landing, the laser shall automatically shut off when the aircraft lands.

Standard:
Aircraft Specification
MIL-STD-1425 paragraph 4.4.8.

Method of Compliance:
The system design for the laser stopping firing upon aircraft landing shall be submitted to the Government for review. Analysis and/or ground tests can be used to verify this requirement.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.2.3.10. Laser System—Break Lock Conditions

Aircraft lasers can be used to designate an object during a weapons engagement. If the system design enables the laser to automatically remain firing during the engagement, procedures must be developed to address how and when the laser shuts off when a break lock condition occurs.

Criteria:
The laser system shall conform to the aircraft's specifications during break lock conditions.

Standard:
Aircraft Specification

Method of Compliance:
The procedures and protocols for the laser firing under break lock conditions will be submitted to the Government for review. Analysis, ground tests and/or flight tests can be used to verify this requirement.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.2.3.11. Laser System—Lost Link Conditions

The laser on an unmanned aircraft (UA) can illuminate objects during manned-unmanned teaming engagements or to assist manned aircraft. The laser on the UA can begin to fire based on a command sent from the controlling platform. Depending on the system design, the laser will either remain firing as long as it receives periodic commands that authorize continued firing (a “heartbeat”); or the laser will remain firing until it receives a command to stop firing. In the latter case, if there is a lost link condition, the UA will be unable to receive the “stop firing” command. Therefore, the system must have lost link procedures to ensure the laser stops firing. If the UA is designating for an ongoing weapons engagement, the system design may permit the laser to continue firing for an additional time after link is lost to complete the weapons engagement task.

Criteria:

The laser systems on unmanned aircraft shall conform to the specified lost link requirements.

Standard:

MIL-STD-1425 paragraph 4.4.8.
Aircraft Specification

Method of Compliance:

The lost link conditions may permit continued lasing for a pre-determined time for target designation. All scenarios must be pre-defined in the requirements and verified for conformance to the requirements. The lost link protocols and procedures shall be submitted to the Government for review. The requirement may be verified by analysis, ground tests and/or flight tests.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3. Weapons.

The purpose of the weapons paragraph is to provide requirements for the airworthiness evaluation of guns, gun turrets, guided and unguided rockets, missiles, launchers, explosive devices such as cartridge actuated devices, dispensed munitions, bombs, mines dispensers, and directed energy weapons such as anti-sensor weapons and lasers, and fire control systems integrated into Army aircraft, including rotorcraft, UAS, and fixed wing aircraft.

17.3.1. Weapon System Integration.
The purpose of the Weapon System Integration is to provide requirements which specifically relate to the weapon system combined with the aircraft to ensure safe integration with the platform.

17.3.1.1. Gun Environments.
The purpose of testing the gun environments is to understand all safety impacts to the platform when firing an integrated gun.
Criteria:
The aircraft weapon system shall meet safe flight operations, integration, and not interfere with aircraft operations.

Standard:
ADS-44-HDBK
ADS-45-HDBK
MIL-STD-882
MIL-HDBK-244 paragraphs 5.1.9.1., 5.1.9.2., 5.1.9.2.4., and 5.1.10.
MIL-HDBK-1763 paragraph 4.1.4.10.

Method of Compliance:
The environment induced by gun operation shall not create unsafe conditions to the aircraft. Muzzle blast and overpressure, vibroacoustics, cooling, egress, human factors and loads of the aircraft shall be tested to ensure safe flight. Requirements/Guidance can be found in ADS-44-HDBK, ADS-45-HDBK, MIL-STD-882; MIL-HDBK-244 paragraphs 5.1.9.1., 5.1.9.2., 5.1.9.2.4., 5.1.10., MIL-HDBK-1763 paragraph 4.1.4.10. The airworthiness substantiation shall include a Gun Environment Integration Test Procedures prepared IAW DI-NDTI-80603, Gun Environment Integration Test Plan prepared IAW DI-NDTI-80566, and a Gun Environment Integration Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
			Chapter 710 5.6.7	

17.3.1.2. Gases and Plumes
The purpose of the gases and plume test is to determine if there is a safety concern for the platform structure with the gases and debris from firing any weapon system that will prohibit use or require special maintenance cleaning requirements. As part of the testing it must also ensure that ejected casings from the gun cannot be ingested by the engines.

Criteria:
The aircraft weapon system shall meet safe flight operations and not interfere with aircraft operations.

Standard:
ADS-44-HDBK paragraph 5.2.8.
ADS-45-HDBK paragraph 5.1. I
MIL-STD-882
ADS-50-PRF
ADS-1-PRF paragraph 6.3.2.4.
MIL-HDBK-244A paragraphs 5.1.1., 5.1.1.1.2.4., 5.1.7.1.2.3., and 5.1.9.
MIL-HDBK-1763 paragraph 4.1.4.7.

Method of Compliance:
The gun/rocket/missile gases and plumes shall not create hazards to the aircraft. Gases or particulates from gun/rocket/missile plume during operation shall not cause engine flameout, stalling, and/or damage. Discharged rounds shall not fuse/detonate until they are a safe distance from the aircraft. Requirements/Guidance's can be found in ADS-44-HDBK paragraph 5.2.8., ADS-45-HDBK paragraph 5.1. I, MIL-STD-882, ADS-50-PRF, ADS-1-PRF paragraph 6.3.2.4., MIL-HDBK-244 paragraphs 5.1.1., 5.1.1.1.2.4., 5.1.7.1.2.3., 5.1.9., MIL-HDBK-1763 paragraph 4.1.4.7. The airworthiness substantiation shall include a Gases and Plumes Test Procedures prepared IAW DI-NDTI-80603, Gases and Plumes Test Plan prepared IAW DI-NDTI-80566, and a Gases and Plumes Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
			Chapter 710 5.6.7	

17.3.1.3. Gas Impingement
The purpose of the gas impingement is to determine the effects of the weapon system exhaust gases on the platform engine and to the crew.

Criteria:
The aircraft weapon system shall meet safe flight operations and not interfere with aircraft operations.

Standard:
MIL-HDBK-244 paragraph 5.1.1., 5.1.1.1.2.4., 5.1.7.1.2.3., 5.1.9., and 5.1.9.2.
ADS-44-HDBK paragraph 5.2.9.
ADS-62-SP
ADS-65-HDBK
MIL-STD-882
MIL-HDBK-1763 paragraph 4.1.4.7.

Method of Compliance:
The gun/rocket/missile gas impingement shall not cause unacceptable erosion of the aircraft structure/skin. Gases from gun/rocket/missile operation must not ablate transparencies, erode fuselage surfaces, and ablate faces of sensors. Requirements/Guidances can be found in MIL-HDBK-244 paragraphs 5.1.1.,

5.1.1.1.2.4., 5.1.7.1.2.3., 5.1.9., 5.1.9.2., ADS-44-HDBK paragraph 5.2.9., ADS-62-SP, ADS-65-HDBK, MIL-STD-882, MIL-HDBK-1763 paragraph 4.1.4.7. The airworthiness substantiation shall include a Gas Impingement Flight Test Procedures prepared IAW DI-NDTI-80603, Gas Impingement Flight Test Plan prepared IAW DI-NDTI-80566, and a Gas Impingement Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
			Chapter 710 5.6.7	

17.3.1.4. Weapon Safety Interlocks

The purpose of the weapon safety interlocks is to prevent the launching/firing of weapons when the aircraft, sensor, or weapon constraints are exceeded for safety or performance.

Criteria:

The aircraft weapon safety interlocks shall meet safe flight operations, integration, and not interfere with aircraft operations.

Standard:

ADS-44-HDBK paragraph 5.2.23
ADS-45-HDBK paragraph 5.1.I
MIL-STD-1425A paragraph 4.4.2., 4.4.3., and 4.4.4.
MIL-STD-882
MIL-STD-1472 paragraph 5.13.3.
ADS-62-SP paragraph 4.4.1.2.
MIL-HDBK-244
ADS-20

Method of Compliance:

The safety Interlocks shall prevent inadvertent laser designation or guns/rockets/missiles release. The Payload, aircraft, and ground station interfaces shall be designed with sufficient hardware and software integrity to prevent unintended laser firing or weapons release during ground or flight operations. Requirements can be found in ADS-44-HDBK paragraph 5.2.23, ADS-45-HDBK paragraph 5.1. 1, MIL-TD-1425A paragraphs 4.4.2., 4.4.3., 4.4.4., MIL-STD-882, MIL-STD-1472 paragraph 5.13.3., ADS-62-SP paragraph 4.4.1.2., MIL-HDBK-244, and ADS-20. FMECA provided IAW AMACC paragraph 14.2.10. and paragraph 14.4.2. ICD's are provide IAW Pa AMACC paragraph 4.1.5. The airworthiness substantiation shall include a Weapon Safety Interlock Test Procedures prepared IAW DI-NDTI-80603, Weapon Safety Interlock Test Plan prepared IAW DI-NDTI-80566, and a Weapon Safety Interlock Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
			Chapter 710	

17.3.1.5. Key Sensor Performance Attributes (performance)

The purpose of the key sensor performance test is to provide safe operation of the sensor and ensure it gives valid data for the weapon systems in a tactical environment.

Criteria:
The aircraft weapon system shall meet safe flight operations, integration, and not interfere with aircraft operations.

Standard:
ADS-44-HDBK paragraph 5.2.10., 5.8.2.2., 5.8.2.3., 5.8.2.4.
ADS-45-HDBK 5.1.I
MIL-STD-1425
MIL-STD-882
ADS-62-SP paragraph 4.4.1.2.
MIL-STD-1472
ADS-65-HDBK paragraphs 5.1., 5.2., 5.3., 5.4., and 5.5.
ADS-20 paragraphs 5.2.1.8., 5.2.1.7.
Aircraft System Specification

Method of Compliance:
The gun/rocket/missile key sensor performance attributes shall be fully characterized IAW the Aircraft System Specification to ensure safe operation in a tactical environment. Total system pointing error (TV and FLIR), target location accuracy, geo-location accuracy, laser range accuracy, laser spot stability, and target detection/identification range shall be designed and tested to ensure targeting and target identification errors do not result in unsafe conditions. Requirements can be found in ADS-44-HDBK paragraphs 5.2.10., 5.8.2.2., 5.8.2.3., 5.8.2.4., ADS-45-HDBK paragraph 5.1. 1, MIL-STD-1425A, MIL-STD-882, ADS-62-SP paragraph 4.4.1.2., MIL-STD-1472, ADS-65-HDBK paragraphs 5.1., 5.2., 5.3., 5.4., 5.5., and ADS-20 paragraph 5.2.1.8., 5.2.1.7. The airworthiness substantiation shall include a Key Sensor Performance Attributes Test Procedures prepared IAW DI-NDTI-80603, Key Sensor Performance Attributes Test Plan prepared IAW DI-NDTI-80566, and a Key Sensor Performance Attributes Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.1.6. Interfaces

The purpose of the interfaces is to provide evaluation of interfaces within the armament and fire control, with other mission equipment packages, and with other aircraft subsystems. All anomalies are tracked until they are resolved and closed.

Criteria:
The aircraft weapon system shall meet safe flight interfaces for release and/or target handover and not interfere with aircraft operations.

Standard:
ADS-44-HDBK paragraph 5.8.2.
ADS-45-HDBK paragraph 5.1.1.
ADS-62-SP
JSSG-2001
ADS-65-HDBK
Aircraft System Specification

Method of Compliance:
he interfaces required for safe gun/rocket/missile authorization/release and/or target handover to other US Army/DoD ground or air forces/assets shall meet safety requirements. Total system level integration of the sensors, aircraft and control station shall be demonstrated in ground and flight evaluations to meet safety requirements stated in the Aircraft System Specification. Requirements can be found in ADS-44-HDBK paragraph 5.8.2., ADS-45-HDBK paragraph 5.1.1., ADS-62-SP, JSSG-2001, and ADS-65-HDBK. ICDs shall be provided IAW AMACC paragraph 4.1.5. The airworthiness substantiation shall include Total System Interface Test Procedures prepared IAW DI-NDTI-80603, Total System Interface Test Plan prepared IAW DI-NDTI-80566, and a Total System Interface Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.1.7. Mini-Weapons Survey (MWS)
The purpose of the MWS is to provide analyses and tests that substantiate that the integration of a weapon system has not adversely affected safety, airworthiness, or the operational capability. The MWS includes weapons firing which determines the compatibility and safe functionality.

Criteria:
The MWS shall be performed for safe flight operations, integration, and not interfere with aircraft operations.

Standard:
ADS-44-HDBK paragraph 4.3.7.
ADS-45-HDBK paragraph 5.4., 5.5., and 5.2.
ADS-62-SP
MIL-HDBK-1763 paragraph 5.2.
ADS-65-HDBK paragraphs 3.2.4., and 5.6.1.

Method of Compliance:
The MWS IAW ADS-44-HDBK, paragraph 4.3.7. shall be performed. An MWS consists of limited analyses and tests that substantiate that a modification to an existing system has not adversely affected safety, airworthiness, or the operational capability. The MWS shall include limited guns/rockets/missiles firing. Primary interests are compatibility and

safe functionality. An MWS may be required even though a current modification has only a minor impact on the overall system. The MWS may be required due to the accumulation of minor modifications that result in the overall system being near or over the acceptable performance or safety margins. Requirements can be found in ADS-44-HDBK paragraph 4.3.7., ADS-45-HDBK paragraphs 5.4., 5.5., 5.2., ADS-62-SP, MIL-HDBK- 1763 paragraph 5.2., and ADS-65-HDBK paragraphs 3.2.4., 5.6.1. The airworthiness substantiation shall include Mini-Weapons Survey (MWS) Test Procedures prepared IAW DI-NDTI-80603, Mini-Weapons Survey (MWS) Test Plan prepared IAW DI-NDTI-80566, and a Mini-Weapons Survey (MWS) Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
			Chapter 710 section 17	

17.3.1.8. Armament Flight Test Reviews

The purpose of the armament flight test reviews is to discuss the planned firing matrices and firing conditions, to determine methods for hardware and software failure modes, and establish coordinated positions for failure analysis reports to ensure safe weapon flight testing on the platform.

Criteria:

The aircraft weapon system shall meet safe flight operations for weapons firings at the range.

Standard:

ADS-44-HDBK paragraph 5.1.
ADS-45-HDBK paragraphs 5.4., 5.5., and 5.2.
MIL-HDBK-1763 paragraph 4.1.4.6.2.

Method of Compliance:

The armament flight test reviews IAW ADS-44-HDBK, paragraph 5.1. shall be completed. The Contractor shall support pre-weapon-firing reviews conducted by the Government at least 30 days before the first gun/rocket/missiles firing test to assess planned firing matrices and firing conditions, assess planned evaluation and diagnosis methods for hardware and software failure modes, and establish coordinated positions for failure analysis reports. Requirements can be found in ADS-44-HDBK paragraph 5.1., ADS-45-HDBK paragraphs 5.4., 5.5., 5.2., and MIL-HDBK-1763 paragraph 4.1.4.6.2. The airworthiness substantiation shall include analysis, demonstration, simulation, inspection and/or review of documentation. The SSHA shall be provided IAW AMACC Paragraph 17.3.2.3. Scientific and technical reports shall be provided IAW DI-MISC-80711. Test and Evaluation Program Plan shall be provided IAW DI-NDTI-81284. ICDs are provided IAW AMACC paragraph 4.1.5.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.1.9. Armament, Fire Control and Sensor Package Description

The purpose of the Armament, Fire Control and Sensor design and test is to assess the effects of weapons' firing on the aircraft and its subsystems, including avionics, support structure and dynamic systems (engines, drive-train and rotors) and demonstrate compliance with the system specification.

Criteria:

The aircraft weapon system shall meet safe flight operations, integration, and not interfere with aircraft operations.

Standard:

ADS-44-HDBK paragraphs 5.1.2., 5.5.2., and 5.5.3.
ADS-45-HDBK 4.1., 4.2., 4.3., and 4.4.
MIL-STD-1760E
MIL-HDBK-1760
MIL-HDBK-1763 paragraph 4.1.3.
ADS-20
SAE AS5726
ADS-62-SP paragraphs 4.1., and 4.4.1.2.
MIL-HDBK-799
ADS-65-HDBK

Method of Compliance:

The armament, fire control and sensor package description, including all installation details of the guns/rockets/missiles, IAW ADS-44-HDBK, paragraphs 5.1.2., 5.5.2., 5.5.3., ADS-45-HDBK, paragraphs 4.1., 4.2., 4.3. and 4.4. shall be provided. The airworthiness substantiation shall include drawings, schematics, and performance data. It shall describe all items of the entire armament, fire control and sensor system/subsystems. The data shall be identified by Governmental nomenclature and shall include the functional relationship and purpose of the items, including interconnections to systems, such as structural mounting surface, electrical, and optical requirements. Structural attachment details of the sensor turret systems to the aircraft shall be shown, including all loaded joints clearly shown. This shall include mounting details depicting the system/subsystem to brackets or pallets or rack attachments to the aircraft. Electro-optical and optical description/analysis/diagrams shall be required. This shall include electrical schematics and wire diagrams internal to the system/subsystem and wire diagrams/cable connection. Requirements can be found in ADS-44-HDBK paragraphs 5.1.2., 5.5.2., 5.5.3., ADS-45-HDBK paragraphs 4.1., 4.2., 4.3., 4.4., MIL-STD-1760E, MIL-HDBK-1760, MIL-HDBK-1763 paragraph 4.1.3., ADS-20, SAE AS5726, ADS-62-SP paragraphs 4.1., 4.4.1.2., MIL-HDBK-799, and ADS-65-HDBK. The airworthiness substantiation shall include analysis, demonstration, simulation, inspection and/or review of documentation. ICDs shall be provided IAW AMACC paragraph 4.1.5. Scientific and technical reports shall be provided IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.1.10. Location

The purpose of the location of the guns/rockets/missiles, fire control, and sensor package is to provide information to ensure these systems meet the standard safety compliances in their proximity to each other and other systems.

Criteria:

The aircraft weapon system shall meet safe flight operations, integration, and not interfere with aircraft operations.

Standard:

ADS-44-HDBK paragraphs 5.1.2., 5.1.3., 5.1.4., and 5.9.3.7.
ADS-45-HDBK 4.1., 4.2. and 4.3.
MIL-STD-1760
MIL-HDBK-1760
MIL-HDBK-1763 paragraphs 4.1.3,. 4.1.4.12.5., and 4.1.4.12.6.
ADS-20
SAE AS5726
ADS-62-SP paragraph 4.1.
MIL-HDBK-799
ADS-65-HDBK
MIL-HDBK-244 paragraph 5.1.1.1.2.

Method of Compliance:

The location of guns/rockets/missiles, fire control, and sensor packages IAW ADS-44-HDBK paragraphs 5.1.2., 5.1.3., 5.1.4. and ADS-45-HDBK paragraphs 4.1., 4.2. and 4.3. shall be provided. The platform shall provide equipment installations and arrangement drawings showing the location of all major items of the armament, fire control and sensor equipment for which provisions have been made and any exterior equipment. Requirements can be found in ADS-44-HDBK 5.1.2., 5.1.3., 5.1.4., 5.9.3.7., ADS-45-HDBK 4.1., 4.2. and 4.3., MIL-STD-1760E, MIL-HDBK-1760, MIL-HDBK-1763 4.1.3., 4.1.4.12.5., 4.1.4.12.6., ADS-20, SAE AS5726, ADS-62-SP 4.1., MIL-HDBK-799, ADS-65-HDBK, and MIL-HDBK-244 5.1.1.1.2. The airworthiness substantiation shall include analysis, demonstration, inspection and/or review of documentation. ICDs shall be provided IAW AMACC paragraph 4.1.5. Scientific and technical reports shall be provided IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
			Chapter 710 5.6	

17.3.1.11. Armament and Fire Control System

The purpose of the armament and fire control system is to provide the safe firing envelope and provide the ballistic tables for the weapon trajectories to ensure the most

accurate data is implemented and it should not be so inaccurate to cause a safety hazard to the firing aircraft and crew.

Criteria:
The aircraft weapon system shall meet safe flight operations, integration, and not interfere with aircraft operations.

Standard:
ADS-44-HDBK paragraphs 5.9.3.7., 5.1.2., 5.5.2., 5.5.3., and 5.8.
ADS-45-HDBK paragraphs 4.1., 4.2., 4.3. and 4.4., and 5.2.
MIL-STD-1760.
MIL-HDBK-1760
MIL-HDBK-1763 paragraphs 4.1.4.12.5. and 4.1.4.12.6.
ADS-20 paragraph 5.2.
SAE AS5726
ADS-65-HDBK
Aircraft System Specification

Method of Compliance:
The validation of an armament and fire control system demonstration IAW ADS-20 paragraphs 5.2., ADS-44-HDBK paragraphs 5.8., and ADS-45-HDBK paragraph 5.2. shall be provided. The testing conducted on an armament and fire control system shall demonstrate the ability of the system to meet the requirements of the Aircraft System Specification and to develop/support the safe firing envelope. The demonstrations shall include both ground and flight tests. Requirements can be found in ADS-44-HDBK paragraphs 5.9.3.7., 5.1.2., 5.5.2., 5.5.3., 5.8; ADS-45-HDBK paragraphs 4.1., 4.2., 4.3. and 4.4., 5.2., MIL-STD-1760E, MIL-HDBK-1760, MIL-HDBK-1763 paragraphs 4.1.4.12.5., 4.1.4.12.6., ADS-20 paragraph 5.2., SAE AS5726 and ADS-65-HDBK. The airworthiness substantiation shall include analysis, demonstration, simulation, inspection and/or review of documentation. Scientific and technical reports shall be provided IAW DI-MISC-80711. ICDs shall be provided IAW AMACC paragraph 4.1.5. The airworthiness substantiation shall include Armament and Fire Control System Demonstration Procedures prepared IAW DI-NDTI-80603, Armament and Fire Control System Demonstration Plan prepared IAW DI-NDTI-80566, and an Armament and Fire Control System Demonstration Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.2. Aircraft Weapon System Integration
The purpose of the weapon system integration is to provide a safe integration into the platform.

17.3.2.1. Stores/Aircraft Interface.
The purpose of the stores/aircraft interface is to provide requirements to ensure the weapon does not adversely affect the platform during ground and flight operations.

Criteria:
The aircraft weapon system shall meet safe integration and not interfere with aircraft operations.

Standard:
ADS-44-HDBK paragraph 5.6.6. and A.2.3.1.
ADS-45-HDBK paragraph 5.1. I
MIL-HDBK-1763 Test 131
MIL-STD-8591
MIL-STD-1289
MIL-STD-882
ADS-65-HDBK paragraph 4.8.3.4. and 4.8.3.13
STANAG 3899
MIL-HDBK-244 paragraph 5.1.4.1.

Method of Compliance:
The stores/aircraft interface shall not adversely affect the aircraft during ground and flight operations IAW ADS 44 & 45. Clearance between store and surroundings shall be sufficient to allow for stores loading, aircraft/munitions servicing, in flight vibration and deployment without contacting aircraft, ASE and other stores. Stores loading/unloading procedures shall be defined and documented. Stores/aircraft interface shall be verified by test IAW ADS 44 & 45 for Army Munitions Board Certification. Stores loading/unloading procedures shall be verified by demonstration using the stores loading manual. The requirements can be found in ADS-44-HDBK paragraphs 5.6.6., A.2.3.1., ADS-45-HDBK paragraph 5.1.1., MIL-HDBK-1763: Test 131, MIL-STD-8591, MIL-STD-1289, MIL-STD-882, ADS-65-HDBK paragraphs 4.8.3.4., 4.8.3.13., STANAG-3899, MIL-HDBK-244 paragraph 5.1.4.1. The airworthiness substantiation shall include analysis, test, demonstration, simulation, inspection and/or review of documentation. The FMECA shall be provided IAW AMACC Paragraph 14.2.10. The Safety Assessment Report (SAR) shall be provided IAW AMACC Paragraph 14.2.11. The SSHA Report shall be provided IAW AMACC Paragraph 14.2.12. The airworthiness substantiation shall include Stores/Aircraft Interface Test Procedures prepared IAW DI-NDTI-80603, Stores/Aircraft Interface Test Plan prepared IAW DI-NDTI-80566, and a Stores/Aircraft Interface Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	JSSG-2001: 3.3; 3.4.2.1.5; 3.4.2.2. for the testing methodology; 10.1.1		Chapter 710	3899

17.3.2.2. Boresight Retention and Accuracy
The purpose of the boresight procedures is to accurately align the weapon system with any aiming and/or fire control system and that this accuracy does not degrade

significantly through normal operations. Boresight retention and accuracy should verify operation, timeliness, and accuracy of the boresight subsystem, both static and dynamic and ensure the accuracy should not be so poor as to cause a safety hazard to the firing aircraft

Criteria:
All weapon systems shall have capabilities to boresight and retain boresight values and they shall meet boresight retention and accuracy for safe flight operations, integration, and not interfere with aircraft operations.

Standard:
ADS-20
ADS-44-HDBK paragraph 5.2.19, 5.5.3, 5.8.2.2, 5.2.15, and 5.5.3.
ADS-45-HDBK paragraph 5.1.1 ADS-62-SP
ADS-65-HDBK
MIL-STD-882
MIL-HDBK-799
MIL-STD-1425 paragraph 4.4.6
MIL-STD-1472 paragraph 5.13.3
MIL-HDBK-1763 paragraph 4.1.4.9, 4.1.4.12.2, and 4.1.4.12.7
Aircraft System Specification

Method of Compliance:
The aircraft armament/fire control boresight shall be tested to ensure operation, timeline, and accuracy are IAW the Aircraft System Specification. Boresighting/alignment procedures and boresight retention shall be tested to ensure the boresight can be retained within the Aircraft System Specification tolerance. Boresight retention shall be rechecked periodically during ground and flight tests. Guidance can be found in ADS-44-HDBK paragraph 5.5.3, MIL-STD-882, MIL-HDBK-799. The airworthiness substantiation shall include a Boresight Test Procedures prepared IAW DI-NDT--80603, Boresight Test Plan prepared IAW DI-NDTI-80566, and a Boresight Test Report prepared IAW DI-NDTI-80809.

The boresight retention and accuracy test and demonstration shall be measured for all weapon systems and target acquisition sensor suite. Requirements can be found in ADS-44-HDBK paragraphs 5.2.19, 5.5.3, 5.8.2.2, 5.2.15, ADS-45-HDBK paragraph 5.1.1, ADS-62-SP, MIL-STD-1425A paragraph 4.4.6, MIL-STD-1472 paragraph 5.13.3, ADS-65-HDBK, ADS-20, and MIL-HDBK-1763 paragraphs 4.1.4.9, 4.1.4.12.2, 4.1.4.12.7. Scientific and technical reports shall be provided IAW DI-MISC-80711. The airworthiness substantiation shall include Boresight Retention Test Procedures prepared IAW DI-NDTI-80603, Boresight Retention Test Plan prepared IAW DI-NDTI-80566, and a Boresight Retention Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
AFOSH STD 48-139 ANSI Z136.1 (now owned by LIA), for the safety design requirements of laser systems. 21 CFR Part 1040	MIL-STD-1425 MIL-HDBK-828 AR 11-9			

17.3.2.3. Stores Safe Separation

The purpose of the stores safe separation is to determine if proper safety is maintained throughout the flight or jettison envelope.

Criteria:

The aircraft weapon system shall meet safe flight operations during release of the weapon.

Standard:

MIL-STD-1289
ADS-44-HDBK paragraph 5.9.3.8.
ADS-45-HDBK paragraph 5.1. I
MIL-HDBK-244 paragraph 5.1.1., 5.1.1.2., 5.1.2., and 5.3.8.
MIL-HDBK-1763 paragraph 4.1.4.5.3., 4.1.4.5.4., and 4.1.4.5.5.
MIL-STD-8591
STANAG 3899

Method of Compliance:

The gun/rocket/missile shall separate safely from the aircraft throughout the aircraft/weapon launch or jettison flight envelope IAW MIL-STD-1289. The gun/rocket/missile shall separate safely from the aircraft throughout the store launch envelope. Gun/rocket/missiles can be jettisoned throughout vehicle/store employment flight envelope without inducing dangerous aerodynamic loads and moments, causing engine or propeller damage, store-aircraft collision, damage to any aircraft surface, or damage or interference to critical control functions. If the stores cannot be jettisoned, then rationale as to why the stores cannot be jettisoned. The requirements can be found in MIL-STD-1289, ADS-44-HDBK paragraph 5.9.3.8., ADS-45-HDBK paragraph 5.1. 1, MIL-HDBK-244 paragraph 5.1.1., MIL-HDBK-1763 paragraphs 4.1.4.5.3., 4.1.4.5.4, 4.1.4.5.5., MIL-STD-8591, STANAG 3899, and MIL-HDBK-244 paragraphs 5.1.1.2., 5.1.2., and 5.3.8. The airworthiness substantiation shall include analysis, test, demonstration, simulation, inspection and/or review of documentation. The FMECA shall be provided IAW AMACC paragraph 14.2.10. and paragraph 14.4.2. The Safety Assessment Report (SAR) shall be provided IAW AMACC Paragraph 14.2.11. The SSHA Report shall be provided IAW AMACC Paragraph 14.2.12. Test plans and procedures shall be prepared IAW DI-NDTI-80566 and DI-NDTI-80603 for all, tests and demonstrations. Test reports shall be prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	JSSG-2001: 3.3; 3.4.2.1.5; 3.4.2.2. for the testing methodology; 10.1.1		Chapter 710	

17.3.2.4. Induced and Operational Environments
The purpose of testing the induced and operational environment is to provide information pertaining to the integration of the platform and weapons to maintain flight safely.

Criteria:
The aircraft weapon system shall meet safe flight operations, integration, and not interfere with aircraft operations.

Standard:
MIL-STD-1289
ADS-44-HDBK paragraphs 5.2.8., 5.2.9., 5.2.12., 5.2.13., 5.2.14., 5.9.3.8., 5.9.3.9., and 4.1.4.5.5.
ADS-45-HDBK paragraph 5.1. I
MIL-HDBK-1763 paragraphs 4.1.4.2., 4.1.4.3., 4.1.4.4., 4.1.4.5.3., and 4.1.4.5.4.
MIL-STD-8591
STANAG 3899
MIL-HDBK-244 paragraphs 5.1.1.2. and 5.1.2.

Method of Compliance:
The environment induced by the gun/rocket/missile on the aircraft, and by the aircraft on the store during carriage and launch/separation/jettison for the cleared usage, shall not adversely affect the aircraft. Store carriage or launch shall not cause problems by inducing dangerous aerodynamic loads and moments, engine damage, store-aircraft collision, damage to any aircraft surface, excessive load on aircraft ECS, damage or interference with critical control functions. The requirements can be found in MIL-STD-1289, ADS-44-HDBK paragraphs 5.2.8., 5.2.9., 5.2.12., 5.2.13., 5.2.14., 5.9.3.8., 5.9.3.9., 4.1.4.5.5., ADS-45-HDBK paragraph 5.1. 1, MIL-HDBK-1763 paragraphs 4.1.4.2., 4.1.4.3., 4.1.4.4., 4.1.4.5.3., 4.1.4.5.4., MIL-STD-8591, STANAG-3899, and MIL-HDBK-244 paragraphs 5.1.1.2., 5.1.2. The airworthiness substantiation shall include analysis, test, demonstration, simulation, inspection and/or review of documentation. The FMECA shall be provided IAW AMACC paragraph 14.2.10. and paragraph 14.4.2. The Safety Assessment Report (SAR) shall be provided IAW AMACC Paragraph 14.2.11. The SSHA Report shall be provided IAW AMACC Paragraph 14.2.12. Internal Loads and Static Strength Analysis Report shall be provided IAW DI-SESS-80198. Test plans and procedures shall be prepared IAW DI-NDTI-80566 and DI-NDTI-80603 for all, tests and demonstrations. Test reports shall be prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
			Chapter 710 5.6.7	

17.3.2.5. Stores Operations
The purpose of the stores operation is to ensure operational compatibility with the platform.

Criteria:
The aircraft weapon system shall meet safe flight operations, integration, and not interfere with aircraft operations.

Standard:
MIL-HDBK-1763 paragraphs 4.1.4.2., 4.1.4.3., 4.1.4.4., 4.1.4.5.3., 4.1.4.5.4., and 4.1.4.5.5.
MIL-STD-8591
MIL-STD-1289
ADS-37
ADS-44-HDBK paragraph 5.9.3.4., ADS-45-HDBK paragraph 5.1.I.
MIL-STD-810
MIL-HDBK-244 paragraphs 5.1.1.2. and 5.1.2.
MIL-STD-882
ADS-62-SP paragraph 4.4.1.2.
ADS-65-HDBK paragraph 4.8.3.4. and 4.8.3.13.

Method of Compliance:
The gun/rocket/missile operations shall not adversely affect the aircraft. The verification includes physical fit and function, loading/installation procedure, HERO test, EMC/EMI, ballistic tables, temperature extremes and thermal test, SIL, and flight testing. Ground vibration test shall be conducted to include wind tunnel tests, effects of aircraft on captive stores/suspension equipment, effects of stores/suspension equipment on aircraft, environmental vibration, aeroacoustic test. The requirements can be found in MIL-HDBK-1763 paragraphs 4.1.4.2., 4.1.4.3., 4.1.4.4., 4.1.4.5.3., 4.1.4.5.4., 4.1.4.5.5., MIL-STD-8591, MIL-STD-1289, ADS-37, ADS-44-HDBK paragraph 5.9.3.4., ADS-45-HDBK paragraph 5.1.1., MIL-STD-810, MIL-HDBK-244 paragraphs 5.1.1.2., 5.1.2., MIL-STD-882, ADS-62-SP paragraph 4.4.1.2., and ADS-65-HDBK paragraphs 4.8.3.4., 4.8.3.13. The airworthiness substantiation shall include a Stores Operations Test Procedures prepared IAW DI-NDTI-80603, Stores Operations Test Plan prepared IAW DI-NDTI-80566, and a Stores Operations Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
			Chapter 710	

17.3.2.6. Manuals

The purpose of the manuals are to provide the crew with any restrictions or notes on using the weapon systems with the platform. The operator's manual will include any warning, caution, notes as well as restrictions given for the platform and weapon integration. Other manual is the cooperative engagement manual which explains each weapon safe engagement ranges and modes when considering another platform or ground personnel lasing for the weapon. The maintenance manual is required for both the weapon, launcher, and platform.

Criteria:

The aircraft's weapon employment operations shall be in the operator's flight manuals.

Standard:

ADS-44-HDBK paragraphs 3.1.6. and 5.2.14
ADS-45-HDBK
MIL-STD-1472 paragraphs 5.7.1.2.

Method of Compliance:

The gun/rocket/missile configurations for the aircraft shall be tested and documented in the flight manuals. The documentation shall include safe available ripple selections, safe release envelopes and flight limits, loading procedures, store checklists, and operational and employment data. The fuze safety certification shall be provided by the Army Munitions Board. The WIL/SIL/AIL testing shall be performed on each configuration. The loading/unloading test plan and procedures for each configuration shall be provided IAW DI-NDTI-80566 and DI-NDTI-80603. The requirements can be found in ADS-44-HDBK paragraphs 3.1.6., 5.2.14., ADS-45-HDBK, MIL-STD-1472 paragraph 5.7.1.2. The airworthiness substantiation shall be provided for Operational Concept Description IAW DI-IPSC-81430, Scientific and technical reports IAW DI-MISC-80711, and Weight and Balance Report for Aircraft shall be IAW DI-MGMT-81503.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.2.7. Health/Status

The purpose of the health/status is to provide the crew with safety related information pertaining to the health and status of the weapon system so an informative decision can be made whether to fire a weapon, release the weapon in jettison, or to do an emergency release of all weapons. This is done to prevent a safety hazard to the pilots and/or platform.

Criteria:

The aircraft weapon system shall meet safe flight operations, integration, and not interfere with aircraft operations.

Standard:
ADS-44-HDBK paragraphs 4.7.2., 4.7.3., 5.9.3.7., and 5.5.1.
ADS-45-HDBK paragraph 5.1. I
MIL-STD-882
MIL-HDBK-244 paragraph 5.1.1.
ADS-62-SP paragraph 4.4.1.2.
ADS-65-HDBK

Method of Compliance:
The aircraft weapons system shall have the capability to determine the health/status of the weapon and the ability to detect a misfire. The aircraft shall have the capability to turn off or release a malfunctioning gun/rocket/missile. Verification by test shall occur in the SIL, hardware in the loop lab, avionics lab and flight testing. This analysis and test is to show the system can control the stores management system; condition the stores properly, confirm release of missile, and jettison. The requirements can be found in ADS-44-HDBK paragraphs 4.7.2., 4.7.3., 5.9.3.7., 5.5.1., ADS-45-HDBK paragraph 5.1.1., MIL-STD-882, MIL-HDBK-244 paragraph 5.1.1., ADS-62-SP paragraph 4.4.1.2., and ADS-65-HDBK. The airworthiness substantiation shall include analysis, test, demonstration, simulation, inspection and/or review of documentation. The FEMCA shall be provided IAW AMACC Paragraph 14.2.10. The Safety Assessment Report (SAR) shall be provided IAW AMACC Paragraph 14.2.11. The SSHA Report shall be provided IAW AMACC Paragraph 14.2.12. ICDs shall be provided IAW AMACC paragraph 4.1.5. Test plans and procedures shall be prepared IAW DI-NDTI-80566 and DI-NDTI-80603 for all, tests and demonstrations. Test reports shall be prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.2.8. System Integration Lab, Aircraft Integration Lab, and Weapons Integration Lab (SIL/AIL/WIL) Testing

The purpose of the integration lab testing is to determine if the system components perform, and interface functionally as intended and verify that the software functionality is complete and will not degrade the platform system software operational performance.

The system integration lab (SIL) tests the system of the weapon and launcher together to ensure it is ready for the other tests.

The weapon integration lab (WIL) tests the full system set up with faults inserted into the missile to determine how the aircraft responds.

The aircraft integration lab (AIL) will test the full system in an aircraft lab set up that will insert faults into the aircraft software to test out the weapon responds.

Criteria:
The aircraft armament systems critical components shall not have any anomalies that impact safe flight.

Standard:
ADS-44-HDBK paragraphs 5.4., 5.5., and 5.8.
ADS-45 paragraph 5.2.
MIL-HDBK-799

Method of Compliance:
The aircraft armament, fire control, sensor systems and flight control systems shall have a system level laboratory test performed IAW ADS-44-HDBK, paragraphs 5.4, 5.4.1 and 5.4.2 Include analysis, ground test, flight test, test plans, test procedures and test reports. Prepare validation of System Integration Lab, Aircraft Integration Lab and Weapons Integration Lab (SIL/AIL/WIL) testing IAW ADS-44-HDBK, paragraphs 5.4, and 5.5, and ADS- 45, paragraph 5.2 and MIL-HDBK-799. The airworthiness substantiation shall include a SIL/AIL/WIL Test Procedures prepared IAW DI-NDTI-80603, SIL/AIL/WIL Test Plan prepared IAW DI-NDTI-80566, and a SIL/AIL/WIL Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.3. Weapon System Ground Requirements
The purpose of the weapon system ground requirements is to provide the validation data for ground non-firing tests. Simulators, hot benches and cockpit mockups, as well as the test aircraft, may be used for these non-firing ground tests.

17.3.3.1. Fire Control System.
The purpose of the Fire Control System is to detect, classify and track a target or multiple targets. The Fire Control system consists of subsystems such as fire control computer, air data sensors, sights, target acquisition/designation subsystem, navigational inputs, and the armament.

Criteria:
Armament and fire control system shall safely and properly interoperate with the aircraft, armament subsystems and crews.

Standard:
ADS-44-HDBK paragraph 5.5.1.
MIL-STD-882
MIL-HDBK-1763 paragraph 4.1.4.12.5.
MIL-HDBK-799
Aircraft System Specification

Method of Compliance:
The aircraft armament and fire control system demonstration shall be conducted to demonstrate proper integration with the aircraft and interaction between armament subsystems and crews. Armament subsystem controls, such as cockpit controls, switches, instruments, sights, and displays, that are part of the armament subsystems, shall be demonstrated to the Aircraft System Specification. Based on nature of the armament integration or modification, Mini Weapon Survey or Full Weapon Survey shall be required. Requirements guidance can be found in ADS-44-HDBK 5.5.1., MIL-STD-882, MIL-HDBK-1763 4.1.4.12.5., MIL-HDBK-799. The airworthiness substantiation shall include a Fire Control System Analysis Report prepared IAW DI-MISC-80711, Fire Control System Test Procedures prepared IAW DI-NDTI-80603, Fire Control System Test Plan prepared IAW DI-NDTI-80566, and a Fire Control System Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.3.2. Deleted

17.3.3.3. Maintenance Procedures.
The purpose of the maintenance procedures is to ensure safety for the physical integration of the weapon/launcher on the platform.

Criteria:
The aircraft armament and munition systems shall have maintenance procedures for arming, rearming and loading.

Standard:
ADS-44-HDBK paragraph 5.5.4.
MIL-STD-1289
MIL-STD-882
Aircraft System Specification

Method of Compliance:
The aircraft armaments and munitions shall be tested IAW the Aircraft System Specification for the times and procedures for arming, rearming and loading. Safety procedures for all operations shall also be tested. Requirements guidance can be found in ADS-44-HDBK 5.5.4., MIL-STD-1289, MIL-STD-882. The airworthiness substantiation shall include a Maintenance Procedures Test Procedures prepared IAW DI-NDTI-80603, Maintenance Procedures Test Plan prepared IAW DI-NDTI-80566, and a Maintenance Procedures Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.3.4. Weapon Clearance

The purpose of the weapon clearance analysis is to ensure that sufficient clearance exists between the weapon firing trajectory and other weapons / launchers, and the platform.

Criteria:
All projectiles, rockets or missiles shall have safe clearances.

Standard:
ADS-44-HDBK paragraphs 5.2.12. and 5.8.1.1.
MIL-HDBK-1763 paragraph 3.1.28.
MIL-STD-1289.

Method of Compliance:
The aircraft weapon clearance analysis is required IAW ADS-44-HDBK paragraph 5.2.12. to demonstrate sufficient clearances between projectiles, rockets or missiles' trajectories. If the clearance analysis does not show sufficient clearance between the propeller(s), rotors, and/or fuselage of the aircraft and the armament trajectory, it shall be tested to ensure a safe firing clearance. Clearance tests shall precede firing flight tests. Requirements guidance can be found in ADS-44-HDBK paragraphs 5.8.1.1., 5.2.12., MIL-HDBK-1763 paragraph 3.1.28, and MIL-STD-1289. The airworthiness substantiation shall include a Weapon Clearance Analysis Report prepared IAW DI-MISC-80711, Weapon Clearance Test Procedures prepared IAW DI-NDTI-80603, Weapon Clearance Test Plan prepared IAW DI-NDTI-80566, and a Weapon Clearance Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.3.5. Target Acquisition Sensor (performance)

The purpose of testing the target acquisition sensor is to ensure compatibility with the weapon systems. The target acquisition sensors detect, lock on and track targets, while accurately transferring engagement information to aircraft armaments.

Criteria:
The Aircraft armament system(s) shall accurately receive data and utilize the information from Target Acquisition Sensor Suite.

Standard:
ADS-44-HDBK paragraph 5.5.2.
MIL-HDBK-1763 paragraph 4.1.4.9.
MIL-HDBK-244

Method of Compliance:
The aircraft Target Acquisition Sensor Suite and armament integration compatibility shall be tested IAW ADS-44-HDBK paragraph 5.5.2. Target Acquisition Sensor Suite

shall be capable of detection, acquisition, locking on and tracking targets. Aircraft armament shall be capable of accurately receiving and employing information from Target Acquisition Sensor Suite. Requirements guidance can be found in ADS-44-HDBK paragraph 5.5.2., MIL-HDBK-1763 paragraph 4.1.4.9. The airworthiness substantiation shall include a Target Acquisition Sensor Analysis Report prepared IAW DI-MISC-80711, a Target Acquisition Sensor Test Plan prepared IAW DI-NDTI-80566 and Target Acquisition Sensor Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.3.6. Recoil Loads and Blast Effects

The purpose of the recoil loads, and blast effects is to ensure the aircraft will not be adversely affected during weapons employment due to recoil loads, airframe response to blast effects, and weapons rate of fire.

Criteria:

The aircraft weapon system shall not have unsafe conditions due to recoil loads and airframe response to blast effects, and weapons rate of fire.

Standard:

ADS-44-HDBK paragraph 5.2.6., 5.2.7., and 5.2.16
MIL-HDBK 1763
MIL-HDBK-244

Method of Compliance:

The aircraft weapon recoil loads and airframe response to blast effects and weapons rate of fire from live weapon firings shall be recorded and documented. Requirements guidance can be found in ADS-44-HDBK paragraphs 5.2.6., 5.2.7., 5.2.16, and MIL-HDBK-1763. The airworthiness substantiation shall include a Recoil Loads and Blast Effects Analysis Report prepared IAW DI-MISC-80711, Recoil Loads and Blast Effects Test Procedures prepared IAW DI-NDTI-80603, Recoil Loads and Blast Effects Test Plan prepared IAW DI-NDTI-80566, and a Recoil Loads and Blast Effects Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.3.7. Ground Firing Test

The purpose of the ground firings is to identify and fix any problems or anomalies prior to in-flight live firing to ensure catastrophic results will not occur to the aircraft and crew during weapons employment.

Criteria:
The aircraft weapon system shall not create unsafe conditions to the aircraft or crew due to firing of gun/rocket/missile while on ground.

Standard:
ADS-44-HDBK paragraph 5.5
MIL-HDBK-1763
MIL-STD-1289

Method of Compliance:
Ground firing is conducted to verify the firing effects on the aircraft and crew. Requirements guidance can be found in ADS-44-HDBK paragraph 5.5.7. Test Procedures prepared IAW DI-NDTI-80603, Ground Firing Test Plan prepared IAW DI-NDTI-80566, and a Ground Firing Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.4. Weapon System Non-Firing Flight Requirements
The purpose of the weapon system non-firing flight test requirements is to confirm safe functionality prior to the start of firing flight tests.

17.3.4.1. Weapon Inhibits, Limits and Interrupts (WILI)
The purpose of the WILI is to ensure the platform prevents the launching/firing of weapons when aircraft, sensor or weapon constraints are exceeded.

Criteria:
The aircraft shall prevent inadvertent launching/firing of weapons.

Standard:
ADS-44-HDBK paragraph 5.2.23
MIL-STD-882
MIL-HDBK-799

Method of Compliance:
The aircraft WILI analysis is required IAW ADS-44-HDBK paragraph 5.2.23 and MIL-STD-882 to identify the constraints and software necessary to limit or prevent inadvertent firing of weapons. Aircraft testing shall verify that the WILIs are congruent with the approved WILIs analysis. The WILI are first identified through analysis and then verified by laboratory tests, ground tests and flight tests. The airworthiness substantiation shall include a WILI Analysis Report prepared IAW DI-MISC-80711, WILI Test Procedures prepared IAW DI-NDTI-80603, WILI Test Plan prepared IAW DI-NDTI-80566, and a WILI Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.4.2. Jettison
The purpose of the jettison analysis is to determine the jettison capabilities of all stores stations that hold jettisonable armament.

Criteria:
The Aircraft shall have safe jettison of external stores.

Standard:
ADS-44-HDBK paragraph 5.2.13
MIL-STD-1289 paragraph4.3.2.5.

Method of Compliance:
The aircraft weapon system shall have a weapon store jettison analysis and test to determine the safe store jettison envelope and the store can be safely released from the aircraft during an emergency. Safe jettison envelope is a subset of the flight envelope. Jettison analyses shall determine the clearances between jettisoning stores and various parts of the aircraft. If the jettison analysis does not show significant clearance for a representative store, then actual store jettison tests during flight shall be required. Requirements guidance can be found in ADS-44-HDBK paragraph 5.2.13. and MIL-STD-1289 paragraph 4.3.2.5. The airworthiness substantiation shall include a Jettison Analysis Report prepared IAW DI-MISC-80711, a Jettison Test Plan prepared IAW DI-NDTI-80566 and Jettison Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.5. Weapon System Firing Flight Requirements
The purpose of the weapon system firing flight requirements is to provide validation prior to the firing flight tests. Testing is conducted for firing flight tests to measure and evaluate the firing effects of all armament subsystems for the range of firing conditions.

17.3.5.1. Debris Dispersion.
The purpose of evaluating the debris dispersion is to characterize the debris dispersion and effects on the aircraft from all casings, links, launch motors, and missile/rocket exhaust.

Criteria:
Debris dispersion and effects on the aircraft from weapon firings shall not damage or degrade the aircraft.

Standard:
ADS-44-HDBK paragraph 5.7.2., 5.8.1.3., and 5.9.3.5.

MIL-STD-882
MIL-HDBK-1763 paragraph 4.4.1.6.2.
MIL-STD-1289 paragraph 4.3.2.6.

Method of Compliance:
Characterize debris dispersion and effects on the aircraft. This includes all casings, links, launch motors, and missile/rocket exhaust. Evaluation utilizes both video and visual inspection. Requirements guidance can be found in ADS-44-HDBK paragraphs 5.7.2., 5.8.1.3., 5.9.3.5., MIL-STD-882, MIL-HDBK-1763 4.4.1.6.2., and MIL-STD-1289 4.3.2.6. The airworthiness substantiation shall include a Debris Dispersion Analysis Report prepared IAW DI-MISC-80711, a Debris Dispersion Test Plan prepared IAW DI-NDTI-80566 and Debris Dispersion Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.5.2. Airframe Loads, Vibrations, and Blast Temperatures and Pressures
The purpose of evaluating the airframe loads, vibrations, and blast temperatures and pressures is to determine effects on the aircraft and crew and evaluate any methods of mitigation. Effects may include, damage to the aircraft, fatigue or injury to crew, or degradation of sensors and avionics performance.

Criteria:
Airframe loads, vibrations, and blast temperatures and pressures from weapon firings shall not damage or degrade the aircraft.

Standard:
ADS-44-HDBK paragraphs 5.2.5., 5.2.6., 5.2.7., 5.2.8., 5.2.9., 5.2.10., and 5.2.11.
MIL-STD-3063 Weapon Effect Analysis, Para 5.2.16.3

Method of Compliance:
The aircraft weapons system shall characterize the effects of airframe loads, vibrations, and blast temperatures and pressures. Evaluation utilizes both video and visual inspection. Requirements guidance can be found in ADS-44-HDBK paragraphs 5.2.5., 5.2.6., 5.2.7., 5.2.8., 5.2.9., 5.2.10., 5.2.11. The airworthiness substantiation shall include an Airframe Load, Vib, Temp and Press Analysis Report prepared IAW DI-MISC-80711, an Airframe Load, Vib, Temp and Press Test Plan prepared IAW DI-NDTI-80566 and Airframe Load, Vib, Temp and Press Test Report IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.5.3. Fire Control Functions.
The purpose of evaluating the fire control functions is to identify any adverse effects on the critical fire control functions during weapons firing.

Criteria:
The aircraft fire control integration shall provide functions for the safe and effective operation of the armament subsystem

Standard:
MIL-HDBK-799
ADS-44-HDBK paragraphs 5.5.1., 5.5.2., and 5.2.15

Method of Compliance:
The aircrafts fire control integration and joint functions of the armament to the installed subsystems shall be tested. Pertinent subsystems include, but are not limited to, fire control computer or weapons processor, stores management system, displays and symbology, armament control panels/switches, air data sensors, sights, target acquisition / designation subsystem, and navigational inputs. Effects on critical fire control functions shall be monitored during testing for the range of firing conditions. Requirements guidance may be found in MIL-HDBK-799, ADS-44-HDBK paragraphs 5.5.1., 5.2.15. The airworthiness substantiation shall include a Fire Control Functional Analysis Report prepared IAW DI-MISC-80711, Fire Control Functional Test Procedures prepared IAW DI-NDTI-80603, Fire Control Functional Test Plan prepared IAW DI-NDTI-80566, and a Fire Control Functional Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.5.4. Aiming Accuracy (Performance)
The purpose of evaluating the aiming accuracy is to identify any adverse effects on final armament accuracy which could result in unsafe conditions for the aircraft crew or personnel on the ground.

Criteria:
The aircraft systems aiming accuracy shall have safe operation for all gun, rocket and missile systems.

Standard:
MIL-HDBK-799
ADS-44-HDBK paragraphs 5.5.1., 5.2.15., and 5.2.16

Method of Compliance:
The aircraft weapon system shall have a fire control integration analysis, an accuracy firing analysis and a launch transient analysis performed to include missile tip-off angle determination, aiming cursor display, and lethality, for each new armament or armament

modification. This analysis is supported by modeling and simulation. Requirements guidance may be found in MIL-HDBK-799, ADS-44-HDBK 5.5.1., 5.2.15., 5.2.16. The airworthiness substantiation shall include a Aiming Accuracy Firing Analysis Report prepared IAW DI-MISC-80711, Aiming Accuracy Firing Simulation Procedures prepared IAW DI-NDTI-80603, Aiming Accuracy Firing Simulation Plan prepared IAW DI-NDTI-80566, and a Aiming Accuracy Firing Simulation Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.5.5. Probability of Hit (Ph) (Performance)

The purpose of evaluating the Ph is to show it meets the Aircraft System Specification and to support the accuracy analysis and the lethality analysis.

Criteria:

The aircraft missile systems Probability of Hit (Ph) shall be safe for the aircraft and personnel on the ground.

Standard:

MIL-HDBK-799
ADS-44-HDBK paragraph 5.8.2.9.
Aircraft Systems Specification

Method of Compliance:

The aircraft missile system shall have an analysis to show the missile Probability of Hit (Ph) IAW the Aircraft System Specification and calculate Ph for all valid test conditions. This is part of the accuracy firing analysis, including lethality, for each new armament or armament modification. This analysis is supported by modeling and simulation. Requirements guidance can be found in MIL-HDBK-799, ADS-44-HDBK 5.8.2.9. The airworthiness substantiation shall include a Missile Ph Analysis Report prepared IAW DI-MISC-80711, Missile Ph Simulation Procedures prepared IAW DI-NDTI-80603, Missile Ph Simulation Plan prepared IAW DI-NDTI-80566, and a Missile Ph Simulation Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.5.6. Self Protection Gun System (SPGS) Ph (Performance)

The purpose of evaluating the SPGS Ph is to show it meets the Aircraft System Specification and to support the accuracy analysis and the lethality analysis.

Criteria:

The aircraft SPGS Ph shall be safe for the aircraft and personnel on the ground.

Standard:
MIL-HDBK-799
ADS-44-HDBK paragraph 5.8.2.7.
Aircraft System Specification

Method of Compliance:
The aircraft gun system shall have an analysis to show the SPGS Ph meets requirements IAW the Aircraft System Specification. This is part of the accuracy firing analysis, including lethality, for each new armament or armament modification. This analysis is supported by modeling and simulation. The airworthiness substantiation shall include a SPGS Ph Analysis Report prepared IAW DI-MISC-80711, SPGS Ph Simulation Procedures prepared IAW DI-NDTI-80603, SPGS Ph Simulation Plan prepared IAW DI-NDTI-80566, and a SPGS Ph Simulation Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.5.7. Rocket Accuracy (Performance)
The purpose of the rocket accuracy analysis is to show it meets the Aircraft System Specification and to support the accuracy analysis and the lethality analysis.

Criteria:
The aircraft rocket systems shall comply with the rocket accuracy requirements of the platform.

Standard:
MIL-HDBK-799
ADS-44-HDBK paragraph 5.8.2.8.

Method of Compliance:
The aircraft rocket systems shall comply with the platform rocket accuracy requirements. An accuracy firing analysis, including lethality, for each new armament or armament modification shall be performed to ensure the rocket accuracy complies with the Aircraft System Specification. This analysis is supported by modeling and simulation. Requirements guidance can be found in MIL-HDBK-799, ADS-44-HDBK paragraphs 5.8.2.8. The airworthiness substantiation shall include a Rocket Accuracy Analysis Report prepared IAW DI-MISC-80711, Rocket Accuracy Simulation Procedures prepared IAW DI-NDTI-80603, Rocket Accuracy Simulation Plan prepared IAW DI-NDTI-80566, and a Rocket Accuracy Simulation Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.5.8. Dynamic Properties

The purpose of evaluating the armament dynamic properties is to ensure the fundamental dynamic properties of the aircraft armament system do not pose a risk to the aircraft or crew.

Criteria:

The aircraft armament system fundamental dynamic properties shall not inhibit safe flight.

Standard:

ADS-44-HDBK paragraph 5.2.7.

Method of Compliance:

The aircraft armament system shall have an analysis that identifies the fundamental dynamic properties of the installed armament system. These properties shall include as a minimum those shown in Table II of ADS-44 section 5.2.7. The airworthiness substantiation shall include an Armament Dynamic Properties Analysis Report prepared IAW DI-MISC-80711, Armament Dynamic Properties Test Procedures prepared IAW DI-NDTI-80603, Armament Dynamic Properties Test Plan prepared IAW DI-NDTI-80566, and an Armament Dynamic Properties Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.5.9. Armament and Fire Control Integration

The purpose of evaluating the armament and fire control integration is to identify all aircraft armament system interfaces and ensure safe integration.

Criteria:

The aircraft armament and fire control interfaces shall ensure safe integration in the platform.

Standard:

ADS-20
ADS-44 paragraph 5.5.2.
ADS-45-HDBK paragraph 5.1.16

Method of Compliance:

The aircraft armament system shall define all interfaces through analysis and test IAW ADS-20, ADS-44, paragraph 5.5.2. and ADS-45-HDBK, paragraph 5.1.16. The airworthiness substantiation shall include a Armament and Fire Control Interface Analysis Report prepared IAW DI-MISC-80711, Armament and Fire Control Interface Test Procedures prepared IAW DI-NDTI-80603, Armament and Fire Control Interface Test Plan prepared IAW DI-NDTI-80566, and a Armament and Fire Control Interface Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.5.10. Firing Loads and Hang Fire Load

The purpose of evaluating the firing loads and hang fire loads is to ensure the aircraft can sustain firing loads and be safely operated after experiencing dynamic hangfire loads.

Criteria:

The aircraft and missile launchers shall be safe for operation after sustaining firing load and dynamic hangfire loads.

Standard:

ADS-44-HDBK paragraphs 5.2.16. and 5.2.6.1.
ADS-45-HDBK paragraph 5.1.3.
MIL-STD-8591 paragraphs 5.1., 5.3., 5.9. and Appendix A or B
MIL-HDBK-1289

Method of Compliance:

The aircraft armament system shall have a firing load and hangfire load analysis to determine the ability of the aircraft and missile launchers to sustain firing load and dynamic hangfire loads. Fatigue Analysis shall be included. Analyses are conducted for all mission configurations. Prepare the firing loads and hang fire load analysis IAW ADS-45-HDBK, paragraph 5.1.3. and MIL-STD-8591, paragraph 5.1. and 5.3., 5.9. and Appendix A or B. Requirements guidance may be found in ADS-44-HDBK, 5.2.16, 5.2.6.1., ADS-45-HDBK, 5.1.3., MIL-STD-8591, 5.1. 5.3., 5.9. and Appendix A or B, MIL-STD-1289. The airworthiness substantiation shall include a Firing Loads and Hang Fire Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.5.11. Surface Danger Area

The purpose of establishing the surface danger area is to ensure range safety during testing and training. The surface danger area should provide a safe area for ground supporting crew.

Criteria:

The aircraft armament system shall ensure an errant missile / ricochet does not exceed the surface danger zone due to excessive launch transient.

Standard:

ADS-44-HDBK paragraph 5.2.16
ADS-45 paragraph 5.1.11

Method of Compliance:
The aircraft armament system shall have a missile/rocket launch transient analysis performed to assess the potential interaction of the aircraft, launcher and missile/rocket during the launch phase and to establish surface danger areas. Prepare a surface area danger analysis IAW ADS-44-HDBK, paragraph 5.2.16. and ADS-45, paragraph 5.1.11. The airworthiness substantiation shall include a Surface Danger Area Transient Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.5.11.1. Safe Firing Envelope.
The purpose of the safe firing envelope is to identify aircraft flight maneuvers where the weapons systems cannot be safely employed for the purpose of restricting weapons engagements during these maneuvers.

Criteria:
The aircraft flight maneuvers shall ensure safe weapons firing.

Standard:
ADS-44-HDBK paragraph 5.2.22
MIL-HDBK-1763

Method of Compliance:
The aircraft weapon system shall have safe firing envelopes throughout the aircraft flight envelope and prevent firing under unsafe flight conditions. The analysis and flight test shall include a safe firing envelope IAW ADS-44-HDBK, paragraph 5.2.22 and MIL-HDBK--763 and includes definition of the Weapons Inhibits, Limits and Interrupts. The airworthiness substantiation shall include a Firing Envelope Analysis Report prepared IAW DI-MISC-80711, Firing Envelope Test Procedures prepared IAW DI-NDTI-80603, Firing Envelope Test Plan prepared IAW DI-NDTI-80566, and a Firing Envelope Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.5.12. Safe Arming
The purpose of the safe arming analysis is to evaluate the minimum safe arming distance (or fuze arm time setting) that is possible once the weapon has left the platform and determines if there is acceptable protection for the platform from the munition fragmentation if early detonation should occur.

Criteria:
The aircraft weapon system shall ensure that the aircraft will not be adversely affected by the debris caused by early detonation of the munition warhead at the time of arming.

Standard:
ADS-44-HDBK paragraph 5.2.14
MIL-STD-1289

Method of Compliance:
The aircraft weapon system shall have a safe arming analysis and safe escape analysis to ensure that the aircraft will not be adversely affected by the debris caused by the explosive capability of the weapon. Prepare the safe arming analysis IAW ADS-44-HDBK, paragraph 5.2.14. and MIL-STD-1289. The airworthiness substantiation shall include a Safe Arming Analysis Report prepared IAW DI-MISC-80711, Safe Arming Test Procedures prepared IAW DI-NDTI-80603, Safe Arming Test Plan prepared IAW DI-NDTI-80566, and a Safe Arming Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.3.5.13. Safe Escape
The purpose of the safe escape analysis is to identify the set of flight conditions (altitude, speed and engagement range) that will provide the platform protection from the munition debris detonation given normal munition functions.

Criteria:
The aircraft weapon system shall ensure that the aircraft will not be adversely affected by the debris caused by the explosive capability of the weapon during normal weapon engagements.

Standard:
ADS-44-HDBK paragraph 5.2.14
MIL-STD-1289
Method of Compliance:
The aircraft weapon system shall have a safe escape analysis to ensure that the aircraft will not be adversely affected by the debris caused by the explosive capability of the weapon during normal weapon engagements. Prepare the safe escape analysis IAW ADS-44-HDBK, paragraph 5.2.14. and MIL-STD-1289. The airworthiness substantiation shall include a Safe Escape Analysis Report prepared IAW DI-MISC-80711, Safe Escape Test Procedures prepared IAW DI-NDTI-80603, Safe Escape Test Plan prepared IAW DI-NDTI-80566, and a Safe Escape Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.4. Aircraft Survivability Equipment (ASE)
The purpose of the ASE is to provide notification of, and protection from, threats to the aircraft.

17.4.1. Safety Evaluation of Emitters
The purpose of evaluating safety of emitters is to ensure that ground and flight crews are safe from the effects of energy emitted from the ASE.

Criteria:
The purpose of evaluating safety of emitters is to ensure that ground and flight crews are safe from the effects of energy emitted from the ASE

Standard:
Evaluate the emitters for safe operation.

Method of Compliance:
The ASE emitters shall be evaluated by the Defense Centers for Public Health – Aberdeen (DCPH-A) for safety and the resulting report provided to the DEVCOM AvMC. The analysis shall evaluate system design control measures and potential hazards (e.g. ocular hazard, skin hazard) of the ASE emitters. Based on the results of the analysis, additional testing (either component level or on-aircraft) may be required. The airworthiness substantiation shall include an emitter safety analysis prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 paragraph 17.3. and 14.1.1.4.6			

17.4.2. Safe Clearance Analysis
The purpose of the safe clearance analysis is to determine whether it is safe to proceed to flight testing with a new type of expendable countermeasure and/or a new dispensing system or dispenser mounting.

Criteria:
The aircraft launched/ejected expendables shall not create unsafe flight conditions.

Standard:
Provide a safe clearance analysis.

Method of Compliance:
Using the 3-sigma clearance cone determined from the process given in the paragraph 17.5.3., apply the cone to the center of the dispenser face(s) on the ASE installation. Provide an analysis identifying the clearance for expendables on all aircraft surfaces. The airworthiness substantiation shall include a safe clearance Safe Clearance Analysis Report prepared IAW DI-MISC-80711.

Additional Information
Generally, only countermeasure flares require a safe clearance analysis since they typically consist of a solid mass traveling along a single trajectory. Countermeasure chaff on the other hand generally disperses into a cloud so there is not solid mass to be concerned with striking the aircraft. However, since countermeasure designs vary widely, there is a not a general rule to cover all cases. It is recommended to conduct an assessment based on countermeasure design and construction in coordination with SRD to determine if safe clearance analysis and testing will be required or not for each countermeasure type that will be used.

Additional Information

Comm Docs	DoD/Mil Docs	FAA/EASA	Def-Stan 970	STANAG
	mil-hdbk-516 paragraph 17.2.6			

17.4.3. Safety Inhibits to Prevent Inadvertent Dispensing
The purpose of safety inhibits is to prevent dispensing and to minimize the probability of creating a hazardous situation by inadvertently dispensing countermeasures.

17.4.3.1. Safety Inhibits to Prevent Inadvertent Dispensing on Ground
The purpose of safety inhibits is to prevent dispensing and to minimize the probability of creating a hazardous situation by inadvertently dispensing countermeasures during ground operations.

Criteria:
The ASE system shall provide three independent safety interlocks/inhibits to prevent dispensing of expendables during ground operations to ensure safe operation.

Standard:
Provide an analysis of the safety inhibits.

Method of Compliance:
The ASE system shall provide three independent safety interlocks/inhibits to prevent dispensing of expendables during ground operations. They are as follows:

a. A Safe/Arm switch controllable by the pilot/co-pilot to allow them to disable the countermeasure when they deem appropriate for safety or other reasons.

b. A Weight-on-Wheels inhibit to automatically inhibit dispensing while on the ground. The design may incorporate a method to manually override this inhibit to conduct ground maintenance/test activities, provided that this override cannot be accidentally bumped/activated.

c. A physical safety switch/pin to disconnect power from the dispensing system for use while the expendables are being loaded.

This requirement is only for aircraft systems incorporating expendable countermeasures. Analysis shall be performed to determine that the safety interlocks have been designed to provide the required level of protection from inadvertent dispensing. The airworthiness substantiation shall include an ASE Safety Inhibits Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 paragraph 17.4			

17.4.3.2. Safety Inhibits to Prevent Inadvertent Dispensing in Flight
The purpose of safety inhibits is to prevent dispensing and to minimize the probability of creating a hazardous situation by inadvertently dispensing countermeasures during flight operations in close proximity to ground crews.

Criteria:
The ASE system shall provide a safety interlocks/inhibits to prevent dispensing of expendables during flight operations in close proximity to ground crews.

Standard:
Provide an analysis of the safety inhibits.

Method of Compliance:
The ASE system shall provide either of the following safety interlocks/inhibits to prevent dispensing of expendables during flight operations. They are as follows:

a. A Safe/Arm switch controllable by the pilot/co-pilot to allow them to disable the countermeasure when they deem appropriate for safety or other reasons.

b. A physical safety switch/pin to disconnect power from the dispensing system, in a location accessible to the pilot/co-pilot while in flight.

This requirement is only for aircraft systems incorporating expendable countermeasures. Analysis shall be performed to determine that the safety interlocks have been designed to provide the required level of protection from inadvertent dispensing. The airworthiness substantiation shall include an ASE Safety Inhibits Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.4.4. Safety Inhibits to Control Emitting
The purpose of safety inhibits is to control emitting and to minimize the probability of creating a hazardous situation by inadvertent emitting of energy from the ASE.

17.4.4.1. Safety Inhibits to Control Emitting on Ground.
The purpose of safety inhibits is to control emitting and to minimize the probability of creating a hazardous situation by inadvertent emitting of energy from the ASE during ground operations.

Criteria:
The ASE system shall provide two independent safety interlocks/inhibits controlling countermeasure emitting to ensure safe ground operations.

Standard:
Provide an analysis of the safety inhibits.

Method of Compliance:
The ASE system shall provide two independent safety interlocks/inhibits controlling countermeasure emitting during flight and ground operations. They are as follows:

a. An enable/disable switch accessible by the pilot/co-pilot.

b. A Weight-on-Wheels inhibit to prevent emitting while on the ground. The design may incorporate a method to manually override this inhibit to conduct ground maintenance/test activities, provided that this override cannot be accidentally bumped/activated.

This requirement is only for aircraft systems incorporating countermeasure emitters.

Analysis shall be performed to determine that the safety interlocks have been designed to provide the required level of protection from inadvertent emitting. The airworthiness substantiation shall include an ASE Safety Inhibits Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 paragraph 17.4			

17.4.4.2. Safety Inhibits to Control Emitting in Flight
The purpose of safety inhibits is to control emitting and to minimize the probability of creating a hazardous situation by inadvertent emitting of energy from the ASE during flight operations in close proximity to ground crews.

Criteria:
The ASE system shall provide a safety interlock/inhibit controlling countermeasure emitting to ensure safe flight operations in the vicinity of ground crews.

Standard:
Provide an analysis of the safety inhibits.

Method of Compliance:
The ASE system shall provide an enable/disable switch accessible by the pilot/co-pilot to control countermeasure emitting.

This requirement is only for aircraft systems incorporating countermeasure emitters.

Analysis shall be performed to determine that the safety interlocks have been designed to provide the required level of protection from inadvertent emitting. The airworthiness substantiation shall include an ASE Safety Inhibits Analysis Report prepared IAW DI-MISC-80711.

Generally, only countermeasure flares require a safe clearance analysis since they typically consist of a solid mass traveling along a single trajectory. Countermeasure chaff on the other hand generally disperses into a cloud so there is not solid mass to be concerned with striking the aircraft. However, since countermeasure designs vary widely, there is a not a general rule to cover all cases. It is recommended to conduct an assessment based on countermeasure design and construction in coordination with SRD to determine if safe clearance analysis and testing will be required or not for each countermeasure type that will be used.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

17.4.5. Deleted

17.4.6. Deleted

17.4.7. Controls and Displays

Criteria:
The purpose of controls and displays requirements are to ensure that ASE-specific control and indicators are provided in addition to the requirements in paragraph 9.7. (Controls and Displays).

The ASE shall provide controls and displays sufficient to allow for safe operation of the ASE.

Standard:
Demonstrate the correct functionality of the ASE-specific controls and displays.

Method of Compliance:
The ASE shall provide the following specific controls and indicators to ensure safe operation:

a. Safe/Arm control

b. Display of countermeasure dispenser inventory

c. Display of ASE health status (ready, failed, etc.)

d. An ARMED indicator. This indicator shall take into account not only the Safe/Arm status but also the status of all safety interlocks. The ASE shall not be able to dispense/emit countermeasures in any condition other than ARMED.

Testing of the Safe/Arm functionality shall be conducted per paragraph 17.4.8. Testing shall be used to verify that the countermeasure dispenser inventory is correct. Testing shall be used to verify that the system can only dispense/emit countermeasures when ARMED is indicated, per paragraph 17.4.8. The airworthiness substantiation shall include an ASE Controls and Displays Test Plan prepared IAW DI-NDTI-80566 and an ASE Controls and Displays Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 paragraph 9.2.1			

17.4.8. Safety Interlock Test

The purpose of the safety interlock test is to ensure that safety mechanisms are sufficient to prevent inadvertent activation of ASE countermeasures.

Criteria:

The ASE shall provide multiple independent safety mechanisms that each individually shall be sufficient prevent the system from dispensing and/or emitting to ensure safe operations.

Standard:

Conduct ground testing of the safety mechanisms.

Method of Compliance:

The airworthiness substantiation shall include an ASE Safety interlocks test to ensure that each individual safety mechanism is sufficient by itself to prevent the system from dispensing and/or emitting. The test shall be conducted for both the normal operating mode(s) of the system as well as any test/maintenance mode(s). For systems incorporating both expendables and emitters, the test shall be conducted for each system. Instrumented ("dummy") expendables should be used instead of real devices, for safety purposes. The test shall be conducted as follows (once for each mode of operation):

a. Enable all interlocks and verify that the ASE system will not dispense/emit (as appropriate).

b. Enable the interlocks one at a time and verify that the ASE will not dispense/emit. This shall verify that each interlock, by itself, can prevent dispensing/emitting.

c. Disable all interlocks and verify that the system will dispense/emit. This final step ensures that the test is valid by proving that the system can dispense/emit once all safeties are disabled. Verify that this is the only condition in which the ARMED indicator is displayed (paragraph 17.4.7).

The airworthiness substantiation shall include an ASE Safety Interlock Test Plan prepared IAW DI-NDTI-80566 and an ASE Safety Interlock Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 paragraph 17.4			

17.4.9. Exclusion Zones

The purpose of exclusions zones is to prevent ASE emitting into defined zones for safety of the flight and ground crews.

Criteria:

The ASE system shall prevent emitting energy into designated keep-out areas to ensure the safety of flight and ground crews.

Standard:

Conduct a test to ensure emitting cannot occur in keep-out areas.

Method of Compliance:

The airworthiness substantiation shall include an ASE test to verify that the ASE (when fully enabled) cannot emit energy into any designated keep-out areas. This shall be verified both by stimulating the system to try and force it to emit into a keep-out area as well as by manually commanding the emitter, as applicable to the system design. The intent is for the system to function in an operationally representative way. For example, if you can force the system to ignore the keep-out regions, yet that isn't an operationally relevant scenario, then that would not be a required mode to check for this test. The airworthiness substantiation shall include an ASE Exclusion Zone Test Plan prepared IAW DI-NDTI-80566 and an ASE Exclusion Zone Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 paragraph 13.2.7			

17.4.10. Deleted

17.4.11. Expendables Safe Clearance Flight Testing

The purpose of expendables testing is to ensure that expendables do not strike the aircraft create an unsafe condition.

Criteria:
The ASE expendables shall not strike the aircraft surface during flight, including during flight maneuvers throughout the typical operating profiles.

Standard:
Conduct a test to ensure expendables do not strike the aircraft during flight.

Method of Compliance:
The airworthiness substantiation shall include an ASE test for all expendable countermeasures. A flight demonstration shall be performed to verify the clearance analysis and to verify proper operation of the dispensers. In addition, jettison timing intervals for the expendable dispenser “Jettison All” firing mode shall be demonstrated and substantiated by the firing analysis and demonstration. This is required to verify there are no resonance and/or cumulative loading concerns for the overall aircraft structure as well as the structure at the dispenser mount location. All modes of dispensing shall be tested, as well as other functions such as inventory control. The airworthiness substantiation shall include an ASE Expendables Clearance Flight Test Plan prepared IAW DI-NDTI-80566 and an ASE Expendables Clearance Flight Test Report prepared IAW DI-NDTI-80809.

The same caveats from paragraph 17.4.2. apply here. It is recommended that an analysis be conducted in coordination with SRD to determine if safe clearance testing is required for a given expendable.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 paragraph 17.2.2			

17.4.12. Functional Testing

The purpose of functional testing is to ensure that the ASE is operating as designed.

Criteria:
The ASE system shall correctly perform all functions required by the ASE and aircraft system specifications once integrated onto the host platform.

Standard:
Conduct a test to verify correct end-to-end operation per the ASE and aircraft system specifications.

Method of Compliance:
The airworthiness substantiation shall include an ASE test to verify that the ASE system operates in an end-to-end manner as designed/intended IAW aircraft system

specification. This shall include verification of controls, displays, audio alerts and proper system response to inputs. Threat stimulators shall be used as appropriate to cause the ASE system to respond so that the proper response (displays, audio, countermeasures) can be observed. Ground testing is recommended to be used to the extent it is safe and feasible to do so, to allow a more controlled testing environment. All modes of operation (normal and test/maintenance) shall be exercised. The Weight-on-Wheels inhibit may be disabled during this test to allow for representative airborne system operation while on the ground. The airworthiness substantiation shall include an ASE Functional Test Plan prepared IAW DI-NDTI-80566 and an ASE Functional Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 paragraph 20.2.1			

17.4.13. Flight Test

The purpose of flight testing is to ensure that the ASE is operating as intended under flight conditions.

Criteria:

The ASE system shall have effectiveness requirements as specified in the ASE and aircraft system specifications.

Standard:

Conduct flight testing to characterize and verify correct behavior of system.

Method of Compliance:

The airworthiness substantiation shall include an ASE flight test IAW the aircraft system specification. Any anomalous behavior of the ASE discovered during the testing shall be investigated and documented, with workarounds given where possible, to allow this information to be passed to the operational users.

a. Correct detection, classification, prioritization and display of all threat types.

b. Field of view of the system as installed.

c. Effectiveness of countermeasures against the threats and effectiveness of countermeasures directed against the ASE system. d. An extensive false alarm flight demonstration in combined urban, industrial, agricultural, and rural environments, to determine potential false alarm sources and false alarm rates.

d. Effects on the system from flight maneuvers (to include high rate turns) and airframe vibration on effectiveness. This testing shall also demonstrate the maximum maneuver limits for which the system can maintain performance and operate satisfactorily.

e. Effects of the system on other onboard equipment (and vice versa), especially any impact on (or from) other ASE equipment.

f. Effects on the system from weapons firing, including effects from vibration, flash, smoke, and debris.

g. Effects on (or from) other aircraft flying in formation.

h. NVG Compatibility: For systems incorporating emitters that present an optical hazard (e.g. lasers), an evaluation shall be conducted to ensure that emitted energy, delivered on-axis to Aviator NVGs, does not result in permanent damage to NVGs and/or blooming/degradation at the Nominal Ocular Hazard Distance.

The airworthiness substantiation shall include an ASE Effectiveness Flight Test Plan prepared IAW DI-NDTI-80566 and an ASE Effectiveness Flight Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 paragraph 20.2.1			

17.5. Expendables

The following paragraph requirements are for new/unqualified expendables. The purpose of expendables is to provide protection to the aircraft from threats.

17.5.1. Lockset Test.

The purpose of the lockset test is to ensure that trapped expendables do not pose a hazard to the aircraft.

Criteria:

Flares that fail to eject from the dispenser shall not impact safe flight.

Standard:

Evaluate via a lockset test.

Method of Compliance:

Perform a lock set test using a dispenser where one expendable is physically blocked from being able to exit the dispenser and the blocked expendable is completely surrounded by 9 other expendables which are not locked down. Ignite the locked down expendable and observe any effect to the surrounding 9 expendables. The maximum allowed reaction is Type IV (deflagration reaction) IAW MIL-STD-2105. The test is only required for Class 1 materials. The test can be accomplished using a dispenser on a test stand instead of on an aircraft. The airworthiness substantiation shall include a Lock Set Test Plan prepared IAW DI-MISC-80566 and Lock Set Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 paragraph 17.2.2			

17.5.2. Setback Force Evaluation.
The purpose of setback force evaluation is to ensure that the aircraft is not damaged by ejection forces from expendables.

Criteria:
Expendable ejection forces shall not impact safe flight.

Standard:
Evaluate the ejection forces of the expendables versus the aircraft structural limitations.

Method of Compliance:
For any new countermeasure, determine by test the setback force versus time to show peak force and damping time. Conduct the test using a rigid test frame in order to determine a peak force unaltered by structural compliance. The airworthiness substantiation shall include a Setback Force Test Plan prepared IAW DI-MISC-80566 and a Setback Force Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 paragraph 17.2.3			

17.5.3. Dispersion Testing
The purpose of dispersion testing is to collect data to support safe separation testing.

Criteria:
Expendables that are launched/ejected from the aircraft shall not impact safe flight.

Standard:
Conduct a dispersion test.

Method of Compliance:
Conduct a dispersion test where a dispenser is mounted on a test stand elevated off the ground (approximately 9 feet), pointed at a witness board placed 50 feet away. The board should be approximately 9x9 feet. Fire a minimum of 50 expendables towards the witness board and measure the distance from the centerline to each impact point. Verify that the mean countermeasure trajectory is within +3-sigma statistical standard deviation dispersion of the existing, worst-case countermeasure dispersion cone (8.1° from center). If dispersion is greater than existing countermeasures, additional analysis may be required to ensure that there is sufficient clearance from the aircraft when countermeasures are launched/ejected. Variations in the size of the witness board are

allowed as long as it is large enough to contain an 8.1. degree half-angle cone projected from the center of the dispenser face. The airworthiness substantiation shall include an Expendable Dispersion Test Plan prepared IAW DI-MISC-80566 and Expendable Dispersion Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 paragraph 17.2.2			

17.5.4. Ballistic Impact
The purpose of ballistic impact testing is to ensure that countermeasures remain safe after a ballistic impact.

Criteria:
Firing ammunition into a loaded dispenser shall not impact safe flight.

Standard:
MIL-STD-2105
STANAG 4241

Method of Compliance:
Conduct a bullet impact test IAW MIL-STD-2105 and STANAG 4241 by firing either military ammunition of small caliber or specially designed projectiles of small caliber into the dispenser to test the flares' reactions in the dispenser. This test is only required for Class 1 materials. The airworthiness substantiation shall include a Ballistic Impact Test Plan prepared IAW DI-MISC-80566 and a Ballistic Impact Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 paragraph 5.4			

17.5.5. Deleted

17.5.6. Deleted

17.5.7. Performance Specification
The purpose of a performance specification is to ensure the countermeasures are operating as designed.

Criteria:
The aircraft ordnance shall conform to the applicable performance specification.

Standard:
Performance specification

Method of Compliance:
Prepare a performance specification for the expendables IAW the Aircraft System Specification. Include the details on the type of materials used in the expendables, the construction of the flares (pellet, bundled, boosted, etc.), and details the performance parameters such as expected output (intensity vs. time) and methods of verification. The airworthiness substantiation shall include an Expendable Performance Specification prepared IAW DI-SDMP-81465.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
	MIL-HDBK-516 paragraph 20.2.1., 20.2.2			

18. AIRCRAFT COMBAT SURVIVABILITY SURVIVABILITY

This section establishes the requirements to ensure safety of flight and survivability in combat hostile environments, i.e. as opposed to non-hostile environments. Aircraft Combat Survivability (hereafter “survivability”) is the capability of a system to avoid (susceptibility) or withstand (vulnerability) combat hostile environments. This section presents the overall survivability program requirements and a focus on the analysis and test requirements for aircraft “vulnerability”. Included are hardening/damage tolerance requirements to withstand ballistic, directed energy, nuclear, and Nuclear Biological Chemical (NBC) threats. Aircraft Survivability Equipment (ASE), which addresses “susceptibility”, is presented in section 17 Armament and Stores because ASE is normally configured as “stores”. Additional guidance is contained in Appendices O and P. Requirements that relate to personal safety are addressed in section 9 Human Systems Integration.

18.1. Military Aircraft Survivability

18.1.1. Survivability Trade Study

The purpose of the Survivability Trade Study is to evaluate alternative survivability enhancement techniques. Based on analytical methods, computer models and measures of effectiveness, the results shall be used to select the most effective technique.

Criteria:
Potential aircraft survivability enhancement techniques shall be evaluated for technical and cost effectiveness.

Standard:
Appendix O, Paragraph 5.1.2.
MIL-HDBK-2069 Paragraph 5.2.12
ADS-66-HDBK
Aircraft System Specification

Method of Compliance:
An aircraft survivability trade study and cost effectiveness analysis shall be performed IAW Appendix O Paragraph 5.1.2., MIL-HDBK-2069 Paragraph 5.2.12., ADS-66-HDBK, and the aircraft system specification. This requirement is to evaluate system effectiveness for alternative survivability enhancement techniques. The airworthiness substantiation shall include a Survivability Trade Study and Cost Effectiveness Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

18.1.2. Ballistics Hardening and Damage Tolerance

The purpose of Ballistic Hardening and Damage Tolerance is to determine the aircraft vulnerability or hardening/damage tolerance requirements in order to withstand ballistic, directed energy, nuclear, and Nuclear Biological Chemical (NBC) threats.

Criteria:

The aircraft vulnerabilities and hardening to withstand ballistic, directed energy, nuclear, and Nuclear Biological Chemical (NBC) threats shall be defined.

Standard:

Appendix O, Paragraph 5.2.1.
USAAMRDL TR 71-41
Aircraft System Specification

Method of Compliance:

The aircraft shall have a ballistic hardening and damage tolerance assessment performed IAW Appendix O Para 5.2.1., USAAMRDL TR 71-41, and the aircraft system specification. Refer to USAAMRDL TR 71-41 as a design guide for small arms protection, 7.62mm through 14.5mm. Blast and fragment characteristics shall also be considered in the design of aircraft systems and subsystems to minimize damage effects of larger munitions as specified by the system specification. The airworthiness substantiation shall include a Ballistic Hardening and Damage Tolerance Assessment Report prepared IAW DI-MISC-80711.

This data shall be handled in accordance with the applicable Aircraft Security Classification Guide or other guidance provided by the procuring activity.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

18.1.3. Battle Damage Assessment and Repair

The purpose of Battle Damage Assessment and Repair analysis is to develop and evaluate concepts, criteria, procedures and time estimates for rapid repair of non-lethal combat damage caused by nonnuclear and nuclear threats, including NBC contamination and to restore survivability.

Criteria:

Aircraft Battle Damage repair concepts, criteria, procedures and time estimates for rapid repair of non-lethal combat damage caused by nonnuclear and nuclear threats, including NBC contamination shall be developed.

Standard:

Appendix O, Paragraph 5.2.1.1.e
MIL-HDBK-2069 paragraph 5.2.13
MIL-STD-3063, Paragraph 5.2.7., 5.2.17, 5.3.2., 5.4.36
Aircraft System Specification

Method of Compliance:
The aircraft shall have a battle damage assessment and repair report performed IAW Appendix O Para 5.2.1.1.e, MIL-HDBK-2069 para 5.2.13., and the aircraft system specification. The analysis shall be performed to develop and evaluate concepts, criteria, procedures and time estimates for rapid repair of non-lethal combat damage caused by nonnuclear and nuclear threats, including NBC contamination IAW paragraph 5.2.13. of MIL-HDBK-2069. The airworthiness substantiation shall include a Battle Damage Assessment and Repair Analysis Report prepared IAW DI-MISC-80711. For application to primary structure, BDAR repair guidelines shall be substantiated in accordance with sections 5.2.7., 5.2.17, 5.3.2., and 5.4.3. of MIL-STD-3063

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
QSTAG-91				

18.1.4. Ballistics Vulnerability
The purpose of Ballistic Vulnerability analysis is to identify weaknesses or deficiencies of the aircraft system when exposed to threat weapon effects and to provide quantified measures of vulnerability (Vulnerability indices) for specified threats. This analysis will define and decrease aircraft vulnerability

Criteria:
The aircraft system's weaknesses or deficiencies when exposed to threat weapons shall be defined

Standard:
Appendix O, Paragraph 5.2.1.2.
MIL-HDBK-2069 Paragraph 5.2.9.
JSSG-2001B
Aircraft System Specification

Method of Compliance:
The aircraft shall have a Ballistic Vulnerability Analysis performed IAW Appendix O, Paragraph 5.2.1.2., MIL-HDBK-2069 paragraph 5.2.9. and Appendix A of MIL-HDBK-2069, the aircraft system specification, and ARL/SLAD for computer model information that can be used to support vulnerability analyses. The vulnerability analysis is to identify weaknesses or deficiencies of the aircraft system when exposed to threat weapon effects and to provide quantified measures of vulnerability (Vulnerability indices) for specified threats. Vulnerability analyses shall be conducted within the following guidelines:

a. An assessment methodology shall conform to USABRL-R-1796, -1930, -2020m, -02061, -02533 and -02191. Extensive ballistic shotline methodology and vulnerability modeling techniques are available through coordination with the ARL/SLAD.

b. Threats shall be defined by the system specification by caliber and striking velocity, and other munitions characteristics, as applicable.

c. Ballistics Vulnerability Analysis shall be conducted for both hover and forward flight conditions.

d. Kill categories of attrition, forced landing and mission abort shall be considered. With respect to mission abort, the Government shall provide inputs to define target type (point/area) and environment (day/night) adverse weather, as well as assist in identifying mission essential equipment. Guidance on kill categories and aircraft survivability requirements is contained in JSSG-2001B for Air Vehicles.

e. Ballistics Vulnerability Analysis shall be conducted with and without stores

The airworthiness substantiation shall include a Ballistics Vulnerability Analysis Report prepared IAW DI-MISC-80711.

This data shall be handled in accordance with the applicable Aircraft Security Classification Guide or other guidance provided by the procuring activity.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

18.1.5. Deleted

18.1.6. Ballistic Test
The purpose of Ballistic Test is to perform ballistic testing on components, subsystems, and full-up aircraft (if mandated for LFT&E) to demonstrate the components, subsystems, or full-up aircraft is ballistically tolerant.

Criteria:
The capability of components, subsystems, and full-up aircraft systems to withstand ballistic impact shall be demonstrated.

Standard:
Appendix O, Paragraph 5.2.1.3.a
Aircraft System Specification

Method of Compliance:
The aircraft shall have a Ballistic test performed IAW Appendix O, Para 5.2.1.3.a and the aircraft system specification. The following guidance is provided for the preparation of the test plan:

a. All test specimens shall be clearly identified by name, description, and part number. Drawings with the proposed shotlines shall be provided as an appendix to the test plan. Where multiple shots are planned, the shot sequence shall be specified.

b. For each component, the threat projectile, impact location, obliquity, tumble, and striking velocity shall be specified. Tabular and drawing presentations are preferred.

c. The structural loads at ballistic impact shall be determined by considering all flight modes.

d. Test setup, including loads to be applied and fixtures to be used shall be clearly described. A sketch of the test arrangement shall be provided. All required Government equipment and special fixtures shall be identified for each test.

e. Criteria shall be established and provided for the following: failure of the component at ballistic impact which will result in no further damage tolerance testing; damage on each multiple shot component which will disqualify the component for the second shot; failure during damage tolerance testing. Pass/fail judgments shall be based on meeting minimum requirements as well as assessing mission completion capability.

The airworthiness substantiation shall include an Aircraft Ballistic Test Plan and Procedures Report prepared IAW DI-NDTI-80566 and an Aircraft Ballistic Test Report prepared IAW DI-NDTI-80809.

This data shall be handled in accordance with the applicable Aircraft Security Classification Guide or other guidance provided by the procuring activity.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

18.1.7. Post Ballistic Impact Damage Assessment

The purpose of ballistic impact test is to submit the ballistically impacted components to a post damage structural and functional tests and to evaluate loss of function.

Criteria:

The post impact functional and structural capability of components shall be demonstrated.

Standard:

ADS-11C Paragraph 5.2.1.2 b
MIL-HDBK-2069
Aircraft System Specification

Method of Compliance:

The aircraft ballistically impacted components shall be subjected to post damage structural and functional tests and to evaluate loss of function IAW MIL-HDBK-2069, ADS-11c (Appendix O) Para 5.2.1.2 b, and the aircraft system specification. This Includes verbiage of projectile and A/C state as is in ADS-11C 5.2.1.2.b (Appendix O). The airworthiness substantiation shall include Post Damage Structural/Functional Test Plan prepared IAW DI-NDTI-80566 and Post Damage Structural/Functional Test Report prepared IAW DI-NDTI-80809.

This data shall be handled in accordance with the applicable Aircraft Security Classification Guide or other guidance provided by the procuring activity.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

18.1.8. Susceptibility and Vulnerability.
The purpose of the susceptibility and vulnerability testing is to provide the impact of a system due to one or more inherent weaknesses and identify characteristics of a system which cause it to suffer a definite degradation in its capability of performing in a combat threat environment.

Criteria:
The susceptibility and vulnerability of the aircraft system shall be defined.

Standard:
ADS-11C (Appendix O)
MIL-HDBK-2069 paragraph 5.3.3.
Aircraft System Specification

Method of Compliance:
If mandated for live-fire test, ballistic testing shall be performed with components, subsystems and a full-up aircraft IAW the aircraft system specification. The validation of the ballistic firing tests, controlled damage tests and a vulnerability reduction demonstration shall be performed by reviewing lab's documents, test requirements, test procedures, test results. The tests shall be performed IAW MIL-HDBK-2069, paragraph 5.3.3. The airworthiness substantiation shall include a Susceptibility and Vulnerability Test Plan prepared IAW DI-NDTI-80566, a Susceptibility and Vulnerability Test Procedure report prepared IAW DI-NDTI-80809 and a Susceptibility and Vulnerability Test Report prepared IAW DI-NDTI-80809.

This data shall be handled in accordance with the applicable Aircraft Security Classification Guide or other guidance provided by the procuring activity.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

18.2. Aircraft Ballistic Protection
The purpose of the aircraft ballistic protection is to provide safe protection of the aircraft and its occupants from ballistic threat and impacts without interference.

18.2.1. Ballistic Protection System (BPS)
The purpose of the aircraft ballistic protection system is to provide ballistic protection for the aircraft critical components and its occupants and are installed throughout the aircraft.

Criteria:
The aircraft's Ballistic Protection System (BPS) shall be fully integrated into the aircraft.

Standard:
Appendix P, paragraph 4.1.
MIL-STD-662

Method of Compliance:
The aircraft armor shall not physically or functionally interfere with the aircraft nor shall it create a hazard to the crew, passengers or maintenance personnel. The aircraft armor shall perform ballistic resistance function test when installed in the aircraft and exposed to the operational and storage environment of the host aircraft IAW Appendix P, para 4.1. and MIL-STD-662. All personnel should be considered in their ‘worst case’ condition from the 5th percentile female to 95th percentile male of both aircrew and ground personnel populations. The airworthiness substantiation shall include a BPS Integration Test Plan prepared IAW DI-NDTI-80566, a BPS Integration Test Procedures Report prepared IAW

DI-NDTI-80603, a BPS Integration Test Report prepared IAW DI-NDTI-80809 and a BPS Integration Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

18.2.2. BPS Characteristics
The purpose of the BPS characteristic analysis is to identify the specific armor design, geometry, coverage, materials, construction and installation. The information will be used to establish the airworthiness assessment baseline for the aircraft and personnel safety.

Criteria:
The BPS characteristics including armor design, geometry, coverage, materials, construction and installation shall be defined.

Standard:
Appendix P, paragraph 4.2., 5.12
MIL-STD-662
MIL-PRF-46103
MIL-PRF-46108

Method of Compliance:
An analysis shall be performed for the aircraft armors characteristics, e.g. the design coverage, geometry, materials, construction and installation IAW Appendix P paragraph 4.2;. This analysis will be used to establish the baseline and to assess aircraft and personnel safety. MIL-PRF-46103 may be used as a guideline for composite armor design and manufacture. MIL-PRF-46108 may be used as a guideline for transparent

armor performance requirements. The airworthiness substantiation shall include a BPS Characteristics Analysis Report prepared IAW DI-MISC-80711.

This data shall be handled in accordance with the applicable Aircraft Security Classification Guide or other guidance provided by the procuring activity.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

18.2.3. V_{50} Ballistic Limit Qualification Test

The purpose of the V_{50} ballistic limit qualification test is to determine whether the BPS can defeat ballistic threats and to certify the armor for a specific aircraft model.

Criteria:

The capability of the BPS armor to defeat the applicable ballistic threats shall be demonstrated by test.

Standard: :

Appendix P
MIL-STD-662
Aircraft System Specification

Method of Compliance:

The aircraft armor panel system (also called ship-set) shall be tested IAW Appendix P and/or MIL-STD-662. All part numbered panel configurations shall be subjected to qualification tests, unless testing can be reduced by “grouping” similar part numbers (Appendix P, paragraph 5.4). Any proposed grouping shall be accompanied by a similarity analysis. The test projectiles shall be determined IAW the aircraft system specification threats and coordinated with the U.S. Army Research Laboratory Survivability Lethality Analysis Directorate (USA ARL/SLAD). The test facility and panel mounting fixture shall be IAW with paragraph 18.2.5. The test panels must be “production representative” and environmentally pre-conditioned prior to ballistic test IAW paragraph 18.2.7. For shot selection, aim-points, and projectile impact conditions, see Appendix P, paragraph 5.11.7. his test data shall be handled in accordance with the applicable Aircraft Security Classification Guide or other guidance provided by the procuring activity. The airworthiness substantiation shall include a BPS Ballistic Test Plan prepared IAW DI-NDTI-80566, a BPS Ballistic Test Procedures Report prepared IAW DI-NDTI-80603 and a BPS Ballistic Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

18.2.4. BPS Material and Construction Analysis

The purpose of the BPS material and construction analysis is to provide the material make-up of the armor, number of plies used (for composite material), the areal density

or weight of the armor, and coverage area (ramp, cabin, cockpit), and manufacturing/formulation process.

Criteria:
The aircraft armor material and construction shall not cause a loss of structural integrity due to environmental conditions.

Standard:
Appendix P, paragraph 5.5.
MIL-STD-662
MIL-STD-810

Method of Compliance:
The aircraft armor material and construction, its planned location within the aircraft, and its planned usage within the operational and storage environment based on the aircraft system specification shall be defined by an analysis IAW Appendix P para 5.5; MIL-STD-662. The analysis shall address operational and storage environmental conditions that may affect armor functional performance and crew safety. Exposure to environmental conditions shall not cause a loss of structural integrity (within the armor panel itself or attachment to the aircraft) that can lead to crew injury, aircraft critical component damage, loss of the aircraft or armor performance degradation. The airworthiness substantiation shall include a BPS Material and Construction Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

18.2.5. Deleted

18.2.6. Ballistic Test Facility and Test Fixture
The purpose of selecting a certified Ballistic Test Facility is to ensure the integrity of the test and the test fixture simulates the aircraft installation.

Criteria:
The Ballistic Test Facility and the test fixture shall be certified to ensure the integrity of the test and that the test fixture simulates the aircraft installation.

Standard:
Appendix P, paragraph 4.10.
MIL-STD-662

Method of Compliance:
The aircraft ballistic tests shall be conducted by the Government, the contractor or subcontractor IAW Appendix P para 4.10; MIL-STD-662. The test fixture shall adequately simulate the aircraft installation of the armor panel or part. The test fixture must be capable of mounting the test specimens with rigidity equal to or greater than

the actual installation of the part. The airworthiness substantiation shall include a Ballistic Test Fixture Analysis Report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

18.2.6. 18.2.6. Ballistic Test Facility and Test Fixture

The purpose of selecting a certified Ballistic Test Facility is to ensure the integrity of the test and the test fixture simulates the aircraft installation.

Criteria:

The Ballistic Test Facility and the test fixture shall be certified to ensure the integrity of the test and that the test fixture simulates the aircraft installation.

Standard:

Appendix P, paragraph 4.10.

MIL-STD-662

Method of Compliance:

The aircraft ballistic tests shall be conducted by the Government, the contractor or subcontractor IAW Appendix P para 4.10; MIL-STD-662. The test fixture shall adequately simulate the aircraft installation of the armor panel or part. The test fixture must be capable of mounting the test specimens with rigidity equal to or greater than the actual installation of the part. The airworthiness substantiation shall include a Ballistic Test Fixture Analysis Report prepared IAW DI-MISC-80711.

18.2.7. BPS Environmental Test

The purpose of the BPS environmental test is to evaluate the proposed armor material and construction, its planned location within the aircraft, and its planned usage within the operational and storage environment.

Criteria:

The ability of the BPS to function satisfactorily when exposed to operational environments shall be demonstrated.

Standard:

Appendix P, paragraph 5.5.
MIL-STD-662

MIL-STD-810 Test Method 500 Low pressure (Altitude)
MIL-STD-810 Test Method 501 High Temperature
MIL-STD-810 Test Method 502 Low temperature
MIL-STD-810 Test Method 504 Contamination by fluids
MIL-STD-810 Test Method 505 Solar Radiation (Sunshine)
MIL-STD-810 Test Method 507 Humidity
MIL-STD-810 Test Method 508 Fungus
MIL-STD-810 Test Method 509 Salt Fog
MIL-STD-810 Test Method 514 Vibration
MIL-STD-810 Test Method 516 Shock

Method of Compliance:
Based on the environmental analysis, a test plan tailored to the specific model aircraft application shall be submitted. Because of potential cumulative effects, all armor panel test specimens shall be subjected to all the tests required in the approved test plan and in the required sequence. Nondestructive test inspection techniques, such as digital radiograph or ultrasound, should be utilized on test specimens (pre-and post-test) to assist in evaluation. The following environmental conditions shall follow the requirements listed in Paragraph 21:

a. Test Method 500 Low pressure (Altitude).

b. Test Method 501 High temperature.

c. Test Method 502 Low temperature.

d. Test Method 504 Contamination by fluids.

e. Test Method 505 Solar Radiation (Sunshine).

f. Test Method 507 Humidity.

g. Test Method 508 Fungus.

h. Test Method 509 Salt Fog.

i. Test Method 514 Vibration.

j. Test Method 516 Shock.

The airworthiness substantiation shall include a BPS Environmental Test Plan prepared IAW DI-NDTI-80566 and a BPS Environmental Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

18.2.8. BPS Structural Composition and Integrity

The purpose of the BPS structural composition and integrity analysis is to determine the armor panel can maintain its structural integrity in the event of a crash. It is to ensure that the armor can remain intact and not disintegrate into small pieces and become projectiles that could strike the occupants.

Criteria:
The BPS system shall maintain structural integrity and not become a projectile during a crash.

Standard:
MIL-STD-3063 section 5.2.16
Appendix P, paragraph 5.7.
Aircraft System Specification

Method of Compliance:
The aircraft crash load analysis of the armor's installation shall be IAW MIL-STD-3063, Appendix P and prepared IAW DI-SESS-80198. The analysis shall show that the armor panel or component will not become a projectile and cause injury to the crew or the aircraft. In addition, the structural requirements for flight and crash loads shall be IAW the aircraft system specification. The analysis shall identify margins of safety, static and fatigue strength of the existing aircraft structure. The airworthiness substantiation shall include a BPS Structural Integrity Analysis Report prepared IAW DI-SESS-80198.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

18.2.9. Ballistic Back-Face Deformation

The purpose of the BPS ballistic deformation analysis is to determine if there is a need to limit the back-face deformation of the armor during ballistic impact. Even though penetration of the armor panel does not occur, ballistic deformation of the armor has the potential to injure occupant or cause interference with flight control components.

Criteria:
The deformations of the BPS following ballistic impact shall not injure occupants or cause interference with flight control components.

Standard:
Appendix P, paragraph 5.8.
MIL-STD-662

Method of Compliance:
An analysis of the aircraft armor's installation shall be conducted IAW Appendix P para 5.8. and MIL-STD-662. The analysis shall determine if there is a need to limit back-face deformation of the armor during projectile impact. Even though penetration of an armored seat does not occur, ballistic deformation of the armor has the potential to

injure or kill the seat occupant. The maximum back-face deflection of an armored seat bucket shall be 1.75 inches when measured post test for velocities resulting in Partial Penetrations. If the armor is installed in proximity to aircraft structure or a critical component, ballistic deformation has the potential to affect the aircraft. Examples include a bulging armored cockpit floor might interfere with flight control pedals or bulging armor panels might cause damage to nearby digital fuel controls or oxygen system even though the projectiles are stopped. Also, the ballistic resistance of the installed armor might be degraded if the aircraft structure restricts the armor's back-face deformation during projectile impact. If any of these installation/interface conditions exist, an armor ballistic deformation (back-face deflection) requirement shall be quantified and included in the test method and acceptance criteria of the ballistic tests. The airworthiness substantiation shall include a Ballistic Deformation Analysis Report prepared IAW DI-MISC-80711, a Ballistic Deformation Test Plan prepared IAW DI-NDTI-80566, a Ballistic Deformation Test Procedures Report prepared IAW DI-NDTI-80603 and a Ballistic Deformation Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

18.2.10. BPS Ballistic Durability

The purpose of the BPS ballistic durability is to determine resistance to wear and tear from human and equipment interface, loading and unloading of equipment, cargo, etc. It shows that there will be no damage to the armor panels other than minor surface wear and the environmental coatings is not breeched.

Criteria:

The BPS system shall be resistant to wear and tear from human and equipment interface, loading and unloading of equipment and cargo.

Standard:

Appendix P, paragraph 5.9.
Aircraft System Specification

Method of Compliance:

An analysis of the armor's location in the aircraft shall be conducted IAW Appendix P paragraph 5.9. and MIL-STD-662. This analysis shall show the required resistance to wear from human and equipment interface. An example is floor armor must have resistance to foot traffic, vehicle traffic, and heavy dragged cargo as applicable to the host aircraft application. A durability endurance test shall be IAW the aircraft system specification to show the durability of the armor panels against resistance and environmental coatings. The armor panels shall be subjected to the life cycle equivalent number of loading and unloading of vehicles, cargo or equipment applicable the aircraft mission. The airworthiness substantiation shall include a BPS Durability Analysis Report prepared IAW DI-MISC-80711, a BPS Durability Endurance Test Plan prepared IAW DI-NDTI-80566, a BPS Durability Endurance Test Procedures Report prepared IAW

DI-NDTI-80603 and a BPS Durability Endurance Test Report prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

18.2.11. Deleted

19. MATERIALS AND PROCESSES.

This section covers material selection, application and specification for the entire flight vehicle including aircraft structure, aircraft subsystems, propulsion systems, electrical power systems, mission systems, crew systems, and armament/stores systems.

Included within the scope of this section are:

a. Material properties and process;

b. Corrosion prevention and control;

c. NDI requirements;

d. Wear and erosion prevention.

19.1. Manufacturing Stability, Producibility, Characterization, Predictability, and Supportability

Materials, processes, and product forms proposal(s) for an aviation platform shall demonstrate the five primary material design factors: Manufacturing Stability, Producibility, Characterized, Predictability and Supportability have been sufficiently matured for the proposed application. Design factors definitions are included in MIL-STD-3063.

19.1.1. Non-Destructive Inspection Plan.

The purpose of the NDI Plan is to establish the inspection and testing requirements for the aircraft or rotorcraft structure providing the means to verify acceptable material condition changes, damage and imperfections already identified and quantified during the equipment qualification. The plan will include all tasks necessary to ensure compliance with the durability, fatigue, and fracture criteria.

Criteria:

The Non-Destructive Inspections necessary to ensure compliance with the durability, fatigue, and fracture criteria for the aircraft structure shall be defined.

Standard:

MIL-STD-3063, section 5.1.7.
MIL-STD-3063, section 5.1.9.
MIL-STD-3063, section 5.4.3.
MIL-STD-3063, section 5.4.5.
MIL-STD-3063, section 5.3.7.
MIL-STD-3063, section 5.4.6.

Method of Compliance:

The NDI plan shall be developed and executed IAW sections 5.1.7., 5.1.9., 5.3.7., 5.4.3., 5.4.5., and 5.4.6. of MIL-STD-3063 using MIL-HDBK-6870 as a guide and shall be incorporated into technical manuals or other maintenance instructions. The NDI plan is to assure adequate NDI of structural components. The system NDI Plan shall include inspection techniques and thresholds of detectable damage at required probabilities

throughout all phases of the program to include design, production, and sustainment. As a minimum, the system NDI Plan shall describe specifications and standards, calibration traceability, inspector training, qualification and certification, method selection, application, and process control, acceptance criteria, application of requirements during manufacturing, maintenance and operations, and NDI applied to fracture-critical hardware. The airworthiness substantiation shall include an NDI Plan IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
NAS410 (for NDI inspector qualifications) SAE ARP5089 ARP5605 ARP5606 ASTM E2533 ASTM E3166	MIL-HDBK-6870 MIL-HDBK-1823 TM 1-1500-335-23 TM 1-1500-366-23 AR750-1 JSSG-2006	14 CFR 29.611, 1529 AC20-107B(1) AC43-214A AC21-26A	Part 7, Leaflet 403, 700, 732, 800, and 802	

19.1.2. Damage Repair Procedures

The purpose of the damage repair procedures is to develop repair concepts and procedures for subsequent use in the technical manuals and other maintenance instructions. Early consideration of repair concepts and post-inspection repair requirements for anticipated damage, as well as consideration of any operational restrictions related to the repairs, should result in improved designs for repairability.

Criteria:

Repair concepts and procedures for anticipated manufacturing and field damage shall be developed to maintain continuing airworthiness.

Standard:

MIL-STD-3063 section 5.4.3.4.
MIL-STD-3063 section 5.4.6.
ISO 14644
TM 1-1500-204-23-11

Method of Compliance:

The airworthiness substantiation shall be provided to ensure that damage repair procedures are developed IAW sections 5.4.3.4., and 5.4.6. of MIL-STD-3063. The airworthiness substantiation shall include a Damage Repair Procedures Report IAW DI-MISC-80711. The Damage Repair Procedures Report will be used to draft the Technical Manuals and other maintenance instructions for sustainment of the aircraft. The Damage Repair Procedures Report shall include:

a. Repair procedures shall specify materials (including material specification per paragraph 19.1.4), processes, tools, equipment, facilities, and training necessary to complete the repairs.

b. Repair procedures shall address damage that occurs during normal operations, such as erosion, delaminations, corrosion, nicks, dents, scratches, gouges, wear, or scuff and tool marks; as well as battle damage.

c. To ensure standardized procedures, the tools required for field repair shall conform to the AVIM Shop Sets (metallic and composite NSN 4920-01-600-7365) unless engineering justification is provided for unique tools and equipment. Elevated temperature cures using a closed loop controller, such as a hot bonder, shall be used for composite and adhesive repairs unless engineering justification is provided for other repair processes.

d. To ensure standardized procedures, the composite and adhesively bonded field repair processes shall utilize the procedures in TM 1-1500-204-23-11, Advanced Composite Material General Maintenance and Practices, unless engineering justification is provided for other repair processes. Composite repair procedures shall include the number of plies, ply orientations with a ply diagram, ply table, and a ply orientation symbol (i.e. warp clock) for each section of the laminate to be repaired.

e. Repair facilities, both field-level and sustainment-level, shall describe the contamination control requirements, including the maximum level of contamination allowed for composite and adhesively bonded field repair. If controlled environmental facilities are required to repair the structure, the level of clean room shall be provided IAW ISO 14644.

f. Field-level or sustainment-level repairs that require new or additional training that maintainers do not currently receive shall have training critical tasks identified by the CDR.

g. Design data and allowable material properties for repair materials or that account for repair procedures shall be IAW the Design Data and Allowable Material Properties paragraph (19.1.3).

h. For testing, field repairs shall be completed by maintainers, using the required tools and facilities in the worldwide environment where the maintainer is expected to conduct the repairs.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
SAE ARP 4916 ARP 4977 ARP4991 ARP5143 ARP5144 ARP5256 ARP5319 AIR5431 ASM HDBK Vol 21	ADS-13-HDBK	14 CFR 29.603-607, 611, 613, 1529 AC20-107B(1), AC43-214A, AC29-2C(8), AC65-33A DOT/FAA/AR-03/19 (for guidance on design data and allowable material properties equivalency)	Part 7, Leaflet 210, 403, 705, 732, 800, 802, and 803	

19.1.3. Design Data and Allowable Material Properties

The purpose of establishing design data and allowable material properties is to support design and analysis of a structurally efficient aircraft design that meets the strength, rigidity, fatigue, damage tolerance, durability, environmental, observability, energy absorption and other requirements of the applicable specifications. Key properties for material selection and design applications include strength, elongation, fracture toughness, damage growth rates, fatigue, stress corrosion, damage initiation thresholds, damage growth thresholds, density, corrosion resistance, population of intrinsic anomalies, surface reflectivity, thermal stability, coefficient of thermal expansion, fire resistance, fluid resistance, and surface roughness.

Criteria:

The design data and allowable material properties necessary to demonstrate the strength, rigidity, fatigue, damage tolerance, durability, environmental, observability, energy absorption and other structural requirements shall be defined.

Standard:

MIL-STD-3063 section 5.2.1.
MIL-STD-3063 section 5.2.17
Aircraft System Specification
ASTM D5229
MMPDS
CMH-17

Method of Compliance:

The airworthiness substantiation shall be provided to ensure design data and allowable material properties is prepared IAW MMPDS, CMH-17, sections 5.2.1. and 5.2.17. of MIL-STD-3063 and the requirements of the Aircraft System Specification, using ADS-13 for guidance. The airworthiness substantiation shall include test plans and reports IAW

DI-NDTI-80566 and DI-NDTI-80809, respectively. A summary report may be a practical document for programs with a large number of materials; the airworthiness substantiation shall include a Design Data and Allowable Material Properties Report prepared IAW DI-MISC-80711 citing the individual test reports and using CMH-17 and MMPDS for guidance. The Design Data and Allowable Material Properties Report(s) shall include:

a. Deleted

b. The test materials and processes shall be those intended for use in production aircraft. The allowables shall be traceable to the production parts via material specifications and process specifications or repair or modification procedures. See paragraphs 19.1.2. and 19.1.4.

c. Allowable properties based on static and fatigue test data shall be substantiated and analyzed IAW procedures used for corresponding data in the appropriate handbook (MMPDS or CMH-17). The contractor may use applicable design mechanical and physical properties and joint allowables contained in MMPDS volume I without the need for additional approval or certification. The contractor may use applicable allowable properties contained in CMH-17-2 with complete documentation without the need for additional approval. If the contractor did not generate the adhesive or composite allowables used or material or process changes are made for primary structure, equivalency by test to the original allowables is required. CMH-17 and DOT/FAA/AR-03/19 provide guidance for equivalency.

d. For composites, adhesives, and plastics, A-basis values shall be calculated from test data using a minimum of five batches of material. For composites, adhesives, and plastics, B-basis values shall be calculated from test data using a minimum of three batches of material.

e. The selection of allowables used for design shall consider reductions in material strength and other properties due to operational and environmental effects, such as fluid contamination, temperature including solar radiation, and humidity exposure. For composites, adhesives, and plastics, static strength shall be determined at -65°F dry, room temperature ambient, 180°F wet, and 220°F dry unless the design requires more extreme conditions, such as engine exhaust impingement and avionics heat. Coupons for wet environments shall be conditioned at a minimum of 85% relative humidity until equilibrium IAW ASTM D5229. Lesser qualification temperature shall be substantiated by test or thermal analysis.

f. For composites, adhesives, and plastics in fatigue critical structure, fatigue curves shall be generated at cold-dry, room temperature ambient and hot-wet conditions. Cold-dry shall be at the minimum ambient operating temperature and hot-wet at the maximum ambient operating temperature. Coupons for wet environments shall be conditioned at a minimum of 85% relative humidity until equilibrium IAW ASTM D5229. Lesser qualification temperature shall be substantiated by test or thermal analysis.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
Aerospace Structural Metals Handbook, Structural Alloys Handbook ASTM D4762 ASTM D6856 ASTM D5687 ASTM D5592 ASTM D4896 AIA Recommended Guidance for Certification of AM Components	ADS-13-HDBK ADS-51-HDBK para 4-7.8. WL-TR-94-4052/3/4/5/6 NAVAIR AR-56 para 3.7.7. JSSG 2006 (for fixed wing)	14 CFR 29.603-607, 609, 611, 613 AC20-107B(1), AC43-214A, AC23-20, AC 25.613-1, AC29-2C(8) DOT/FAA/AR-03/19 (for guidance on design data and allowable material properties equivalency) 14 CFR 33.15 14 CFR 35.16-17 NASA-STD-6030,	Part 7, Leaflet 200, 201, 301, 307, 400, 403, 405, 406, 408, 409, 705, 708, 712, and 732	

19.1.4. Material and Process Specifications

The purpose of material and process specifications is to establish, and control process parameters and methods as required for the design to meet the specification, including inherent requirements for manufacturing stability, producibility, characterization of material properties, predictability of material performance, and supportability.

Criteria:

The material control process parameters and methods necessary to meet the design requirements and the inherent requirements for manufacturing stability, producibility, characterization of material properties, predictability of material performance, and supportability shall be defined. Material and process specifications shall ensure that the paragraph 19.1.3. design data and allowable material properties used in the design are achieved.

Standard:

MIL-STD-3063 section 5.2.1.
MIL-STD-3063 section 5.2.17
MIL-STD-1587
MIL-STD-31000

Method of Compliance:

Material and process specifications shall be IAW paragraphs 5.1.9., 5.2.1., and 5.2.17. of MIL-STD-3063 and the specification requirements of MIL-STD-1587. The airworthiness substantiation shall include new or program-unique military specifications IAW DI-SDMP-81464 or DI-SDMP-81465. The airworthiness substantiation shall include new or program-unique contractor specifications IAW DI-MFFP-82119. Alternatively,

airworthiness substantiation may include specifications as part of a production level Technical Data Package IAW MIL-STD-31000 and DI-SESS-80776. ADS-13, CMH-17, MMPDS, and MIL-STD-961 may be used for guidance. DOT/FAA/AR-03/19, DOT/FAA/AR-02/110, DOT/FAA/AR-06/10, DOT/FAA/AR-07/3, and DOT/FAA/AR-06/25 provide guidance for composite materials and processes. Specifications shall include:

a. Specifications covering material procurement, material processing, and fabrication procedures shall be developed to ensure a basis for fabricating reproducible and reliable structure. Design data and allowable material properties shall be traceable to the production part through material and process specifications.

b. The limits permitted by the specifications shall be substantiated by analysis supported by test evidence, or tests at the coupon, element or subcomponent level. See paragraph 19.1.3. Design Data and Allowable Material Properties. Adhesion failures for adhesive bonding which indicate the lack of chemical bonding between substrate and adhesive materials are considered an unacceptable failure mode in all test types and service. Material or bond process problems that lead to adhesion failures are solved before proceeding with qualification tests. Adhesion failures found in production require immediate action to identify the specific cause and isolate all affected parts and assemblies for disposition. Adhesion failures discovered in service require immediate action to determine the cause, to isolate the affected aircraft, and to conduct directed inspection and repair. Depending on the suspected severity of the bonding problem, immediate action may be required to restore the affected aircraft to an airworthy condition.

c. Process specifications and manufacturing documentation shall control fabrication and assembly, especially for composites. Key fabrication process considerations requiring such control, particularly for composites and adhesively bonded structures, include:

(1) Material handling and storage

(2) Facility temperature and humidity environment (see Figure below for limits) and control

Temperature Humidity Requirements of the Lay-up/bonding Room

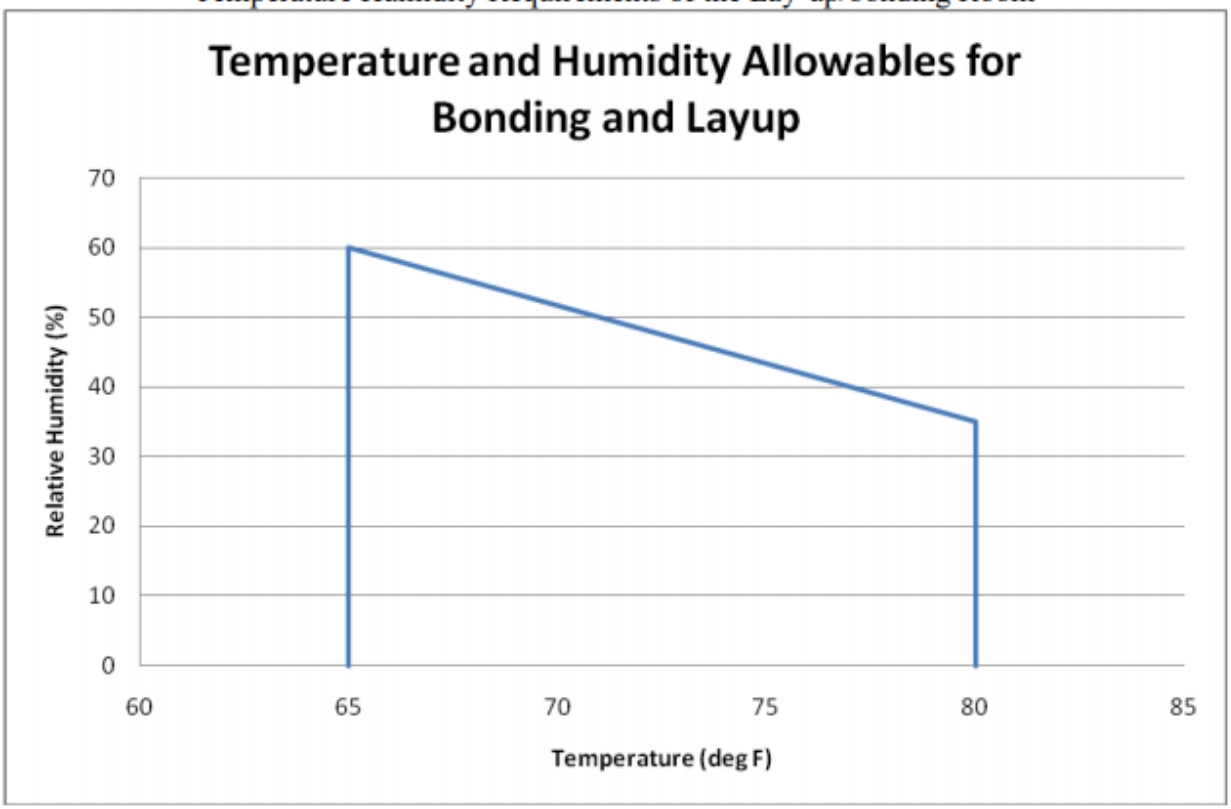

Figure 3. Facility temperature and humidity environment

(3) Contamination sources and control

(4) Laminate layup and bagging (or other alternate process steps for non-laminated material forms and advanced processes)

(5) Mating part dimensional tolerance control

(6) Part cure (thermal management)

(7) Machining and assembly

(8) Technician training for specific material, processes, tooling and equipment.

(9) Process verification tests and inspections, including initial and periodic destructive teardowns for processes with limited or no available non-destructive inspection methods.

(10) Record retention, change management, and equivalency requirements.

(11) Adhesive bond-related specifications, such as substrates, adhesive, peel plies and release films and fabrics, solvents, cleaning cloths and wipes, surface preparation, abrasives, facilities, and adhesive bond primers, shall be demonstrated to

produce a surface free from contamination, chemically active surface, and dry in the allowed process times and environment via relevant analytical and test methods, such as ASTM D3762 and ASTM D5528. Surface preparation methods shall remove known contaminants used in the fabrication processes, such as mold release, tackifier, and peel ply. Automated surface preparation is preferable to reduce variability. Hand sanding is not a viable process for wide area or critical bond applications due to significant variability.

d. Material specifications shall include:

(1) Classification, such as type, class, grade, or form, if applicable.

(2) Chemical composition including limits. For materials that cannot be defined, a Process Control Document is required defining the specific ingredients and their form, sources, mixing, sequence, equipment, thermal management, and any other factors that may affect material properties and performance.

(3) Physical and mechanical properties including limits that ensure the allowable material properties are achieved.

(4) Verification requirements including analytical and test methods, sampling frequency, number of samples, test sample preparation and conditioning, responsibility for test/inspection.

(5) Record retention, change management, and equivalency requirements.

(6) Packaging, handling, storage, shelf life, and out time requirements.

(7) Qualified products list, including product, source, production site, and production line (if applicable).

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
CMH-17 MMPDS AIA Recommended Guidance for Certification of AM Components	DoDM 4120.24 ADS-13-HDBK ADS-51-HDBK 4-11.3. JSSG 2006 (for fixed wing) MIL-STD-961	14 CFR 29.603-607, 611, 613, 33.15, 35.16-17 AC20-107B(1), AC43-214A, AC23-20, AC21-26A, AC29-2C(8) DOT/FAA/AR-03/19, DOT/FAA/AR- 02/110, DOT/FAA/AR-06/10, DOT/FAA/AR-07/3, and DOT/FAA/AR- 06/25 NASA-STD-6030, NASA-STD-6033,	Part 7, Leaflet 400, 402, 403, 404, 408, 409, 705, and 708	

19.1.5. Selection Rationale for Materials, Processes, and Joining Methods
The purpose of providing the selection rationale is to allow for verification of the manufacturing stability, producibility, characterization of mechanical and physical material properties, predictability of structural performance, and supportability of the selected materials, processes, and joining methods.

Criteria:
The analyzed, tested, and fielded materials, processes, and joining methods shall be defined.

Standard:
MIL-STD-3063, section 5.1.9.
MIL-STD-1587
MIL-STD-1568
MMPDS
Aircraft System Specification

Method of Compliance:
The airworthiness substantiation shall include selection rationale for materials, processes, and joining methods IAW section 5.1.9. of MIL-STD-3063, the requirements of the Aircraft System Specification, and MIL-STD-1587 using ADS-13, MMPDS, and CMH-17 for guidance. Select, process, and join metal alloys to minimize susceptibility to stress corrosion cracking IAW MIL-STD-1568, MIL-STD-1587, MMPDS, and the requirements of the Aircraft System Specification using SAE ARP 1110, SAE ARP 823, SAE ARP 982, and NASA MSFC-STD-3029 for guidance. If the stress corrosion cracking susceptibility of a material is unknown, its susceptibility shall be determined IAW ASTM G44, ASTM G47, Annex 4 of ASTM G85, or other approved test method.

Substantiating tests and analyses shall be submitted for approval. The airworthiness substantiation shall include a Selection Rationale for Materials, Processes, Joining Methods, and Structural Concepts report prepared IAW DI-MISC-80711.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
SAE ARP 1110 SAE ARP 823 SAE ARP 982 CMH-17	ADS-13	NASA MSFC-STD-3029		

19.2. Materials and Processes Military Suitability
Selected materials and processes used in the aircraft design must be suitable for use in a military environment, including operation and supportability.

19.2.1. Corrosion Prevention and Control Plan
The purpose of the Corrosion Prevention and Control Plan is to provide guidance to minimize the life cycle cost of Army aviation systems due to corrosion. The plan will define specific prevention and control measures to be implemented for controlling corrosion. The information will assist as a mechanism for the implementation of sound materials selection practices and finish treatments during the design, development, production, and operational cycles of Army aviation systems.

Criteria:
Guidance to minimize life cycle cost of the aircraft system due to corrosion and specific prevention and control measures to be implemented for controlling corrosion shall be defined.

Standard:
MIL-STD-3063 section 5.1.6.
MIL-STD-3063 section 5.2.12
MIL-STD-3063 section 5.3.11
MIL-STD-3063 section 5.4.1.
MIL-STD-3063 section 5.5.
MIL-STD-1568
MIL-STD-7179
MIL-DTL-5002

Method of Compliance:
The airworthiness substantiation shall include a CPC Plan IAW sections 5.3.11., 5.4.1., and 5.5. of MIL-STD-3063 and MIL-STD-1568 and prepare the plan IAW DI-MFFP-81403. The Corrosion Prevention and Control Plan (CPCP) input shall be prepared containing the following data (describing contractor and subcontractor CPC measures):

a. Corrosion prevention and control management planning is essential to ensure continuing airworthiness of aviation assets. Although the CPCP is required apart from airworthiness and also addresses readiness and suitability, the CPCP provides a tremendous benefit in terms of reduced lifecycle cost and improved operational readiness. Corrosion is a time dependent and operating environment sensitive phenomenon which can degrade the structural integrity of an aircraft, thereby reducing its inherent ability to sustain design load. Program offices shall implement corrosion prevention and control planning to mitigate corrosion during design and sustainment. The purpose for planning is to use corrosion best practices for design, manufacturing and maintenance to ensure timely detection of corrosion issues and to prevent unacceptable combination of corrosion and fatigue during the lifecycle of the aircraft.

b. The CPCP should be developed and implemented IAW the guidance provided in the Corrosion Prevention and Control Planning Guidebook for Military Systems and Equipment.

c. The continuing airworthiness requirements shall be addressed as follows: to establish damage limits, inspection intervals, and to ensure safety of flight. Approved repairs are also needed once damage has been found during an inspection.

d. Program managers need to focus on impacts to lifecycle costs and eliminate shortcuts taken where corrosion prevention is concerned which can result in tremendous increase in life cycle cost to maintain continuing airworthiness. As a minimum CPCP requirements during the acquisition phase shall include implementing finish specifications, sealing faying surfaces and wet installing fasteners.

e. Describe the preventive and corrective materials and corrosion control procedures utilized during design/development, testing, modification, manufacturing, materials handling, packaging, and shipping.

f. Describe the materials selection criteria and design approaches to prevent corrosion. If possible, materials unsuitable to the operational environment should be avoided. Use of materials susceptible to Stress Corrosion Cracking shall be minimized. If using multiple materials, compatibility should be taken into consideration; MIL-STD-889 defines compatibility between dissimilar metals in contact in different environments. If dissimilar materials cannot be avoided, the materials shall be isolated from each other to protect against galvanic corrosion.

g. Describe how existing data collected through design studies, failure analysis reports, and aircraft system inspections are included to guide corrosion prevention design.

h. Describe how system corrosion requirements are translated into sub-tier requirements, considering criticality of particular hardware (as determined by the Failure Mode, Effects, and Criticality Analysis), severity of local environment and difficulty of maintenance.

i. Describe how the contractor verifies subcontractor compliance with the requirements prior to acceptance of the design production.

j. Describe the methods used to minimize the impact of corrosion on life cycle cost, readiness, reliability, supportability, safety, and structural integrity.

k. The CPCP should reflect that corrosion prevention and control is an ongoing iterative process over the entire life cycle of the aircraft that includes engineering design and analysis, quality assurance, non-destructive inspection (NDI), manufacturing, corrosion inspections, maintenance procedures, touch up and repair of finish systems, aircraft washing/rinsing schedules and procedures, corrosion inhibiting compounds applications procedures and schedules, etc. The CPCP should establish the personnel for this ongoing process to ensure that support for the system and equipment is planned and will be in place.

l. The CPCP should define processes and metrics for the tracking and repair of corrosion problems. The metrics should include but are not limited to acquisition cost, maintenance man-hours for repair and replacement, cost of component repair and replacement, and operational readiness. These metrics need to be established and data needs to be collected in order to prioritize and justify funding the pursuit of new corrosion prevention and control initiatives via a Cost Based Analysis.

m. The airworthiness substantiation shall include contractor’s finish specification IAW MIL-STD-7179, MIL-STD-1568, or MIL-DTL-5002, as applicable. The airworthiness substantiation shall include the finish specification IAW DI-MFFP-81402. The airworthiness substantiation shall ensure that specifications (process/finish specifications in system/equipment) that outline the applications of coatings and other corrosion prevention compounds (i.e. sealants, CPCs, platings) and procedures that address personnel training and qualification, material inspection, surface preparation, and coating or compound application procedures are established.

n. The CPCP should be compatible with existing Army infrastructure for logistics, maintenance, repair, and non-destructive inspection techniques.

o. The CPCP should take into account and have a methodology in place to evaluate the tradeoffs that must be made between environmental, safety, and health issues, and corrosion prevention and control technologies that rely on the use of toxic or carcinogenic materials, i.e. hexavalent chromium, cadmium, lead, hazardous air pollutants, ozone depleting compounds, etc.

p. The CPCP should address the airworthiness requirements for environmentally friendly replacement materials if used. Any test data procured or to be procured for new replacement coatings shall be included in the CPCP.

Additional Information

Comm Docs	*DoD/MIL Docs*	*FAA/EASA*	*Def-Stan 970*	*STANAG*
ASM HDBK Vol 21	MIL-STD-889 MIL-DTL-53039 MIL-DTL-64159 MIL-DTL-53072 AR 750-1 TM 1-1500-344-23-1/-2/-3/-4 DFARS 207.105 PGI 207.105(b)(13)(ii) Corrosion Prevention and Control Planning Guidebook for Military Systems and Equipment ADS-51-HDBK para 10-12 JSSG 2006 (for fixed wing)	14 CFR 29.609 AC 43.206	Part 7, Leaflet 404, 405, 406, 407, 700, 705, 708, 732, and 803	NATO STANAG 4370

19.2.2. Aircraft Environmental Requirements

The purpose of assessing environmental performance of the aircraft and installed equipment is to ensure continuing airworthiness, as well as suitability for use in the specified environments.

Criteria:

Performance of the aircraft and installed equipment for use in the specified environments shall be demonstrated to ensure airworthiness and military suitability .

Standard:

MIL-STD-3063 section 5.2.4.
MIL-STD-3063 section 5.3.11
MIL-STD-810
Aircraft System Specification
ASTM B117
ASTM G85 Annex A4
MIL-HDBK-310

Method of Compliance:

The airworthiness substantiation shall be provided to ensure design and tests of the systems /equipment for its intended environmental exposure, use and performance as described below.

a. Assess the equipment, installation design, and functional interfaces for potential adverse environmental impact (aircraft structure, components, external systems, and flight critical equipment) IAW sections 5.2.4 and 5.3.11 of MIL-STD-3063. The aircraft shall meet all environmental requirements of the Aircraft System Specification.

AR70-38, MIL-HDBK-310, and MIL-STD-810 may be used as guidelines to verify the following requirements: extreme hot and cold temperatures, humidity, rain, sand and dust, salt fog, fungus, fluid contamination, solar radiation, hail, icing, and snow.

b. For external equipment or hardware, the corrosion design shall be verified by specific corrosion testing on the system or subsystem per ASTM B117. The system should be corrosion free and functional after a minimum of 504 hours of ASTM B117 salt fog testing IAW MIL-STD-810 509-8 procedure II. Finish and corrosion protection verification should include cyclic sodium chloride - sulfur dioxide test of ASTM G85 Annex A4 for a minimum of 504 hours IAW MIL-STD-810 509-8 procedure II if the subsystem of interest is exposed to exhaust or plume gases.

c. The airworthiness substantiation shall include an Aircraft Environmental Test Plan prepared IAW DI-NDTI-80566, and Aircraft Environmental Test Reports prepared IAW DI-NDTI-80809. The contractor may demonstrate qualification by similarity, analysis, demonstration, inspection or test. No corrosion, materials degradation, or functional degradation is desired. While functional testing may prove satisfactory, corrosion or minor materials degradation after short duration test is undesirable and indicates components will not perform satisfactorily over its expected service life. Therefore, if the article is functional and minor corrosion occurs, the airworthiness substantiation shall specify an inspection interval in order to detect and mitigate the problem before a safety or airworthiness issue arises. Corrosion inspection requirements and intervals will be documented in the technical manuals and/or corrosion prevention and control plan.

d. The material/finishes to be used during the installation procedure, including the mounting hardware, shall be compatible with the adjacent aircraft structure from a corrosion point of view using MIL-STD-7179 as a guide.

Additional Information

Comm Docs	*DoD/MIL Docs*	*FAA/EASA*	*Def-Stan 970*	*STANAG*
CMH-17 ASM HDBK Vol 21	MIL-STD-810 MIL-STD-7179 MIL-HDBK-310 AR 70-38 JSSG 2006 (for fixed wing) ADS-13-HDBK FM 3-04	14 CFR 29.603, 29.609, 35.17 AC20-107B(1), AC29-2C(8)	Part 7, Leaflet 101, 407, 700, 705, 732, 803, and 1013	

20. OTHER MILITARY CRITERIA

This section covers criteria that result from unique military requirements for the system.

Areas covered in this section include:

- Cybersecurity
- Shipboard Compatibility
- Air and Land Transportability
- Ballistic Protection Systems.
- Carry-on equipment
- Oxygen Systems
- Life Support Systems
- Helmets
- etc.

The following criteria, standards and methods of compliance apply to all air systems and represent the minimum requirements necessary to establish, verify, and maintain an airworthy design.

20.1. Cybersecurity

There is no current defined airworthiness requirement for cybersecurity, but cyber incursion has the potential to impact safety of flight and performance of the aircraft. It therefore falls under the definition of airworthiness: the property of an air vehicle/aircraft system configuration to safely attain, sustain, and terminate flight in accordance with the approved usage limits.

20.1.1. Plan for Security Aspects of Certification (PSecAC)

The PSecAC is the primary means an applicant uses to show their plan to identify the security vulnerabilities of their system, to define risk of these vulnerabilities to that system and the systems it interacts with that affect airworthiness, and to identify the means and methods to be used to mitigate these vulnerabilities to the appropriate level of risk.

Criteria:

The applicant outlines how they will comply with DO-326A Section A.1.1 and what deliverables they will provide to substantiate that compliance. The applicant outlines how they will comply with DO-355A to maintain security in support of airworthiness throughout the life of the product.

Standard:

RTCA/DO-326A Sec A.1.1
RTCA/DO-355A

Method of Compliance:

The applicant shall provide the PSecAC and demonstrate that it is complete and consistent in addressing security by identifying the processes, activities, artifacts, and products IAW RTCA/DO-326A Section A.1.1. The PSecAC shall be prepared IAW DI-MISC-80508 and RTCA/DO-326A Section A.1.1.

The PSecAC shall include:

a. description of major security-related milestones with accompanying schedule

b. overview of the aircraft computer architecture

c. overview of system architecture of selected systems, with emphasis on elements pertinent to security threats and security measures

d. identification of all systems whose compromise could impact its airworthiness and/or the aircraft's airworthiness

e. identification of processes to be used to show compliance with DO-326A Sec A.1.1.

f. overview of Preliminary Aircraft Security Risk Assessment

g. list of all artifacts to substantiate security compliance, who is responsible for producing them, and who is responsible for approving them

h. relationships between this security plan and other certification plans

i. schedule of interactions with the Certification Authority

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-326A				

20.1.2. Aircraft Security Scope Definition (ASSD)
The ASDD defines the operational environment of the aircraft and system regarding information security IAW DO-326A Section A.2.1.

Criteria:
The applicant outlines the various environments that the aircraft operates within. The applicant addresses the current security in place, the roles and responsibilities regarding the aircraft security, the security perimeter, the threats, the trust relationships in place, and any assumptions regarding maintenance and operation.

Standard:
RTCA/DO-326A Sec A.2.1
RTCA/DO-356A

Method of Compliance:
The applicant shall provide the ASSDD and demonstrate that it is complete and consistent in complying with DO-326A Sec A.2.1. The ASSDD shall include the following:

a. description of the aircraft security perimeter

b. description of the aircraft assets (DO-326A defines ‘assets’ as “the logical and physical resources of the aircraft which contribute to the airworthiness of the aircraft, including functions, systems, items, data, interfaces, processes and information”). Assets may be of physical (e.g. an LRU) or purely logical nature (e.g. software, data).

c. list of all aircraft information interfaces

(1) identify all assets that exchange data electronically between the aircraft and the outside world (i.e., off-helicopter sources); this includes, but is not limited to, radio, SATCOM, electronic exchange via WiFi, electronic exchange via physical connection (e.g. Ethernet), and media (e.g. PCMIA cards). Provide the systems, the means of data exchange, and the data exchanged.

(2) identify all data exchanges between assets aboard the aircraft; this includes identification of buses (e.g. MIL-STD-1553B, ARINC-429), analog data lines, digital data lines, media transfers, and WiFi. Provide the systems, the means of on-board data exchange, and the data exchanged.

d. list of all existing security measures

e. definition of the roles and organizations that interact with the aircraft

f. definition of the security environment

g. identification of trust relationships and security risk related to:

(1) roles and entities

(2) external tools and systems

(3) external security measures

(4) other external dependencies, if any

h. identification of all operational and maintenance assumptions

i. identification of the current external agreements

j. identification and classification of the threat sources

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-326A DO-356A				

20.1.3. Preliminary Aircraft Security Risk Assessment (PASRA)
The PASRA identifies and assesses all aircraft-level security risks IAW DO-326A Section A.2.2.

Criteria:
The PASRA defines the current security threat risk and proposes a plan/design to mitigate the risks to an acceptable level. The applicant outlines the current threats to the aircraft and its systems, the severity of cyber incursion to the aircraft and its systems, the existing security measures, means of attack, risk assessment, and directives to the design team needed to mitigate security risks to an acceptable level.

Standard:
RTCA/DO-326A Sec A.2.2
RTCA/DO-356A

Method of Compliance:
The applicant shall provide the PASRA and demonstrate that it is complete and consistent in complying with DO-326A Section A.2.2. The PASRA shall include the following:

a. Identification of all threat conditions associated with the aircraft assets

b. evaluation of the severity of effect of threat conditions and associated assets

c. identification of functional security dependencies between threat conditions and threat sources

d. assessment of the aircraft security architecture and requirements

e. identification of existing security measures

f. identification of all attack paths

g. identification of all assets associated with threat conditions

h. determination and classification of the threat scenarios for the severity and level of threat

i. evaluation of the security risk from intentional unauthorized electronic interaction

j. determination of the need for risk mitigation, including possible gaps in security architecture and requirements

k. identification of residual risk

l. identification of security requirement

m. identification of security requirements, guidance, and assurance actions to be provided to the design team

n. risk assessment prior to changes

o. residual risk assessment, including the decision action (choice between accept, mitigate, avoid, transfer risk) after changes implemented

PASRA should be consistent with the Aircraft FHA. The security risks should be at an acceptable level.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-326A DO-356A				

20.1.4. Aircraft Security Risk Assessment (ASRA)
The ASRA identifies and assesses all aircraft-level security risks and vulnerabilities after implementation of security mitigations IAW DO-326A Section A.2.3.

Criteria:
The applicant assesses the modifications implemented to address security and outlines the final aircraft-level security risks and vulnerabilities.

Standard:
RTCA/DO-326A Sec A.2.3
RTCA/DO-356A

Method of Compliance:
The applicant shall provide the ASRA and demonstrate that it is complete and consistent in complying with DO-326A Section A.2.3. The ASRA shall include the following:

a. assessment of the changes (delineated in the PASRA) to the aircraft and its systems to address the security risks

b. final Aircraft Security Risk Assessment

c. evaluation of the residual vulnerabilities

d. the final security risks should be at an acceptable level

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-326A DO-356A				

20.1.5. System Security Scope Definition (SSDD)
The SSDD identifies and assesses all aircraft-level security risks IAW DO-326A Section A.2.4.

Criteria:
The applicant outlines the environment that the system operates within. The applicant addresses the current security in place, the roles and responsibilities regarding the system security, the security perimeter, the threats, the trust relationships in place, and any assumptions regarding maintenance and operation.

Standard:
RTCA/DO-326A Sec A.2.4
RTCA/DO-356A

Method of Compliance:
The applicant shall provide the SSDD and demonstrate that it is complete and consistent in complying with DO-326A Section A.2.4. The ASRA shall include the following:

a. assumptions about the system's operational and maintenance environment(s)

b. list of the system's trust relationships and security risk related to:

(1) roles and entities,

(2) external tools and systems,

(3) external security measures

c. the system's security perimeter and system assets:

(1) hardware interfaces, including radio-frequency signals (e.g., Wi-Fi, mobile cellular, GPS, VHF)

(2) software interfaces, including services and protocols running over the hardware interfaces

(3) identify information exchanges, (e.g. file transfer, ACARS messages, software loads, database updates) (e.g. file exchanges going over a Virtual Private Network (VPN) session, protocols for exchanges), including all physical paths by which information from outside the perimeter could reach the inside

d. updated preliminary external agreements (e.g. operator requirements, maintenance requirements)

e. allocation of threat source to systems.

f. security requirements assigned to the system

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-326A DO-356A				

20.1.6. Preliminary System Security Risk Assessment (PSSRA)
The PSSRA identifies and assesses all system security risks IAW DO-326A Section A.2.5.

Criteria:
The PSSRA defines the system's current security threat risk and proposes a plan/design to mitigate the risks to an acceptable level. The applicant outlines the current threats to the system, the severity of cyber incursion to the system, the existing security measures, means of attack, risk assessment, and directives to the design team needed to mitigate security risks to an acceptable level.

Standard:
RTCA/DO-326A Sec A.2.5
RTCA/DO-356A

Method of Compliance:
The applicant shall provide the PSSRA and demonstrate that it is complete and consistent in complying with DO-326A Section A.2.5. The PSSRA shall include the following:

a. all threat conditions associated with the system assets

b. the severity of effect of each threat condition and associated assets

c. the functional security dependencies between threat conditions and threat sources

d. the assets associated with threat conditions

e. assessment of the system security architecture and requirements

f. existing security measures.

g. attack paths to the system

h. threat scenarios with their severities and threat levels

i. evaluation of the risk from intentional unauthorized electronic interaction

j. determination of the need for risk mitigation, including possible gaps in security architecture

k. residual risk

l. security requirements assigned to the system resulting from this analysis

m. directives to the system's design team in support of security: security requirements and assurance actions.

n. residual risk assessment, including the decision action (choice between accept, mitigate, avoid, transfer risk)

o. assumptions about external agreements (e.g. operator requirements, maintenance requirements) when applicable to the system

Additional Information

Comm Docs	*DoD/MIL Docs*	*FAA/EASA*	*Def-Stan 970*	*STANAG*
DO-326A DO-356A				

20.1.7. System Security Risk Assessment (SSRA)
The SSRA identifies and assesses the system's security risks IAW DO-326A Section A.2.6.

Criteria:
The applicant assesses the modification implemented to address security and outlines the system's final security risks and vulnerabilities.

Standard:
RTCA/DO-326A Sec A.2.6
RTCA/DO-356A

Method of Compliance:
The applicant shall provide the SSRA and demonstrate that it is complete and consistent in complying with DO-326A Section A.2.6. The SSRA shall include the following:

a. assessment of the changes (delineated in the PSSRA) to the system to address the security risks

b. final System Security Risk Assessment

c. evaluation of the residual vulnerabilities

d. final security risks should be at an acceptable level

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-326A DO-356A				

20.1.8. Aircraft Security Architecture and Measures (ASAM)
The ASAM establishes an effective aircraft security architecture and measures to implement them IAW DO-326A Section A.3.1.

Criteria:
The applicant defines the security elements of the aircraft architecture, the security means (processes and procedures), the security objectives, assignment of security requirements to either the system implementation or the operator or combined, and process to assure the architecture and means are being implemented.

Standard:
RTCA/DO-326A Sec A.3.1
RTCA/DO-355A
Method of Compliance:
The applicant shall provide the ASAM and demonstrate that it is complete and consistent in complying with DO-326A Section A.3.1. The ASAM shall include the following:

a. the Aircraft Security Architecture and Measures

b. list of security requirements for security measures

c. list of security effectiveness objectives and requirements

d. validation of security effectiveness objectives and requirements

e. allocation of security measures to systems or operator guidance

f. list of security assurance actions

g. description of means for periodically establishing airworthiness with respect to security issues.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-326A DO-356A				

20.1.9. Aircraft Security Operator Guidance (ASOG)
The ASOG provides roles and responsibilities of aircraft personnel to implement and maintain aircraft security IAW DO-326A Section A.3.2.

Criteria:
The applicant provides a list of processes and procedures that the aircraft personnel must follow to implement and maintain security.

Standard:
RTCA/DO-326A Sec A.3.2

RTCA/DO-356A

Method of Compliance:
The applicant shall provide the ASOG and demonstrate that it is complete and consistent in complying with DO-326A Section A.3.2. The ASOG shall include the following:

a. aircraft-level security operating procedures

b. aircraft-level maintenance procedures related to security

c. modification and addition of processes in support of continued airworthiness

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-326A DO-356A				

20.1.10. Aircraft Security Verification (ASV)
The ASV shows compliance with aircraft security requirements and evaluates the security effectiveness of the measures within the intended environment IAW DO-326A Section A.3.3.

Criteria:
The applicant provides verification that the security processes, procedures, and implementation met the security objectives and met the acceptable level of risk. Identifies any remaining vulnerabilities.

Standard:
RTCA/DO-326A Sec A.3.3
RTCA/DO-356A

Method of Compliance:
The applicant shall provide the ASV and demonstrate that it is complete and consistent in complying with DO-326A Section A.3.3. The ASV shall include the following:

a. verification of the aircraft security implementation; it is correct and that aircraft security requirements are met

b. latest vulnerability dossier

c. final security verification and test plan

d. security-related problem reports

e. verification that the aircraft security measures are effective against the aircraft threat scenarios

f. final vulnerability test plan - evaluate how well it covers the security requirements in its context of the threat scenarios in the security risk assessment, including its security effectiveness

g. final Aircraft Security Operator Guidance (ASOG)

h. vulnerability assessment and testing and analyze results for security risk

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-326A DO-356A				

20.1.11. System Security Architecture and Measures (SSAM)
The SSAM establishes an effective system security architecture and measures to implement security IAW DO-326A Section A.3.4.

Criteria:
The applicant defines the security elements of the system's architecture, the security means (processes and procedures), the security objectives, assignment of security requirements to either the system implementation or the operator or combined, and process to assure the architecture and means are being implemented.

Standard:
RTCA/DO-326A Sec A.3.4
RTCA/DO-356A

Method of Compliance:
The applicant shall provide the SSAM and demonstrate that it is complete and consistent in complying with DO-326A Section A.3.4. The ASAM shall include the following:

a. the System Security Architecture and Measures

b. list of the system's security requirements for security measures

c. list of the system's security effectiveness objectives and requirements

d. validation of the system's security effectiveness objectives and requirements

e. identification of any supporting the system's lower-level systems or item assets

f. allocation of security measures to subsystems, items, or operator guidance

g. list of the system's security assurance actions

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-326A DO-356A				

20.1.12. System Security Integrator Guidance (SSIG)

The SSIG provides roles and responsibilities of the system's personnel to implement and maintain system security IAW DO-326A Section A.3.5.

Criteria:

The applicant provides a list of processes and procedures that the system's personnel must follow to implement and maintain security.

Standard:

RTCA/DO-326A Sec A.3.5
RTCA/DO-356A

Method of Compliance:

The applicant shall provide the SSIG and demonstrate that it is complete and consistent in complying with DO-326A Section A.3.5. The SSIG shall include the following:

a. the system's security operating procedures

b. the system's maintenance procedures related to security

c. modification and addition of processes in support of continued airworthiness

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-326A DO-356A				

20.1.13. System Security Verification (SSV)

The SSV shows compliance with the system's security requirements and evaluates the security effectiveness of the measures within the intended environment IAW DO-326A Section A.3.6.

Criteria:

The applicant provides verification that the security processes, procedures, and implementation met the system's security objectives and met the acceptable level of risk. Identifies any remaining vulnerabilities.

Standard:

RTCA/DO-326A Sec A.3.6
RTCA/DO-356A

Method of Compliance:
The applicant shall provide the SSV and demonstrate that it is complete and consistent in complying with DO-326A Section A.3.6. The SSV shall include the following:

a. verification of the system security implementation; it is correct and that system security requirements are met

b. latest vulnerability dossier

c. final security verification and test plan

d. security-related problem reports

e. verification that the system security measures are effective against the system threat scenarios

f. final vulnerability test plan - evaluate how well it covers the security requirements in its context of the threat scenarios in the security risk assessment, including its security effectiveness

g. assessment of the System Security Integrator Guidance (SSIG) that it meets the security requirements assigned to it

h. vulnerability assessment and testing and analyze results for security risk

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-326A DO-356A				

20.1.14. Plan for Security Aspects of Certification Summary (PSecAC Summary)
The PSecAC Summary provides a list of data items to show compliance to the plans and processes set forth in the PSecAC.

Criteria:
The applicant outlines, using DO-326A Section A.1.2, the processes they executed and deliverables they provided to substantiate their compliance with the plans set forth in the PSecAC.

Standard:
RTCA/DO-326A Sec A.1.2
RTCA/DO-355A

Method of Compliance:
The applicant shall provide the PSecAC Summary and demonstrate that it is complete and consistent by identifying the processes, activities, artifacts, and products provided by the applicant IAW RTCA/DO-326A Section A.1.2. The PSecAC Summary shall be

prepared IAW DI-MISC-80508 and RTCA/DO-326A Section A.1.2. The PSecAC Summary shall include:

a. evidence on activities which have been performed in compliance with their assigned objective

b. identification and justifications for any deviations from PSecAC.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-326A DO-356A				

20.2. Shipboard Compatibility.
The purpose of the shipboard compatibility requirement is to define all aircraft systems, performance data and operating procedures necessary for safe operation of aircraft on naval ships.

Criteria:
The envelopes, limitations, procedures and system requirements for landing on ships shall be defined.

Standard:
NAVAIR 00-80T-122

Method of Compliance:
The airworthiness substantiation shall include the following IAW NAVAIR 00-80T-122:

a. Rotor brake operation and limitations.

b. Engagement, disengagement, takeoff, and landing wind envelopes.

c. Flight deck, Recovery Assist, Secure and Traverse, and spotting/handling compatibility.

The airworthiness substantiation shall include a Shipboard Compatibility Report.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG

21. ENVIRONMENTAL EFFECTS FOR ELECTRICAL/ELECTRONIC EQUIPMENT AND OTHER INSTALLED MATERIEL

The purpose of this section is to evaluate the influences that environmental stresses have on materiel throughout all phases of its life cycle. Tailoring is essential, based on materiel location and environments, to ensure that the appropriate tests, and test parameters, are performed. The tailoring process is described in the standard (MIL-STD-810) and ADS-71 SP. (The term fielding applies to Level II UAV and FMS aircraft only.)

The performance parameters of the materiel are identified in the aircraft system specification, the equipment specification, and component specification.

The following Criteria, Standard and Methods of Compliance represent the minimum requirements necessary to establish, verify, and maintain an airworthy design.

21.1. Combined Temperature/ Altitude/ Humidity/ Vibration

The purpose of the combined temperature/altitude/humidity/vibration test is to determine the synergistic effects of combinations of temperature, altitude, humidity, input electrical power, and vibration on airborne electronic and electro-mechanical materiel with regard to safety, integrity, and performance during ground and flight operations. The synergistic effects may induce failures that would not be exhibited during individual environment testing.

Criteria:
The materiel shall perform IAW the equipment specification before, during, and after exposure to Combined Temperature/ Altitude/ Humidity/ Vibration environment

Standard:
MIL-STD-810, Method 520

Method of Compliance:
The materiel shall perform IAW the equipment / platform specification before, during, and after exposure to synergistic (temp/alt/humidity/vibration) environmental effects that occur over the life cycle of the materiel. It is acceptable to treat vibration individually. Compliance may be by test, similarity analysis, analysis, demonstration, or a combination of methods. Testing shall be IAW MIL-STD-810, Method 520, procedure III. Provided a separate Vibration test is conducted, the test may be tailored to a Temperature/Altitude/Humidity test which will be the maximum tailoring allowed. Testing shall be in accordance with MIL-STD-810 Method 514. Test Plans shall be prepared IAW DI-NDTI-80566 and Test Procedures IAW DI-NDTI-80603 prior to testing. Test Reports shall be prepared IAW DI-NDTI-80809. A minimum of 10 cycles are required for qualification. For development flight, this requirement may also be satisfied by conducting Procedure II of the individual MIL-STD-810 Test Methods 500.5, 501.5 or 502.5 for altitude, high, low temperatures respectively. The combined test may be tailored to a Temperature/Altitude/Humidity or a Temperature/Altitude test (Temp/Alt - for developmental flight purposes only). A minimum of three (3) cycles shall be conducted.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.2. Low Pressure

The purpose of the low pressure (altitude) test is to determine if materiel can withstand and/or operate in a low pressure environment and/or withstand rapid pressure changes.

21.2.1. Low Pressure. Procedure I Storage

The purpose of the low pressure (altitude) storage test is to determine if materiel can withstand and/or operate in a low pressure storage environment.

Criteria:

The materiel shall perform IAW the equipment specification before and after exposure to Low Pressure Storage environment.

Standard:

MIL-STD-810, Method 500

Method of Compliance:

Testing shall meet the Low Pressure requirements specified in MIL-STD-810, Method 500, Procedure I. The airworthiness substantiation shall include Low Pressure Storage Test Plans that shall be prepared IAW DI-NDTI-80566 and Low Pressure Storage Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Low Pressure Storage Test Reports shall be prepared IAW DI-NDTI-80809. This test is required for both fielding and qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.2.2. Low Pressure. Procedure II Operation

The purpose of the low pressure (altitude) operation test is to determine if materiel can withstand and/or operate in a low pressure environment.

Criteria:

The system shall perform IAW the equipment specification before, during, and after exposure to Low Pressure Operation environment.

Standard:
MIL-STD-810, Method 500

Method of Compliance:
Testing shall meet the Low Pressure requirements specified in MIL-STD-810, Method 500, Procedure II. The airworthiness substantiation shall include a Low Pressure Operation Test Plans that shall be prepared IAW DI-NDTI-80566 and Low Pressure Operation Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Low Pressure Operation Test Reports shall be prepared IAW DI-NDTI-80809. The combined Temperature/Humidity/Vibration/Altitude (Method 520) test is the recommended method to meet the development test AWR Altitude requirements although tailoring is permissible.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.2.3. Low Pressure. Procedure III Rapid Decompression
The purpose of the low pressure (altitude) decompression test is to determine if materiel can withstand rapid pressure changes.

Criteria:
The system shall perform IAW the equipment specification before, during, and after exposure to Low Pressure Rapid Decompression environment.

Standard:
MIL-STD-810, Method 500

Method of Compliance:
Testing shall meet the Low Pressure requirements specified in MIL-STD-810, Method 500, Procedure III. The airworthiness substantiation shall include Low Pressure Rapid Decompression Test Plans that shall be prepared IAW DI-NDTI-80566 and Low Pressure Rapid Decompression Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Low Pressure Rapid Decompression Test Reports shall be prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.3. High Temperature
The purpose of the high temperature test is to evaluate effects of high temperature conditions on materiel safety, integrity, and performance.

21.3.1. High Temperature. Procedure I, Storage
The purpose of the high temperature test is to evaluate effects of high temperature conditions on materiel safety, integrity, and performance.

Criteria:
The system shall perform IAW the equipment specification before and after exposure to High Temperature Storage environment.

Standard:
MIL-STD-810, Method 501

Method of Compliance:
Testing shall meet the MIL-STD-810, Method 501, procedures I (Storage). The airworthiness substantiation shall include High Temperature Storage Test Plans that shall be prepared IAW DI-NDTI-80566 and High Temperature Storage Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. High Temperature Storage Test Report shall be prepared IAW DI-NDTI-80809. This test is required for both fielding and qualification. A minimum of 7 diurnal cycles shall be conducted for aircraft non-operational temperature requirements to the max aircraft specification temperature.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.3.2. High Temperature. Procedure II, Operation
The purpose of the high temperature test is to evaluate effects of high temperature conditions on materiel safety, integrity, and performance.

Criteria:
The system shall perform IAW the equipment specification before, during, and after exposure to High Temperature Operation environment.

Standard:
MIL-STD-810, Method 501

Method of Compliance:
Testing shall meet the MIL-STD-810, Method 501, procedures II (Operation). The airworthiness substantiation shall include High Temperature Operation Test Plans that shall be prepared IAW DI-NDTI-80566 and High Temperature Operation Test

Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. High Temperature Operation Test Report shall be prepared IAW DI-NDTI-80809. This test is required for both fielding and qualification. A minimum of 7 diurnal cycles shall be conducted for aircraft non-operational temperature requirements to the max aircraft specification temperature.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.3.3. High Temperature. Procedure III, Tactical Standby to Operation
The purpose of the high temperature test is to evaluate effects of high temperature conditions on materiel safety, integrity, and performance.

Criteria:
The system shall perform IAW the equipment specification before, during, and after exposure to High Temperature Tactical Standby to Operational environment.

Standard:
MIL-STD-810, Method 501

Method of Compliance:
Testing shall meet the MIL-STD-810, Method 501, procedures III (Tactical Standby to Operational). The airworthiness substantiation shall include High Temperature Tactical Standby to Operation Test Plans that shall be prepared IAW DI-NDTI-80566 and High Temperature Tactical Standby to Operation Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. High Temperature Tactical Standby to Operation Test Reports shall be prepared IAW DI-NDTI-80809. The combined Temperature/Humidity/Vibration/Altitude (Method 520) test is the recommended method to meet the development test flight, high temperature requirements although tailoring is permissible.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.4. Low Temperature

The purpose of the low temperature test is to evaluate effects of low temperature conditions on materiel safety, integrity, and performance during storage, operation, and manipulation.

21.4.1. Low Temperature. Procedure I, Storage

The purpose of the low temperature test is to evaluate effects of low temperature conditions on materiel safety, integrity, and performance during storage.

Criteria:
The system shall perform IAW the equipment specification before and after exposure to Low Temperature Storage environment.

Standard:
MIL-STD-810, Method 502

Method of Compliance:
Testing shall meet the MIL-STD-810, Method 502, procedures I (Storage). The airworthiness substantiation shall include Low Temperature Storage Test Plan that shall be prepared IAW DI-NDTI-80566 and Low Temperature Storage Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Low Temperature Storage Test Reports shall be prepared IAW DI-NDTI-80809. This test is required for both fielding and qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.4.2. Low Temperature. Procedure II, Operation

The purpose of the low temperature test is to evaluate effects of low temperature conditions on materiel safety, integrity, and performance during operation.

Criteria:
The system shall perform IAW the equipment specification before, during, and after exposure to Low Temperature Operation environment.

Standard:
MIL-STD-810, Method 502

Method of Compliance:
Testing shall meet the MIL-STD-810, Method 502, procedures II (Operation). The airworthiness substantiation shall include Low Temperature Operation Test Plans that shall be prepared IAW DI-NDTI-80566 and Low Temperature Operation Test

Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Low Temperature Operation Test Reports shall be prepared IAW DI-NDTI-80809. The combined Temperature/Humidity/Vibration/Altitude (Method 520) test is the recommended method to meet the development test flight, low temperature requirements although tailoring is permissible.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.4.3. Low Temperature. Procedure III, Manipulation

The purpose of the low temperature test is to evaluate effects of low temperature conditions on materiel safety, integrity, and performance during manipulation.

Criteria:

The system shall perform IAW the equipment specification before, during, and after exposure to Low Temperature Manipulation environment.

Standard:

MIL-STD-810, Method 502

Method of Compliance:

Testing shall meet the MIL-STD-810, Method 502, procedures III (Manipulation). The airworthiness substantiation shall include Low Temperature Manipulation Test Plans that shall be prepared IAW DI-NDTI-80566 and Low Temperature Manipulation Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Low Temperature Manipulation Test Reports shall be prepared IAW DI-NDTI-80809. This test is required for both fielding and qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.5. Temperature Shock

The purpose of the temperature shock test is to determine if materiel can withstand sudden changes in the temperature of the surrounding atmosphere without experiencing physical damage or deterioration in performance. For the purpose of this document, "sudden changes" is defined as "an air temperature change greater than 10°C (18°F) within one minute”.

Criteria:
The materiel shall perform IAW the equipment specification before and after exposure to Temperature Shock environment.

Standard:
MIL-STD-810, Method 503

Method of Compliance:
The materiel shall perform IAW the equipment / platform specification before and after exposure to temperature shock environmental effects that occur over the life cycle of the materiel. Compliance may be by test, similarity analysis, analysis, demonstration, or a combination of methods. Testing shall be IAW MIL-STD-810, Method 503, procedure I-C (Multi-cycle shocks from constant extreme temperature). The airworthiness substantiation shall include Temperature Shock Test Plans that shall be prepared IAW DI-NDTI-80566 and Temperature Shock Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Temperature Shock Test Reports shall be prepared IAW DI-NDTI-80809. This test is required for both fielding and qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.6. Solar Radiation
The purpose of the solar radiation test is to determine the heat effects on exposed equipment and actinic (photo degradation) effects of sunlight.

21.6.1. Solar Radiation. Cycling.
The purpose of the solar radiation test is to determine the heat effects on exposed equipment and actinic (photo degradation) effects of sunlight.

Criteria:
The system shall perform IAW the equipment specification before, during, and after exposure to Solar Radiation Cycling environment.

Standard:
MIL-STD-810 Method 505

Method of Compliance:
Testing shall meet the MIL-STD-810, Method 505, procedure I (Cycling). The airworthiness substantiation shall include Solar Radiation Cycling Test Plans that shall be prepared IAW DI-NDTI-80566 and Solar Radiation Cycling Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Solar Radiation Cycling Test Reports shall be prepared IAW DI-NDTI-80809. This test is required for both fielding and qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.6.2. Solar Radiation. Steady State

The purpose of the solar radiation test is to determine the heat effects on exposed equipment and actinic (photo degradation) effects of sunlight.

Criteria:

The system shall perform IAW the equipment specification before, during, and after exposure to Solar Radiation Steady State environment.

Standard:

MIL-STD-810 Method 505

Method of Compliance:

Testing shall meet the MIL-STD-810, Method 505, procedure II (Steady State). The airworthiness substantiation shall include Solar Radiation Steady State Test Plans that shall be prepared IAW DI-NDTI-80566 and Solar Radiation Steady State Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Solar Radiation Steady State Test Reports shall be prepared IAW DI-NDTI-80809. This test is required for both fielding and qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.7. Rain

The purpose of the rain test is to determine the capability of the materiel to satisfy its performance requirements during and after exposure to water and the effectiveness of protective covers, cases, seals and water removal systems.

21.7.1. Rain. Blowing Rain

The purpose of the rain test is to determine the capability of the materiel to satisfy its performance requirements during and after exposure to blowing rain and the effectiveness of protective covers, cases, seals and water removal systems.

Criteria:

The system shall perform IAW the equipment specification before, during, and after exposure to Blowing Rain Environment

Standard:

MIL-STD-810, Method 506

Method of Compliance:
Testing shall meet the MIL-STD-810, Method 506, procedure I (Blowing Rain). The airworthiness substantiation shall include Blowing Rain Test Plans that shall be prepared IAW DI-NDTI-80566 and Blowing Rain Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Blowing Rain Test Report shall be prepared IAW DI-NDTI-80809. This test is required for both fielding and qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.7.2. Rain. Dripping Rain
The purpose of the rain test is to determine the capability of the materiel to satisfy its performance requirements during and after exposure to dripping rain and the effectiveness of protective covers, cases, seals and water removal systems.

Criteria:
The system shall perform IAW the equipment specification before, during, and after exposure to Dripping Rain environment.

Standard:
MIL-STD-810, Method 506

Method of Compliance:
Testing shall meet the MIL-STD-810, Method 506, procedure II (Dripping Rain). The airworthiness substantiation shall include Dripping Rain Test Plans that shall be prepared IAW DI-NDTI-80566 and Dripping Rain Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Dripping Rain Test Reports shall be prepared IAW DI-NDTI-80809. This test is required for both fielding and qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.8. Humidity
The purpose of the humidity test is to determine the resistance of materiel to the effects of a warm, humid atmosphere.

Criteria:
The materiel shall perform IAW the equipment specification before, during, and after exposure to Aggravated Cycle Humidity environment

Standard:
MIL-STD-810, Method 507

Method of Compliance:
The materiel shall perform IAW the equipment / platform specification before, during, and after exposure to Humidity environmental effects that occur over the life cycle of the materiel. Compliance may be by test, similarity analysis, analysis, demonstration, or a combination of methods. Testing shall be IAW MIL-STD-810, Method 507, procedure II (Aggravated Cycle). The airworthiness substantiation shall include Humidity Test Plans that shall be prepared IAW DI-NDTI-80566 and Humidity Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Humidity Test Reports shall be prepared IAW DI-NDTI-80809. This test is required for both fielding and qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.9. Fungus
The purpose of the fungus test is to assess the susceptibility of materials to fungal growth. The primary objectives of the fungus test are to determine:

a. If the materials or the assembled combination of same, will support fungal growth, and where possible, identify dominant species present.

b. How rapidly fungus will grow on the materiel.

c. How fungus may affect the materiel, its mission, and its safety for use following the growth of fungus on the materiel.

d. If the materiel can be stored effectively in a field environment.

e. If there are simple cleaning processes.

Criteria:
The materiel shall perform IAW the equipment specification before and after exposure to Fungus environment.

Standard:
MIL-STD-810, Method 508

Method of Compliance:
The materiel shall perform IAW the equipment / platform specification before and after exposure to fungal environmental effects that occur over the life cycle of the materiel. Compliance may be by test, similarity analysis, analysis, demonstration, or a combination of methods. Testing shall be IAW MIL-STD-810, Method 508. Coupon testing is allowed. The airworthiness substantiation shall include Fungus Test Plans that

shall be prepared IAW DI-NDTI-80566 and Fungus Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Fungus Test Reports shall be prepared IAW DI-NDTI-80809. This test is required for both fielding and qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.10. Salt Fog

The purpose of the salt fog test is to determine the effectiveness of protective coatings and finishes on materials. It is applied to determine the effects of salt deposits on the physical and electrical aspects of materiel.

Criteria:

The materiel shall perform IAW the equipment specification after exposure to Salt Fog environment.

Standard:

MIL-STD-810, Method 509

Method of Compliance:

The materiel shall perform IAW the equipment / platform specification after exposure to Salt Fog environmental effects that occur over the life cycle of the materiel. Compliance may be by test, similarity analysis, analysis, demonstration, or a combination of methods. Testing shall be IAW MIL-STD-810, Method 509. The airworthiness substantiation shall include Salt Fog Test Plans that shall be prepared IAW DINDTI-80566 and Salt Fog Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Salt Fog Test Reports shall be prepared IAW DI-NDTI-80809. This test is required for both fielding and qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.11. Sand and Dust

The purpose of the dust test is to evaluate the ability of materiel to resist the effects of dust (particulates less than 150 µm in diameter) that may obstruct openings, penetrate into cracks, crevices, bearings, and joints, and to evaluate the effectiveness of filters. The purpose of the sand test (particulates 150 to 850 µm in size) is to evaluate the ability of materiel to be stored and operated in blowing sand conditions without degrading performance, effectiveness, reliability, and maintainability due to abrasion (erosion) or clogging effects of sharp-edged particles.

21.11.1. Blowing Dust

The purpose of the dust test is to evaluate the ability of materiel to resist the effects of dust (particulates less than 150 µm in diameter) that may obstruct openings, penetrate into cracks, crevices, bearings, and joints, and to evaluate the effectiveness of filters.

Criteria:
The materiel shall perform IAW the equipment specification before, during, and after exposure to Blowing Dust environment.

Standard:
MIL-STD-810, Method 510

Method of Compliance:
Testing shall meet the MIL-STD-810, Method 510, Procedures I (Blowing Dust). The airworthiness substantiation shall include Blowing Dust Test Plans that shall be prepared IAW DI-NDTI-80566 and Blowing Dust Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Blowing Dust Test Reports shall be prepared IAW DI-NDTI-80809. This test is required for both fielding and qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.11.2. Blowing Sand

The purpose of the sand test (particulates 150 to 850 µm in size) is to evaluate the ability of materiel to be stored and operated in blowing sand conditions without degrading performance, effectiveness, reliability, and maintainability due to abrasion (erosion) or clogging effects of sharp-edged particles.

Criteria:
The materiel shall perform IAW the equipment specification before, during, and after exposure to Blowing Sand environment.

Standard:
MIL-STD-810, Method 510

Method of Compliance:
Testing shall meet the MIL-STD-810, Method 510, Procedures II (Blowing Sand). The airworthiness substantiation shall include Blowing Sand Test Plans that shall be prepared IAW DI-NDTI-80566 and Blowing Sand Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Blowing Sand Test Reports shall be prepared IAW DI-NDTI-80809. This test is required for both fielding and qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.12. Explosive Atmosphere

The purpose of the explosive atmosphere test is to demonstrate the ability of materiel to operate in fuel-air explosive atmospheres without causing ignition and the explosive containment of the material.

21.12.1. Explosive Atmosphere

The purpose of the explosive atmosphere test is to demonstrate the ability of materiel to operate in fuel-air explosive atmospheres without causing ignition.

Criteria:

The materiel shall operate IAW the equipment specification before, during, and after exposure to Explosive Atmosphere environment.

Standard:

MIL-STD-810, Method 511

Method of Compliance:

Testing shall meet the MIL-STD-810, Method 511, Procedures I (Explosive Atmosphere). The airworthiness substantiation shall include an Explosive Atmosphere Test Plans that shall be prepared IAW DI-NDTI-80566 and Explosive Atmosphere Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Explosive Atmosphere Test Reports shall be prepared IAW DI-NDTI-80809. This test is required for developmental test flights and all qualification levels.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.12.2. Explosive Containment

The purpose of the explosive atmosphere test is to demonstrate that an explosive or burning reaction occurring within encased materiel will be contained and will not propagate outside the test item.

Criteria:

The materiel shall operate IAW the equipment specification before, during, and after exposure to Explosion Containment environment.

Standard:
MIL-STD-810, Method 511

Method of Compliance:
Testing shall meet the MIL-STD-810, Method 511, Procedures II (Explosion Containment). The airworthiness substantiation shall include Explosive Containment Test Plan that shall be prepared IAW DI-NDTI-80566 and Explosive Containment Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Explosive Containment Test Reports shall be prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.13. Acceleration
The purpose of the acceleration test is to ensure that materiel can structurally withstand the steady state inertia loads that are induced by platform acceleration, deceleration, and maneuver in the service environment, and function without degradation during and following exposure to these forces. Acceleration tests are also used to assure that materiel does not become hazardous after exposure to crash inertia loads.

21.13.1. Acceleration, Structural
The purpose of the acceleration test is to ensure that materiel can structurally withstand the steady state inertia loads that are induced by platform acceleration, deceleration, and maneuver in the service environment.

Criteria:
The materiel shall perform IAW the equipment specification before, during, and after exposure to Structural Acceleration environment.

Standard:
MIL-STD-810, Method 513

Method of Compliance:
Testing shall meet the MIL-STD-810, Method 513, Procedure I (Structural). The airworthiness substantiation shall include Acceleration Structural Test Plans that shall be prepared IAW DI-NDTI-80566 and Acceleration Structural Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Acceleration Structural Test Report shall be prepared IAW DI-NDTI-80809.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.13.2. Acceleration, Operational

The purpose of the acceleration test is to ensure that materiel can function without degradation during and following exposure to operational acceleration Environment.

Criteria:

The materiel shall perform IAW the equipment specification before, during, and after exposure to Operational Acceleration environment.

Standard:

MIL-STD-810, Method 513

Method of Compliance:

Testing shall meet the MIL-STD-810, Method 513, Procedure II (Operational). The airworthiness substantiation shall include Acceleration Operational Test Plans that shall be prepared IAW DI-NDTI-80566 and Acceleration Operational Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Acceleration Operational Test Report shall be prepared IAW DI-NDTI-80809. This test is required for both fielding and qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.13.3. Acceleration, Crash Hazard

The purpose of the acceleration test is to assure that materiel does not become hazardous after exposure to crash inertia loads.

Criteria:

The materiel shall perform IAW the equipment specification before, during, and after exposure to Crash Hazard Acceleration environment.

Standard:

MIL-STD-810, Method 513

Method of Compliance:

Testing shall meet the MIL-STD-810, Method 513, Procedure III (Crash Hazard Acceleration). The airworthiness substantiation shall include Acceleration Crash Hazard Test Plan that shall be prepared IAW DI-NDTI-80566 and Acceleration Crash Hazard Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing.

Acceleration Crash Hazard Test Reports shall be prepared IAW DI-NDTI-80809. This test is required for both fielding and qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.14. Functional Shock

The purpose of the functional shock is to test materiel (including mechanical, electrical, hydraulic, and electronic) in its functional mode, and to assess the physical integrity, continuity, and functionality of the materiel to shock. In general, the materiel is required to function during and after the shock, and to survive without damage resulting from shocks representative of those that may be encountered during operational service.

Criteria:

The materiel shall perform IAW the equipment specification before, during, and after exposure to Functional Shock environment

Standard:

MIL-STD-810, Method 516

Method of Compliance:

The materiel shall perform per the equipment / platform specification before, during, and after exposure to functional shocks that occur over the life cycle of the materiel. Compliance may be by test, similarity analysis, analysis, demonstration, or a combination of methods. Testing shall be IAW MIL-STD-810, Method 516, Procedure I (Functional Shock). The shock response spectrum input is the preferred input for this test. The Terminal Peak Sawtooth Waveform may be used if approved by the procuring agency. The airworthiness substantiation shall include Functional Shock Test Plan that shall be prepared IAW DI-NDTI-80566 and Functional Shock Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Functional Shock Test Report shall be prepared IAW DI-NDTI-80809. This test is required for both fielding and qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.15. Crash Shock

The purpose of the crash shock test is to demonstrate that the materiel mounted or contained within or on the aircraft will not break loose from its mounts, tie downs, or

eject sub-elements, that present a hazard to vehicle occupants and bystanders during a crash.

Criteria:
The materiel shall remain structurally intact and no material shall be ejected when exposed to Crash Hazard Shock environment.

Standard:
MIL-STD-810, Method 516

Method of Compliance:
The materiel shall remain structurally intact and no material shall be ejected during shocks or crash events that occur over the life cycle of the materiel. Compliance may be by test, similarity analysis, analysis, demonstration, or a combination of methods. Testing shall be IAW MIL-STD-810, Method 516, Procedure V (Crash Hazard Shock). The Shock Response Spectrum input is the preferred input for this test. The Terminal Peak Sawtooth Waveform may be used if approved by the procuring agency. The airworthiness substantiation shall include Crash Shock Test Plans that shall be prepared IAW DI-NDTI-80566 and Crash Shock Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Crash Shock Test Reports shall be prepared IAW DI-NDTI-80809. This test is required for developmental test flights and all qualification levels.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.16. Bench Handling Shock

The purpose of the bench handling shock test is to determine the ability of the materiel to withstand representative levels of shock encountered during bench handling, bench maintenance, or packaging.

Criteria:
The materiel shall remain structurally intact and no material shall be ejected Bench Handling Shock environment.

Standard:
MIL-STD-810, Method 516

Method of Compliance:
The materiel shall perform IAW the equipment / platform specification before and after exposure to representative shocks that occur during typical bench handling over the life cycle of the materiel. Compliance may be by test, similarity analysis, analysis, demonstration, or a combination of methods. Testing shall be IAW MIL-STD-810,

Method 516, Procedure VI (Bench Handling Shock). The airworthiness substantiation shall include Bench Handling Shock Test Plan that shall be prepared IAW DI-NDTI-80566 and Bench Handling Shock Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Bench Handling Shock Test Reports shall be prepared IAW DI-NDTI-80809. This test is required for qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.17. Transit Drop Shock

The purpose of the transit drop test is to determine if the materiel is capable of withstanding the shocks normally induced by loading and unloading when it is (1) outside of its transit or combination case, e.g., during routine maintenance, when being removed from a rack, being placed in its transit case, etc., or (2) inside its transit or combination case.

Criteria:

The materiel shall perform IAW the equipment specification before and after exposure to Transient Drop Shock environment.

Standard:

MIL-STD-810, Method 516

Method of Compliance:

The materiel shall perform IAW the equipment / platform specification before and after exposure to representative shocks that occur during transportation and installation over the life cycle of the materiel. Compliance may be by test, similarity analysis, analysis, demonstration, or a combination of methods. Testing shall be IAW MIL-STD-810, Method 516, Procedure IV (Transit Shock). The airworthiness substantiation shall include Transit Drop Shock Test Plans that shall be prepared IAW DI-NDTI-80566 and Transit Drop Shock Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Transit Drop Shock Test Report shall be prepared IAW DI-NDTI-80809. This test is required for qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.18. Icing/Freezing Rain

The purpose of the icing/freezing rain test is to determine the effect of icing on the operational capability of materiel. It also determines the effectiveness of de-icing equipment and techniques, including prescribed means to be used in the field.

Criteria:
The materiel shall perform IAW the equipment specification before, during, and after exposure to Icing/Freezing Rain environment.

Standard:
MIL-STD-810, Method 521

Method of Compliance:
The materiel shall perform IAW the equipment / platform specification before, during, and after exposure to Icing / Freezing Rain environmental effects that occur over the life cycle of the materiel. This applies to external equipment / stores. Compliance may be by test, similarity analysis, analysis, demonstration, or a combination of methods. Testing shall be IAW MIL-STD-810, Method 521. The airworthiness substantiation shall include Icing/Freezing Rain Test Plans that shall be prepared IAW DI-NDTI-80566 and Icing/Freezing Rain Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Icing/Freezing Rain Test Reports shall be prepared IAW DI-NDTI-80809. This applies to external equipment / stores. This test is required for qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.19. Contamination by Fluids

The purpose of the contamination by fluids test is to determine if materiel (or material samples) is affected by temporary exposure to contaminating fluids (liquids) during its life cycle, either occasionally, intermittently, or over extended periods.

Criteria:
The materiel shall perform IAW the equipment specification after exposure to contamination by Fluids environment.

Standard:
MIL-STD-810, Method 504

Method of Compliance:
The materiel shall perform IAW the equipment / platform specification after exposure to commonly used aircraft fluids. Compliance may be by test, similarity analysis, analysis, demonstration, or a combination of methods. Coupon testing is allowed. Testing shall be IAW MIL-STD-810, Method 504. The airworthiness substantiation shall include Contamination by Fluids Test Plans that shall be prepared IAW DI-NDTI-80566 and

Contamination by Fluids Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Contamination by Fluids Test Reports shall be prepared IAW DI-NDTI-80809. Coupon testing is allowed. This test is required for qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.20. Immersion.
The purpose of the immersion test is to determine if materiel can withstand immersion or partial immersion in water (e.g., fording), and operate as required during or following immersion.

Criteria:
The materiel shall perform IAW the equipment specification before, during, and after exposure to Immersion environment.

Standard:
MIL-STD-810, Method 512

Method of Compliance:
The materiel shall perform IAW the equipment / platform specification before, during, and after exposure to water immersion. This applies only to material that may be totally or partially immersed during its life cycle. Compliance may be by test, similarity analysis, analysis, demonstration, or a combination of methods. Testing shall be IAW MILSTD-810, Method 512. The airworthiness substantiation shall include Immersion Test Plans that shall be prepared IAW DI-NDTI-80566 and Immersion Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Immersion Test Reports shall be prepared IAW DI-NDTI-80809. This applies only to material that may be totally or partially immersed during its life cycle. This test is required for qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		

21.21. Rail Impact.
The purpose of rail impact test is to determine if the material can withstand a railroad car impact that occurs during rail shipment, and the adequacy of tie down arrangements.

Criteria:
The materiel shall perform IAW the equipment specification before and after exposure to Rail Impact environment.

Standard:
MIL-STD-810, Method 526

Method of Compliance:
The materiel shall perform IAW the equipment / platform specification before and after exposure to rail impact. This applies only to material that may transported via rail during its life cycle. It does not apply to small, individually packaged items that may be transported on a pallet. Compliance may be by test, similarity analysis, analysis, demonstration, or a combination of methods. Testing shall be IAW MIL-STD-810, Method 526. The airworthiness substantiation shall include Rail Impact Test Plans that shall be prepared IAW DI-NDTI-80566 and Rail Impact Test Procedures that shall be prepared IAW DI-NDTI-80603 prior to testing. Rail Impact Test Reports shall be prepared IAW DI-NDTI-80809. This applies only to material that may transported via rail during its life cycle. It does not apply to small, individually packaged items that may be transported on a pallet. This test is required for qualification.

Additional Information

Comm Docs	DoD/MIL Docs	FAA/EASA	Def-Stan 970	STANAG
DO-160	MIL-STD-810 ADS-71-SP	14 CFR 23.1309, 25.1309, 27.1309, 29.1309		