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DEPARTMENT OF DEFENSE HANDBOOK

AIRWORTHINESS CERTIFICATION CRITERIA

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AMSC: N/A

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FOREWORD

1. This handbook is approved for use by all departments and agencies of the Department of Defense.

2. The criteria contained herein are qualitative in nature. More specific guidance and background for specific criteria may be found in the appropriate Joint Service Specification Guides (JSSG) and Title 14, Code of Federal Regulations referenced herein. Also, note that each section contains a list of typical certification source data that may be referenced for evaluating system compliance with that section's criteria. Terms such as "acceptable" used in the criteria are parameters whose specific definition must be determined and documented by the implementing office in the context of each unique air system.

3. Note that in electronic versions, the blue highlighted paragraph headings or text in handbook sections 4 through 19 are internal hyperlinks to bookmarks in the appendix Technical Points of Contact table. Clicking the mouse cursor on the blue jumps you to the referenced location in the table. To return from the Technical Points of Contact table to your jump point in the handbook, use the back arrow ← key on the menu bar (enable View-Toolbars-Web for the back arrow tool). Gray shaded internal cross-references within the document perform similarly.

4. Comments, suggestions, or questions on this document should be addressed to (ASC/ENRS, 2530 Loop Road West, Wright-Patterson AFB OH 45433-7101) or emailed to (Engineering.Standards@wpafb.af.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at http://assist.daps.dla.mil.

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1. SCOPE

1.1 Purpose.

This document establishes the airworthiness certification criteria to be used in the determination of airworthiness of all manned and unmanned, fixed and rotary wing air vehicle systems. It is a foundational document to be used by the system program manager, chief engineer, and contractors to define their air system's airworthiness certification basis.

This handbook is for guidance only. This handbook cannot be cited as a requirement. If it is, the contractor does not have to comply.

1.2 Applicability.

These criteria should be tailored and applied at any point throughout the life of an air vehicle system when an airworthiness determination is necessary, especially whenever there is a change to the functional or product baseline.

Rotary wing air vehicle and unmanned aerial vehicle/remotely operated aircraft (UAV/ROA) features demand unique safety-of-flight (SOF) system requirements. Therefore, unique criteria are included for these types of systems to ensure that minimum levels of design for safe operation and maintenance are established. The UAV/ROA operating system can be built into the vehicle or be part of the control station for remotely operated aircraft. The UAV/ROA system comprises the control station, data links, flight control system, communications systems/links, etc., as well as the air vehicle. UAV/ROA vary greatly in size, weight, and complexity. Because they are unmanned, SOF risks associated with loss of aircrew may not apply. However, as with manned air vehicles, SOF risk associated with personnel, damage to equipment, property, and/or environment must be considered. As such, the airworthiness criteria may be tailored for this unique application, including when a UAV/ROA is designed to be "expendable" or where the UAV/ROA will conduct missions with "minimum life expectancy." Consideration should be given to the environment in which the UAV/ROA will be operated (controlled test range, national airspace, fleet usage, including ship based applications), to the airframe life for which the air vehicle is designed, and to the "expendability" of the UAV/ROA in close proximity to the control system, personnel, property, or other equipment.

Similarly, air vehicles intended for use aboard ship 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 Certificate of Airworthiness. 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 contact the FAA Military Certification Office (MCO) in Wichita, KS at the earliest opportunity. Agreements for reimbursement for military service work performed by the FAA are in place, and in many cases MCO assistance on these alterations may be accomplished without additional cost.

In all instances, complete and accurate documentation of both applicability and system specific measurable criteria values is critical to ensuring consistent, timely, and accurate airworthiness assessments.

1.2.1 Tailoring to create the certification basis

Not all of the airworthiness criteria apply to every type of air vehicle; also, platform-unique, previously undefined criteria may need to be added to fully address safety aspects of unique configurations. Therefore, tailor the total set of criteria to identify a complete (necessary and sufficient) subset of applicable airworthiness criteria, 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 either applicable or nonapplicable, considering system or product complexity, type, data, and intended use. Document the rationale for identifying any criteria as nonapplicable.

b. Applicable criteria may not be deleted or modified in any manner. However, if a portion of otherwise applicable criteria does not apply, identify the applicable and nonapplicable portions, and document the rationale.

c. Supplement applicable criteria with specific measurable parameters, where appropriate (i.e., they add value to the definition of airworthiness requirements).

d. Develop additional criteria, as appropriate, for any capabilities or systems not fully addressed by the criteria contained in this handbook.

1.3 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 additional assistance in interpreting or applying the criteria, call the appropriate section technical point of contact, or the FAA MCO, provided at appendix A.2.

1.4 Information sources.

Each section in the Airworthiness Certification Criteria is matched with corresponding Title 14, Code of Federal Regulations reference (14CFR reference) and Joint Service Specification Guides (JSSG). In addition, the complete listing of 14CFR reference advisory circulars was consulted for appropriate guidance in airworthiness certification.

The FAA Title 14 Code of Federal Regulations Part (i.e., 23, 25, 27, 29) referenced is dependent on airplane type, and must be consistent with airplane size and usage. The list shown is not all inclusive, and the user is cautioned to look at the reference material only as a guide and not for purposes of citing requirements. The user is also advised to use additional FAA Advisory Circulars or other FAA Policy documents, such as Orders and Notices that may be found on the FAA website, to assist in understanding the FAA's implementation of the regulatory requirements.

2. APPLICABLE DOCUMENTS

2.1 General.

The documents listed below are not necessarily all of the documents referenced herein but are those necessary to understand the information provided by this handbook. Refer to the current version of these documents, unless otherwise indicated.

2.1.1 Government specifications, standards, and handbooks.

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

DEPARTMENT OF DEFENSE SPECIFICATIONS

Joint Service Specification Guides (JSSG):

JSSG-2000	Air System
JSSG-2001	Air Vehicle
JSSG-2005	Avionic Subsystem, Main Body
JSSG-2006	Aircraft Structures
JSSG-2007	Engines, Aircraft, Turbine
JSSG-2008	Vehicle Control and Management System (VCMS)
JSSG-2009	Air Vehicle Subsystems
JSSG-2010	Crew Systems

Click the link below to view the unlimited distribution JSSGs

(http://engineering.wpafb.af.mil/corpusa/specification/jssg)

Military Specifications:

MIL-PRF-5041	Tires, Ribbed Tread, Pneumatic, Aircraft, General Specification for
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-5920	Manuals, Technical: Sample Basic Weight Checklists and Loading Data
MIL-E-7016	Electric Load and Power Source Capacity, Aircraft, Analysis of
MIL-DTL-7700	Flight Manuals, Air Refueling Procedures, and Abbreviated Checklists
MIL-L-8552	Landing Gear, Aircraft Shock Absorber (Air-Oil Type)
MIL-B-8584	Brake Systems, Wheel, Aircraft, Design of
MIL-A-8591	Airborne Stores, Suspension Equipment and Aircraft-Store Interface (Carriage Phase); General Design Criteria for
MIL-F-8615	Fuel System Components, General Specification for

MIL-S-8812	Steering System, Aircraft General Requirements for
MIL-A-8865	Airplane Strength and Rigidity Miscellaneous Loads
MIL-A-18717	Arresting Hook Installation, Aircraft
MIL-A-19736	Air Refueling Systems, General Specification for
MIL-G-21480	Generator System, 400 Hz Alternating Current, Aircraft, General Specification for
MIL-DTL-25959	Tie Down, Cargo, Aircraft
MIL-PRF-27260	Tie Down, Cargo, Aircraft CGU-1/B
MIL-T-81259	Tie-Downs, Airframe Design, Requirements for
MIL-PRF-85676	Lighting, Emergency Egress, Subassembly
AFGS-87139	Landing Gear Systems
AFGS-87154	Fuel Systems, General Design Specification for
AFGS-87219	Electrical Power Systems, Aircraft
AFGS-87256	Integrated Diagnostics
MIL-A-87166	Aerial Refueling Receiver Subsystem (canceled)

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-188-141	Interoperability and Performance Standards for Medium and High Frequency Radio Systems
MIL-STD-188-242	Interoperability and Performance Standards for Tactical Single Channel Very High Frequency (VHF) Radio Equipment
MIL-STD-188-243	Interoperability and Performance Standards for Tactical Single Channel Ultra High Frequency (UHF) for Radio Communications
MIL-STD-411	Aircrew Station Alerting Systems
MIL-STD-461	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-464	Electromagnetic Environmental Effects Requirements for Systems
MIL-STD-704	Aircraft Electric Power Characteristics
MIL-STD-805	Towing Fittings & Provisions for Military Aircraft, Design Requirements for
MIL-STD-810	Environmental Engineering Considerations and Laboratory Tests
MIL-STD-882	System Safety, Standard Practice for
MIL-STD-961	Defense and Program Unique Specifications Format and Content
MIL-STD-1289	Airborne Stores, Ground Fit and Compatibility Requirements
MIL-STD-1290	Aircraft Crash Survival Design Guide

MIL-STD-1310	Shipboard Bonding, Grounding, and Other Techniques for Electromagnetic Compatibility and Safety
MIL-STD-1399-300	Interface Standard for Shipboard Systems Section 300A Electric Power, Alternating Current (Metric)
MIL-STD-1399-390	Interface Standard for Shipboard Systems Section 390 Electric Power, Direct Current (other than ship's battery) for Submarines (Metric)
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-1683	Connectors and Jacketed Cable, Electric, Selection Standard for Shipboard Use
MIL-STD-1760	Aircraft/Store Electrical Interconnection System
MIL-STD-1787	Aircraft Display Symbology
MIL-STD-1797	Flying Qualities of Piloted Aircraft
MIL-STD-2169	High-Altitude Electromagnetic Pulse (HEMP) Environment (u) classified SECRET
MIL-STD-3005	Analog-to-Digital Conversion of Voice by 2,400 bit/second Mixed Excitation Linear Prediction (MELP)
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 Capability
MIL-STD-7080	Selection and Installation of Aircraft Electric Equipment
MIL-STD-27733	Modification and Marking Requirements for Test Equipment in Aerospace Vehicles and Related Support Equipment
MIL-STD-38784	Standard Practice for Manuals, Technical: General Style and Format Requirements

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-61	Configuration Management Guidance
MIL-HDBK-221	Fire Protection Design Handbook for U.S. Navy Aircraft Powered by Turbine Engines
MIL-HDBK-244	Guide to Aircraft/Stores Compatibility
MIL-HDBK-299	Cable Comparison Handbook Data Pertaining to Electric Shipboard Cable
MIL-HDBK-310	Global Climatic Data for Developing Military Products

MIL-HDBK-419	Grounding, Bonding, and Shielding for Electronic Equipments and Facilities, Volume 1 & 2
MIL-HDBK-454	General Guidelines for Electronic Equipment
MIL-HDBK-514	Operational Safety, Suitability, and Effectiveness for the Aeronautical Enterprise
MIL-HDBK-515	Weapon System Integrity Guide
MIL-HDBK-704	Guidance for Test Procedure for Demonstration of Utilization Equipment Compliance to Aircraft Electrical Power Characteristics (Parts 1 through 8)
MIL-HDBK-828	Laser Safety on Ranges and in Other Outdoor Areas
MIL-HDBK-1568	Materials and Processes for Corrosion Prevention and Control in Aerospace Weapons Systems
MIL-HDBK-1587	Materials and Process Requirements for Air Force Weapon Systems
MIL-HDBK-1760	Aircraft/Store Electrical Interconnection System
MIL-HDBK-1763	Aircraft/Stores Compatibility: Systems Engineering Data Requirements and Test Procedures
MIL-HDBK-1783	Engine Structural Integrity Program (ENSIP)
MIL-HDBK-1791	Designing for Internal Aerial Delivery in Fixed Wing Aircraft
MIL-HDBK-1798	Mechanical Equipment and Subsystems Integrity Program
MIL-HDBK-2165	Testability Program for Systems and Equipment
MIL-HDBK-5400	Electronic Equipment, Airborne, General Guidelines for
MIL-HDBK-6870	Inspection Program Requirements, Nondestructive, for Aircraft and Missile Materials and Parts
MIL-HDBK-46855	Human Engineering Program Process and Procedures
MIL-HDBK-87213	Electronically/Optically Generated Airborne Displays
MIL-HDBK-87244	Avionics/Electronics Integrity

(Copies of these documents are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094 or http://assist.daps.dla.mil. or http://assist.daps.dla.mil/quicksearch/. Copies of documents indicating a distribution limitation (for example, statement D) may be ordered from ASC/ENRS, 2530 Loop Rd West, Bldg. 560, Wright-Patterson AFB, OH 45433-7101 or online at https://www.en.wpafb.af.mil/engstds/engstds.asp).

2.1.2 Other Government publications.

The following other Government publications form a part of this document to the extent specified herein.

AIR FORCE INSTRUCTIONS

AFI 11-202V3	General Flight Rules (Volume 3)
AFI 11-2C-130V3	C-130 Operations Procedures (Volume 3)
AFI 21-101	Aircraft and Equipment Maintenance Management
AFI 63-1401	Aircraft Information Programs
AFI 63-501	Air Force Acquisition Quality Program
AFI 63-1201	Life Cycle Systems Engineering
AFI 63-1301	Assurance of Communications Navigation Surveillance/Air Traffic Management and Navigation Safety Performance

AIR FORCE POLICY DIRECTIVES

AFPD 62-4	Standards of Airworthiness for Passenger Carrying Commercial Derivative Transport Aircraft
AFPD 62-5	Standards of Airworthiness for Commercial Derivative Hybrid Aircraft
AFPD 62-6	USAF Aircraft Airworthiness Certification
AFPD 63-12	Assurance of Operational Safety, Suitability, and Effectiveness (OSS&E)
AFPD 63-13	Communications Navigation Surveillance/Air Traffic Management and Navigation Safety Performance for USAF Aircraft

(Copies of Air Force Policy Directives and Instructions can be viewed online at the AFDPO web site at http://www.e-publishing.af.mil/forms-pubs/.

AIR FORCE OCCUPATIONAL SAFETY AND HEALTH

AFOSH 48-139	Laser Radiation Protection Program

AIR FORCE TECHNICAL ORDER

T.O. 00-5-1	AF Technical Order System
T.O. 31Z-10-4	Electromagnetic Radiation Hazards

(Copies of Air Force technical orders may be obtained via https://www.toindex-s.wpafb.af.mil/.)

AERONAUTICAL SYSTEMS CENTER ENGINEERING GUIDE

ASC/EN Manufacturing Development Guide

(Copies of this ASC/EN Manufacturing Development Guide may be obtained by mail from ASC/ENSM, 2530 Loop Rd W., Wright-Patterson AFB, OH 45433-7101; by phone request, Commercial 937-255-1656, or DSN 785-1656; or view online at this link: Manufacturing Development Guide.)

ARMY AERONAUTICAL DESIGN STANDARDS

ADS-10C-SP	Air Vehicle Technical Description
ADS-13F-HDBK	Air Vehicle Materials and Processes
ADS-27	Requirements for Rotorcraft Vibration Specifications, Modeling and Testing
ADS-29	Structural Design Criteria for Rotary Wing Aircraft
ADS-33E-PRF	Performance Specification: Handling Qualities Requirements for Military Rotorcraft
ADS-36	Rotary Wing Aircraft Crash Resistance
ADS-37A-PRF	Electromagnetic Environmental Effects (E3) Performance and Verification Requirements
ADS-40A-SP	Air Vehicle Flight Performance Description
ADS-43A-HDBK	Qualification Requirement and Identification of Critical Characteristics for Aircraft and Engine Components
ADS-44-HDBK	Aeronautical Design Standard Handbook Armament Airworthiness Qualification
ADS-50-PRF	Rotorcraft Propulsion Performance Qualification Requirements and Guidelines
ADS-51-HDBK	Rotorcraft and Aircraft Qualification (RAQ) Handbook
ADS-62-SP	Data and Test Requirements for Airworthiness Release for Helicopter Sensor Data and Testing Requirements in Development Stage
ADS-63-SP	Radar System Airworthiness Qualification and Verification Requirements
ADS-65-HDBK	Airworthiness Qualification and Verification Requirements for Electro-Optics and Infrared Sensor Systems
ADS-66-HDBK	Guidance for Data for Safety of Flight Airworthiness Release for Helicopter Aircraft Survivability Equipment (ASE)

(Copies of Army Aeronautical Design Standards may be obtained via http://www.redstone.army.mil/amrdec/sepd/tdmd/StandardAero.htm)

ARMY REGULATIONS

PAM 385-24	The Army Radiation Safety Program

(Copies of Army Regulations may be obtained via http://www.army.mil/usapa/index.html.

ARMY TECHNICAL BULLETINS (TB)

TB MED 523	Control of Hazards to Health from Microwave and Radio Frequency Radiation and Ultrasound

(Official Department of Army (DA) administrative publications and forms are managed by the Army Publishing Directorate (APD) under the direction of the Administrative Assistant to the Secretary of the Army (AASA). APD uses the latest publishing technologies to produce high-quality, enhanced, electronic publications and forms. This is the Army's latest collection of

electronic DA administrative publications and DA forms. Copies of Army Technical Bulletins may be obtained via http://www.army.mil/usapa/med/index.html)

NAVY AERONAUTICAL REQUIREMENTS

AR-56	Structural Design Requirements (Helicopters)
AR-89	Structural Ground Test Requirements (Helicopters)

(Copies of Navy Aeronautical Requirements documents may be obtained via U. S. Mail from the following address: Structures Division, ATTN: Bldg. 2187, Suite 2340A, NAVAIRSYSCOM, 48110 Shaw Road, Unit 5, Patuxent River, MD 20670-1906. For inquiries, phone 301-342-9381.)

NAVAL AIR SYSTEMS COMMAND INSTRUCTIONS

NAVAIRINST 4200.25D	Management of Critical Application Items including Critical Safety Items.
NAVAIRINST 13034.1C	Flight Clearance Policy for Air Vehicles and Aircraft Systems
NAVAIR 00-80T-110	NATOPS Air Refueling Manual (USN/USMC)

(Copies of Naval Air System Command documents may be obtained via Commander, Naval Air System Command, 47123 Buse Rd, B2272 Unit IPT, Patuxent River MD 20670-1547. Copies of NAVAIR Flight Clearance instructions may be obtained via http://airworthiness.navair.navy.mil/.)

NAVAL SEA SYSTEMS COMMAND INSTRUCTIONS

NAV SEA OP 3565	Electromagnetic Radiation Hazard
NAV SEA TM-59310-AQ-SAF-010	Technical Manual for Batteries, Navy Lithium Safety Program, Air Vehicle Subsystems
NAV SEA TM-59310-AQ-SAF-010	Technical Manual for Batteries, Navy Lithium Safety Program, Air Vehicle Subsystems

(Copies of Naval Sea System Command documents may be obtained via Naval Air System Command, 1333 Isaac Hull Ave S. E., Washington Navy Yard, DC 20376, phone 202-781-0000. Additional information is available online through the NAV SEA specs and standards website: http://www.navsea.navy.mil/specsAndstandards/. Copies of NAVSEA technical manuals can be ordered from the Naval Inventory Control Point (NAVICP), Mechanicsburg, PA. They can be ordered using the Naval Logistic Library (NLL) at http://www.nll.navsup.navy.mil/. Tech Manuals can also be acquired at Defense Automatic Addressing System Center Automatic Message Exchange System (DAMES), Standard Automated Logistic Tool Set (SALTS) or Naval Message.)

JOINT SERVICE DOCUMENTS

Joint Software System Safety Committee, Software System Safety Handbook: A Technical & Managerial Team Approach, Dec 1999 (For copies, call 301-342-2350.)

Range Commander's Council (RCC) 316-98, Laser Range Safety

(Copies of DoD instructions and documents may be obtained via Secretariat, Range Commanders Council, ATTN CSTE-DTC-WS-RCC, Building 100 Room 138, White Sands Missile Range NM 88002-5110, Commercial 505-678-1107/1108, DSN 258-1107.)

DEPARTMENT OF DEFENSE DOCUMENTS

DoDD 3150.2	DoD Nuclear Weapon System Safety Program Manual
DoDD 4650.1	Management and Use of Radio Frequency Spectrum
DoD 6055.9-STD	DoD Ammunition and Explosives Safety Standards

DEPARTMENT OF DEFENSE FORMS

DD Form 1494	Application for Equipment Frequency Allocation

DEPARTMENT OF DEFENSE INSTRUCTIONS

DoDI 5000.2	Operation of the Defense Acquisition System
DoDI 6055.11	Protection of DoD Personnel from Exposure to Radiofrequency Radiation and Military Exempt Lasers

DEPARTMENT OF DEFENSE PUBLICATIONS

DoD 4140.1-R	DoD Supply Chain Materiel Management Regulation DoD Aviation Critical Safety Item (CSI)/Flight Safety Critical Aircraft Part (FSCAP); Section C8.5

DEPARTMENT OF DEFENSE TECHNICAL ORDER

T.O. 11A-1-47	DoD Ammunition and Explosives Hazard Classifications

NORTH ATLANTIC TREATY ORGANIZATION (NATO)

ATP-56	Air To Air Refueling
STANAG 3098	Aircraft Jacking
STANAG 3278	Aircraft Towing Attachments and Devices
STANAG 3447	Aerial Refueling Equipment Dimensional and Functional Characteristics
STANAG 4101	Towing Attachments

(Copies of NATO STANAGs may be obtained via SAF/AQRE, 1060 Air Force Pentagon, Washington DC, DSN 223-3221.)

FEDERAL AVIATION ADMINISTRATION CODE OF FEDERAL REGULATIONS (CFR)

TITLE 14	Aeronautics and Space
	Part 23, Airworthiness Standards: Normal, Utility, Acrobatic and Commuter Category Airplanes
	Part 25, Airworthiness Standards: Transport Category: Airplanes
	Part 27, Airworthiness Standards: Normal Category Rotorcraft

	Part 29, Airworthiness Standards: Transport Category: Rotorcraft
	Part 33, Airworthiness Standards: Aircraft Engines
	Part 133, Rotorcraft External-Load Operations
	SFAR 88, Special Federal Aviation Regulation: Fuel Tank System Fault Tolerance Evaluation Requirements
TITLE 21	Food and Drugs, Part 1040, Subchapter J - Radiological Health, Performance Standards for Light-Emitting Products

FEDERAL AVIATION ADMINISTRATION ADVISORY CIRCULARS (AC)

AC 20-29	Use of Aircraft Fuel Anti-icing Additives
AC 20-30	Aircraft Position Light and Anti-Collision Light Installations
AC 20-41	Substitute Technical Standard Order (TSO) Aircraft Equipment
AC 20-42	Hand Fire Extinguishers for Use in Aircraft
AC 20-53	Protection of Aircraft Fuel Systems Against Fuel Vapor Ignition Due to Lightning
AC 20-60	Accessibility to Excess Emergency Exits
AC 20-115	Radio Technical Commission for Aeronautic, Inc. Document RTCA/DO-178B
AC 20-119	Fuel Drain Valves
AC 20-129	Airworthiness Approval of Vertical Navigation (VNSV) Systems for use in the U.S. National Airspace System (NAS) and Alaska
AC 20-130	Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors
AC 20-145	Guidance for Integrated Modular Avionics (IMA) that Implement TSO-C153 Authorized Hardware Elements
AC 25-9	Smoke Detection, Penetration, and Evacuation Tests and Related Flight Manual Emergency Procedures
AC 25-16	Electrical Fault and Fire Prevention and Protection
AC 25-17	[Large AC] Transport Airplane Cabin Interiors Crashworthiness Handbook
AC 25.853-1	Flammability Requirements for Aircraft Seat Cushions
AC 25.869-1	Electrical System Fire and Smoke Protection
AC 25.963-1	Fuel Tank Access Covers
AC 25.981-1	Fuel Tank Ignition Source Prevention Guidelines
AC 25.981-2	Fuel Tank Flammability Minimization
AC 25.994-1	Design Considerations to Protect Fuel Systems During a Wheels-Up Landing
AC 27-1	[Large AC] Certification of Normal Category Rotorcraft

AC 29-2	[Large AC] Certification of Transport Category Rotorcraft
AC 33-1	Turbine Engine Foreign Object Ingestion and Rotor Blade Containment Type Certification Procedures
AC 33-2	Aircraft Engine Type Certification Handbook
AC 33-3	Turbine and Compressor Rotors Type Certification Substantiation Procedures
AC 33-4	Design Considerations Concerning the Use of Titanium in Aircraft Turbine Engines
AC 33.4-2	Instructions for Continued Airworthiness: In-Service Inspection of Safety Critical Turbine Engine Parts at Piece-Part Opportunity
AC 33-5	Turbine Engine Rotor Blade Containment/Durability
AC 33.28-1	Compliance Criteria for 14 CFR 33.28, Aircraft Engines, Electrical and Electronic Engine Control Systems
AC 43.13-1	[Large AC. This includes Change 1.] Acceptable Methods, Techniques, and Practices- Aircraft Inspection
AC 90-96	Approval of U.S. Operators and Aircraft to Operate Under Instrument Flight Rules (IFR) in European Airspace Designated for Basic Area Navigation (B-RNAV) and Precision Area Navigation (P-RNAV)
AC 90-97	Use of Barometric Vertical Navigation (VNAV) for Instrument Approach Operations Using Decision Altitude
AC 120-40	Airplane Simulator Qualification
AC 120-42	Extended Range Operation with Two-Engine Airplanes (ETOPS)
AC 120-63	Helicopter Simulator Qualification

FEDERAL AVIATION ADMINISTRATION HANDBOOK)

DOT/FAA/AR-MMPDS-01	Metallic Materials Properties Development and Standardization (MMPDS)

FEDERAL AVIATION ADMINISTRATION TECHNICAL STANDARDS ORDERS (TSOs)

TSO C70A	Life Rafts (Reversible and Nonreversible)
TSO C77B	Gas Turbine Auxiliary Power Units
TSO C112	Air Traffic Control Radar Beacon System/Mode Select (ATCRBS) Airborne Equipment
TSO C153	Integrated Modular Avionics Hardware Elements

(Copies of Federal Aviation Administration Regulations may be viewed at http://www.faa.gov, or may be obtained from the Federal Aviation Administration, 800 Independence Ave., SW, Washington, DC 20591.)

2.1.3 Non-Government publications.

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

Aerial Refueling Systems Advisory Group (ARSAG)

ARSAG 00-03-01 Aerial Refueling Pressure Definitions and Terms

(Copies of ARSAG may be obtained via ARSAG International, PO Box 54903, Cincinnati, OH 45254-0903 phone 937-429-7014 or email orders to arsaginc@earthlink.net.)

Aeronautical Radio, Inc (ARINC)

ARINC Report 609 Design Guidance for Aircraft Electrical Power Systems

(Application for copies should be addressed to the Aeronautical Radio, Inc (ARINC), Annapolis (International Headquarters), 2551 Riva Road, Annapolis, MD 21401-7435, phone: 410-266-4000, or 301-858-4000; order online at http://www.arinc.com/.)

American Society of Mechanical Engineers

ASME Y14.5 Dimensioning and Tolerancing

(Application for copies should be addressed to the ASME Headquarters, Three Park Avenue, New York, NY 10016-5990, phone: 212-591-7722; order online at http://www.ansi.org.)

American Society of Testing and Materials and Listing (ATSM)

ASTM-F33a Enclosure, Aerospace Transparent, Bird Impact, Testing of

(Application for copies should be addressed to the ASTM, 100 Barr Harbor, Drive, West Conshohocken, PA 19428-2959, phone: 610-832-9585; order online at http://www.astm.org.)

Government Electronics and Information Technologies Association

EIA 649 National Consensus Standard for Configuration Management

(Application for copies should be addressed to the Engineering Industries Alliance (EIA), Technology Strategy and Standards Department, 2500 Wilson Boulevard, Arlington, VA 22201; order online at http://www.eia.org or http://global.ihs.com/.)

Institute for Electronic and Electrical Engineers (IEEE)

IEEE/EIA 12207.0 Software Life Cycle Processes; Industry Implementation of ISO/IEC 12207: 1995 Standard for Information Technology (DoD adopted)

IEEE/EIA 12207.1 Software Life Cycle Processes - Life Cycle Data; Industry Implementation of ISO/IEC 12207: 1995 Standard for Information Technology (DoD adopted)

IEEE/EIA 12207.2 Software Life Cycle Processes – Implementation Considerations: Industry Implementation of ISO/IEC 12207: 1995 Standard for Information Technology (DoD adopted)

(Application for copies should be addressed to the IEEE Corporate Office, 3 Park Avenue, 17th Floor, New York, NY 10016-5997 U.S.A.; order online at: IEEE Customer Service, customer-service@ieee.org.)

National Fire Protection Association (NFPA)

NFPA 70 National Electrical Code

(Application for copies should be addressed to the National Fire Protection Association, 1 Battery March Park, Quincy, MA 02269-9101, phone: 617-770-3000; order online at http://www.nfpa.org.)

Occupational Safety & Health Administration (OSHA)/American National Standards Institute

ANSI Z136.1 American National Standard for Safe Use of Lasers

(Application for copies should be addressed to the American National Standards Institute, 11 West 42nd Street, New York NY 10036; order online at http://www.ansi.org.)

Radio Technical Commission for Aeronautics (RTCA)

DO 160	Environmental Conditions and Test Procedures for Airborne Equipment
DO 178	Software Considerations in Airborne Equipment and Equipment Certification
DO 181	Minimum Operational Performance Standards for Air Traffic Control Radar Beacon System/Mode Select (ATCRB/Mode S) Airborne Equipment (ERRATA)
DO 185	Minimum Operational Performance Standards for Traffic Alert and Collision Avoidance System II (TCAS II) Airborne Equipment
DO 186	Minimum Operational Performance Standards for Radio Communications Equipment Operating Within the Radio Frequency Range 117.975 – 137 MHz
DO 200	Standards for Processing Aeronautical Data
DO 212	Minimum Operational Performance Standards for Airborne Automatic Dependent Surveillance (ADS) Equipment
DO 219	Minimum Operational Performance Standards for ATC Two-Way Data Link Communications
DO 254	Design Assurance Guidance for Airborne Electronic Hardware
SC 189	Operational Safety Assessment

(Application for copies should be addressed to the RTCA, Inc., 1828 L Street N. W., Suite 805, Washington DC 20036, phone: 202-833-9339; order online at http://www.rtca.org.)

Society of Allied Weight Engineers (SAWE) Recommended Practices (RP)

SAWE RP7	Weight and Balance Control System (for Aircraft and Rotorcraft)
SAWE RP8	Weight and Balance Data Reporting Forms for Aircraft (including Rotorcraft)

(Application for copies should be addressed to the Society of Allied Weight Engineers, PO Box 60024, Terminal Annex, Los Angeles, CA 90060; order online at http://www.sawe.org.)

Society of Automotive Engineers (SAE)

AIR 1419	Inlet Total-Pressure-Distortion Considerations for Gas-Turbine Engines (DoD adopted)
AIR 4845	The FMECA Process in the Concurrent Engineering (CE) Environment
AIR 5826	Distortion Synthesis/Estimation Techniques
ARP 994	Recommended Practice for the Design of Tubing Installations for Aerospace Fluid Power Systems (DoD adopted)
ARP 1070	Design and Testing of Antiskid Brake Control Systems for Total Aircraft Compatibility
ARP 1420	Gas Turbine Engine Inlet Flow Distortion Guidelines (DoD adopted)
ARP 1493	Wheel and Brake Design and Test Requirements for Military Aircraft
ARP 1538	Arresting Hook Installation, Land Based Aircraft, Emergency
ARP 1870	Aerospace Systems Electrical Bonding and Grounding for Electromagnetic Compatibility and Safety
ARP 4754	Certification Considerations for Highly-Integrated or Complex Aircraft Systems
ARP 4761	Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment
ARP 5412	Aircraft Lightning Environment and Related Test Waveforms
ARP 5580	Recommended Failure Modes and Effects Analysis (FMEA) Practices for Non-Automobile Applications
ARP 5583	Guide to Certification of Aircraft in a High Intensity Radiated Field (HIRF) Environment
AS 1055	Fire Testing of Flexible Hose, Tube Assemblies, Coils, Fittings, and Similar System Components (DoD adopted)
AS 1831	Electrical Power, 270 V DC, Aircraft, Characteristics and Utilization of
AS 9100	Quality Management Systems - Aerospace - Requirements (DoD adopted)
AS 50881	Wiring Aerospace Vehicle (DoD adopted)

(Application for copies should be addressed to the SAE World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-0001; order online at http://www.sae.org/.)

3. DEFINITIONS & ABBREVIATIONS

3.1 Definitions.

All definitions, unless otherwise referenced, are to be considered within the context of this document.

3.1.1 Advisory circular (AC) - The Federal Aviation Administration (FAA) issues advisory circulars (AC) to inform the aviation public, in a systematic way, of nonregulatory material. Unless incorporated into a regulation by reference, the contents of an advisory circular are not binding on the public. Advisory circulars are issued in a numbered-subject system corresponding to the subject areas of the Title 14, Code of Federal Regulations (14CFR reference), Chapter I, Federal Aviation Administration. An AC is issued to provide guidance and information in a designated subject area or to show a method acceptable to the Administrator for complying with a related FAR. When using 14CFR references for compliance with airworthiness certification criteria, consult applicable ACs for guidance.

3.1.2 Air system - An air vehicle plus the training and support systems for the air vehicle, and any weapons to be employed on the air vehicle. (JSSG-2000)

3.1.3 Air vehicle - An air vehicle includes the installed equipment (hardware and software) for airframe, propulsion, air vehicle applications software, air vehicle system 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)

3.1.4 Airframe: The structure of an aircraft, guided missile or the like, apart from accessories and power plant. The principal parts of the airframe include the fuselage, wings, empennage, landing gear, and nacelles or pods. (Navy & Marine Corps use only)

3.1.5 Airworthiness - The property of a particular air system configuration to safely attain, sustain, and terminate flight in accordance with the approved usage and limits.

3.1.6 Airworthiness certification - A repeatable process implemented to verify that a specific air vehicle 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 certificate are 1) the aircraft must conform to its type design as documented on its type certificate, and 2) the aircraft must be in a condition for safe operation.

3.1.7 Allocated baseline - The approved, performance-oriented documentation, for a configuration item (CI) to be developed, which describes the functional and interface characteristics that are allocated from those of the higher level CI and the verification required to demonstrate achievement of those specified characteristics. [Ref: MIL-HDBK-61A]

3.1.8 Baseline (configuration) - (1) An agreed-to description of the attributes of a product at a specified point in time, which serves as a basis for defining change. (2) An approved and released document or set of documents, each of a specific revision, the purpose of which is to provide a defined basis for managing change. (3) The currently approved and released configuration documentation. (4) A released set of files consisting of a software version and associated configuration documentation. [Ref: EIA 649]

3.1.9 Certification basis - The tailored, complete (necessary and sufficient), documented set of MIL-HDBK-516 airworthiness criteria utilized to assess the safety of a specific system design.

3.1.10 Chief engineer - The individual responsible for all system technical activities on a single air vehicle system, in support of the system program manager.

3.1.11 Configuration control - (1) A systematic process that ensures that changes to a baseline are properly identified, documented, etc. (2) The configuration management activity concerning: the systematic proposal, justification, evaluation, coordination, and disposition of proposed changes; and the implementation of all approved and released changes into (a) the applicable configurations of a product, (b) associated product information, and (c) supporting and interfacing products and their associated product information. [Ref: EIA 649]

3.1.12 Configuration item (CI) - A configuration item is 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 [Ref: MIL-HDBK-61A]

3.1.13 Configuration management - A management process for establishing and maintaining consistency of a product's performance, functional, and physical attributes with its requirements, design, and operational information throughout its life. [Ref: EIA 649]

3.1.14 Configuration status accounting - The configuration management activity concerning capture and storage of, and access to, configuration information needed to manage products and product information effectively. [Ref: EIA 649]

3.1.15 Critical safety item (CSI) - A part, assembly, installation equipment, launch equipment, recovery equipment, or support equipment for an aircraft or aviation weapons system that contains a characteristic, any failure, malfunction, or absence of which could cause a catastrophic or critical failure resulting in the loss 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. Damage is considered serious or substantial when it would be sufficient to cause a "Class A" accident or a mishap of severity category I. The determining factor in CSIs is the consequence of failure, not the probability that the failure or consequence would occur. [Ref: Joint Aeronautical Commanders' Group Memorandum, 22 Jan 04, "Proposed Instruction on Management of Aviation Critical Safety Items (CSIs)"]

3.1.16 End-item - Equipment that can be used by itself to perform a military function or provides an enhanced military capability to a system and has a distinct management activity to control its technical and performance baseline. [Ref: MIL-HDBK-514]

3.1.17 Failure modes, effects, and criticality analysis (FMECA) - A procedure for identifying potential failure modes in a system and classifying them according to their severity. A FMECA is usually carried out progressively in two parts. The first part identifies failure modes and their effects (also known as failure modes and effects analysis). The second part ranks the failure modes according to the combination of their severity and the probability of occurrence (criticality analysis).

3.1.18 Flight Clearance: Document that certifies and assures airworthiness of an air vehicle or system. Formal evidence that an engineering assessment has been successfully completed by the cognizant technical areas, which indicates the aircraft system can be operated with an acceptable level of technical risk. (Navy & Marine Corps use only)

3.1.19 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.

3.1.20 Functional baseline - The approved configuration documentation describing a system's or top-level configuration item's performance (functional, interoperability, and interface characteristics) and the verification required to demonstrate the achievement of those specified characteristics. [Ref: MIL-HDBK-61A]

3.1.21 Hazard - (1) A condition that is prerequisite to a mishap. [Ref: MIL-STD-882C] (2) Any real or potential condition that can cause injury, illness, or death to personnel, or damage to or loss of property. [Ref: MIL-STD-882D]

3.1.22 Integrity - Refers to the essential characteristics of a system, subsystem, or equipment that allows specific performance, reliability, safety, and supportability to be achieved under specified operational and environmental conditions over a specific service life. [Ref: MIL-HDBK-87244]

3.1.23 Interface - The performance, functional, and physical attributes required to exist at a common boundary. [Ref: EIA 649]

3.1.24 Lead engineer - The individual responsible for all end-item technical activities, including engineering and configuration changes, in support of the end-item system program manager and/or chief engineer.

3.1.25 Mishap - An unplanned event or series of events resulting in death, injury, occupational illness, or damage to or loss of equipment or property, or damage to the environment. [Ref: MIL-STD-882D]

3.1.26 Mission critical - A term applied to any condition, event, operation, process or item, the failure of which may result in the inability to achieve successful mission completion or to maintain combat capability.

3.1.27 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. NOTE: Mission training constitutes specialized air vehicle training beyond preflight safety briefings.

3.1.28 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. Thus, supportability parameters, manufacturing process variability, reliability, and so forth are all performance measures.

3.1.29 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-61A). When used for reprocurement of a CI, the product baseline documentation also includes the allocated configuration documentation to ensure that performance requirements are not compromised.

3.1.30 Remotely operated aircraft (ROA) - A remotely operated, semi-autonomous, or autonomous aircraft and its operating system. This does not include air vehicles designed for one-time use as a weapon (e.g., cruise missile). The operating system can be built into the aircraft or be part of the control station for remotely operated vehicles. This “system” includes the control station, data links, flight control system, communications systems/links, etc., as well as the aircraft. [Ref: FAA Order 7610.4K and AFI 202 V3]

3.1.31 Safety critical - A term applied to any condition, event, operation, process, or item whose proper recognition, control, performance, or tolerance is essential to safe system operation.

3.1.32 Safety-of-flight (SOF) - The property of a particular air system configuration to safely attain, sustain, and terminate flight within prescribed and accepted limits for injury/death to personnel and damage to equipment, property, and/or environment. The intent of safety-of-flight clearance is to show that appropriate risk management has been completed and the level of risk (hazards to system, personnel, property, equipment, and environment) has been appropriately identified and accepted by the managing activity prior to flight of the air system.

3.1.33 SOF items or equipment - Items or equipment that, if they failed, have the potential for precluding the continued safe flight of the air vehicle within prescribed and accepted limits for injury/death to personnel and damage to equipment, property, and/or environment.

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

3.1.35 System program manager (SPM) - The single individual specifically designated to be responsible for the life cycle management of a system or end-item. The system program manager is vested with full authority, responsibility, and resources to execute and support an approved program. [Ref: DoDI 5000.2]

3.1.36 System safety - The application of engineering and management principles, criteria, and techniques to achieve acceptable mishap risk, within the constraints of operational effectiveness and suitability, time, and cost, throughout all phases of the system life cycle. [Ref: MIL-STD-882D]

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

3.1.38 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; and

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.

3.1.39 Unmanned aerial vehicle (UAV) - A remotely piloted, semi-autonomous, or autonomous air vehicle and its operating system. This does not include air vehicles designed for one-time use as a weapon (e.g., cruise missile). The operating system can be built into the vehicle or be part of the control station for remotely piloted vehicles. This “system” includes the control station, data links, flight control system, communications systems/links, etc., as well as the air vehicle. [Ref: NAVAIRINST 13034.2]

3.1.40 Vehicle control functions (VCFs) - VCFs include all functions and their associated components used to transmit flight control commands from the pilot and/or other sources to appropriate force and moment producers. Flight control commands may result in control of aircraft flight path, attitude, airspeed, aerodynamic configuration, ride, and structural modes. Integrated VCFs are a combination of flight controls and any other air vehicle functions or subsystems that cause, augment, or replace pilot initiated commands or provide basic, necessary data/information for the flight control subsystem to function and ensure safety of flight.

3.2 Abbreviations and acronyms.

14CFR	Title 14, Code of Federal Regulations
AC	advisory circulars
ADS	Aeronautical Design Standard
AFGS	Air Force Guide Specification
AFI	Air Force Instruction
AFPD	Air Force Policy Directive
AFR	Air Force Regulation
APC	aircraft pilot coupling
APS	auxiliary power system
APU	auxiliary power unit
AR	Army Regulation
ARSAG	Aerial Refueling Systems Advisory Group
BARO VNAV	barometric vertical navigation
BIT	built-in-test
CAD	cartridge actuated devices
CDR	critical design review
CFD	computational fluid dynamics
CFR	Code of Federal Regulations
C.G.	center of gravity
CI	configuration item
CNS/ATM	communication, navigation, surveillance/air traffic management
Comm’l	commercial
CSA	configuration status accounting
CSCI	computer software configuration item
CSI	critical safety item

DoD	Department of Defense
DOD	domestic object damage
ECP	engineering change proposal
ECS	environmental control system
E^3	electromagnetic environmental effects
EHMS	engine health monitoring systems
EMI	electromagnetic interference
EMP	electromagnetic pulse
EMS	environmental management system
EPS	emergency power system
FAA	Federal Aviation Administration
FAR	Federal Acquisition Regulation
FCA	functional configuration audit
FMECA	failure modes, effects, and criticality analysis
FMET	failure modes and effects testing
FOD	foreign object damage
FRACAS	failure report and corrective action system
FSCAP	flight safety critical aircraft part
g	acceleration or load factor in units of acceleration of gravity
HCF	high cycle fatigue
HERF	hazards of electromagnetic radiation to fuel
HERO	hazards of electromagnetic radiation to ordnance
HERP	hazards of electromagnetic radiation on personnel
HUD	head-up display
ICD	interface control document
I/O	input/output
JACG	Joint Aeronautical Commanders Group
JFS	jet fuel starter
JSSG	Joint Service Specification Guide
LCF	low cycle fatigue
LEP	laser eye protection
MSL	mean sea level
MWL	maximum wear limit
NATO	North Atlantic Treaty Organization
NBC	nuclear, biological, and chemical
NDI	nondestructive inspection
NFPA	National Fire Protection Association
NVIS	night vision imaging system
OFP	operational flight program
PAD	pyrotechnic actuated devices

PCA	physical configuration audit
PDR	preliminary design review
PFR	primary flight reference
PIO	pilot-induced oscillations
PLA	power lever angle
PLOC	probability loss of control
POD	probability of detection
PTO	power take-off
PVI	pilot vehicle interface
RAT	ram air turbine
RF	radio frequency
RNAV	radio navigation
RNAV VNAV	area navigation vertical navigation
RNP	required navigation performance
ROA	remotely operated aircraft
RVSM	reduced vertical separation minima
RTO	refused takeoff
SAE	Society of Automotive Engineers
SAWE	Society of Allied Weight Engineers
SDIMP	software development integrity master plan
SDP	software development plan
SFAR	Special Federal Aviation Regulation
SOF	safety-of-flight
SPM	system program manager
SRS	software requirements specification
SSHA	subsystem hazard analysis
STANAG	standardization agreement
STLDD	software top-level design document
TBD	to be determined
TEMP	test and evaluation master plan
T.O.	technical order
TSO	technical standard order
UAV	unmanned aerial vehicle
VCF	vehicle control function
VCMS	vehicle control and management system
V_L/M_L	limit speed

4. SYSTEMS ENGINEERING

The following criteria apply to all air vehicle systems and represent the minimum requirements necessary to establish, verify, and maintain an airworthy design.

TYPICAL CERTIFICATION SOURCE DATA

1. Reliability, quality, and manufacturing program plans
2. Contractor policies and procedures
3. Durability and damage tolerance control plans
4. Work instructions
5. Process specifications
6. Production/assembly progress reports
7. Quality records
8. Defect/failure data
9. Failure modes, effects, and criticality analysis (FMECA) documentation
10. Tech data package
11. As-built list to include part numbers/serial numbers for all critical safety items/components
12. List of deviations/waivers and unincorporated design changes
13. List of approved class I engineering change proposals (ECPs)
14. Proposed DD Form 250, Material Inspection and Receiving Report
15. Configuration management plans/process description documents
16. Diminishing Manufacturing Sources Plan
17. Obsolete Parts Plan
18. Test reports
19. Test plans
20. FAA Airworthiness Directives and Advisory Circulars
21. Manufacturer-issued service bulletins
22. Civil aviation authority certification plan
23. Civil aviation authority certification basis
24. Civil aviation authority certification report
25. System Safety Analysis Report

CERTIFICATION CRITERIA

4.1 Design criteria.

FAA Doc: 14CFR references: 23.21, 23.601-23.629, 25.601-25.631

4.1.1 Verify that the design criteria, including requirements and rules, adequately address safety for mission usage, full permissible flight envelope, duty cycle, interfaces, induced and natural environment, inspection capability, and maintenance philosophy.

DoD/MIL Doc: Appropriate design criteria paragraphs of JSSG-2000, 2001, 2005, 2006, 2007, 2008, 2009, 2010, and others

FAA Doc: 14CFR references: 23.21-23.3, 25.21-25.33

4.1.2 Verify that the design criteria address all components, system and subsystem interfaces, and software.

DoD/MIL Doc: Appropriate design criteria paragraphs of JSSG-2000, 2001, 2005, 2006, 2007, 2008, 2009, 2010, and others

FAA Doc: 14CFR references: 23.21, 23.601-23.629, 25.601-25.631

4.1.3 Verify that, for commercial derivative air vehicles, the air vehicle's certification basis addresses all design criteria appropriate for the planned military usage.

DoD/MIL Doc: Appropriate design criteria paragraphs of JSSG-2000, 2001, 2005, 2006, 2007, 2008, 2009, 2010, and others

FAA Doc: 14CFR references: 23.21, 23.601-23.629, 25.601-25.631

4.1.4 Verify that failure conditions have been adequately addressed in the design criteria.

4.2 Tools and databases.

4.2.1 Verify that all tools, methods, and databases used in the requirements definition/allocation, design, risk control and assessments of safety have been adequately validated and/or certified.

DoD/MIL Doc: Appropriate design criteria paragraphs of JSSG-2000, 2001, 2005, 2006, 2007, 2008, 2009, 2010, and others

FAA Doc: Refer to technical point of contact for this discipline (listed in section A.2)

4.3 Materials selection.

4.3.1 Verify that the material selection process uses validated and consistent material properties data, including design mechanical and physical properties such as material defects, and corrosion and environmental protection requirements. (For Navy aircraft, see section 19, Materials)

FAA Doc: DOT/FAA/AR-MMPDS-01

4.4 Manufacturing and quality.

4.4.1 Verify that key product characteristics have been identified.

Comm'l Doc: ASME Y14.5 "Dimensioning and Tolerancing"

AS 9100

DoD/MIL Doc: ASC/EN Manufacturing Development Guide, Section 6.5, "Key Characteristics and Processes"

AFI 63-501

FAA Doc: 14CFR reference: 23.601-23.605, 25.601-25.603

4.4.2 Verify that all critical process capabilities exist to meet key product characteristic requirements.

Comm'l Doc: AS 9100

DoD/MIL Doc: ASC/EN Manufacturing Development Guide, Section 6.6, "Variability Reduction," for additional information on Cpk, Critical Processes, and Process Control Plans

AFI 63-501

FAA Doc: 14CFR references: 23.601-23.605, 25.601-25.603

4.4.3 Verify that all critical process controls exist to assure key product characteristic requirements are met.

Comm'l Doc: AS 9100

DoD/MIL Doc: ASC/EN Manufacturing Development Guide

AFI 63-501

Joint Aeronautical Commander's Group's Performance Based Product Definition Guide, Section 5.0, "Performance Based Approach," for additional information on Product Acceptance Criteria.

FAA Doc: 14 CFR references: 23.601-23.605, 25.601-25.603

4.4.4 Verify that production allowances and tolerances are within acceptable limits and assure conformance to design.

Comm'l Doc: AS 9100

DoD/MIL Doc: ASC/EN Manufacturing Development Guide, Section 5, "Quality Systems," and Section 6.6 "Variability Reduction"

AFI 63-501

Joint Aeronautical Commander's Group's "Engineering and Manufacturing Practices for Defect Prevention"

FAR Part 46, "Quality Assurance"

FAA Doc: 14CFR reference: 23.601-23.605, 25.601-25.603

4.4.5 Verify that nondestructive inspection (NDI) accept/reject criteria have been validated.

DoD/MIL Doc: JSSG-2006 Appendix A: A.3.11.6, A.4.11.6

FAA Doc: Refer to technical point of contact for this discipline (listed in section A.2)

4.5 Operator's and maintenance manuals/technical orders.

FAA Doc: 14CFR reference: 23.1501, 23.1529, 25.1501, 25.1503-25.1533, 25.1529, 25.1541, 25.1543, 25.1557, 25.1563

4.5.1 Verify that processes are in place to identify and document all restrictions, warnings, and cautions.

DoD/MIL Doc: MIL-STD-38784, Standard Practice for Manuals, Technical: General Style and Format Requirements

FAA Doc: 14CFR reference: 23.1581, 25.1581, 23.1541, 25.1541

4.5.2 Verify that processes are in place to identify and document the technical data, and that the technical data reflects the defined functional and product baseline.

DoD/MIL Doc: MIL-STD-38784, Standard Practice for Manuals, Technical: General Style and Format Requirements.

FAA Doc: 14CFR reference: 23.21, 25.21, 23.601, 25.601, 23.1301, 25.1301

4.5.3 Verify that procedures are in place for establishing and maintaining flight vehicle integrity.

DoD/MIL Doc: MIL-HDBK-515, Weapon System Integrity Guide

MIL-STD-1530, Aircraft Structural Integrity Program

MIL-HDBK-87244, Avionics/Electronics Integrity

JSSG-2001A: 3.3.5.1, 3.3.7.1

JSSG-2009: Appendix I

4.6 Configuration identification.

4.6.1 Verify that the functional baseline is properly documented, established, and brought under configuration control.

DoD/MIL Doc: MIL-STD-961E, Defense and Program Unique Specifications Format and Content, Appendix A

MIL-HDBK-61A, Configuration Management, sections 3, and 5.5.1 Configuration Baselines for definitions and purposes of configuration baselines

FAA Doc: 14CFR reference: 23.21, 25.21, 23.601, 25.601, 23.1301, 25.1301

4.6.2 Verify that the product baseline is properly documented, established, and brought under configuration control.

DoD/MIL Doc: MIL-STD-961E, Defense and Program Unique Specifications Format and Content, Appendix A

MIL-HDBK-61A, Configuration Management, sections 3, and 5.5.1 Configuration Baselines for definitions and purposes of configuration baselines

FAA Doc: 14CFR reference: 23.21, 25.21, 23.601, 25.601, 23.1301, 25.1301

4.7 Configuration status accounting.

4.7.1 Verify that the configuration status accounting (CSA) information system has the capability to track the configuration of safety-critical items.

DoD/MIL Doc: MIL-HDBK-61A, Configuration Management, section 7 Configuration Status Accounting for purpose of CSA, lifecycle considerations, and information to be captured.

FAA Doc: 14CFR reference: 23.21, 25.21, 23.601, 25.601, 23.1301, 25.1301

5. STRUCTURES

The air vehicle structure includes the fuselage, wing (fixed or rotating), empennage, structural elements of landing gear, the control system, control surfaces, drive system, rotor systems, radome, antennae, engine mounts, nacelles, pylons, thrust reversers (if not part of the engine), air inlets, aerial refueling mechanisms, structural operating mechanisms, structural provisions for equipment/payload/cargo/personnel, etc.

TYPICAL CERTIFICATION SOURCE DATA

1. Design criteria
2. Loads analyses
3. Internal load and stress analyses
4. Materials, processes, corrosion prevention, nondestructive evaluation and repair data
5. Results from any design development tests conducted
6. Proof test results
7. Flutter, mechanical stability and aeroservoelastic analyses
8. Loads wind tunnel test data
9. Flutter wind tunnel test data
10. Ground vibration test results
11. Damage tolerance and durability analyses
12. Component/full-scale static and fatigue test results
13. Live fire test results and ballistic analysis
14. Bird strike test and analysis results
15. Arresting wire strike test and analysis results
16. User and maintainer manuals, or equivalent
17. Flight operating limits
18. Strength summary and operating restrictions
19. Damage tolerance and durability test results
20. Full-scale durability test results
21. Functional test results
22. Flight loads test results
23. Instrumentation and calibration test results
24. Control surface, tabs and damper test results
25. Thermoelastic test results
26. Limit-load rigidity test results
27. Flight flutter test results
28. Mass properties control and management plan (interface)
29. Weight and balance reports (interface)
30. Inertia report
31. Design trade studies and analyses
32. Fuel system test results
33. Results of actual weighing

34. Weight and balance handbook, or equivalent
35. Hazard analysis
36. Environmental criteria and test results
37. Vibration and acoustic test results
38. Aircraft tracking program
39. Landing gear and airframe drop test plans and results
40. Mechanical stability test plans and results
41. Whirl test plans and results
42. Tie-down test plans and results
43. Structural description report
44. Tipover and rollover stability analyses
45. External store interface and release data
46. Ground and/or air transport rigging procedures, interface loads, and associated inspection requirements
47. Failure modes, effects, and criticality analysis (FMECA) documentation
48. Ground and rotor blade clearance dimensional data
49. Loss of lubrication testing
50. Heat generation/rejection analysis
51. Airframe and component fatigue analyses and test results
52. Hydraulic and Control System “RAP” test results

CERTIFICATION CRITERIA

5.1 Loads.

DoD/MIL Doc: ADS-29 (Army use)

5.1.1 Verify that the limit loads used in the design of the aircraft include the maximum and most critical combination of loads that can result from authorized ground and flight loading conditions for the air vehicle. These include loads during piloted or autonomous maneuvers, loss of control maneuvers, gusts, turbulence, take-off, landing, catapult (if applicable), shipboard and land based arrestments (if applicable), ground operations, maintenance activity, systems failures from which recovery is expected, and loads expected to be seen throughout the specific lifetime of usage.

DoD/MIL Doc: JSSG-2006: A.3.2.9, A.4.2.9

5.1.2 Verify that the ultimate loads used in the design of the airframe are obtained by multiplication of limit loads by the appropriate factor of safety, or in the case of crash conditions, the ultimate loads are obtained by applying the appropriate crash load factors sufficient to prevent injury to occupants and to maintain the integrity of egress paths.

DoD/MIL Doc: JSSG-2006: A.3.2.10, 3.2.10.1-6, A.4.2.10, Figure 4 & 5

JSSG-2006: Figure 4, pg 459, “Discrete bumps and dips for slow speeds up to 50 knots-single and double excitations”. (for standard development)

JSSG-2006: Figure 5, pg 460, “Discrete bumps and dips for high speeds above 50 knots-

single and double excitations". (for standard development)

5.1.3 Verify the design service loads spectra include all sources of repeated loads.

DoD/MIL Doc: JSSG-2006: A.3.2.11, A.4.2.11

5.1.4 Verify that loads used in the design of the airframe include loads due to foreign object damage (FOD) from birds, hail, runway, taxiway, and ramp debris.

DoD/MIL Doc: JSSG-2006: A.3.2.24

5.1.5 Verify that the airframe is designed such that ultimate loads are obtained by multiplication of limit loads by the appropriate factors of safety. Also verify that the ultimate loads are used in the design of elements of the airframe subject to a deterministic design approach.

DoD/MIL Doc: JSSG-2006: A.3.2.12, A.4.2.12

5.1.6 Verify that the airframe is designed such that all sources of repeated loads are considered and included in the development of the service loads spectra and do not detract from the airframe service life.

DoD/MIL Doc: JSSG-2006: A.3.2.14.3, A.4.2.14

5.1.7 Verify that the airframe is designed such that the power or thrust of the installed propulsion system is commensurate with the ground and flight conditions of intended use, including system failures, and the capabilities of the propulsion system and crew.

DoD/MIL Doc: JSSG-2006: A.3.2.17, A.4.2.17

5.1.8 Verify, in the generation of loads, that flight control and automatic control devices, including load alleviation and ride control devices, are to be in all modes (operative, inoperative, and transient) for which use is required. This includes use due to, or likely due to single or multiple system failure conditions.

DoD/MIL Doc: JSSG-2006: A.3.2.18 and A.4.2.18

5.1.9 Verify that flight loading conditions are based upon essentially realistic, physically achievable conditions of airframe response to pilot induced or autonomous maneuvers, loss of control maneuvers, gusts, and turbulence. Also verify that the realistic conditions considered are both required and expected to be encountered critical combinations of configurations, gross weights, centers of gravity, thrust or power, altitudes, speeds, and type of atmosphere and are used in the design of the airframe.

DoD/MIL Doc: JSSG-2006: A.3.4.1, A.3.4.1.1-15

JSSG-2006: Power Spectrum Equation on pg 264 under A.3.4.1.6 (for standard development)

JSSG-2006: Table XI "Turbulence Field Parameters," pg 441 (for standard development)

5.1.10 Verify that the airframe is designed for ground loading conditions which reflect ground and maintenance operations.

DoD/MIL Doc: JSSG-2006: A.3.4.2, 3.4.2.1-11, 3.4.2.12 and 15, 4.4.2

5.1.11 Verify that in the generation of loads the airframe is able to withstand crashes and to protect personnel to the extent reflected by the ultimate loading conditions and parameters.

DoD/MIL Doc: ADS-36 (Army use)

JSSG-2006: A.3.4.2.11, Table XIV, “Seat Crash Load Factors,” pg 443 (for standard development)

5.2 Structural dynamics.

5.2.1 Verify that the air vehicle, in all configurations including store carriage and system failures, is free from flutter, whirl flutter, divergence, and other related aeroelastic or aeroservoelastic instabilities, including transonic aeroelastic instabilities, for all combinations of altitude and speed encompassed by the limit speed (VL/ML) versus altitude envelope enlarged at all points by the airspeed margin of safety. Also, verify that all aerodynamic surfaces and components of the air vehicle are free from aeroelastic divergence and that the inlet, transparency, and other aerodynamically loaded panels are designed to prevent flutter and limited amplitude oscillations when exposed to high transonic or supersonic flow.

DoD/MIL Doc: JSSG-2006: A.3.1.2, A.3.7.1, A.3.7.1.2, A.3.7.1.4, A.3.7.1.5, A.3.7.1.6, A.3.7.1.7, A.3.7.2, A.3.7.3, A.3.3.9, A.4.3.9, A.4.7

5.2.2 Verify that the control surfaces and tabs contain sufficient static and dynamic mass balance, or sufficient bending, torsional, and rotational rigidity; or a combination of these means to prevent flutter; or limited-amplitude instabilities of all critical modes under all flight conditions for normal and failure operating conditions of the actuating systems. Verify that all control surfaces and parts thereof are free from single-degree-of-freedom flutter, such as buzz. Also verify that all other air vehicle components exposed to the airstream, such as spoilers, dive brakes, scoops, landing gear doors, weapon bay doors, ventral fins, movable inlet ramps, movable fairings, and blade antennae are free from aeroelastic instability.

DoD/MIL Doc: JSSG-2006: A.3.7.1.1, A.3.7.1.3, A.3.7.1.8, A.3.7.2, A.3.7.3, A.3.7.4, A.3.7.5, A.4.7, A.4.7.5

5.2.3 Verify that the airframe structure (including cavities), equipment, and equipment provisions withstand the aeroacoustic loads and vibrations induced by the aeroacoustic environment for the air vehicle specified service life and usage without cracking or functional impairment.

DoD/MIL Doc: JSSG-2006: A.3.5.1, A.4.5.1

5.2.4 Verify that sound pressure levels in areas of the air vehicle occupied by personnel during flight are controlled as required by human factors requirements.

DoD/MIL Doc: JSSG-2006: A.3.5.2, A.4.5.2

5.2.5 Verify that the airframe is designed such that it can operate in the vibration environments induced by the operational use for the specified service life. Also verify that the airframe is designed such that no fatigue cracking or excessive vibration of the airframe structure or components occurs that would result in the air vehicle or the components of the air vehicle systems not being fully functional.

DoD/MIL Doc: JSSG-2006: A.3.6.2, A.4.6.2

5.2.6 Verify that equipment and structure behind and near vents and louvers are designed for the effects of flow through the vents and louvers during conditions of normal and reverse flows.

DoD/MIL Doc: JSSG-2006: A.3.3.8

5.3 Strength.

5.3.1 Verify the sufficient static strength is provided to react all design loading conditions without yielding and detrimental deformations (including delamination) at 115 percent of limit loads, unless higher loads are specified, without structural failure at ultimate loads, and when applicable, without detrimental deformations resulting from the application of Navy design landing loads. Verify sufficient strength for operations, maintenance functions, occurrences of system failures, and any tests that simulate load conditions. This includes modifications, new or revised equipment installations, major repairs, extensive reworks, extensive refurbishment, or remanufacture.

DoD/MIL Doc: JSSG-2006: A.3.2.13, A.3.10.5, A.3.10.9, A.3.10.10 (for standard development); A.4.10.5, A.4.10.5.1, A.4.10.5.2, A.4.10.9, A.4.10.10 (for compliance development)

5.3.2 Verify that the allowables for materials are derived using statistical compensations appropriate to part criticality and the nature of the material; are established considering component and assembly variability, the expected environmental extremes, fabrication processes, repair techniques, and quality assurance procedures; and are validated. Verify that conditions and properties associated with material repairs satisfy design requirements.

DoD/MIL Doc: MIL-STD-1568

MIL-HDBK-1587

JSSG-2006: A.3.2.19, A.3.2.19.1, A.3.2.19.2 (for standard development)

JSSG-2006: A.4.2.19, A.4.2.19.1, A.4.2.19.2 (for compliance development)

5.3.3 Verify that stresses and strains in structural members are controlled through proper sizing, detail design, and materials selection. Verify that for all limit, design (including the Navy design landing condition, where applicable), and ultimate loads are reacted resulting in zero or positive margins of safety for all configurations within allowable operating conditions (including probable failure and defined emergency conditions).

DoD/MIL Doc: JSSG-2006: A.3.3.1.1, A.3.10.4, A.3.10.4.1, A.3.10.4.2, A.3.10.4.3, A.3.10.4.4, A.3.10.5 (for standard development)

JSSG-2006: A.4.10.4, A.4.10.4.1, A.4.10.4.2, A.4.10.4.3, A.4.10.4.4 (for compliance development)

5.4 Damage tolerance and durability (fatigue).

5.4.1 Verify that all safety-of-flight (SOF) structure, including dynamic components, have adequate safe life or damage tolerance capability (depending on certification authority).for the required service life.

DoD/MIL Doc: JSSG-2006: A.3.12 Damage Tolerance, pg 398

JSSG-2006: A.4.12 Damage Tolerance, pg 400 (for compliance development)

5.4.2 Verify the airframe structure has sufficient durability to preclude adverse safety, economic, operational, maintenance, repair, or modification cost impacts throughout its intended service life.

DoD/MIL Doc: JSSG-2006: A.3.11 Durability, pg 378

JSSG-2006: A.4.11 Durability, pg 379 (for compliance development)

5.4.3 Verify that a durability and damage tolerance control process is established and implemented in the engineering design and manufacturing process.

DoD/MIL Doc: MIL-HDBK-6870 for guidance in the development of Nondestructive Inspection procedures.

JSSG-2006: A.3.13, pg 417

JSSG-2006: A.4.13, pg 419 (for compliance development)

5.4.4 Verify that corrosion prevention systems remain effective during the service life. Specific corrosion prevention and control measures, procedures, and processes are to be identified and established commensurate with the operational and maintenance capability required of the airframe.

DoD/MIL Doc: JSSG-2006: A.3.11.2 Corrosion Prevention and Control, pg 389

JSSG-2006: A.4.11.2 Corrosion Prevention and Control, pg 392 (for compliance development)

5.5 Mass properties.

5.5.1 Verify that the mass properties fully support safe vehicle operations for all defined mission requirements, variation in useful load, basing/deployment concepts, interfaces, and necessary maintenance.

Comm'l Doc: SAWE RP No. 7: 3.2.6 and 3.3

DoD/MIL Doc: JSSG-2006: 3.2.5

5.5.2 Verify that center of gravity margins are properly defined to handle aerodynamic, center of gravity, 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.

Comm'l Doc: SAWE RP No. 7: 3.4.9, 3.5, 3.2.7.3.1, and 3.2.7.3.1.4

DoD/MIL Doc: JSSG-2006: 3.2.6

5.5.3 Verify that flight and maintenance manuals are consistent and contain all required checklists and loading data necessary to conduct required weight and balance checks while complying with specific weight and balance requirements.

Comm'l Doc: SAWE RP No. 7 3.4.9 and DI-MGMT-81502

DoD/MIL Doc: DI-MGMT-81502

TO 1-1B-50 "USAF Weight and Balance"

TM 55-1500-342-23 "Army Aviation Maintenance Engineering Manual – Weight and Balance"

NA 01-1B-50 "USN/USMC Aircraft Weight and Balance Control"

5.6 Flight release.

5.6.1 Verify that the flight release is based on up-to-date design criteria and mass properties, and the completion of all required analyses; laboratory, ground, and flight tests relating to loads, strength, durability, damage tolerance, structural dynamics, and stiffness; and verify that the structural data generated by the required analysis and test substantiates the integrity and flight worthiness of the design.

DoD/MIL Doc: JSSG-2006: A.3.5, A.3.6, A.3.7, A.4.7, A.4.10.5.3, A.4.10.5.4, A.4.10.5.5

6. FLIGHT TECHNOLOGY

Flight technology comprises the flight mechanics functional areas consisting of stability & control, flying qualities, vehicle management functions, flight control functions, external aerodynamics, internal aerodynamics and performance. The air vehicle aerodynamic and stability configuration, engine/inlet/nozzle compatibility, performance and integrated control airworthiness of an air vehicle should be assessed using the criteria provided in the text below (not all items apply in each case; similarly, items may have to be added for vehicles employing new or innovative technology/techniques).

TYPICAL CERTIFICATION SOURCE DATA

1. Design criteria
2. Design studies and analyses
3. Design, installation, and operational characteristics
4. Simulation tests, modeling, and results (including simulation verification, validation and accreditation data)
5. Design approval and function/system compatibility tests
6. Component and functional level qualification and certification tests
7. Electromagnetic environmental effects
8. Installed propulsion compatibility tests
9. Acceptance criteria for test results
10. Failure modes, effects, and criticality analysis/testing (FMECA/FMET)
11. Hazard analysis and classification
12. Safety certification program
13. Computational, theoretical, and/or semi-empirical prediction methods
14. Configuration: aerodynamic design and component location
15. Wind tunnel test results and correction methods
16. Mathematical representation of system dynamics
17. Ground resonance and loop stability tests
18. Aeroservoelastic design criteria and analysis
19. Performance analysis
20. Flight manual
21. Natural environmental sensitivities
22. Flight path guidance analysis and simulation to include ship launch and recovery routines if applicable (including sensor or processor failure modes and effects on flight control)
23. Interface/integration control documents
24. Function, subfunction, and component specifications
25. Selection criteria and patterns selected for screens constructed to demonstrate inlet/engine compatibility
26. Flight test plan
27. Detailed flight profiles
28. Aircraft/engine operating limitations

29. Software development plan
30. Software development and product specifications
31. Software test plans, test procedures, and test reports
32. Software configuration control/management plan and procedure
33. Control laws
34. Flight test reports
35. Aerodynamic and air data uncertainty sensitivity studies
36. Thrust-drag bookkeeping system
37. Mass properties: weights, C.G.'s, and inertias

CERTIFICATION CRITERIA

DoD/MIL Doc: JSSG-2001 Air Vehicle

JSSG-2008 Vehicle Control and Management Systems

FAA Doc: NOTE: As each section applies, flight technology must be checked for a variety of 14CFR references and ACs. Due to the complexity of different design configurations, each section in Subpart C of 14CFR reference 23/25 should be consulted for applicability.

6.1 Stability and control.

DoD/MIL Doc: JSSG-2001 Air Vehicle Specification and Appendix C

MIL-STD-1797A: refer to appropriate sections to comply with the airworthiness criteria, standards, and methods of compliance for piloted air vehicles throughout this section

ADS-33E-PRF (rotary aircraft)

For UAV/ROA: TDB

FAA Doc: 14CFR references: 23.21-23.3, 23.171-23.181

14CFR references: part 25 (Airworthiness Standards: Transport Category Airplanes)

AC-23-8B (Flight Test Guide for Certification of Part 23 Airplanes)

AC-25-7A (Flight Test Guide for Certification for Transport Category Airplanes)

6.1.1 Control power.

6.1.1.1 Verify control power:

a. At minimum controllable speeds
b. For rotation on takeoff
c. To handle control surface mis-trim on takeoff
d. To prevent or stop over-rotation in takeoff
e. To provide safe control for go-around with engine(s) failure (critical engine(s) inoperative)
f. To provide safe maneuver margins during trimmed flight on approach
g. For sufficient trim capability

h. To provide safe control margins in the event of abnormal or asymmetric fuel function operation

i. To safely handle transient effects

j. To safely handle problems arising from asymmetric or symmetric failures of trim controls and any adverse control surface positioning or special use surface(s)/devices

k. To safely handle unwanted deployment or activation of thrust reverser or vectored thrust equipment whenever the possibility is not extremely improbable

l. Sufficient for unique vehicle performance

m. To safely handle engine failures during take-off ground roll

DoD/MIL Doc: JSSG-2001A: Appendix C C.3.1, C.3.13.4.2 & C.4.1, " Control power"

MIL-STD-1797A: 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8 and 5.9

6.1.2 Stability characteristics and transients.

6.1.2.1 Verify that safe static and dynamic stability exists with augmentation or active control functions operating. If sufficient redundancy is not provided in the air vehicle flight control functions to provide fail-safe operation, verify that the basic airframe (unaugmented) possesses the required stability characteristics and safety margins.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3

FAA Doc: 14CFR reference: 25.171-25.181

6.1.2.2 Verify that augmentation function(s), active control function(s), and related flight mode(s) engagements and disengagements do not result in unsafe transients.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR reference: 25.171-25.181

6.1.2.3 For autonomous vehicle control, verify that the net stability, with the guidance and control system operating, is safe for the intended mission under normal operating conditions.

DoD/MIL Doc: TBD: Refer to technical point of contact for this discipline (listed in section A.2)

FAA Doc: TBD: Refer to technical point of contact for this discipline (listed in section A.2)

6.1.3 Flying, handling, and ride qualities.

6.1.3.1 Verify safe flying quality characteristics in turbulence (including ship's airwake/burble).

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR reference: 23.361, 25.341, 23.1501-23.1529, 25.1501-25.1529

6.1.3.2 Verify that the control law concepts employed are compatible with mission and safety requirements.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR reference: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.3.3 Verify that the design exhibits safe vehicle flying characteristics for:

a. Classical, safe, second-order response in pitch
b. First-order, well-behaved response in roll without roll ratcheting or other roll sensitivities
c. Equivalent system time delay

6.1.3.4 Verify that aeroelastic, nonlinear, discontinuous, and unsteady aerodynamic effects demonstrate a safe vehicle.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.3.5 Verify that aircraft pilot coupling (APC) and pilot-induced oscillation (PIO) tendencies and flight characteristics are safe.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.3.5.1 Verify safe phase and gain margins.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.3.5.2 Verify, under high gain conditions, that the design does not exhibit unsafe limit cycle oscillations, unbounded oscillations, unsafe triggering mechanisms during mode transitions, or unsafe sudden/steep gain changes.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.3.6 Verify general ground handling characteristics to be safe for

a. Positive steering control
b. Steering sensitivities
c. Steering fade in/out
d. Failure conditions
e. Ground control paths

6.1.3.7 Verify safe aerodynamic/flight characteristics for

a. High angle of attack
b. Pitch-up tendencies
c. Recovery from stall angles of attack
d. Post-stall maneuvering/control
e. Recovery from the loss of control during accelerated/nonaccelerated flight
f. Recovery from buffet effects
g. Normal and abnormal effects of secondary/infrequently used control surfaces/devices
h. High slip angles
i. Large and unusual attitudes
j. Spin recovery

6.1.3.8 Verify hinge moment characteristics are adequate to satisfy safety requirements.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.3.9 Verify safe stability and control dynamics under symmetrical and asymmetrical maneuvers, *with and without stores, for:*

a. Control surface float angles
b. Control surface blow-back
c. Control surface nonlinearities
d. The vehicle control system or actuation functions to overcome actual moments
e. Establishing levels of flying qualities for the vehicle
f. Control surface hinge moment limiting

6.1.3.10 Verify that the stability and control effects of basic design features, as well as unique features, are safe in the entire flight envelope(s).

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.3.11 Verify all rate-limiting functions of the control function are safe to fly under flight scenarios employing all types of gain changes.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.4 Mission evaluations including flight path guidance.

6.1.4.1 Verify that the air vehicle responds safely in all axes to commands coming from the flight path guidance devices and processors.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.4.2 Verify that flight path guidance systems safely compensate for degraded modes/failures of operation.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.4.3 Verify that all transitions to and from normal flight path guidance modes, whether augmented or manually selected, are safe.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.5 Other effects.

6.1.5.1 Verify that no unsafe roll-yaw-pitch coupling(s) occur due to aerodynamic, kinematic, or inertial effects.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.5.2 Verify that no unsafe roll-yaw-pitch coupling(s) occur due to engine coupling for symmetrical or asymmetrical thrust and gyroscopic effects.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.5.3 Verify that stall or loss of control warning function(s) and limiting and prevention functions to be safe for all required combinations of maneuver configurations, flight conditions, and loadings.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.5.4 Verify that "WRONG CONFIGURATION" warning functions are safe in all flight regimes. These include wing sweep, flap and landing gear position, and other variable geometry features.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references:23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.5.5 Verify that flying quality nonlinear effects are safe when these effects or characteristics influence the vehicle characteristics including degradation and retention of critical pilot vehicle interface (PVI) and vehicle control functions (VCF) due to failures.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.5.6 Verify adequate actuator dynamics for a safe vehicle.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.5.7 Verify sensor dynamic characteristics for a safe vehicle.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.5.8 Verify adequate cockpit control dynamics for a safe vehicle.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.5.9 Verify safe failure mode effects with operator-in-the-loop.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.5.10 Verify that control gradient forces are safe for the entire range of applications.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.5.11 Verify safe, unimpeded crew visual characteristics for all flight and ground conditions.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.5.12 Verify that proposed ship launch/recovery wind envelopes and ship pitch and roll limits are safe.

DoD/MIL Doc: TBD: Refer to NAVAIR technical point of contact for this discipline (listed in section A.2)

6.1.5.13 Verify that the control tasks and workload levels associated with flight profiles are safe.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.5.14 Verify that handling qualities with backup power sources are safe.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.6 Envelopes.

6.1.6.1 Verify that stability and response characteristics are safe for the anticipated critical flight conditions for the entire ground and flight envelopes.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.6.2 Verify that the air data function is safe.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.6.3 Verify that the flight-critical parameters list for completeness.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

FAA Doc: 14CFR references: 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.1.6.4 Verify that the flight manual, and any supplements containing the air vehicle/engine operating limits, adequately describes the air vehicle's:

a. Performance
b. Flight characteristics under normal and emergency conditions
c. Control functions under normal and emergency conditions
d. Other critical limits to ensure safe flight.

6.1.7 Store carriage and separation.

6.1.7.1 Verify that store carriage and separation response characteristics and limitations are safe.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

6.1.7.2 Verify that existing stores are safe for use in the intended envelope and environment.

DoD/MIL Doc: JSSG-2001: 3.3.11.1 thru 3.3.11.1.3; and Appendix C

6.1.7.3 Verify the safety and envelope of intentional and unintentional asymmetric stores combinations.

DoD/MIL Doc: JSSG-2001: 3.4.2.1, JSSG-2008: 3.1.5.3, 3.1.5.8, 3.2.1.2

6.1.8 Validation of modeling, simulation and analysis tools.

DoD/MIL Doc: MIL-STD-1797A sections 4.1.9 and 4.1.10

JSSG-2008: section 3.0

6.2 Vehicle control functions (VCF).

DoD/MIL Doc: MIL-STD-1797A, "Flying Qualities of Piloted Aircraft"

6.2.1 VCF architecture design.

6.2.1.1 Verify the functional criteria to be safe.

DoD/MIL Doc: JSSG-2008: 3.0 thru 3.8, 4.0 thru 4.8

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.1.2 Verify the VCF high-level architecture function to be safe for the supporting control function.

DoD/MIL Doc: JSSG-2008: 3.1.7 thru 3.1.7.3, 4.1.7 thru 4.1.7.3

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.1.3 Verify that the integrated VCF architecture safely implements the proper levels of redundancy, fault tolerance, physical/functional separation of flight/safety-critical functions/components and other aspects.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.11 thru 3.1.12.1, 4.1.11 thru 4.1.12.1

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.1.4 Verify the autonomy of each function integrated in or by the VCF design to be safe.

DoD/MIL Doc: JSSG-2008: 3.1.1 thru 3.1.4, 4.1.1 thru 4.1.4

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.1.5 Verify that failure mode effects are safe for the entire VCF operation.

DoD/MIL Doc: JSSG-2008: 3.1.9, 4.1.9

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.1.6 Verify that special failure states of single fail, dual fail, and special single fail/combination failure(s), as well as order of failure(s), are safe.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.11 thru 3.1.11.2, 4.1.11 thru 4.1.11.2

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2 Basic VCF.

6.2.2.1 Verify that the VCF which transmit crew control commands or generate and/or convey commands are safely implemented for the entire range of vehicle and crew responses.

DoD/MIL Doc: JSSG-2008: 3.1.1, 4.1.1, 3.1.11.10, 4.1.11.10, 3.1.11.11 thru 3.1.11.11.4, 4.1.11.11 thru 4.1.11.11.4, 3.2.2 thru 3.2.2.5.4, 4.2.2 thru 4.2.2.5.4

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.2 Verify that functional characteristics of friction levels, breakout forces, dead zones, hysteresis, and backlash are safe.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.2.2.5.1.1, 4.2.2.5.1.1

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.3 Verify that longitudinal, lateral-directional, lift, drag, performance limiting, and variable geometry control functions are safely mechanized.

DoD/MIL Doc: JSSG-2008: 3.1.5.3, 4.1.5.3, 3.2.1 thru 3.2.1.4, 4.2.1 thru 4.2.1.4, 3.2.2.5.4, 4.2.2.5.4

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.4 Verify that the vehicle control system is safely able to obtain the maximum required control surface positions without mechanical interference.

DoD/MIL Doc: JSSG-2008: 3.2.1 thru 3.2.1.4, 4.2.1 thru 4.2.1.4, 3.2.2.5 thru 3.2.2.5.1.1, 4.2.2.5 thru 4.2.2.5.1.1, 3.2.3, 4.2.3

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.5 Verify actuation for surface rate and hinge moments under normal conditions and capability under blowback conditions to be safe.

DoD/MIL Doc: JSSG-2008: 3.1.5.6 thru 3.1.5.7, 4.1.5.6 thru 4.1.5.7, 3.2.2.1, 4.2.2.1, 3.2.1, 4.2.1, 3.2.1.1, 4.2.1.1

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.6 Verify that the cockpit control forces are safe for any control mechanization.

DoD/MIL Doc: JSSG-2008: 3.2.2.3, 4.2.2.3, 3.2.2.5.1, 4.2.2.5.1, 3.2.2.5.1.1, 4.2.2.5.1.1, 3.2.2.5.1.3, 4.2.2.5.1.3

FAA Doc: 14CFR references: 23.779, 25.779, 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.7 Verify that functional control nonlinearities are safe.

DoD/MIL Doc: JSSG-2008: 3.2.2.5.4 thru 3.2.2.5.4.5, 4.2.2.5.4 thru 4.2.2.5.4.5

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-

23.1529, 25.1501-25.1529

6.2.2.8 Verify that trim ranges and rates are safe.

DoD/MIL Doc: JSSG-2008: 3.2.2.5.1.3, 4.2.2.5.1.3

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.9 Verify that trim failure protection is safe.

DoD/MIL Doc: JSSG-2008: 3.2.2.5.1.3, 4.2.2.5.1.3

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.10 Verify that control devices in normal and failed states intended for intermittent operation are safe (e.g., flaps, speed brakes, geometry mechanisms, auxiliary control devices).

DoD/MIL Doc: JSSG-2008: 3.1.8, 4.1.8, 3.2.1.3, 4.2.1.3, 3.2.1.4, 4.2.1.4, 3.2.1, 4.2.1, 3.2.2.5.4.5, 4.2.2.5.4.5, 3.1.12 thru 3.1.12.1, 4.1.12 thru 4.1.12.1

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.11 Verify that safety protection functions/devices are safely implemented.

DoD/MIL Doc: JSSG-2008: 3.1.5.3, 3.1.5.2, 3.1.5.4, 3.1.9, 3.1.11.1, 3.1.10, 3.1.11.1.1, 3.1.13 to 3.1.13.2, 3.1.16, 3.2.2.5.4.1, 3.2.4 thru 3.2.4.6, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.12 Verify that alternate control paths available for each control axis or mode are safe.

DoD/MIL Doc: JSSG-2008: 3.1.2.1, 4.1.2.1, 3.1.11.1, 4.1.11.1, 3.1.12 thru 3.1.12.1, 4.1.12 thru 4.1.12.1

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.13 Verify that ratio changers and artificial feel devices with proper protection are safely implemented.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1.7.2, 4.1.7.2, 3.1.11.11, 4.1.11.11, 3.1.11.11.1, 4.1.11.11.1, 3.1.12.1, 4.1.12.1, 3.1.14.4, 4.1.14.4

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.14 Verify that no single, like dual, second, or single combination failure points in any VCF function result in an unacceptable probability of loss of function.

DoD/MIL Doc: JSSG-2008: 3.1.11.1, 3.1.11.1.1, 3.1, 3.1.2, 3.1.5.5, 3.1.5.6, 3.1.7.3, 3.1.9, 3.1.11.4, 3.1.11.7, 3.1.12, 3.1.13.2, 3.1.14.4, 3.1.17, 3.2.2.2 thru 3.2.2.2.13, 3.3.3, 3.4.2, 3.5.7 and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-

23.1529, 25.1501-25.1529

6.2.2.15 Verify that the VCF components meet safety requirements.

DoD/MIL Doc: JSSG-2008: 3.1.14 thru 3.1.14.9, 4.1.14 thru 4.1.14.9, 3.1.15 thru 3.1.18, 4.1.15 thru 4.1.18, 3.2.3 thru 3.2.3.3, 4.2.3 thru 4.2.3.3, 3.4 thru 3.5.2, 4.4 thru 4.5.2

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.16 Verify that no unsafe mechanical interference or jamming situations exist in VCF mechanization.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1.11.11, 4.1.11.11, 3.1.11.11.1, 4.1.11.11.1, 3.1.14, 4.1.14, 3.2.2.1, 4.2.2.1, 3.5.7, 4.5.7

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.17 Verify that the clearances available safely tolerate foreign object damage (FOD).

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.7.2, 4.1.7.2, 3.1.7.3, 4.1.7.3, 3.1.11.11, 4.1.11.11, 3.1.13, 4.1.13, 3.1.14, 4.1.14, 3.1.14.5, 4.1.14.5, 3.2.3, 4.2.3, 3.2.3.3, 4.2.3.3, 3.4.4, 4.4.4, 3.5.7, 4.5.7

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.18 Verify that control laws are safe for the normal intended application.

DoD/MIL Doc: JSSG-2008: 3.1, 3.1.5.2, 3.1.5.5, 3.1.5.7, 3.1.8, 3.1.11.6, 3.1.11.8, 3.1.13, 3.1.14.8, 3.1.16, 3.1.17, 3.1.18, 3.2.2.1, 3.2.2.4, 3.2.2.5.2, 3.2.2.5.4 thru 3.2.2.5.4.5, 3.2.2.6, 3.3.1, 3.3.4, 3.3.5, 3.3.7, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.19 Verify that control laws transients for gain and mode changes prevent unsafe flight conditions.

DoD/MIL Doc: JSSG-2008: 3.1, 3.1.2, 3.1.2.1, 3.1.3, 3.1.5, 3.1.5.1, 3.1.5.2, 3.1.5.4, 3.1.5.5, 3.1.5.7, 3.1.5.8, 3.1.7, 3.1.7.2, 3.1.7.3, 3.1.9, 3.1.10, 3.1.11, 3.1.11.2, 3.1.11.4, 3.1.11.5, 3.1.11.6, 3.1.11.9, 3.1.11.10, 3.1.11.11.2, 3.1.11.11.3, 3.1.12, 3.1.12.1, 3.1.13.1, 3.1.13.2, 3.1.14.2.2, 3.1.14.2.4, 3.2.2.1, 3.2.2.2, 3.2.2.5, 3.3 thru 3.3.4, 3.3.6, 3.3.6.2, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.20 Verify that control laws do not induce any kind of unsafe oscillatory effects.

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.5, 3.1.5.1, 3.1.5.6, 3.1.5.9, 3.1.7, 3.1.7.3, 3.1.11.11.3, 3.2.1.1, 3.2.2.1, 3.2.2.5.4, 3.2.2.5.4.2, 3.2.2.5.4.3, 3.2.2.5.4.4, 3.2.2.6, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.21 Verify that control laws do not have unsafe PIO tendencies.

DoD/MIL Doc: JSSG-2008: 3.1, 4.1, 3.1.5.2, 4.1.5.2, 3.1.5.7, 4.1.5.7, 3.1.7.2, 4.1.7.2, 3.1.11.6, 4.1.11.6, 3.1.14.7, 4.1.14.7,3.2.2.5.4, 4.2.2.5.4

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.22 Verify that control laws redundancy and failure management designs are safely implemented.

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.1, 3.1.2, 3.1.2.1, 3.1.4, 3.1.5.5, 3.1.5.7, 3.1.7, 3.1.7.2, 3.1.9, 3.1.10, 3.1.11, 3.1.11.2, 3.11.5, 3.1.11.6, 3.1.11.7, 3.1.12, 3.1.12.1, 3.1.13.1, 3.1.17, 3.2.2.4, 3.2.2.5, 3.2.2.5.1.4, 3.2.2.5.4, 3.2.5.2, 3.3.1, 3.3.2, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.23 Verify that control laws sensitivity margins and phase and gain margins for each feedback loop are safe (see 6.1).

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.5, 3.1.5.7, 3.1.5.8, 3.1.5.9, 3.1.7.2, 3.1.7.3, 3.1.11.2, 3.1.11.10, 3.1.11.11.1, 3.1.17, 3.2.2.1, 3.2.2.2.9, 3.2.2.5.4, 3.2.2.5.4.2, 3.2.2.5.4.3, 3.2.2.5.4.4, 3.2.2.6, 3.3.2.1, 3.3.4, 3.5, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.24 Verify that functional command control authority limits are safe.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.5.3, 4.1.5.3, 3.1.7, 4.1.7, 3.1.8, 4.1.8, 3.1.12, 4.1.12, 3.1.13.2, 4.1.13.2, 3.2.2.5, 4.2.2.5, 3.2.2.5.1.2, 4.2.2.5.1.2, 3.2.2.5.1.3, 4.2.2.5.1.3, 3.2.2.5.1.4, 4.2.2.5.1.4, 3.2.2.5.4.1, 4.2.2.5.4.1, 3.2.2.6, 4.2.2.6

FAA Doc: 14CFR references: 23.345, 23.397, 23.672, 23.675, 23.677, 23.679, 25.345, 25.397, 25.672, 25.675, 25.677, 25.679

6.2.2.25 Verify that dynamic VCF functional performance is safe.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.2, 4.2, 3.3, 4.3, 3.4, 4.4, 3.5, 4.5

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.26 Verify that the vehicle provides the crew with the capability to override the design-limited vehicle control functions safely.

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.5.2, 3.1.5.4, 3.1.7, 3.1.10, 3.1.11, 3.1.11.1, 3.1.11.1.1, 3.1.11.10, 3.1.14.7, 3.2, 3.2.2.3, 3.2.2.5.1, 3.2.2.5.1.2, 3.2.2.5.1.4, 3.2.2.5.4, 3.2.2.5.4.1, 3.2.2.5.4.3, 3.2.2.5.4.4, 3.2.2.5.4.5, 3.2.2.6, 3.5.3, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.27 Verify that nonoperative devices/programs can be safely locked out of any functions.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.13, 4.1.13, 3.1.13.1, 4.1.13.1, 3.1.13.3, 4.1.13.3, 3.1.14.7, 4.1.14.7, 3.2.2.2.2, 4.2.2.2.2, 3.2.2.5.1.3, 4.2.2.5.1.3, 3.2.2.6, 4.2.2.6

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.28 Verify that engage/disengage functions/devices are safely assigned and identified for the crew.

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.5.2, 3.1.5.8, 3.1.5.9, 3.1.7.2, 3.1.7.3, 3.1.11, 3.1.11.2, 3.1.13.1, 3.1.13.3, 3.1.14, 3.1.14.7, 3.2.2.2.4, 3.2.2.2.5, 3.2.2.2.9, 3.2.2.2.11, 3.2.2.4, 3.2.2.5.1, 3.2.2.5.1.1 thru 3.2.2.5.1.4, 3.2.2.5.4.1, 3.2.2.6, 3.3.2.1, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.29 Verify that interlocks safely preclude incompatible modes, simultaneous engagement, and engagement with incompatible flight conditions or air vehicle configurations.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.7.3, 4.1.7.3, 3.1.11.2, 4.1.11.2, 3.2.2.5.4.3, 4.2.2.5.4.3, 3.2.2.5.4.4, 4.2.2.5.4.4

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.30 Verify that engage and disengage transient times are safe.

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.5.2, 3.1.5.4, 3.1.5.5, 3.1.7.2, 3.1.7.3, 3.1.11, 3.1.11.5, 3.1.12, 3.1.12.1, 3.1.13.2, 3.1.14, 3.2.2.1, 3.2.2.2.1, 3.2.2.2.2, 3.2.2.2.6, 3.2.2.2.12, 3.2.2.5.4, 3.2.2.5.4.3, 3.2.2.6, 3.3.1, 3.3.2, 3.3.2.1, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.31 Verify that mode change transient times are safe.

DoD/MIL Doc: For more guidance on mode change transient times:

JSSG-2008: 3.0, 3.1, 3.1.2, 3.1.5, 3.1.5.1, 3.1.5.2, 3.1.7, 3.1.7.3, 3.1.11.2, 3.1.11.10, 3.1.14.7, 3.1.17, 3.2.2.2.9, 3.2.2.5, 3.2.2.5.1.1, 3.2.2.5.1.2, 3.2.2.5.4, 3.2.2.5.4.3, 3.2.2.5.4.5, 3.2.2.6, 3.2.4.6, 3.2.5.1, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.32 Verify that warning and caution functions safely operate and properly notify the crew.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.11.10, 4.1.11.10, 3.1.13.4, 4.1.13.4, 3.1.17, 4.1.17, 3.2.2.2.7, 4.2.2.2.7, 3.2.2.5.1.2, 4.2.2.5.1.2, 3.2.2.5.1.4, 4.2.2.5.1.4

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.33 Verify that sensors are safely located to minimize/avoid structural mode coupling including vibration from configuration loading and gun fire, and to have safe sensitivity margins.

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.2.1, 3.1.5, 3.1.5.6, 3.1.7.2, 3.1.11, 3.1.13, 3.1.15, 3.1.17, 3.2.2.2, 3.2.2.5, 3.2.2.5.1.1, 3.2.2.5.2, 3.2.2.5.4.3, 3.2.2.5.4.4, 3.3.4, 3.3.6.2, 3.5.7, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.34 Verify that sensitivities with variations in slope and bias conditions of air data functions have safe margins.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.5, 4.1.5, 3.1.5.7, 4.1.5.7, 3.1.7, 4.1.7, 3.1.7.2, 4.1.7.2, 3.1.17, 4.1.17, 3.2.1.1, 4.2.1.1, 3.2.1.2, 4.2.1.2, 3.2.2.5, 4.2.2.5, 3.3.2.5.4.2, 4.3.2.5.4.2, 3.2.2.5.4.4, 4.2.2.5.4.4

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.35 Verify that the processor design of VCF is safe.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.14.6, 4.1.14.6, 3.1.18, 4.1.18, 3.2.2.2, 4.2.2.2, 3.3, 4.3, 3.3.1, 4.3.1, 3.3.2, 4.3.2, 3.3.2.1, 4.3.2.1, 3.3.2.2, 4.3.2.2, 3.3.2.3, 4.3.2.3, 3.3.4, 4.3.4

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.36 Verify that preflight checklists of VCF are all-inclusive and safe.

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.12, 3.1.13, 3.1.13.1, 3.1.14.7, 3.2.2.2, 3.2.2.5, 3.2.2.5.1, 3.2.2.5.2, 3.2.2.5.3, 3.3.6.2, 3.7.1, 3.7.1.1, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.37 Verify that interfaces/integration with other functions and sub-functions are safe.

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.2, 3.1.5, 3.1.7, 3.1.8, 3.1.11, 3.1.12, 3.1.13, 3.1.14.4, 3.2.2.2, 3.2.2.4, 3.2.2.5, 3.2.2.6, 3.3, 3.2.4, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.38 Verify the effects of loss of function(s) on safety.

DoD/MIL Doc: JSSG-2008: 3.0 thru 3.3.8, 4.0 thru 4.3.8

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.39 Verify that any functional modes do not defeat any limiters designed for vehicle safety.

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.5.2, 3.1.5.8, 3.1.5.9, 3.1.7.2, 3.1.7.3, 3.1.11, 3.1.11.2, 3.1.13.1, 3.1.13.3, 3.1.14, 3.1.14.7, 3.2.2.2.4, 3.2.2.2.5, 3.2.2.2.9, 3.2.2.2.11, 3.2.2.4, 3.2.2.5.1, 3.2.2.5.1.1 thru 3.2.2.5.1.4, 3.2.2.5.4.1, 3.2.2.6, 3.3.2.1, 3.3.6.2, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.40 Verify that data transfer and update rates are safe with adequate margins.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.5.1, 4.1.5.1, 3.1.5.5, 4.1.5.5, 3.1.5.6, 4.1.5.6, 3.1.7.3, 4.1.7.3, 3.1.17, 4.1.17, 3.3.2.1, 4.3.2.1, 3.3.4, 4.3.4

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.41 Verify that air vehicle functional/transient interruption characteristics are safe.

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.2, 3.1.5, 3.1.5.1, 3.1.5.2, 3.1.7, 3.1.7.3, 3.1.11.2, 3.1.11.10, 3.1.14.7, 3.1.17, 3.2.2.1, 3.2.2.2, 3.2.2.5, 3.2.2.5.1.1, 3.2.2.5.1.2, 3.2.2.5.4, 3.2.2.5.4.3, 3.2.2.5.4.5, 3.2.2.6, 3.2.4.6, 3.2.5.1, 3.3.6.2, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.42 Verify that failure mode effects for critical maneuvers and critical flight regions are safe.

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.5, 3.1.5.7, 3.1.5.8, 3.1.5.9, 3.1.9, 3.1.14, 3.2.1.3, 3.2.1.2, 3.2.2.2, 3.2.2.5, 3.2.2.5.4, 3.2.2.6, 3.3, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.43 Verify that flow rates for hinge moment, stiffness, and control surface rates are safe.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.5.6, 4.1.5.6, 3.1.5.7, 4.1.5.7, 3.2.1, 4.2.1, 3.2.2.1, 4.2.2.1, 3.2.2.2.1, 4.2.2.2.1, 3.2.2.5.4.4, 4.2.2.5.4.4

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.44 Verify that the actuator design meets safety requirements for

a. Actuator redundancy techniques
b. Failure isolation design capability and limitations
c. Hydraulic contamination effects
d. Bottoming and snubbing

6.2.2.45 Verify that the actuation system is safe (e.g., burst pressure, normal performance, high and low temperature, pressure impulses).

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.5.6, 4.1.5.6, 3.1.14.1, 4.1.14.1, 3.1.14.3, 4.1.14.3, 3.2.2.1, 4.2.2.1

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.46 Verify that motor/torque tube driven and similar control actuation mechanisms are safe (e.g., performance, implementation, redundancy management).

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.5.6, 4.1.5.6, 3.1.5.7, 4.1.5.7, 3.1.9, 4.1.9, 3.1.11, 4.1.11, 3.1.11.1, 4.1.11.1, 3.1.11.1.1, 4.1.11.1.1, 3.1.12, 4.1.12, 3.1.14.1, 4.1.14.1, 3.1.14.3, 4.1.14.3, 3.2.2.1, 4.2.2.1

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.47 Verify that command and control communications on the vehicle, other linked vehicles, and ground control are integrated safely with an acceptable probability of failure.

DoD/MIL Doc: JSSG-2008: 3.1, 4.1, 3.1.8, 4.1.8, 3.1.7.3, 4.1.7.3, 3.1.11, 4.1.11, 3.1.11.7, 4.1.11.7, 3.1.11.9, 4.1.11.9, 3.1.13, 4.1.13, 3.2.2.2, 4.2.2.2, 3.2.2.5.1.2, 4.2.2.5.1.2, 3.2.2.5.3, 4.2.2.5.3, 3.3, 4.3, 3.3.1, 4.3.1, 3.3.2.3, 4.3.2.3, 3.3.3, 4.3.3

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.48 Verify that all command and control communications are secure against unwanted intrusions and security techniques used are implemented safely.

DoD/MIL Doc: JSSG-2008: 3.1.8, 4.1.8, 3.1.14.6, 4.1.14.6, 3.1.16, 4.1.16, 3.2, 4.2, 3.3.1, 4.3.1

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.49 Verify that single space radiation upset events do not cause loss of control and that the probability of encountering multiple upsets producing loss of control is acceptably low.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.2, 4.1.2, 3.1.3, 4.1.3, 3.1.7.3, 4.1.7.3, 3.1.8, 4.1.8, 3.1.9, 4.1.9, 3.1.11.1, 4.1.11.1, 3.1.12, 4.1.12, 3.1.13.2, 4.1.13.2, 3.1.14.4, 4.1.14.4, 3.1.17, 4.1.17

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.50 Verify that propulsion control integration, control mechanisms, feedback loops, automatic throttle control systems, asymmetric thrust controlling conditions, special thrust control use conditions, atmospherics and hypersonic effects on thrust control are safe.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.2, 4.1.2, 3.1.5.3, 4.1.5.3, 3.1.5.5, 4.1.5.5, 3.1.7.3, 4.1.7.3, 3.1.11, 4.1.11, 3.1.13, 4.1.13, 3.1.13.3, 4.1.13.3, 3.1.17, 4.1.17, 3.2.2.2.9, 4.2.2.2.9, 3.2.2.5.1.1, 4.2.2.5.1.1, 3.2.2.5.4.5, 4.2.2.5.4.5, 3.3.1, 4.3.1

FAA Doc: 14CFR references: 25.901

6.2.2.51 Verify that VCF primary and integrated control function(s) security design is implemented safely.

DoD/MIL Doc: JSSG-2008: 3.1.11, 4.1.11, 3.1.14.6, 4.1.14.6, 3.1.16, 4.1.16, 3.2, 4.2, 3.3.1, 4.3.1

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.52 Verify that air data is safe for the following:

a. Implementation
b. Accuracy
c. Ground and air safety provisions
d. Anti-ice or ice prevention
e. Bird strike vulnerability

6.2.2.53 Verify that the environmental design and the equipment installation are safe.

DoD/MIL Doc: JSSG-2008: 3.1.14, 4.1.14, 3.4, 4.4, 3.5, 4.5(all)

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.2.54 Verify that vehicle control, payload, and ground system latencies and synchronizations are safe for mission accomplishment.

DoD/MIL Doc: ADS-51-HDBK

ADS-33E-PRF

Refer to Army Aviation technical point of contact for this discipline for specific guidance (listed in section A.2)

FAA Doc: TBD: Refer to technical point of contact for this discipline (listed in section A.2)

6.2.2.55 Verify that emergency procedures are appropriate and safe for the emergency that they address.

DoD/MIL Doc: ADS-51-HDBK

ADS-33E-PRF

Refer to Army Aviation technical point of contact for this discipline for specific guidance (listed in section A.2)

FAA Doc: TBD: Refer to technical point of contact for this discipline (listed in section A.2)

6.2.2.56 Verify, for rotary wing air vehicles, adequate transient response for single axis (collective or pedal) inputs.

DoD/MIL Doc: ADS-51-HDBK

ADS-33E-PRF

Refer to Army Aviation technical point of contact for this discipline for specific guidance (listed in section A.2)

FAA Doc: TBD: Refer to technical point of contact for this discipline (listed in section A.2)

6.2.2.57 Verify that multi-axis inputs (e.g., collective, pedal, and cyclic) are safe during typical operational mission maneuvers.

DoD/MIL Doc: ADS-51-HDBK

ADS-33E-PRF

Refer to Army Aviation technical point of contact for this discipline for specific guidance (listed in section A.2)

FAA Doc: TBD: Refer to technical point of contact for this discipline (listed in section A.2)

6.2.3 VCF power source criteria.

(Note: See section 12 for specific electrical power system criteria.)

6.2.3.1 Verify that hydraulic distribution has no single failure points resulting in loss of more than one hydraulic function.

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.2, 3.1.2.1, 3.1.3, 3.1.7.2, 3.1.7.3, 3.1.11, 3.1.11.11.3, 3.1.12, 3.1.12.1, 3.1.14.4, 3.1.14.9, 3.2.1.3, 3.2.2.2.1, 3.2.2.2.5, 3.2.3.1, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.3.2 Verify that hydraulic function dynamics do not have any unsafe pressure pulsating or resonant conditions.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.5.6, 4.1.5.6, 3.1.7.2, 4.1.7.2, 3.1.11.11.3, 4.1.11.11.3, 3.2.2.2.1, 4.2.2.2.1, 3.3 thru 3.3.4, 4.3 thru 4.3.4, 3.3.6, 4.3.6, 3.3.6.2, 4.3.6.2

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.3.3 Verify that backup and emergency hydraulic power function(s) do not have any unsafe effects from reduced flow rates or pressure or flutter margin.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.5.6, 4.1.5.6, 3.1.7.2, 4.1.7.2, 3.1.11.11.3, 4.1.11.11.3, 3.2.2.2.1, 4.2.2.2.1, 3.2.2.2.5, 4.2.2.2.5

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.3.4 Verify that any VCF flight limitations with emergency/backup hydraulic power and switchover time constants are safe.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.5.2, 4.1.5.2, 3.1.5.6, 4.1.5.6, 3.1.7.2, 4.1.7.2, 3.1.10, 4.1.10, 3.1.11.11.3, 4.1.11.11.3, 3.1.13, 4.1.13, 3.2.2.2.1, 4.2.2.2.1, 3.2.2.2.5, 4.2.2.2.5

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.3.5 Verify that VCF effects due to loss of each or part of each hydraulic function are safe. (See 8.1 for specific criteria.)

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.2, 3.1.2.1, 3.1.3, 3.1.7.2, 3.1.7.3, 3.1.11.11.3, 3.1.12.1, 3.1.13, 3.1.14.4, 3.1.14.9, 3.2.1.3, 3.2.2.2, 3.2.2.2.1, 3.2.2.2.5, 3.3 thru 3.3.4, 3.3.6, 3.3.6.2, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.3.6 Verify that electrical power normal/backup/emergency capability following loss of engine(s) and generator(s) for VCF is safe.

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.2, 3.1.5.2, 3.1.5.4, 3.1.7.2, 3.1.10, 3.1.11, 3.1.11.11.2, 3.1.13, 3.2.2.2, 3.2.2.2.2, 3.2.2.2.5, 3.3 thru 3.3.4, 3.3.6, 3.3.6.2, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.1351-23.1367, 25.1351-25.1363, 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.3.7 Verify that independent electrical power sources provide safe redundancy for VCF.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.2, 4.1.2, 3.1.2.1, 4.1.2.1, 3.1.3, 4.1.3, 3.1.7.2, 4.1.7.2, 3.1.11, 4.1.11, 3.1.11.11.2, 4.1.11.11.2, 3.1.12, 4.1.12, 3.1.12.1, 4.1.12.1, 3.2.2.2.2, 4.2.2.2.2, 3.2.2.2.5, 4.2.2.2.5, 3.3 thru 3.3.4, 4.3 thru 4.3.4, 3.3.6, 4.3.6, 3.3.6.2, 4.3.6.2

FAA Doc: 14CFR references: 23.1351-23.1367, 25.1351-25.1363, 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.3.8 Verify that electrical power transients, both normal and switchover, are safe.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.5.2, 4.1.5.2, 3.1.7.2, 4.1.7.2, 3.1.10, 4.1.10, 3.1.11.11.2, 4.1.11.11.2, 3.2.2.2.2, 4.2.2.2.2, 3.2.2.2.5, 4.2.2.2.5

FAA Doc: 14CFR references: 23.1351-23.1367, 25.1351-25.1363, 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.3.9 Verify that, if batteries are employed for SOF backup power, adequate charging methods and checks are provided and installation provisions for all batteries are safe.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.2, 4.1.2, 3.1.5.2, 4.1.5.2, 3.1.7.2, 4.1.7.2, 3.1.11.11.2, 4.1.11.11.2, 3.1.13, 4.1.13, 3.2.2.2.2, 4.2.2.2.2, 3.2.2.2.5, 4.2.2.2.5

FAA Doc: 14CFR references: 23.1351-23.1367, 25.1351-25.1363, 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.3.10 Verify that electrical power bus separation for prevention of single failure points is safe.

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.2, 3.1.2.1, 3.1.3, 3.1.7.2, 3.1.7.3, 3.1.10, 3.1.11.11.2, 3.1.12, 3.1.12.1, 3.1.14.4, 3.2.1.3, 3.2.2.2.2, 3.2.2.2.5, 3.2.3.1, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.1351-23.1367, 25.1351-25.1363, 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.3.11 Verify that effects of normal, abnormal, and failure modes of the electrical power function are safe for VCF.

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.2, 3.1.2.1, 3.1.3, 3.1.7.2, 3.1.7.3, 3.1.11.11.2, 3.1.13, 3.1.14.4, 3.2.1.3, 3.2.2.2.2, 3.2.2.2.5, 3.3 thru 3.3.4, 3.3.6, 3.3.6.2, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.1351-23.1367, 25.1351-25.1363, 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.3.12 Verify that direct, uninterruptible, quality electrical power implementation for VCF is safe.

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.2, 3.1.2.1, 3.1.3, 3.1.7.2, 3.1.7.3, 3.1.11, 3.1.11.11.2, 3.1.12, 3.1.12.1, 3.1.14.4, 3.2.1.3, 3.2.2.2.2, 3.2.2.2.5, 3.3 thru 3.3.4, 3.3.6, 3.3.6.2, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.1351-23.1367, 25.1351-25.1363, 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.4 Flight worthiness evaluations.

6.2.4.1 Verify that flight-critical components meet safety criteria.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.2, 4.1.2, 3.1.2.1, 4.1.2.1, 3.1.5, 4.1.5, 3.1.13, 4.1.13, 3.1.14, 4.1.14, 3.5.3, 4.5.3

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.4.2 Verify that all single point failures are identified with the associated probability of failure(s) and that they demonstrate an acceptable flight safety risk.

DoD/MIL Doc: JSSG-2008: 3.0, 4.0, 3.1, 4.1, 3.1.2, 4.1.2, 3.1.2.1, 4.1.2.1, 3.1.5.6, 4.1.5.6, 3.1.11, 4.1.11, 3.1.11, 3.1.11.1, 4.1.11.1, 3.2.4.1, 4.2.4.1, 3.5.3, 4.5.3

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.4.3 Verify that transient effects of failures impacting controllability or structure do not have any safety impacts to the vehicle or crew.

DoD/MIL Doc: JSSG-2008: 3.1, 3.1.2, 3.1.2.1, 3.1.3, 3.1.5, 3.1.5.1, 3.1.5.2, 3.1.5.4, 3.1.5.5, 3.1.5.7, 3.1.5.8, 3.1.7, 3.1.7.2, 3.1.7.3, 3.1.9, 3.1.10, 3.1.11, 3.1.11.2, 3.1.11.4, 3.1.11.5, 3.1.11.6, 3.1.11.9, 3.1.11.10, 3.1.11.11.2, 3.1.11.11.3, 3.1.12, 3.1.12.1, 3.1.13.1, 3.1.13.2, 3.1.14.2.2, 3.1.14.2.4, 3.2.2.1, 3.2.2.2, 3.2.2.5, 3.3 thru 3.3.4, 3.3.6, 3.3.6.2, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.4.4 Verify that the VCF can safely recover the air vehicle under worst-case flight envelope and engine failure conditions and identify any flight limitations in the flight manual.

DoD/MIL Doc: JSSG-2008: 3.0, 3.1, 3.1.5, 3.1.5.3, 3.1.5.7, 3.1.5.8, 3.1.5.9, 3.1.9, 3.1.14, 3.2.1.3, 3.2.1.2, 3.2.2.2, 3.2.2.5, 3.2.2.5.4, 3.2.2.6, 3.3, and associated section 4 paragraphs

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.4.5 Verify that undetected, latent, or unannounced failures do not result in unacceptable flying qualities.

DoD/MIL Doc: JSSG-2008: 3.1.8, 3.1.9

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.4.6 Verify that no unsafe handling characteristics are exhibited in critical flight phases for aerodynamic and air data uncertainty sensitivity studies/analyses.

DoD/MIL Doc: TBD: Refer to technical point of contact for this discipline (listed in section A.2)

FAA Doc: TBD: Refer to technical point of contact for this discipline (listed in section A.2)

6.2.4.7 Verify that vehicle control's and payload system's latency and synchronization responses are safe.

DoD/MIL Doc: TBD: Refer to technical point of contact for this discipline (listed in section A.2)

FAA Doc: TBD: Refer to technical point of contact for this discipline (listed in section A.2)

6.2.5 VCF software.

(Note: VCF software verification is accomplished under section 15.)

6.2.5.1 Verify the safe operation of each computer software configuration item (CSCI)/operational flight program (OFP) from unit to full flight program levels for all modes, inputs, failure detection, reconfiguration techniques, self-check operations, interfaces, and integration under all dynamic conditions.

DoD/MIL Doc: JSSG-2008: 3.3.6.2

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.5.2 Verify that the flight software version demonstrates acceptable performance and safety.

DoD/MIL Doc: JSSG-2008: 3.2.4.6, 3.3.6-3.3.8

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.5.3 Verify that critical control modes in all flight conditions are safe.

DoD/MIL Doc: JSSG-2008: 3.1.5.2, 3.1.5.8, 3.1.9, 3.1.11.2, 3.2.1.2, 3.2.3.2

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.5.4 Verify that single-point or probable multiple failures that can paralyze redundant controlling functions are within the required safety probabilities.

DoD/MIL Doc: JSSG-2008: 3.1.9-3.1.11.1.1

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.5.5 Verify that software compatibility with external, integrating software functions is safe.

DoD/MIL Doc: JSSG-2008: 3.2.4.6, 3.3.6-3.3.8

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.5.6 Verify that effects of the following are safe:

a. Software interrupts
b. Reinitialization
c. Resynchronization
d. Recheck
e. Reconfiguration
f. Restarts
g. Resets
h. Negation of environmental and generic error

DoD/MIL Doc: JSSG-2008: 3.2.4.6, 3.3.6-3.3.8

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.5.7 Verify that software design of self-check, failure monitoring, redundancy management, reconfiguration, voting, transient suppression, overflow protection, anti-aliasing, saturation, interlocks, memory protection, failure propagation, and other techniques prevent unsafe flight situations.

DoD/MIL Doc: JSSG-2008: 3.2.4.6, 3.3.6-3.3.8

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.5.8 Verify that built-in-test implementation operates failure free and safely identifies, isolates, and corrects malfunctions.

DoD/MIL Doc: JSSG-2008: 3.1.11.11.2, 3.1.13

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.2.5.9 Verify that security design of VCF software loading techniques is safe.

DoD/MIL Doc: JSSG-2008: 3.1.14.6

FAA Doc: 14CFR references: 23.141-23.253, 25.21-25.255, 23.321-23.459, 25.321-25.459, 23.1501-23.1529, 25.1501-25.1529

6.3 Aerodynamics and performance.

DoD/MIL Doc: JSSG-2001: Appendix D

6.3.1 Flight vehicle.

6.3.1.1 Verify that the air vehicle can be recovered safely over the entire flight envelope in the presence of malfunctions.

DoD/MIL Doc: MIL-STD-1797

MIL-HDBK-516: 14.1.1.4j-k

JSSG-2001A: 3.3.11.1, 3.3.11.1.1.3, 3.3.11.2, C.3.1-2, C.3.6

JSSG-2006: 3.7.3

JSSG-2007: 3.7.2.1, Appendix A

JSSG-2008: 3.1.4, 3.2.1.2, 4.3.10, A.3.3.3.2

JSSG-2000: 3.3.6.1

FAA Doc: 14CFR references: 23.21, 23.141, 23.347, 23.671-2, 25.21, 25.143, 25.671-2, 27.21, 27.141, 27.671-2, 29.21, 29.141, 29.671-2

6.3.1.2 Verify that safe takeoff, landing, and critical field length performance are safe for the intended atmospheric conditions.

DoD/MIL Doc: MIL-STD-3013: 3.2, 3.2.10, 3.8, Appendix A

MIL-DTL-7700

JSSG-2001A, Appendix E

FAA Doc: 14CFR references: 23.45, 25.101, 27.45, 29.45

6.3.1.3 Verify that engine(s) inoperative performance (if appropriate) is safe, including optimum speeds for energy management and possible autorotation.

DoD/MIL Doc: MIL-STD-3013: 3.2.11, 3.3.1.4, 4.2.2.1.2

MIL-HDBK-1797A

JSSG-2001A: Appendix E

ADS-40A-SP Air Vehicle Flight Performance Description

FAA Doc: 14CFR references: 23.903, 23.1501, 23.1541, 23.1581, 25.903, 25.1501, 25.1541, 25.1581, 27.175, 27.547, 27.691, 27.917, 27.1027, 29.175, 29.547, 29.691, 29.917, 29.1027

6.3.1.4 Verify that the flight manual data limits for takeoff, landing, hover, climb, maneuver, cruise, descent, emergency conditions, including height/velocity diagrams for rotary wing air vehicles, and any other critical factors, are adequate to conduct safe flights.

DoD/MIL Doc: JSSG-2001A Appendix C: C.3.2

MIL-STD-3013: 4.1.10

MIL-DTL-7700

ADS-40A-SP Air Vehicle Flight Performance Description

FAA Doc: 14CFR reference Part: 23.45, 23.1501, 23.1541, 23.1581, 25.101, 25.1501, 25.1541, 25.1581, 27.45, 27.79, 27.1501, 27.1587, 27.1541, 27.1581, 29.45, 29.87, 29.1501, 29.1517, 29.1541, 29.1581, 29.1587

6.3.1.5 Verify that store carriage and separation characteristics for the prescribed stores are safe.

DoD/MIL Doc: JSSG-2000A: 6.3.25

JSSG-2001A: 4.1.1.2, 4.4.1.1, 4.4.1.2

JSSG-2001A Appendix C: 4.4, 4.5

MIL-HDBK-1763, Aircraft/Stores Certification Process

MIL-HDBK-244A, Guide to Aircraft Stores Compatibility

MIL-HDBK-516B: 17.2.1, 17.2.2, 17.2.3

6.3.1.6 Verify that flight manual specified performance or other predictions of power available, power required, fuel flow, ground effect, engine out and autorotation performance are sufficiently accurate to assure safe conduct of flight operations throughout the range of gross weights and ambient conditions.

DoD/MIL Doc: MIL-STD-3013: 4.1.10

MIL-DTL-7700

ADS-40A-SP Air Vehicle Flight Performance Description

ADS-10C-SP Air Vehicle Technical Description

FAA Doc: 14CFR references: 23.21, 23.25, 23.29, 23.45, 23.333, 23.1501, 23.1563, 23.1581, 25.21, 25.25, 25.27, 25.29, 25.101, 25.333, 25.1501, 25.1563, 25.1581, 27.21, 27.25, 27.27, 27.29, 27.45-75, 27.1501, 27.1581, 29.21, 29.25, 29.27, 29.29, 29.45-85, 29.1501, 29.1581

6.3.2 Installed propulsion capability.

Comm'l Doc: ARP 1420 Gas Turbine Engine Inlet Flow Distortion Guidelines

AIR 1419 Inlet Total-Pressure-Distortion Considerations for Gas-Turbine Engines

AIR 5826 Distortion Synthesis/Estimation Techniques

DoD/MIL Doc: JSSG-2001: 3.3.1.1.1, 4.3.1.1.1, 3.3.1.1.1.1, 4.3.1.1.1.1, 3.3.1.1.1.2, 4.3.1.1.1.2, 3.3.1.1.2, and 4.3.1.1.2

JSSG-2007A: A.3.2, A.4.2, A.3.11, A.4.11, A.3.12, A.4.12, A.3.2.2, A.4.2.2, A.3.2.2.7, and A.4.2.2.7

FAA Doc: 14CFR references: 33.5, 33.7, AC 33-2B

6.3.2.1 Verify that airframe/inlet/engine compatibility evaluations are adequate for safe operation (see Section 7).

DoD/MIL Doc: JSSG-2001: 3.3.1.1.1, 4.3.1.1.1, 3.3.1.1.1.1, 4.3.1.1.1.1, 3.3.1.1.1.2, 4.3.1.1.1.2, 3.3.1.1.2, and 4.3.1.1.2

JSSG-2007A: A.3.2, A.4.2, A.3.11, A.4.11, A.3.12, A.4.12, A.3.2.2, A.4.2.2, A.3.2.2.7, and A.4.2.2.7

FAA Doc: 14CFR references: 23.1521, 25.1521

6.3.2.2 Verify safe operation for the following:

a. Engine steady and transient response characteristics of the engine and engine control system (see 7.2.4.1.3 and 7.2.4.1.5)

b. Fuel flow modulation (see 7.2.2.2 and 7.2.4.1)

c. Engine responses to input signals at different frequencies (see 7.2.4.1)

d. Engine control and vehicle control system communication (see 7.2.4.1.1)

e. Fuel, air induction, exhaust and bleed air extraction systems, ambient temperatures, ambient pressures, and vibratory environment (see 7.2.5.2.2, 7.2.5.2.3, 7.2.5.3, 7.2.5.4, and 7.2.5.5)

f. Sensitivity, stability, control response, and torque predictability for engine and vehicle control during engine power changes (acceleration and deceleration) (see 7.2.2.2, 7.2.4.1.3, and 7.2.4.1.5)

g. Auxiliary engine control functions (see 7.2.4.1.3 and 7.2.4.1.4)

h. Altitude cold start and hot restart capability (see 7.2.2.3 and 7.2.2.4).

DoD/MIL Doc: For a. – e., g., and h. above: JSSG-2007: 3.1.1.15, 4.1.1.15, 3.3, 4.3, 3.4, 4.4, 3.5, 4.5, 3.7, 4.7, 3.11, 4.11, 3.12, 4.12

For f. above: JSSG-2007: 3.2, 4.2, 3.11, 4.11, 3.12, 4.12, 3.2.2, 4.2.2, 3.2.2.7, 4.2.2.7

FAA Doc: For a., c., d., and g. above: 14CFR references: 33.28, 33.53, AC 33-2B, 33.28-1

For b. and h. above: 14CFR references: 33.35, 33.67, AC 33-2B, 33-5

For f. above: 14CFR references: 33.5, 33.7, AC 33-2B

6.3.2.3 Verify that engine performance restrictions resulting from thermal boundaries (reflected in the proper databases and manuals) are safe (see 7.1.4).

DoD/MIL Doc: JSSG-2001: 3.3.1.1

FAA Doc: 14CFR references: 23.901-23.943, 25.901-25.945

6.3.2.4 Verify that inlet buzz boundaries and flight limitations are well defined (see 7.1.4).

DoD/MIL Doc: JSSG-2001: 3.3.1.1

FAA Doc: 14CFR references: 23.901-23.943, 25.901-25.945

6.3.2.5 Verify that there are no severe performance impacts due to flow disturbance and blockage items. Also ensure that these items are safely implemented and located, especially ahead of or near the inlets.

DoD/MIL Doc: JSSG-2001: 3.3.1.1

FAA Doc: 14CFR references: 23.901-23.943, 25.901-25.945

6.3.2.6 Verify that engine performance for hot anti-icing air discharged into the inlet or inlet duct surface is safe (see 7.2.1.2 and 7.2.4.1.8).

DoD/MIL Doc: JSSG-2007: 3.2, 4.2, 3.11, 4.11, 3.12, 4.12, 3.2.2, 4.2.2

FAA Doc: 14CFR references: 33.5, 33.7

AC 33-2B

6.3.2.7 Verify safe engine performance for an inlet sand and dust separator (see 7.2.1.2 and 7.2.5.3.1).

DoD/MIL Doc: JSSG-2007: 3.2, 4.2, 3.11, 4.11, 3.12, 4.12, 3.2.2, 4.2.2

FAA Doc: 14CFR references: 33.5, 33.7

AC 33-2B

6.3.2.8 Verify that effects of armament gas (and debris) ingestion on engine performance (i.e., surge and resulting torque spikes) are safe (see 7.2.2.4).

DoD/MIL Doc: JSSG-2007: 3.3, 4.3, 3.4, 4.4, 3.11, 4.11, 3.12, 4.12

FAA Doc: 14CFR references: 33.14, 33.19, 33.63, 33.75, 33.76, 33.77, 33.90, 33.94, 33.97

AC 33.1B, AC 33.3, AC 33.4, AC 33.4-2, AC 33.5

6.3.3 Flight limits.

6.3.3.1 Verify that buffet boundaries and flight limitations are safe.

DoD/MIL Doc: JSSG-2001A: 6.4.6.1

JSSG-2001A Appendix C: 4.2, 4.3, 4.5

MIL-STD-3013: 3.2.2, 3.5.16

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ADS-40A-SP Air Vehicle Flight Performance Description

ADS-27 Requirements for Rotorcraft Vibration Specifications, Modeling and Testing

ADS-10C-SP Air Vehicle Technical Description

FAA Doc: 14CFR references: 23.251, 23.333, 25.251, 25.333

6.3.3.2 Verify that stall angle of attack and velocity reflected in the flight manual are safe.

DoD/MIL Doc: JSSG-2001A Appendix C: 4.2, 4.13.2, 4.13.3; Appendix D: 4.2.2; Appendix E: 11.2.2

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FAA Doc: 14CFR references: 23.49

6.3.3.3 Verify that maximum allowable angle of attack, angle of attack limiter, and set margins are safe.

DoD/MIL Doc: JSSG-2001A Appendix C: 4.2

FAA Doc: 14CFR references: 23.333, 25.333

6.3.3.4 Verify that center of gravity and gross weight limitations are safe.

Comm'l Doc: SAWE RP#7 & 8

DoD/MIL Doc: JSSG-2006: 3.2.3, 3.2.4, 3.2.5, 3.2.6, 3.2.3, 4.2.4, 4.2.5, 4.2.6

MIL-HDBK-516: 5.8.1-3

MIL-DTL-7700: 3.4.5, 3.5

MIL-STD-3013: 3.10

MIL-PRF-5920

FAA Doc: 14CFR references: 23.23, 23.25, 23.29, 23.31, 23.1519, 25.23, 25.25, 25.27, 25.29, 25.31, 25.1519, 27.21, 27.25, 27.27, 27.29, 27.31, 27.1519, 29.21, 29.25, 29.27, 29.29, 29.31, 27.1519

6.3.3.5 Verify that safe flight limitations account for vortex ring state, settling with power, retreating blade stall, advancing blade compressibility, and critical azimuth factors.

DoD/MIL Doc: ADS-51-HDBK

ADS-33E-PRF

ADS-40A-SP Air Vehicle Flight Performance Description

ADS-10C-SP Air Vehicle Technical Description

FAA Doc: 14CFR references: 27.21, 27.33, 27.143, 27.177, 27.1509, 27.1581, 29.21, 29.33, 29.143, 29.177, 29.1509, 29.1581

7. PROPULSION AND PROPULSION INSTALLATIONS

TYPICAL CERTIFICATION SOURCE DATA

1. Design criteria
2. Design studies and analyses
3. Design, installation, and operational characteristics
4. Engine ground and simulated altitude tests
5. Engine design function/system compatibility tests
6. Engine component and functional level qualification and certification tests
7. Electromagnetic environmental effects
8. Installed propulsion compatibility tests
9. Acceptance test results
10. Failure modes, effects, and criticality analysis/testing (FMECA/FMET)
11. Hazard analysis and classification
12. Safety certification program
13. Engine endurance and accelerated mission testing
14. Engine and component structural and aeromechanical tests
15. Flight test plans and results
16. Engine structural integrity program (ENSIP) analyses and tests
17. Engine life management plans
18. Over-speed and over-temperature tests
19. Overall engine and component performance analyses
20. Flight manual
21. Natural environmental sensitivities
22. Inlet airflow distortion/engine stability assessments and audits
23. Interface/integration control documents
24. Function, subfunction, and component specifications
25. Selection criteria and inlet distortion patterns selected to demonstrate inlet/engine compatibility.
26. Engine control system rig tests
27. Engine health monitoring system design reports and tests
28. Aircraft/engine operating limitations
29. Engine software development plan and product specifications
30. Engine software test plans, test procedures and test reports
31. Engine software configuration control/management plan and procedure
32. Propulsion and Power Flight Clearance Plan, JSSG-2007A, Table XLVIIIb
33. Diminishing manufacturing sources plan
34. Obsolete parts plan

CERTIFICATION CRITERIA

7.1 Propulsion safety management.

7.1.1 Verify that safety-critical propulsion system risks are identified, probabilities are validated, and risk controls are in place.

Comm'l Doc: SAE ARP 5580

DoD/MIL Doc: JSSG-2007A: A.3.2, A.3.2.1, A.3.3.1, A.3.3.2, A.3.3.7, A.3.5.1, A.3.11, A.3.12, A.4.2, A.4.2.1, A.4.3.1, A.4.3.2, A.4.3.7, A.4.5.1, A.4.11, A.4.12, propulsion system failure analysis and reliability.

PCOE-BP-99-06C, Aircraft Gas Turbine Engine Flight Safety Risk Management Process, (an ASC Propulsion Squadron Best Practice).

FAA Doc: 14CFR references: 33.5, 33.35, 33.7, 33.8

AC 33-2B

7.1.2 Verify that an engine out condition on multi-engine aircraft allows safe recovery of the aircraft.

DoD/MIL Doc: JSSG-2007A: A.3.2, A.4.2, A.3.11, A.4.11, A.3.12, A.4.12

FAA Doc: 14CFR references: 33.35, 33.5, 33.7, 33.8

AC 33-2B

7.1.3 Verify that single engine direct lift systems comply with specified safety requirements.

DoD/MIL Doc: JSSG-2007A: A.3.2.1.4/A.4.2.1.4, Thrust Retention and A.3.11, A.4.11, A.3.12, A.4.12 for guidance on Direct Lift and STOVL thrust requirements.

FAA Doc: 14CFR references: 33.35, 33.5, 33.7, 33.8

AC 33-2B

7.1.4 Verify that technical data includes all operational and maintenance procedures and limitations necessary for safe operation of the air vehicle.

FAA Doc: 14CFR references: 23.1585

7.1.5 Verify that the engine configuration is controlled.

DoD/MIL Doc: JSSG-2007A: A.3.10/A.4.10

MIL-HDBK-61A

7.1.6 Verify that critical safety items (CSI) and critical characteristics are identified.

DoD/MIL Doc: DoD 4140.1-R, Section C8.5, DoD Supply Chain Materiel Management Regulation DoD Aviation Critical Safety Item (CSI)/Flight Safety Critical Aircraft Part (FSCAP)

NAVAIRINST 4200.25D Management of Critical Application Items Including Critical Safety Items.

Critical Item Management Desktop Guide (to NAVAIR 4200.25D)

(Draft) JACG Instruction on Management of Aviation Critical Safety Items.

7.2 Gas turbine engine applications.

7.2.1 Performance.

7.2.1.1 Verify that engine performance is adequate for safe operation of the air vehicle. This includes consideration of all installation effects imposed by the air vehicle, and all intended operational environments.

DoD/MIL Doc: JSSG–2007A: A.3.2, A.4.2, A.3.2.1, A.4.2.1, A.3.2.1.1, A.4.2.1.1, A.3.3.1, A.4.3.1, A.3.3.2, A.4.3.2, A.3.3.7, A.4.3.7, A.3.11, A.4.11, A.3.12, A.4.12 and JSSG-2001B 3.3.1.1/4.3.1.1

FAA Doc: 14CFR references: 33.5, 33.35, 33.7, 33.8, AC 33.2B

7.2.1.2 Verify that degraded engine performance meets requirements for safety considerations. Degraded engine performance includes performance in any backup control mode, as well as performance after bird, ice, and sand ingestion.

DoD/MIL Doc: JSSG-2007A: Backup control: A.3.7.2.1.1, A.4.7.2.1.1; Bird ingestion: JSSG-2007A A.3.3.2.1, A.4.3.2.1; Ice ingestion: A.3.3.1.4, A.4.3.1.4; and Sand ingestion: A.3.3.2.4, A.4.3.2.4

FAA Doc: 14CFR references: 33.1, 33.68, 33.89

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7.2.2 Operability.

DoD/MIL Doc: JSSG-2007A: A.3.2, A.4.2, A.3.11, A.4.11, A.3.12, A.4.12, A.3.2.2, A.3.2.2.7, A.4.2.2, A.4.2.2.7

FAA Doc: 14CFR references: 33.5, 33.7

AC 33-2B

7.2.2.1 Verify that positive stability margin exists at all flight conditions or that placards are documented in the flight manual.

DoD/MIL Doc: JSSG-2007A: A.3.2.2.6, A.4.2.2.6, A.3.2.2.11, A.4.2.2.11, A.3.3.2.5, A.4.3.2.5, A.3.3.2.6, A.4.3.2.6, A.3.3.2.7, A.4.3.2.7

FAA Doc: 14CFR references: 33.65, 33.73 (stability), 33.5 (distortion)

7.2.2.2 Verify that the engine has 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.

DoD/MIL Doc: JSSG-2007A: A.3.2.2.6, A.4.2.2.6, A.3.2.2.7, A.4.2.2.7

MIL-HDBK-516: criteria 7.2.4.1.3

FAA Doc: 14CFR references: 33.65, 33.73, 33.89

7.2.2.3 Verify that air start requirements are met and documented in the flight manual. Air starts include spool-down, windmill, cross-bleed and starter-assisted as appropriate for the air vehicle system.

DoD/MIL Doc: JSSG–2007A: A.3.2.2.3.2, A.4.2.2.3.2

FAA Doc: 14CFR references: 33.89

7.2.2.4 Verify that the engine recovers from instability induced by external influences (such as inlet distortion and steam and armament gas ingestion) after the external influence is removed, without employing measures such as commanded idle or shutdown and without exceeding thermal or structural limits.

DoD/MIL Doc: JSSG–2007A: A.3.2.2.3.5, A.4.2.2.3.5, A.3.2.2.11.2, A.4.2.2.11.2, A.3.7.2.1, A.4.7.2.1

FAA Doc: 14CFR references: 33.27, 33.28, 33.91

7.2.3 Structures.

DoD/MIL Doc: JSSG-2007A: A.3.2, A.4.2, A.3.11, A.4.11, A.3.12, A.4.12

FAA Doc: 14CFR references: 23.901-23.1165, 25.901-25.1167

7.2.3.1 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.

DoD/MIL Doc: MIL-HDBK-1783B: A.4.10/A.5.10 through A.4.10.14/A.5.10.14, A.4.5.3, A.5.5.3

FAA Doc: 14CFR references: 33.75, 33.91, 33.23

7.2.3.2 Verify that the engine has positive durability margins over the defined operational interval and duty cycle to preclude adverse safety, economic, or operational impacts.

DoD/MIL Doc: MIL-HDBK-1783B: A.4.9/A.5.9 through A.4.9.3/A.5.9.3 for LCF/durability/economic life design and compliance methods

MIL-HDBK-1783B: A.4.13/A.5.13 through A.4.13.3.3/A.5.13.3.3 for high cycle fatigue/vibration guidance

MIL-HDBK-1783B: A.4.12/A.5.12 for creep guidance

MIL-HDBK-1783B: A.4.11/A.5.11 for deterioration guidance

MIL-HDBK-1783B: A.4.14/A.5.14 for noise guidance

MIL-HDBK-1783B: A.4.15/A.5.15 for foreign object damage/domestic object damage (FOD/DOD) guidance

MIL-HDBK-1783B: A.4.16/A.5.16a and b, for durability and compliance criteria for repaired components

FAA Doc: 14CFR references: 33.14, 33.5, 33.63, 33.83, 33.19

7.2.3.3 Verify that all safety- and mission-critical parts are designed to be damage tolerant over the defined operational interval and duty cycle.

DoD/MIL Doc: MIL-HDBK-1783B: A.4.7/A.5.7 through A.4.8.6/A.5.8.6 for application of damage tolerance and inspection methods

FAA Doc: 14CFR references: 33.75

7.2.3.4 Verify that the allowables for materials are minimums and 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.

DoD/MIL Doc: MIL-HDBK-1783B: A.4.6/A.5.6 for material characterization guidance

FAA Doc: 14CFR references: 33.15

7.2.3.5 Verify that 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.

DoD/MIL Doc: MIL-HDBK-1783B: A.4.3/A.5.3 through A.4.5.3/A.5.5.3, for design service life and usage

FAA Doc: 14CFR references: 33.4

7.2.3.6 Verify that all inspection intervals and life-limited components are identified in the technical manuals and a process to track life consumption is operational and current.

DoD/MIL Doc: MIL-HDBK-1783B: A.4.19/A.5.19 for component life management guidance.

MIL-HDBK-1783B: A.5.9.1.1 through A.5.9.1.6 for accelerated mission testing concepts

7.2.4 Engine subsystems, components, computer resources and software.

DoD/MIL Doc: JSSG-2007A: A.3.2, A.4.2, A.3.11, A.4.11, A.3.12, A.4.12, A.3.2.2, A.4.2.2

FAA Doc: 14CFR references: 33.5, 33.7

AC 33-2B

7.2.4.1 Subsystems.

7.2.4.1.1 Verify that the engine control system maintains safe engine operation under all required conditions.

DoD/MIL Doc: JSSG-2007A: A.3.7.2/A.4.7.2, control systems design and verification.

FAA Doc: 14CFR references: 33.27, 33.28, 33.91

7.2.4.1.2 Verify that multiple propulsion subsystems are physically, systemically, and operationally isolated from each other to prevent the failure of more than one propulsion subsystem due to any single or common cause.

DoD/MIL Doc: JSSG-2007A: A.3.7.2/A.4.7.2, control systems guidance..

FAA Doc: 14CFR references: 33.27, 33.28, 33.91

7.2.4.1.3 Verify that the control system maintains both stable engine operation and response during all steady state and transient conditions.

DoD/MIL Doc: JSSG-2007A: A.3.7.2/A.4.7.2, control systems guidance.

MIL-HDBK-516 criteria 7.2.2.2

FAA Doc: 14CFR references: 33.27, 33.28, 33.91

7.2.4.1.4 Verify that any failure of the engine controls and associated subsystems results in a fail-operational or fail-safe condition.

DoD/MIL Doc: JSSG-2007A: A.3.7.2/A.4.7.2, control systems guidance.

FAA Doc: 14CFR references: 33.27, 33.28, 33.91

7.2.4.1.5 Verify that the engine control system failures do not cause unexpected engine transients; or result in unacceptable controllability, stability, or handling qualities; or require any urgent or excessive pilot action.

DoD/MIL Doc: JSSG-2007A: A.3.7.2, A.4.7.2, A.3.7.6, A.4.7.6

FAA Doc: 14CFR references: 33.27, 33.28, 33.91

7.2.4.1.6 Verify that the engine fuel system safely provides the required fuel supply to the combustor, augmentor, and fueldraulics subsystems under all required conditions.

Comm'l Doc: SAE-AS1055B, Fire Testing

DoD/MIL Doc: JSSG-2007A: A.3.7.3.2/A.4.7.3.2, Fuel Systems Performance, engine fuel system design and verification testing

JSSG-2007A: A.3.1.8.1/A.4.1.8.1, Flammable Fluid Systems - fire resistance testing requirements and procedures.

FAA Doc: 14CFR references: 33.17, 33.67, 33.87(a)(7), 33.89, 33.91

7.2.4.1.7 Verify that the engine ignition system provides a safe ignition source for the main combustor and augmentor.

DoD/MIL Doc: JSSG-2007A: A.3.2.2.3.5/A.4.2.2.3.5, Auto-Relight and A.3.7.5/A.4.7.5, Ignition Systems

FAA Doc: 14CFR references: 33.89, 33.69

7.2.4.1.8 Verify that 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.

DoD/MIL Doc: JSSG-2007A: A.3.7.1/A.4.7.1, Anti-ice and De-ice Systems

FAA Doc: 14CFR references: 25.1419

7.2.4.1.9 Verify that engine cooling and thermal management systems safely remove excess heat from the engine and its subsystems (see 8.2.16).

DoD/MIL Doc: JSSG-2007A: A.3.2.2.13/A.4.2.2.13

FAA Doc: 14CFR references: 27.1121

7.2.4.1.10 Verify that the engine variable geometry systems safely operate under all engine operating conditions.

Comm'l Doc: SAE-AS1055B, Fire Testing

DoD/MIL Doc: JSSG-2007A: A.3.7/A.4.7, variable geometry system design and verification testing.

JSSG-2007A: A.3.1.8.1/A.4.1.8.1, Flammable Fluid Systems - fire resistance and fire proof testing.

FAA Doc: 14CFR references: 25.671, 27.695, 29.695, 33.17, 33.72, 43.1

7.2.4.1.11 Verify that the engine lubrication system safely operates under all engine operating conditions.

DoD/MIL Doc: JSSG-2007A: A.3.7.8/A.4.7.8, Lubrication System

FAA Doc: 14CFR references: 33.5, 33.71, 33.87, 33.89

7.2.4.1.12 Verify that the lubrication system is free from excessive discharge at the breather.

DoD/MIL Doc: JSSG-2007A: paraA.3.7.8.3/A.4.7.8.3, Breather Mist - engine breather exhaust emissions design and verification testing.

7.2.4.1.13 Verify that the lubrication system and bearing compartments do not support combustion.

Comm'l Doc: SAE-AS1055B, Fire Testing

DoD/MIL Doc: JSSG-2007A: A.3.7.8/A.4.7.8, Lubrication System

JSSG-2007A: A.3.1.8.1/A.4.1.8.1, Flammable Fluid Systems - fire resistance and fireproof testing.

7.2.4.1.14 Verify that the engine health monitoring and prognostics systems provide adequate warnings in a timely manner to reduce occurrences of in-flight shutdowns and power losses.

DoD/MIL Doc: JSSG-2007A: A.3.7.6/A.4.7.6, Engine Health Monitoring Systems (EHMS), the Interface Control Document (ICD) and the pilot's operating manual

FAA Doc: 14CFR references: 33.28

7.2.4.2 Components: mechanical and electrical.

7.2.4.2.1 Verify that any uncontained failure of an engine control or subsystem component with rotating parts does not adversely affect the continued safe operation of the air vehicle.

DoD/MIL Doc: JSSG-2007A: A.3.7/A.4.7, Subsystems, engine subsystem component design and verification.

MIL-HDBK-1783B: A.4.8/A.5.8, Damage Tolerance; A.4.10.3/A.5.10.3, Containment, component containment design requirements.

FAA Doc: 14CFR references: 33.19, 33.94

7.2.4.2.2 Verify that changes in bearing thrust balance do not result in the bearing operating in failure prone regions of operation.

DoD/MIL Doc: MIL-HDBK-1783B: A.4.10.10/A.5.10.10, Pressure balance

FAA Doc: 14CFR references: 33.93

7.2.4.2.3 Verify that all engine mounted tubing, manifolds and clamps are safely affixed and routed on the engine.

Comm'l Doc: SAE ARP 994, Tubing/Plumbing Routing

DoD/MIL Doc: JSSG-2007A: A.3.1.1.3/A.4.1.1.3, Interface Loads, A.3.11/A.4.11, Controls and Externals Verification, the Interface Control Document (ICD)

FAA Doc: 14CFR references: 33.5

7.2.4.2.4 Verify that all engine mounted tubing, manifolds and clamps do not contain natural frequencies within the engine and subsystems operating ranges.

DoD/MIL Doc: JSSG-2007A: A.3.11/A.4.11, Controls and Externals Verification.

FAA Doc: 14CFR references: 29.993

7.2.4.2.5 Verify that all pressure vessels, tubes and manifolds have design margin for their maximum operating conditions.

Comm'l Doc: SAE-AS1055B, Fire Testing

DoD/MIL Doc: JSSG-2007A: A.3.7.3.2, A.4.7.3.2 and A.3.7.8, A.4.7.8, pressure vessel proof and burst testing.

JSSG-2007A: A.3.1.8.1, A.4.1.8.1, Flammable Fluid Systems, fire resistance and fire proof testing.

MIL-HDBK-1783B: A.4.10/A.5.10

7.2.4.2.6 Verify that engine gearboxes have design margin for their maximum operating conditions.

DoD/MIL Doc: JSSG-2007A: A.3.7.16/A.4.7.16, Gearbox.

7.2.4.2.7 Verify that failure of any gearbox mounted component (oil pumps, fuel pumps, starters, generators, etc.) does not result in failure of the gearbox itself.

DoD/MIL Doc: JSSG-2007A: A.3.7.16/A.4.7.16, Gearbox.

7.2.4.2.8 Verify that failure of the engine power take-off (PTO) coupling assembly does not adversely affect safe operation of the air vehicle.

DoD/MIL Doc: JSSG-2007A: A.3.1.1.10/A.4.1.1.10, Power Take-Off and A.3.7.16/A.4.7.16, Gearbox.

MIL-HDBK-516 criteria 7.2.5.1.3

7.2.4.2.9 Verify that all engine mounted electrical components and cabling are safely affixed and routed on the engine.

Comm'l Doc: SAE-AS-50881, for required clearances for electrical cables, and requirements for appropriate selection and installation of wiring and wiring devices.

DoD/MIL Doc: JSSG-2007A: A.3.1.1.3/A.4.1.1.3, Interface Loads and A.3.7.4/A.4.7.4, Electrical System.

MIL-STD-464A, for requirements for proper bonding and grounding

FAA Doc: 14CFR references: 33.5

7.2.4.2.10 Verify that all engine mounted electrical components and cabling can safely operate in the lightning and electromagnetic effects environment of the air vehicle.

DoD/MIL Doc: For guidance on engine EMI, EMP, and Lightning design and verification testing:

JSSG-2007A: A.3.3.3/A.4.3.3

MIL-STD-461E

MIL-STD-464A.

FAA Doc: 14CFR references: 33.28

7.2.4.2.11 Verify that all engine mounted electrical components and associated cabling do not react to engine or air vehicle induced vibratory and acoustic excitations.

DoD/MIL Doc: JSSG-2007A: A.3.11/A.4.11, Controls and Externals Verification and A.3.7.4/A.4.7.4, Electrical System.

FAA Doc: 14CFR references: 29.993, 33.5

7.2.4.2.12 Verify that electrical power is supplied to all safety critical engine systems under all flight conditions.

DoD/MIL Doc: JSSG-2007A: A.3.7.4/A.4.7.4, Electrical System.

FAA Doc: 14CFR references: 29.993, 33.5

7.2.4.3 Computer resources and software.

See section 15

Comm'l Doc: IEEE/EIA 12207.0, IEEE/EIA 12207.1, IEEE/EIA 12207.2 and RTCA DO 178 and 254

DoD/MIL Doc: JSSG-2007A: 3.8/4.8 Software Resources.

FAA Doc: 14 CFR reference: 33.28

7.2.5 Installations.

DoD/MIL Doc: JSSG-2007A: A.3.2, A.4.2, A.3.3.2, A.4.3.2

JSSG-2001B: 3.3.1.1/4.3.1.1, Engine Compatibility

FAA Doc: 14CFR reference: 23.901-23.1203, 25.901-25.1207, 23.1305, 25.1305, H25

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(Note: 14CFR reference paragraphs listed in the following section are not necessarily sufficient to fully satisfy the corresponding criteria.)

7.2.5.1 Physical Installation.

7.2.5.1.1 Verify that all engine/air vehicle physical interfaces such as mechanical, fluid, and electrical connections are safe.

DoD/MIL Doc: JSSG-2007A: A.3.1.1.3, A.4.1.1.3, Interface Loads.

JSSG-2001B: 3.3.1.1/4.3.1.1

FAA Doc: 14CFR references: 33.5

7.2.5.1.2 Verify that the aircraft/engine mounts contain adequate design margin to secure the engine properly under all operating conditions and failure modes.

DoD/MIL Doc: JSSG-2007A: A.3.1.1.4, A.4.1.1.4, Mounts, A.4.10.12, A.5.10.12:

MIL-HDBK-1783B, Engine Structural Integrity.

FAA Doc: 14CFR references: 33.5, 33.23

7.2.5.1.3 Verify that, when applicable, the installed power-take-off (PTO) shaft system is free of any potentially damaging resonant conditions (refer to section 8.6 for additional details) for all loads and modes of operation.

7.2.5.1.4 Verify that the probability of failure due to uncontained rotating parts damaging air vehicle safety of flight (SOF)/critical safety items (CSIs) is acceptable.

DoD/MIL Doc: JSSG-2001B: 3.3.10/4.3.10

7.2.5.1.5 Verify that clearance between the air vehicle and engine (including associated components, plumbing, and harnesses) is maintained under all operating conditions within the ground and flight envelopes.

DoD/MIL Doc: JSSG-2001_B: 3.3.1.1/4.3.1.1

7.2.5.1.6 Verify that drain systems have sufficient capacity, operate throughout required ground and flight attitudes and regimes, and expel/store the fluids in a safe manner.

DoD/MIL Doc: JSSG-2007A: A.3.1.1.8, A.4.1.1.8, for design and verification guidance for drains.

JSSG-2001B: 3.3.1.1/4.3.1.1

7.2.5.1.7 Verify the engine air inlet components have adequate structural margin to withstand the over-pressures generated by inlet/compressor anomalies.

7.2.5.1.8 Verify accessibility to propulsion-system-related equipment for the performance of required servicing, inspections, and maintenance.

DoD/MIL Doc: JSSG-2001B: 3.3.1.1/4.3.1.1

7.2.5.1.9 Verify that airframe and propulsion systems eliminate sources of self-induced foreign/domestic object damage (FOD/DOD) to engines.

DoD/MIL Doc: JSSG-2001B: 3.3.1.1.1/4.3.1.1.1

7.2.5.2 Functional installation.

7.2.5.2.1 Verify that functional compatibility of the integrated system is safe.

DoD/MIL Doc: JSSG-2001B: 3.3.1.1/4.3.1.1

7.2.5.2.2 Verify that the engine can safely supply all customer extractions (bleed air, horsepower, electrical power, etc.) under all operating conditions.

DoD/MIL Doc: JSSG-2007A: A.3.2, A.4.2 and A.3.7, A.4.7, engine performance and operability impacts of customer extractions.

JSSG-2007A: A.3.1.1.7, A.4.1.1.7, bleed air interface design and verification.

JSSG-2007A: A.3.1.1.10, A.4.1.1.10 and A.3.7.16, A.4.7.16, PTO horsepower extraction.

JSSG-2007A: A.3.7.4.1, A.4.7.4.1, electrical power design and verification requirements.

7.2.5.2.3 Verify customer bleed air contamination does not exceed safe limits.

DoD/MIL Doc: JSSG-2007A: A.3.1.1.7.1, A.4.1.1.7.1, customer bleed air contaminants guidance

7.2.5.3 Inlet compatibility.

7.2.5.3.1 Verify that the air induction system(s) functions under all expected ground, flight, and environmental (including ice, sand, and dust, as applicable) conditions without adversely affecting engine operation or resulting in engine damage.

DoD/MIL Doc: JSSG-2007A: A.3.3.2.4, A.4.3.2.4, for sand and dust design and verification; A.3.3.2.3, A.4.3.2.3, for ice ingestion guidance; A.3.2.2.11, A.4.2.2.11, distortion guidance; and A.3.3.2.5, A.4.3.2.5, for atmospheric liquid water ingestion guidance.

JSSG-2001B: 3.3.1.1.1/4.3.1.1.1

7.2.5.4 Exhaust system compatibility.

7.2.5.4.1 Verify that exhaust systems direct exhaust gases to the atmosphere clear of the flight crew, boarding or discharging passengers, externally mounted equipment, fluid drains, air intakes, stores, rotor blades, and airframe structure.

DoD/MIL Doc: JSSG-2001B: 3.3.1.1.2/4.3.1.1.2, Nozzle and Exhaust Systems

JSSG-2007A: A.3.1.8.2, A.4.1.8.2, A.3.1.8.5, A.4.1.8.5 and A.3.1.8.7, A.4.1.8.7, fire prevention, air and gas leakage and jet wake; A.3.7.10, A.4.7.10, engine exhaust nozzle system design and verification

7.2.5.4.2 Verify that thrust reverser/thrust vectoring systems are fail-safe and compatible with engine and air vehicle systems.

DoD/MIL Doc: JSSG-2007A: A.3.1.1.12 to A.4.1.1.13, for exhaust system and thrust reverser interfaces design and verification guidance; A.3.7.10, A.4.7.10, Exhaust Nozzle System and A.3.7.10.2, A.4.7.10.2, Vectored Nozzle

7.2.5.5 Environmental compatibility.

7.2.5.5.1 Verify that 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, under ground and flight operating conditions, and after normal engine shutdown. (These provisions should be compatible with the fire protection certification criteria of 8.4.)

7.2.5.5.2 Verify the installed vibratory compatibility of the engine/airframe system.

DoD/MIL Doc: JSSG-2001B: 3.3.1.1.2/4.3.1.1, exhaust integration design and verification requirements.

7.2.5.5.3 Verify compatibility with shipboard jet blast deflectors.

DoD/MIL Doc: JSSG-2007A: A.3.1.8.7/A.4.1.8.7

7.2.5.6 Installation other.

7.2.5.6.1 Verify that the air vehicle propulsion controls and crew station information are adequate for proper crew control and operation of the propulsion system.

DoD/MIL Doc: JSSG-2001B: 3.4.3.1.6/4.4.3.1.6 and MIL-STD-411

7.3 Alternate propulsion systems.

7.3.1 Propeller driven systems.

DoD/MIL Doc: JSSG-2007: A.3.3, A.4.3, A.3.4, A.4.4, A.3.11, A.4.11, A.3.12, A.4.12

JSSG-2007B: A.3.1.1.4.3, A.4.1.1.4.3, Engine Stiffness; A.3.1.1.8, A.4.1.1.9, Power Absorber Interface; A.3.2.2.7, A.4.2.2.7, Transients; A.3.3.2.1, A.4.3.2.1, Bird Ingestion; A.3.3.2.3, A.4.3.2.3, Ice Ingestion; A.3.7.2.3, A.4.7.2.3, Overspeed Protection System; A.3.7.13, A.4.7.13, Brake System; A.3.7.14.1, A.4.7.14.1, Multiple Power Section Engines; A.3.7.15, A.4.7.15, Power Absorber, Engine Supplied; A.3.7.15.1, A.4.7.15.1, Propeller Feathering and Reverse Pitch; 4.12.3.5.1.2, Engine Calibration; and B.4.13.5.1, Initial Run

FAA Doc: 14CFR references: 33.14, 33.19, 33.27, 33.5, 33.63, 33.65, 33.73, 33.75, 33.76, 33.77, 33.88, 33.89, 33.90, 33.92, 33.94, 33.95, 33.97

AC 33.1B, AC 33.3, AC 33.4, AC 33.4-2, AC 33.5

7.3.1.1 Verify that adequate margins exist for the performance, strength, and durability of the following: propeller and propeller system components, including the propeller drive shaft, reduction gearbox, torque measurement system, negative torque system, propeller brake, and mechanical over-speed governor.

DoD/MIL Doc: JSSG-2009: L.3.4.12/L.4.4.12 and L.3.4.12.4/L.4.4.12.4, performance and structural design and compliance methods

7.3.1.2 Verify that any critical propeller speeds (e.g., speeds that excite resonant frequencies and cause detrimental blade stresses) are outside the engine operating range or identified limitations are placed in the appropriate operators and maintenance technical manuals (T.O.'s).

DoD/MIL Doc: JSSG-2009: L.3.4.12/L.4.4.12 and L.3.4.12.6/L.4.4.12.6, propeller vibration and flutter criteria and compliance methods

FAA Doc: 14CFR references: 33.43, 33.83, 33.63

7.3.1.3 Verify the safety and functionality of the hardware and software components of propeller reversing systems and pitch controls for all steady state, transient, and emergency operating conditions.

DoD/MIL Doc: JSSG-2009: L.3.4.12/L.4.3.12

FAA Doc: 14CFR references: 35.21

7.3.1.4 Verify the safety of all physical and functional interfaces between the propeller and any system that drives the propeller.

DoD/MIL Doc: JSSG-2009: L.3.4.12/L.4.3.12

FAA Doc: 14CFR references: 35.21, 35.39, 35.41

7.3.1.5 Verify that the manual and automatic feathering systems are operational for all steady state, transient, and emergency operating conditions.

DoD/MIL Doc: JSSG-2009: L.3.4.12.1, L.4.4.12.1, feathering systems.

7.3.1.6 Verify the compatibility of the propeller and engine control systems under all steady state, transient, and emergency operating conditions.

DoD/MIL Doc: JSSG-2009: L.3.4.12.5, L.4.4.12.5, control system compatibility.

7.3.1.7 Verify that the propeller system is free of destructive vibrations at all steady state and transient operating conditions and is capable of balancing to remove vibration that could cause equipment to operate below specified requirements or cause excessive crew discomfort.

DoD/MIL Doc: JSSG-2009: L.3.4.12.6, L.4.4.12.6, guidance on vibration and balance.

7.3.1.8 Verify that the propeller ice control system prevents the dangerous accumulation of ice during all operating conditions.

DoD/MIL Doc: JSSG-2009: L.6.3.1, for guidance on propeller anti-icing systems.

7.3.1.9 Verify that the propeller can tolerate bird strikes.

FAA Doc: 14CFR references: 35.36

7.3.2 Rotary wing systems.

DoD/MIL Doc: JSSG-2007A: A.3.1.1.5.2, A.4.1.1.5.2, Load Demand Command and Signal, A.3.1.1.5.3, A.4.1.1.5.3, Output Speed Level and Signal, A.3.1.1.9, A.4.1.1.9, Power Absorber Interface, A.3.1.1.13, A.4.1.1.13, Exhaust System Interface, A.3.3, A.4.3, A.3.4, A.4.4, A.3.11, A.4.11, A.3.12, A.4.12

MIL-HDBK-1783B: A.4.9, A.5.9, Durability, A.4.10, A.5.10, Strength, A.4.10.7, A.5.10.7, Output Shaft Torque Limits and A.4.10.8, A.5.10.8, Output Shaft Speed Limits.

FAA Doc: 14CFR references: 33.15, 33.19, 33.5, 33.28

AC 33.3, AC 33.15-1

7.3.2.1 Verify that the rotary wing and all associated components and systems (drive shaft, reduction gearbox, torque measurement system, negative torque system, brake system, and mechanical overspeed governor) provide sufficient power, torque, strength, and durability for safe operation at sea level hover and margin for vertical climb and hover throughout the flight envelope.

DoD/MIL Doc: JSSG-2007A: A.3.7.16, A.4.7.16

JSSG-2009: K.4.4.11, for drive system bench and system level testing.

FAA Doc: 29.1309

7.3.2.2 Verify that the rotor system provides safe controllability of the air vehicle under all expected operating conditions.

DoD/MIL Doc: JSSG-2007A: A.3.7.16, A.4.7.16

FAA Doc: 14CFR references: 27.1143

7.3.2.3 Verify that, for rotary wing air vehicles, the effects of high-energy, low-frequency vibrations, generated by main rotor blade passage (fundamental and harmonic) frequencies at all engine and related component operating speeds and powers, do not adversely affect the operation of the engine and the drive system.

DoD/MIL Doc: JSSG-2007A: A.3.4.1.8, A.4.4.1.8, for engine vibration and dynamic response.

FAA Doc: 14CFR references: 29.907

7.3.2.4 Verify, for rotary wing air vehicles, that a satisfactory interface is achieved between the engine (including subsystems/accessories) and the airframe relative to both high-frequency engine-excited and low-frequency air vehicle rotor(s) excited vibrations.

DoD/MIL Doc: JSSG-2007A: A.3.4.1.8, A.4.4.1.8, for engine vibration and dynamic response.

FAA Doc: 14CFR references: 29.907

7.3.2.5 Verify that the transmission/gearbox lubrication system safely operates under all air vehicle operating conditions.

DoD/MIL Doc: JSSG-2007A: A.3.7.8, A.4.7.8, Lubrication System.

JSSG-2009: K.4.4.11.4, for lubrication element, component, and system level testing.

7.3.2.6 Verify that unfavorable dynamic coupling modes do not occur when the engine, engine accessories, rotor system, and all dynamic transmission components are operated as a combined dynamic system.

7.3.2.7 Verify that the engine's control/rotor system torsional stability has required gain and phase margins and main rotor torque damping during steady-state and transient operation.

FAA Doc: 14CFR references:29.939

7.3.2.8 Verify that the torque and misalignment capabilities of drive shaft couplings are suitable for all possible combinations of torque and speed when installed in the aircraft at the maximum permissible misalignment.

DoD/MIL Doc: JSSG-2007A: A.3.1.1.9, A.4.1.1.9, A.3.7.16, A.4.7.16

FAA Doc: 14CFR references: 33.5

7.3.2.9 Verify that the rotors can be held from rotating in winds at specified velocities and directions, during engine nonoperation, power up, and ground idle conditions.

DoD/MIL Doc: JSSG-2009: I.3.4.9.4.1, I.4.4.9.4.1

7.3.2.10 Verify that the normal and emergency braking systems (consisting of aerodynamic rotor drag and subsequent mechanical braking) are capable of stopping the rotor, from 100% speed, within specified times after engine shutdown.

7.3.2.11 Verify that rotor system condition monitoring provides warning of impending failure that could result in loss of the air vehicle or prevent a safe landing.

7.3.2.12 Verify that the drive system permits engagement and disengagement of the engines from the load absorbers as required for all applicable modes of air vehicle operation.

7.3.2.13 Verify that, during a loss of the primary lubrication system, the gearboxes continue to function and transmit required power until appropriate pilot action can be accomplished.

DoD/MIL Doc:JSSG-2007A: A.3.7.8.1.3, A.4.7.8.1.3

7.3.2.14 Verify that inadvertent operation of externally phased intermeshing-rotor systems cannot occur if the rotors become dephased and that cockpit indications are provided to the pilot.

7.3.2.15 Verify that failure or seizure of any individual accessory does not cause damage to any power drive subsystem components during all phases of air vehicle operation.

7.3.3 Reciprocating engines.

DoD/MIL Doc: JSSG-2007A: A.3.3, A.4.3, A.3.4, A.4.4, A.3.11, A.4.11, A.3.12, A.4.12

FAA Doc: 14CFR references: 33.83

7.3.3.1 Verify that reciprocating engines meet 14 Code of Federal Regulation (CFR) certification as used for the military mission.

FAA Doc: 14CFR reference 33 subpart C for design requirements for commercial applications.

14CFR reference 33 subpart D for verification requirements for commercial applications.

8. AIR VEHICLE SUBSYSTEMS

TYPICAL CERTIFICATION SOURCE DATA

1. Design criteria
2. Functional operations test results
3. Performance test results
4. Failure modes, effects, and criticality analyses (FMECA)
5. Hazard analysis
6. Component and system SOF certifications/qualifications
7. Design studies and analysis
8. Installation and operational characteristics
9. Flight manual and limitations
10. Electromagnetic environmental effects analysis and test results
11. Diminishing manufacturing sources plan
12. Obsolete parts plan

CERTIFICATION CRITERIA

(Note: For subsystems that use computer resources, see section 15 for additional, specific criteria.)

DoD/MIL Doc: JSSG-2000: Air System, JSSG-2001 Air Vehicle, JSSG-2009 Air Vehicle Subsystems, and their associated Appendices.

8.1 Hydraulic and pneumatic systems.

DoD/MIL Doc: JSSG-2009: Appendix B and Appendix M.

FAA Doc: 14CFR references: 23.1435, 23.1438

8.1.1 If there is more than one hydraulic system or pneumatic system, verify that safe operation can be continued if any one hydraulic or pneumatic system fails.

DoD/MIL Doc: JSSG-2009: B.3.4.2, B.4.4.2, B.3.4.2.1.10, B.4.4.2.1.10, B.3.4.2.1.16, B.4.4.2.1.16, Emergency Operation and Appendix M: M.3.4.13/M.4.4.13, Pneumatic Subsystems.

FAA Doc: 14CFR references: 25.1435 b4

8.1.1.1 Verify that any single-point failure locations are identified and their consequences of failure are acceptable, eliminated, or mitigated.

DoD/MIL Doc: JSSG-2009: B.3.4.2/B.4.4.2 Hydraulic Power Subsystem; and Appendix M: M.3.4.13/M.4.4.13 Pneumatic Subsystem

8.1.2 Verify that interfaces and redundancies with the flight control, electrical, and avionics systems are evaluated and verified to be safe.

DoD/MIL Doc: JSSG-2009: B.3.4.2, B.4.4.2, B.3.4.2.1.10/ B.4.4.2.1.10 Emergency Operation; B.3.4.2.1.9/B.4.4.2.1.9 Leakage Control; B.3.4.2.2/B.4.4.2.2 Interface requirements; B.3.4.2/B.4.4.2 Hydraulic power subsystem; and Appendix M: M.3.4.13/M.4.4.13 Pneumatic Subsystem.

8.1.3 Verify normal, back-up, and emergency hydraulic or pneumatic system operation.

DoD/MIL Doc: JSSG-2009 Appendix B: B.3.4.2.1.2/B.4.4.2.1.2 System Fluid Capacity; B.3.4.2.1.10/B.4.4.2.1.10 Emergency Operation; and Appendix M: M.3.4.13, M.4.4.13

8.1.4 Verify that hydraulic fluid temperatures do not exceed the maximum allowable temperature.

DoD/MIL Doc: JSSG-2009: B.3.4.2.1.14/B.4.4.2.1.14 High Temperature Operation; B.3.4.2.1.14.1/B.4.4.2.1.14.1 Thermal Relief; B.3.4.2.1.15/B.4.4.2.1.15 Fire and Explosion Proofing

8.1.5 Verify that adequate crew station information is available to notify the flight crew of the hydraulic and pneumatic systems' operating conditions.

DoD/MIL Doc: JSSG-2009 Appendix B: B.3.4.2.1.3/B.4.4.2.1.3 System Fluid Monitoring; B.3.4.2.1.4.3/B.4.4.2.1.4.3 System Pressure Indication; B.3.4.2.1.4.4/B.4.4.2.1.4.4 System Low-Pressure Warning; B.3.4.2.2.3/B.4.4.2.2.3 Instrumentation interface(s); and Appendix M: M.3.4.13.3/M.4.4.13.3 Status Indication.

FAA Doc: 14CFR references: 23.1435 a2, 25.1435 b1

8.1.6 Verify that flight and maintenance manuals include normal, back-up and emergency operating procedures, limitations, restrictions, servicing, and maintenance information.

DoD/MIL Doc: JSSG-2000: 3.6.2

FAA Doc: Refer to technical point of contact for this discipline (listed in section A.2)

8.1.7 Verify that the plumbing installation and component installations are safe for flight.

DoD/MIL Doc: JSSG-2009: B.3.4.2.1.1/B4.4.2.1.1 Fluid Selection; B.3.4.2.1.2/4.4.2.1.2 System fluid capacity; B.3.4.2.1.4/B.4.4.2.1.4 System Pressure; B.3.4.2.1.5/B.4.4.2.1.5 Pressure Control; B.3.4.2.1.14.1/B.4.4.2.1.14.1 Thermal Relief; B.3.4.2.1.15/B.4.4.2.1.15 Fire and Explosion Proofing; B.3.4.2.1.17/B.4.4.2.1.17 Clearances, M.3.4.13.2/M.4.4.13.3 Pressure, M.3.4.13.4/M.4.4.13.4 Moisture Content, M.6.4 Component Information

FAA Doc: 14CFR references: 23.1435 a1, a3, c1, c2, 25.1435 a2, a4, a5

8.1.8 Verify that the air vehicle hydraulic and pneumatic systems' size/power meets demand.

DoD/MIL Doc: JSSG-2009 Appendix B: B.3.4.2/B.4.4.2 Hydraulic Power Subsystem; B.3.4.2.1.2/B.4.4.2.1.2 System Fluid Capacity; and Appendix M: M.3.4.13/M.4.4.13 Pneumatic Subsystems.

FAA Doc: Refer to technical point of contact for this discipline (listed in section A.2)

8.1.9 Verify that undesirable pressure fluctuations are precluded from the system.

DoD/MIL Doc: JSSG-2009 Appendix B: B.3.4.2.1.5/B.4.4.2.1.5 Pressure Control; B.3.4.2.1.5.1/B.4.4.2.1.5.1 Peak Pressure; and B.3.4.2.1.5.2/B.4.4.2.1.5.2 Pressure Ripple; and Appendix M: M.3.4.13.2/M.4.4.13.2 Pressure.

FAA Doc: 14CFR references: 23.1435 a3, 25.1435 b2

8.1.10 Verify that methods and procedures exist for controlling and purging impurities from the hydraulic and pneumatic systems and that the systems' level of contamination is acceptable.

DoD/MIL Doc: JSSG-2009: B.3.4.2.1.6/B.4.4.2.1.6 System Level Contamination Prevention; B.3.4.2.1.7/B.4.4.2.1.7 System Air Removal; and B.3.4.2.1.8/B.4.4.2.1.8 Moisture Removal; M.3.4.13/M.4.4.13 Pneumatic Subsystem.

8.2 Environmental control system (ECS).

FAA Doc: Note: 14CFR reference paragraphs listed in the following section are not necessarily sufficient to fully satisfy the corresponding criteria.

8.2.1 Verify that the design incorporates system safety requirements of the air vehicle.

DoD/MIL Doc: JSSG-2009: 3.3.3, 4.3.3

FAA Doc: 14CFR reference: 23 Miscellaneous & Cooling paragraphs

8.2.2 Verify that the ECS meets safety requirements when operating under installed conditions over the design envelope and maintains integration integrity to ensure the weapon system’s SOF.

DoD/MIL Doc: JSSG-2009: 3.3.6, 4.3.6

JSSG-2001: 3.3.10, 3.3.10.1

8.2.3 Verify the availability of alternate means of cooling of safety-critical avionics and sufficient cockpit ventilation when the primary ECS is nonoperational.

DoD/MIL Doc: JSSG-2009 Appendix D: D.3.4.4.5.2/D.4.4.4.5.2 Occupied compartment emergency ventilation and smoke removal; D.3.4.4.5.3/D.4.4.4.5.3 Avionic equipment and equipment compartment emergency cooling

FAA Doc: 14CFR references: 23.831, 25.831

8.2.4 Verify that normal and emergency pressurization requirements are met in the air vehicle and, as appropriate, are indicated or monitored at the ground station to ensure SOF.

DoD/MIL Doc: JSSG-2009 Appendix D: D.3.4.4.1, D.4.4.4.1

FAA Doc: 14CFR references: 23.365, 25.841

8.2.5 Verify that the effects of loss of some or all ECS functions on air vehicle safety, on air vehicle performance, or on the safety and performance of other air vehicle systems are understood and acceptable.

DoD/MIL Doc: JSSG-2009: 3.2.4, 3.2.5, 3.2.7.4.4, 3.2.7.6, 3.3.3, 4.2.4, 4.2.5, 4.2.7.4.4, 4.2.7.6, 4.3.3; Appendix D: D.3.4.4.3, D.3.4.4.5, D.3.4.4.12, D.4.4.3.3, D.4.4.4.5, D.4.4.4.12, D.3.4.4.5.2/D.4.4.4.5.2 Occupied compartment emergency ventilation and smoke removal; D.3.4.4.5.3/D.4.4.4.5.3 Avionic equipment and equipment compartment emergency cooling; D.3.4.4.12.2/D.4.4.4.12.2 Bleed air source shut off; D.3.4.4.5.2/D.4.4.4.14.1 Proof pressure; D.3.4.4.14.2/D.4.4.4.14.2 Burst pressure; D.3.4.4.14.3/D.4.4.4.14.3 Rotating equipment structural integrity

8.2.6 Verify that normal and emergency procedures are included in the flight manual and training curriculum for the air vehicle.

DoD/MIL Doc: Refer to technical point of contact for this discipline (listed in section A.2)

FAA Doc: 14CFR references: 23.1581

8.2.7 Verify that adequate controls and displays for the ECS are installed in the crew station/ground segment control station or other appropriate locations to allow the ECS to function as intended.

DoD/MIL Doc: JSSG-2009: D.3.4.4.3/D.4.4.4.3 ECS crew station interface

8.2.8 Verify that the ECS meets the requirements for personnel atmosphere including adequate crew/occupant ventilation and protective flight garment supply systems (oxygen equipment, pressure suits, and anti-g garments or ventilation garments).

DoD/MIL Doc: JSSG-2009 Appendix D: D.3.4.4.3, D.4.4.3.3, D.3.4.4.5.4/D.4.4.4.5.4 ECS Suit ventilation and pressurization

8.2.9 Verify that subsystems used for environmental protection (e.g., windshield rain/snow/ice removal, ice protection and defog) provide for safe operation of the air vehicle in the specified environment.

DoD/MIL Doc: JSSG-2009: D.3.4.4.8/D.4.4.4.8 Transparent area fog and frost protection; D.3.4.4.9/D.4.4.4.9 Rain removal; D.3.4.4.10/D.4.4.4.10 Transparency cleaning; D.3.4.4.11/D.4.4.4.11 Ice protection

FAA Doc: 14CFR references: 23.1419, 25.1419, 23 Miscellaneous (Safe Operations Certification)

8.2.10 Verify that the crewmember's breathing air is protected from contamination in all forms, including oil leakage in the engine and nuclear-chemical-biological warfare conditions.

DoD/MIL Doc: JSSG-2009: D.3.4.4.2.8/D.4.4.4.2.8 Occupied compartment flow shutoff; D.3.4.4.5.1/D.4.4.4.5.1 Occupied compartment normal ventilation; D.3.4.4.5.2/D.4.4.4.5.2 Occupied compartment emergency ventilation and smoke removal; D.3.4.4.6.1/D.4.4.4.6.1 Occupied compartment; D.3.4.4.6.3/D.4.4.4.6.3 Nuclear, biological, and chemical contamination

FAA Doc: 14CFR references: 23.1109, 23.1111, 25.832

8.2.11 Verify that the bleed air or other compressed air duct system is monitored for leaks and structural integrity. Verify that hot air leaking from damaged ducting does not cause ignition of any flammable fluids or other materials or cause damage to SOF items/CSIs.

DoD/MIL Doc: JSSG-2009 Appendix D: D.3.4.4.12, D.4.4.4.12, D.3.4.4.12.8/D.4.4.4.12.8 Bleed air leak detection

MIL-HDBK-221: 2.8

FAA Doc: 14CFR references: 23.1109, 23.1111

8.2.12 Verify that bleed air shut-off provisions are available at, or as close as possible to, the bleed source.

DoD/MIL Doc: JSSG-2009: D.3.4.4.12.2/D.4.4.4.12.2 Bleed source shut off; D.3.4.4.12.3/D.4.4.4.12.3 Bleed distribution control; D.3.4.4.12.4/D.4.4.4.12.4 Isolation and crossover control; D.3.4.4.12.10/D.4.4.4.12.10 Uncontrolled bleed air

FAA Doc: 14CFR references: 23.1109, 23.1111

8.2.13 Verify that pressurization rate control is available to preclude pressure surges in the cockpit.

DoD/MIL Doc: JSSG-2009: D.3.4.4.1.1/D.4.4.4.1.1 Occupied compartment pressure schedule; D.3.4.4.1.4/D.4.4.4.1.4 Compartment positive and negative pressure relief; D.3.4.4.1.5/D.4.4.4.1.5 Occupied compartment pressure release; D.3.4.4.1.6/D.4.4.4.1.6 Occupied compartment leakage rate; D.3.4.4.1.7/D.4.4.4.1.7 Occupied compartment pressure source

FAA Doc: 14CFR references: 23.841, 23.843, 25.841, 25.843

8.2.14 Verify that nuclear, biological, and chemical (NBC) equipment and/or procedures are provided for protecting or maintaining ECS cooling air free from contaminants.

DoD/MIL Doc: JSSG-2009: D.3.4.4.2.8/D.4.4.4.2.8 Occupied compartment flow shutoff; D.3.4.4.5.1/D.4.4.4.5.1 Occupied compartment normal ventilation; D.3.4.4.5.2/D.4.4.4.5.2 Occupied compartment emergency ventilation and smoke removal; D.3.4.4.6.1/D.4.4.4.6.1 Occupied compartment; D.3.4.4.6.3/D.4.4.4.6.3 Nuclear, biological, and chemical contamination

8.2.15 Verify that the air vehicle's thermal management system is stable for all flight conditions and environments.

DoD/MIL Doc: JSSG-2009 Appendix D: D.3.4.4.2, D.3.4.4.18, D.4.4.4.2, D.4.4.4.18

JSSG-2001: 3.3.10, 3.3.10.1

8.2.16 Verify adequate smoke clearance is available to ensure safe operation with or without an operational ECS.

DoD/MIL Doc: JSSG-2009 Appendix D: D.3.4.4.5, D.4.4.4.5, D.3.4.4.5.1/D.4.4.4.5.1 Occupied compartment normal ventilation; D.3.4.4.5.2/D.4.4.4.5.2 Occupied compartment emergency ventilation and smoke removal

FAR 21.183; FAR 21.189; FAR 23.1041, 23.1043-1045, 23.1047; FAR 25.1041 Powerplant Cooling; FAR 25.961 Fuel System Hot Weather Operation

FAA Doc: 14CFR references: 23.831, 25.831

8.2.17 Verify that all surface touch temperatures remain within required limits to preclude any operational limitations to safety of flight operations of the air vehicle.

DoD/MIL Doc: JSSG-2009 Appendix D: D.3.4.4.4, D.4.4.4.4 Surface touch temperatures

8.3 Fuel system.

(Refuel, defuel, feed, transfer, pressurization, vent, quantity gauging, dump, and inerting, including external and auxiliary fuel systems (tanks, plumbing, and pumps))

FAA Doc: 14CFR references: 23.951-23.979, 23.991-23.1001, 25.951-25.981, 25.991-25.1001

(Note: 14CFR reference paragraphs listed in the following section are not necessarily sufficient to fully satisfy the corresponding criteria.)

8.3.1 Verify that the fuel system is safely compatible with other system interfaces.

DoD/MIL Doc: JSSG-2009: 3.4.4.1/4.4.4.1; Appendix E: E.3.4.5.1.1, E.4.4.5.1.1, E.3.4.5.1.2, E.4.4.5.1.2, E.3.4.5.1.3, E.4.4.5.1.3, E.3.4.5.1.3.11, E.4.4.5.1.3.11, E.3.4.5.2.1, E.4.4.5.2.1, E.3.4.5.2.2, E.4.4.5.2.2, E.3.4.5.3, E.4.4.5.3

FAA Doc: 14CFR references: 23.951-23.979, 23.991-23.1001, 25.951-25.981, 25.991-25.1001

8.3.1.1 Verify that all components, either individually or as part of a subsystem, have passed all safety-related qualification tests (e.g., proof, burst, vibration, containment, over-speed, acceleration, explosive atmosphere, pressure cycling, and temperature cycling as required for airworthy performance). (For Navy and Marine Corps use only, verify external fuel tanks survive without rupture after fragment impact, forced ejection, overpressure following ignition of fuel vapors, and are fire resistant.)

8.3.1.2 Verify that adequate crew station information is available to notify the flight crew of the system operating conditions.

8.3.2 Verify that the fuel system functions under all probable conditions with the approved fuels.

DoD/MIL Doc: JSSG-2009 Appendix E: E.3.4.5.1.1, E.4.4.5.1.1, E.3.4.5.1.2, E.4.4.5.1.2, E.3.4.5.1.3, E.4.4.5.1.3, E.3.4.5.1.4, E.4.4.5.1.4, E.3.4.5.2.1, E.4.4.5.2.1, E.3.4.5.2.2, E.4.4.5.2.2

FAA Doc: 14CFR references: 23.951-23.979, 23.991-23.1001, 25.951-25.981, 25.991-25.1001

AC 20-29

8.3.3 Verify that all fuel system critical failure modes and hazards have acceptable risk levels.

DoD/MIL Doc: JSSG-2009 Appendix E: E.3.4.5.1.12, E.4.4.5.1.12

FAA Doc: 14CFR references: 23.951-23.979, 23.991-23.1001, 25.951-25.981, 25.991-25.1001

8.3.4 Verify the safe installation of the fuel system and components.

DoD/MIL Doc: JSSG-2009: 3.3.3.1, 4.3.3.1, 3.3.8, 4.3.8

FAA Doc: 14CFR references: 23.963, 23.993, 23.994, 25.963, 25.993, 25.994

8.3.5 Verify that the plumbing and components in the fuel system (as completely assembled and installed within the air vehicle) can withstand exposure to the specified proof pressure limit for the subsystem without resulting in fuel leakage, critical system performance degradation or critical life limited durability.

DoD/MIL Doc: JSSG-2009 Appendix E: E.3.4.5.1.5, E.4.4.5.1.5, E.3.4.5.1.6, E.4.4.5.1.6, E.3.4.5.1.7, E.4.4.5.1.7, E.3.4.5.1.8, E.4.4.5.1.8, E.3.4.5.6.1, E.4.4.5.6.1

FAA Doc: 14CFR references: 23.993, 25.993

8.3.6 Verify that the fuel feed system provides a continuous supply of fuel to the engine at sufficient pressure throughout the flight and ground operation envelopes, including starting and all flight maneuvers.

DoD/MIL Doc: JSSG-2009 Appendix E: E.3.4.5.2.1, E.4.4.5.2.1, E.3.4.5.2.2, E.4.4.5.2.2, E.3.4.5.2.4, E.4.4.5.2.4, E.3.4.5.2.5, E.4.4.5.2.5

FAA Doc: 14CFR references: 23.951, 23.953, 23.955, 23.959, 25.951, 25.953, 25.955, 25.959

8.3.7 Verify that fuel transfer flow rates meet the operational ground and flight envelope requirements.

DoD/MIL Doc: JSSG-2009 Appendix E: E.3.4.5.2.3, E.4.4.5.2.3, E.3.4.5.4, E.4.4.5.4, E.3.4.5.4.1, E.4.4.5.4.1

FAA Doc: 14CFR references: 23.951, 23.952, 23.953, 23.955, 23.961, 25.951, 25.952, 25.953, 25.955, 25.961

8.3.8 Verify that the air vehicle center-of-gravity limits are not exceeded during all fuel system and air vehicle functions, including release of stores, aerial refueling (if applicable), fuel transfer, fuel dumping operations, wing sweep operations, catapult launches, arrested landings, and engine feed.

DoD/MIL Doc: JSSG-2009 Appendix E: E.3.4.5.5, E.4.4.5.5

FAA Doc: 14CFR references: 23.1001, 25.1001

8.3.9 Verify that the fuel system is designed to prevent pressures from exceeding the system's proof pressure limits (both minimum and maximum) during refueling (aerial and ground), defueling, transfer, fuel feed, fuel dump operations and engine feed.

DoD/MIL Doc: JSSG-2009 Appendix E: E.3.4.5.1.7, E.4.4.5.1.7, E.3.4.5.1.8, E.4.4.5.1.8, E.3.4.5.8, E.4.4.5.8

FAA Doc: 14CFR references: 23.963, 23.979, 25.963, 25.979

8.3.10 Verify that the flight and maintenance manuals include normal and emergency operating procedures, limitations, restrictions, servicing, and maintenance information.

DoD/MIL Doc: JSSG-2009: 3.2.6, 4.2.6; Appendix E, E.3.4.5.6.8, E.4.4.5.6.8

8.3.11 Verify that the design and procedures are adequate for controlling and purging impurities from the fuel system and that the fuel system's level of contamination is acceptable at all times.

DoD/MIL Doc: JSSG-2009 Appendix E: E.3.4.5.6.2, E.4.4.5.6.2, E.3.4.5.6.3, E.4.4.5.6.3, E.3.4.5.1.3, E.4.4.5.1.3

MIL-F-8615

FAA Doc: 14CFR references: 23.971, 23.973, 23.977, 23.997, 25.971, 25.973, 25.977, 25.997

AC 20-119

8.3.12 Verify that the system is designed to withstand the hazards associated with lightning, static electricity, fuel leaks, and the introduction of electrical power into fuel tanks.

DoD/MIL Doc: JSSG-2009 Appendix E: E.3.4.5.1.9, E.4.4.5.1.9, E.3.4.5.1.11, E.4.4.5.1.11, E.3.4.5.7, E.4.4.5.7, E.3.4.5.8.12, E.4.4.5.8.12

FAA Doc: 14CFR references: 23.863, 23.954, 23.971, 23.975, 25.863, 25.954, 25.971, 25.975, 25.981

AC 20-53A, AC 25.981-2, AC 25.981-1B, AC 25-16

8.3.12.1 Verify that the fuel system is designed and arranged to prevent the ignition of fuel vapor within the system.

DoD/MIL Doc: JSSG-2009 Appendix E: E.3.4.5.1.9, E.4.4.5.1.9, E3.4.5.1.11 & E4.4.5.1.11; Appendix G: 3.4.7, G4.4.7

FAA Doc: 14CFR references: 23.954, 23.975, 25.954, 25.975, 25.981

AC 20-53A, AC 25-16, AC 25.981-1B, AC 25.981-2

8.3.12.2 Verify that secondary fuel and vapor tight barriers is provided between fuel tanks, fire hazard areas, and inhabited areas.

DoD/MIL Doc: JSSG-2009 Appendix E: E.3.4.5.6.11, E.4.4.5.6.11

FAA Doc: 14CFR references: 23.863, 23.967, 23.1185, 25.863, 25.967, 25.1185, 25.981

AC 25-981-2, AC 25-981-1B

8.3.12.3 Verify that drainage provisions are provided to remove all normal and accidental fuel leakage to a safe location outside of the air vehicle.

DoD/MIL Doc: JSSG-2009 Appendix E: E.3.4.5.6.2, E.4.4.5.6.2, E.3.4.5.1.10, E.4.4.5.1.10

FAA Doc: 14CFR references: 23.977, 23,997, 23.999, 25.977, 25.997, 25.999

8.3.12.4 Verify that fuel jettison, fuel venting, fuel leaks, or fuel spills can not be ingested by the engine, flow into hazardous ignition areas, onto the environmental management system, or become reingested into the air vehicle.

DoD/MIL Doc: JSSG-2009 Appendix E: E.3.4.5.2.6, E.4.4.5.2.6

FAA Doc: 14CFR references: 23.971, 23.999, 23.1001, 25.971, 25.999, 25.1001

8.3.13 Verify that fuel tanks are capable of withstanding, without failure, the vibration, inertia, fluid, and structural loads that they may be subject to in operation.

DoD/MIL Doc: JSSG-2009 Appendix E: E.3.4.5.6, E.4.4.5.6, E.3.4.5.6.13, E.4.4.5.6.13

FAA Doc: 14CFR references: 23.963, 23.965, 23.993, 25.963, 25.965, 25.993

AC 25.963-1

8.3.14 Verify that tank pressure does not exceed tank structural limits due to a single failure under normal operation.

DoD/MIL Doc: JSSG-2009: 3.2.9.1, 4.2.9.1, and Appendix E: E.3.4.5.1.7, E.4.4.5.1.7, E.3.4.5.1.8, E.4.4.5.1.8, E.3.4.5.1.12, E.4.4.5.1.12

FAA Doc: 14CFR references: 23.957, 23.963, 23.965, 25.957, 25.963, 25.965

AC 25.963-1

8.3.15 Verify that the air vehicle can be safely refueled and defueled.

DoD/MIL Doc: JSSG-2009 Appendix E: E.3.4.5.1.12, E.4.4.5.1.12, E.3.4.5.8.1, E.4.4.5.8.1, E.3.4.5.8.4, E.4.4.5.8.4, E.3.4.5.8.5, E.4.4.5.8.5, E.3.4.5.8.6, E.4.4.5.8.6, E.3.4.5.8.7, E.4.4.5.8.7, E.3.4.5.8.8, E.4.4.5.8.8

FAA Doc: 14CFR references: 23.863, 23.973, 23.975, 23.979, 25.863, 25.973, 25.975, 25.979

8.3.16 Verify that the fuel system has been designed to prevent fuel spills during refuel operations.

DoD/MIL Doc: JSSG-2009 Appendix E: E.3.4.5.1.12, E.4.4.5.1.12, E.3.4.5.6.1, E.4.4.5.6.1, E.3.4.5.8.1, E.4.4.5.8.1, E.3.4.5.8.11, E.4.4.5.8.11, E.3.4.5.8.14, E.4.4.5.8.14, E.3.4.5.9, E.4.4.5.9

FAA Doc: 14CFR references: 23.969, 23.975, 25.969, 25.975

8.3.17 Verify that adequate controls and displays for the fuel system functions are provided for the appropriate crewmember(s) to indicate the necessary fuel system functions and warn of hazardous conditions.

DoD/MIL Doc: JSSG-2009 Appendix E: E.3.4.5.1.12, E.4.4.5.1.12, E.3.4.5.8.11, E.4.4.5.8.11, E.3.4.5.12, E.4.4.5.12, E.3.4.5.12.1, E.4.4.5.12.1, E.3.4.5.12.2, E.4.4.5.12.2, E.3.4.5.12.3, E.4.4.5.12.3, E.3.4.5.12.4, E.4.4.5.12.4, E.3.4.5.12.5, E.4.4.5.12.5

8.3.18 Verify that built-in-test (BIT) and fault isolation provisions are available to ensure safe fuel system operations.

DoD/MIL Doc: JSSG-2009: 3.2.9, 4.2.9 and Appendix E: E.3.4.5.8.11, E.4.4.5.8.11, E.3.4.5.12.5, E.4.4.5.12.5

FAA Doc: 14CFR references: 23.979, 25.979

8.3.19 Verify that jettisoned fuel does not impinge on air vehicle surfaces or become re-ingested into the air vehicle.

8.4 Fire and hazard protection.

Includes prevention, detection, and extinguishing and explosion suppression provisions.

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

(Note: 14CFR reference paragraphs listed in the following section are not necessarily sufficient to fully satisfy the corresponding criteria.)

8.4.1 Verify that the fire protection system safely integrates within the air vehicle, both physically and functionally.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7, G.4.4.7, G.3.4.7.1, G.4.4.7.1, G.3.4.7.2, G.4.4.7.2, G.3.4.7.29, G.4.4.7.29

MIL-HDBK-221: 2.7, 2.12, 2.13, 2.16, 2.17

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.1.1 Verify that any single-point failure conditions are identified and their consequences of failure are acceptable, eliminated or mitigated.

8.4.1.2 Verify that all components, either individually or as part of a subsystem, have passed all safety-related qualification tests (e.g., proof, burst, vibration, containment, over-speed, acceleration, explosive atmosphere, pressure cycling, and temperature cycling as required for airworthy performance).

8.4.1.3 Verify that adequate crew station information is available to notify the flight crew of the system operating conditions.

8.4.2 Verify that each component of the air vehicle is 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.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7, G.4.4.7

MIL-HDBK-221: 2.11

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.3 Verify that the design of subsystems other than fire protection have taken into consideration any potential for fire hazards.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.1, G.4.4.7.1

MIL-HDBK-221: 2.1, 2.2.1.2, 2.2.1.4, 2.2.1.5, 2.2.1.6, 2.2.1.7, 2.2.1.8, 2.2.2 through 2.2.9, 2.5, 2.6, 2.7.3, 2.7.11, 2.7.13, 2.10.2 though 2.10.8

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.3.1 Verify that, in areas where a fluid system might leak flammable fluids or vapors, there is a means to minimize the probability of ignition of the fluids and vapors and to minimize the resultant hazards if ignition does occur.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.3, G.4.4.7.3, G.3.4.7.6, G.4.4.7.6

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.3.2 Verify that provisions exist for air vehicle safety-critical components to withstand fire and heat to a predetermined safe level.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.6, G.4.4.7.6, G.3.4.7.21, G.4.4.7.21

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.4 Verify that provisions for drainage and ventilation of combustible fluids or vapors are adequate to preclude the occurrence of fire or explosion hazards.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.3, G.4.4.7.3, G.3.4.7.4, G.4.4.7.4, G.3.4.7.5, G.4.4.7.5, G.3.4.7.18, G.4.4.7.18

MIL-HDBK-221: 2.4

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.4.1 Verify that drainage and ventilation provisions are located so that combustibles are removed from the air vehicle to a safe location on the ground and can not reenter the air vehicle in flight or ground operations.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.3, G.4.4.7.3, G.3.4.7.4, G.4.4.7.4, G.3.4.7.17, G.4.4.7.17, G.3.4.7.18, G.4.4.7.18, G.3.4.7.22, G.4.4.7.22

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.5 Verify that drains and vents from areas that might carry flammable fluids are not manifolded with drains from areas that do not carry a potentially flammable fluid.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.3, G.4.4.7.3, G.3.4.7.5, G.4.4.7.5

MIL-HDBK-221: 2.4.5

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.6 Verify that engine nacelle cooling and ventilation provisions are adequate to provide required heat rejection and maintain nacelle conditions necessary to avoid both hot surface ignition sources and collection of flammable fluids or vapors.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.4, G.4.4.7.4, G.3.4.7.18, G.4.4.7.18

MIL-HDBK-221: 2.11.2.4, 2.11.2.5

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.7 Verify that all potential fire zones (e.g. engine, auxiliary power unit (APU) and other compartments, such as engine-driven airframe accessory area) are designated as such and that suitable fire warnings and protection are provided.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.19, G.4.4.7.19, G.3.4.7.20, G.4.4.7.20, G.3.4.7.24, G.4.4.7.24, G.3.4.7.27, G.4.4.7.27

MIL-HDBK-221: 2.12, 2.13 (All except any reference to Halon), 2.17

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.8 Verify that essential flight controls, engine mounts, and other flight structures located in designated fire zones or adjacent areas are qualified to withstand the effects of fire.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.20, G.4.4.7.20, G.3.4.7.21, G.4.4.7.21

MIL-HDBK-221: 2.7.4

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.9 Verify that each electrically powered fire protection subsystem (e.g., fire detection, extinguishing, and explosion suppression) is provided power at all times during air vehicle operations, including engine start and battery operations.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.10, G.4.4.7.10

MIL-HDBK-221: 2.12, 2.13

FAA Doc: 214CFR references: 3.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.10 Verify that the air vehicle explosion suppression system meets performance requirements for fire and hazard protection.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.8, G.4.4.7.8, G.3.4.7.9, G.4.4.7.9, G.3.4.7.26, G.4.4.7.26, G.3.4.7.27, G.4.4.7.27, G.3.4.7.28, G.4.4.7.28

MIL-HDBK-221: 2.17

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.11 Verify that the fire detection system is designed to preclude false warnings.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.9, G.4.4.7.9, G.3.4.7.10, G.4.4.7.10, G.3.4.7.11, G.4.4.7.11, G.3.4.7.12, G.4.4.7.12, G.3.4.7.13, G.4.4.7.13, G.3.4.7.14, G.4.4.7.14, G.3.4.7.15, G.4.4.7.15

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.12 Verify the performance of the fire suppression system.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.24, G.4.4.7.24, G.3.4.7.25, G.4.4.7.25, G.3.4.7.26, G.4.4.7.26

MIL-HDBK-221: 2.12

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.13 Verify that fireproof protective devices are provided to isolate a fire within a defined fire zone from any portion of the air vehicle where a fire could create a hazard.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.20, G.4.4.7.20

MIL-HDBK-221: 2.7.8, 2.11

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.14 Verify that air vehicle interior finishes and materials deter combustion and that any toxic by-products of combustion are at acceptable levels.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.7, G.4.4.7.7, G.3.4.7.22, G.4.4.7.22

MIL-HDBK-221: 2.7.9

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

AC 25.853-1, AC 25.869-1

8.4.15 Verify that hazardous quantities of smoke, flames, or extinguishing agents are prevented from entering inhabited areas, UAV/ROA control station, or UAV/ROA flight-critical sensor bays.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.22, G.4.4.7.22

MIL-HDBK-221: 2.4.2, 2.19

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

AC 25-9

8.4.16 Verify that proper separation is provided between oxidizers and flammable fluid systems or electrical components.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.16, G.4.4.7.16, G.3.4.7.17, G.4.4.7.17

MIL-HDBK-221: 2.7.2, 2.7.10, 2.10.4.2, 2.10.2.1

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.17 Verify that provisions are available to shut off flammable fluids and de-energize all electrical ignition sources in the identified fire zone(s) for all mission phases including ground operations.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.17, G.4.4.7.17, G.3.4.7.19, G.4.4.7.19

MIL-HDBK-221: 2.1.1.5, 2.2.6, 2.4.8, 2.11.1.4, 2.11.2.7

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.18 Verify that ground firefighting access provisions are compatible with standard ground firefighting systems and that fire suppression can be accomplished through this access provision.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.7, G.4.4.7.7, G.3.4.7.13, G.4.4.7.13, G.3.4.7.31, G.4.4.7.31

MIL-HDBK-221: 2.11.2.10, 2.11.3.6

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

AC 20-42C

8.4.19 Verify that the air vehicle provides safety features for post-crash fire and explosion hazards.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.7, G.4.4.7.7

MIL-HDBK-221: 2.7.3.2, 2.15

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

AC 25-17, AC 25.994.1

8.4.20 Verify that the air vehicle has provisions to detect and control overheat conditions that are potential fire and explosion hazards.

DoD/MIL Doc: JSSG-2009 Appendix G: G.3.4.7.23, G.4.4.7.23, G.3.4.7.28, G.4.4.7.28

MIL-HDBK-221: 2.20

FAA Doc: 14CFR references: 23.851-23.865, 25.851-25.869, 23.1181-23.1203, 25.1181-25.1207, 23.1411, 25.1411

8.4.21 Verify, if unoccupied cargo holds are present, that fire protection, fire detection/ suppression, and smoke detector requirements are met.

DoD/MIL Doc: JSSG-2010-7: 3.7.3.4

JSSG-2009-Appendix G: 3.4.7, 3.4.7.22, 3.4.7.25, 3.4.7.28

FAA Doc: 14CFR references: 25.855, 25.857, 25.858, 25.859

8.5 Landing gear and deceleration systems.

DoD/MIL Doc: AFGS-87139

JSSG-2009 Appendix A

FAA Doc: 14CFR references: 23.721-23.745, 25.721-25.737

(Note: 14CFR reference paragraphs listed in the following section are not necessarily sufficient to fully satisfy the corresponding criteria.)

8.5.1 Verify safe ground flotation capability of the landing gear systems.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.2.1, A.4.4.1.2.1, Ground Flotation

AFGS-87139: 3.2.1.1.b Ground Flotation.

8.5.2 Arrangement, dynamics, and clearances.

DoD/MIL Doc: AFGS-87139: 3.2.1.1, 3.2.1.2

FAA Doc: 14CFR reference: 23.721-23.745, 25.721-25.737 -Covers dynamics and some of arrangements, no clearances

8.5.2.1 Verify that the landing gear arrangement and servicing criteria prevents ground contact (including servicing equipment, arresting cables, runway lights, etc.) at all weapons loading configurations, engine runs, and for flat gear or flat tire, or flat gear and flat tire situations.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.1.1, A.4.1.1.1, A.3.4.1.1.6, A.4.4.1.1.6, A.3.4.1.1.3, A.4.4.1.1.3, Appendix A: A.3.4.1.1.1/A.4.4.1.1.1 Gear arrangement; A.3.4.1.1.3/A.4.4.1.1.3 Extended Clearances; and A.3.4.1.1.6/A.4.4.1.1.6 Clearance with flat tire and flat strut.

AFGS-87139: 3.2.1.2 Arrangement and 3.2.1.3.a Clearances.

FAA Doc: 14CFR reference: 13.1-13.2.4, 23.1501, 23.1529, 25.1501, 25.1503-25.1533, 25.1529, 25.1541, 25.1543, 25.1557, 25.1563

8.5.2.2 Verify that, for all ground operations, the air vehicle maintains operational control and stability such that no part of the air vehicle or its weapons contacts the ground or other permanent ground structures (servicing equipment, arresting cables, runway lights, etc.).

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.1.2/A.4.4.1.1.2 Pitch Stability; and A.3.4.1.1.7/A.4.4.1.1.7 Gear Stability

AFGS-87139: 3.2.1.2 Arrangement and 3.2.5.1 General

FAA Doc: 14CFR reference: 25.233

8.5.2.3 For retractable gears, verify that sufficient clearance exists within the wheel well under all ground and flight conditions so that no part of the gear contacts the airframe or becomes stuck in the up position due to interference with any air vehicle structure or component.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.1.4/A.4.4.1.1.4 Retraction Clearances

AFGS-87139: 3.2.1.2 Arrangement and 3.2.1.3.b Clearances (retractable landing gears)

FAA Doc: 14CFR references: 23.745

8.5.2.4 Verify that the design of the landing gear system prevents the occurrence of unsafe dynamics, vibrations, or pitching motions for all operational phases of the air vehicle on the ground and in the transition to air.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.1.2/A.4.4.1.1.2 Pitch Stability; A.3.4.1.1.7/A.4.4.1.1.7 Gear Stability; A.3.4.1.4.2/A.4.4.1.4.2 Directional Control; A.3.4.1.4.3/A.4.4.1.4.3 Emergency directional control; A.3.4.1.4.5.1/A.4.4.1.4.5.1 Steering characteristics

AFGS-87139: 3.2.1.2.b Arrangement; and 3.2.1.4 Damping

FAA Doc: 14CFR references: 23.721-23.745, 25.721-25.737

8.5.2.5 Verify that the air vehicle does not tip back when reverse braking or towing is done at the specified conditions.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.3.1.14/A.4.4.1.3.1.14 Empennage protection; and A.3.4.1.2.2.1.3/A.4.4.1.2.2.1.3 Landing gear towing

FAA Doc: 14CFR references: 23.509, 25.507, 25.509

8.5.2.6 Verify the landing gear kneeling capability allows for safe kneeling of the air vehicle.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.10/A.4.4.1.10 Specialized subsystems

AFGS-87139: 3.1.9 Specialized subsystems.

8.5.2.6.1 Verify the servicing procedures for landing gear kneeling and unkneeling are safe and properly sequenced.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.10/A.4.4.1.10 Specialized subsystems

AFGS-87139: 3.1.9 Specialized subsystems

8.5.3 Landing gear structure.

DoD/MIL Doc: AFGS-87139: 3.2.2

JSSG-2009 Appendix A: A.1.2

FAA Doc: 14CFR reference: 23.721-23.745, 25.721-25.737

8.5.3.1 Verify that any structural failure of the gear does not result in penetration of the crew station (for manned air vehicles), fuel tanks, or any other bay that may explode.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.3.1.3/A.4.4.1.3.1.3 Failure Tolerance

AFGS-87139: 3.2.2.1.e General (limits on structural failure modes)

FAA Doc: 14CFR reference: 23.721 & 25.721 cover fuel spillage

8.5.3.2 Verify the functionality of the shock strut to perform all its required suspension, stroking, and energy absorption for all ground operations, landing, and takeoffs with normal servicing and with acceptable levels of misservicing.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.3.1.8/A.4.4.1.3.1.8 Energy Absorption 3.4.1.3.1.11/4.4.1.3.1.11 Repeated Operation

AFGS-87139: 3.2.2.1 General and 3.2.2.2 Shock absorption

MIL-L-8552

Comm'l Doc: SAE AS 6053 Tests, Impact, Shock Absorber, Landing Gear, Aircraft (formerly MIL-T-6053)

FAA Doc: 14CFR reference: 23.721-23.745, 13.1-13.2.4, 23.1501, 23.1529, 25.721-25.737, 25.1501, 25.1503-25.1533, 25.1529, 25.1541, 25.1543, 25.1557, 25.1563

8.5.3.3 Verify that a misserviced gear safely supports all weapons loading, fueling and defueling, does not compromise takeoff and landings nor result in ground resonance.

DoD/MIL Doc: AFGS-87139: 3.2.1.3 Clearances

MIL-L-8552 Landing Gear, Aircraft Shock Absorbers (Air-Oil Type)

Comm'l Doc: SAE AS 6053 Tests, Impact, Shock Absorber, Landing Gear, Aircraft (formerly MIL-T-6053)

FAA Doc: 14CFR reference: 13.1-13.2.4, 23.1501, 23.1529, 25.1501, 25.1503-25.1533, 25.1529, 25.1541, 25.1543, 25.1557, 25.1563

8.5.3.4 Verify that, for both main and nose/tail landing gear, landing conditions (normal and emergency) are within the safe operating limits.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.3.1.7/A.4.4.1.3.1.7 Flat tire and flat strut operation; A.3.4.1.3.1.8/A.4.4.1.3.1.8 Energy absorption; A.3.4.1.3.1.11/A.4.4.1.3.1.11 Repeated operation

AFGS-87139: 3.6 Environmental Conditions, 3.2.2.1 General and 3.2.2.2 Shock absorption

FAA Doc: 14CFR references: 23.721-23.731, 23.473, 23.477, 23.479, 23.481, 23.483, 23.485, 25.721-25.731, 25.101, 25.511, 25.1583

8.5.3.5 Verify that dynamic stability is adequate and landing gear shimmy is not evident.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.1.7/A.4.4.1.1.7 Gear Stability; and A.3.4.1.4.5.1/A.3.4.1.4.5.1 Steering Characteristics.

AFGS-87139: 3.2.1.2 Arrangement and 3.2.1.4 Damping.

FAA Doc: 14CFR reference: 23.721-23.745, 25.721-25.737- shimmy is not covered, the rest of the paragraphs imply coverage

8.5.4 Verify that all mission and all ground handling conditions, including maximum air vehicle deceleration at the most critical C.G. and gross weight, have a maximum expected tire load and speed below that demonstrated for the selected tire at its intended inflation pressure and maximum wear limit (MWL).

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.2.2/A.4.4.1.2.2 Ground handling; A.3.4.1.3.1.4/A.4.4.1.3.1.4 Strength; and A.3.4.1.11.1.1/A.4.4.1.11.1.1 Air vehicle tire performance.

AFGS-87139: 3.1.8 Ground handling (operations), 3.2.4.1 Tires

MIL-PRF-5041

FAA Doc: 14CFR reference: 23.473, 23.726, 23.733, 25.473, 25.726, & 25.733

8.5.5 Verify that the worst-case loads expected during operational missions on the nose/tail wheels and main gear wheels are not exceeded.

Comm'l Doc: SAE ARP-1493

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.2.2/A.4.4.1.2.2 Ground handling; A.3.4.1.3.1.4/A.4.4.1.3.1.4 Strength; A.3.4.1.11.2.1/A.4.4.1.11.2.1 Air vehicle wheel performance; and A.3.4.1.11.2.4/A.4.4.1.11.2.4 Nonfrangibility criteria (flat tire operation)

AFGS-87139: 3.1.8 Ground handling (operations) and 3.2.4.2 Wheels

MIL-B-8584

MIL-W-5013 Wheel and Brake Assemblies - inactive for new design

FAA Doc: 14CFR reference: 23.721-23.732, 25.721-25.732, 23.471-23.511 & 25.471-25.511, 25.101 (see 13.1-13.2.4)

8.5.6 Verify that protection is incorporated to preclude wheel and tire overpressurization.

Comm'l Doc: SAE ARP-1493

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.11.2.3/A.4.4.1.11.2.3 Brake Overheat Capability; and A.3.4.1.11.2.6/A.3.4.1.11.2.6 Pressure-release criteria; A.3.4.1.11.3.1/A.4.4.1.11.3.1 Air vehicle stopping and turn-around performance; and A.3.4.1.11.3.7/A.4.4.1.11.3.7 Temperature interface criteria

AFGS-87139: 3.2.4.2.c Wheel overheat capability

MIL-W-5013 Wheel and Brake Assemblies - inactive for new design

FAA Doc: 14CFR reference: 11.2.2 & 11.2.2.1 Included in each specific 14CFR reference per section

8.5.7 Brake assemblies.

Comm'l Doc: SAE ARP-1493

DoD/MIL Doc: AFGS-87139: 3.2.3 & 3.2.4.3

JSSG-2009: A.3.4.1.4.1,4.4.1.4.1; A.3.4.1.11.3, A.4.4.1.11.3

MIL-W-5013 Wheel and Brake Assemblies - inactive for new design

FAA Doc: 14CFR reference: 23.45, 23.55, 23.493, 23.735, 25.45, 25.55, 25.493, 25.735, 25.101

8.5.7.1 Verify that the energy, torque, and distance performance are at least equal to the levels required for the air vehicle when it is operated within its design limits.

Comm'l Doc: ARP-1493

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.11.3.1/A.4.4.1.11.3.1 Air vehicle stopping and turn-around performance.

AFGS-87139: 3.2.3.1.a & b Brake system (General)

MIL-W-5013 Wheel and Brake Assemblies - inactive for new design

FAA Doc: 14CFR reference: 23.45, 23.55, 23.493, 23.735, 25.45, 25.55, 25.493, 25.735, 25.101

8.5.7.2 Verify that failure of any brake (structural or control system) does not prevent the air vehicle from stopping within the runway length needed to conduct the missions.

Comm'l Doc: SAE ARP-1493

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.11.2.4/A.4.4.1.11.2.4 Nonfrangibility criteria (flat tire operation); A.3.4.1.11.3.3/A.4.4.1.11.3.3 Structural failure criteria; and A.3.4.1.11.3.4/A.4.4.1.11.3.4 Secondary braking capability (fail-safe).

AFGS-87139: 3.2.3.1.c Brake system, General and 3.2.4.3 Brakes

MIL-W-5013 Wheel and Brake Assemblies - inactive for new design

FAA Doc: 14CFR reference: 11.2.2.1

8.5.7.3 Verify that the brakes provides sufficient torque to prevent wheel rotation with engine thrust at least equal to normal preflight test levels.

Comm'l Doc: SAE ARP-1493

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.7/A.4.4.1.7 Restraint capability.

AFGS-87139: 3.2.3.1.b Brake System, General, and 3.2.4.3 Brakes

MIL-W-5013 Wheels and Brake Assemblies – inactive for new design

MIL-B-8584 Design of Brake Systems

FAA Doc: 14CFR references: 23.735, 25.735

8.5.7.4 Verify that an appropriate device is installed to release tire pressure if the brakes overheat.

Comm'l Doc: ARP-1493

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.11.2.3/A.4.4.1.11.2.3 Brake Overheat Capability; A.3.4.1.11.2.6/A.4.4.1.11.2.6 Pressure-release criteria; and A.3.4.1.11.3.7/A.4.4.1.11.3.7 Temperature interface criteria.

AFGS-87139: 3.2.3.1 General and 3.2.4.3.a Brakes

MIL-W-5013 Wheel and Brakes - presently in active for new designs.

FAA Doc: 14CFR reference: 11.2.2 & 11.2.2.1

8.5.8 Brake control and anti-skid control.

Comm'l Doc: SAE ARP-1493

DoD/MIL Doc: AFGS-87139: 3.2.3 & 3.2.4.3

JSSG-2009: A.3.4.1.4.1, 4.4.1.4.1; A.3.4.1.11.3, A.4.4.1.11.3

MIL-W-5013 Wheel and Brake Assemblies - inactive for new design

FAA Doc: 14CFR reference: 25.101, inferred in 23.45, 23.55, 23.493, & 23.735 &25.45, 25.55, 25.493 & 25.735

8.5.8.1 Verify that there is a separate and independent method of stopping the air vehicle within the required distance when the primary stopping method is unavailable or compromised.

Comm'l Doc: SAE ARP-1070

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.4.4.2/A.4.4.1.4.4.2 Alternate independent braking

AFGS-87139: 3.2.3.2.a Brake actuation system and 3.2.4.3 Brakes

MIL-B-8584 Design of Brake Systems

FAA Doc: 14CFR reference: 11.2.2 & 11.2.2.1

8.5.8.2 Verify that the braking function can be maintained from the pilot's station in a smooth and controllable manner for all normal and emergency operations.

Comm'l Doc: SAE ARP-1070

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.4.2/A.4.4.1.4.2 Directional Control; and A.3.4.1.4.4.1/A.4.4.1.4.4.1 Braking control interface.

AFGS-87139: 3.2.3.1 General, 3.2.3.2 Brake actuation system; 3.2.3.3 Anti-skid brake control; and 3.2.4.3 Brakes

MIL-B-8584 Design of Brake Systems

FAA Doc: 14CFR reference: inferred in 23.45, 23.55, 23.493, 23.735, 25.45, 25.55, 25.493, 25.735 & 25.101

8.5.8.3 If a parking brake is required, verify that it provides holding power for the required time and conditions.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.9.5/4.4.1.9.5 Parking Brake

AFGS-87139: 3.2.3.2.d Brake actuation system

MIL-B-8584 Design of Brake Systems

8.5.8.4 Verify safe stopping performance for all expected runway conditions (dry, wet, snow, ice, etc.) over all mission speed ranges and for all ground maneuvering conditions.

Comm'l Doc: SAE ARP-1070

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.4.4.3/A.4.4.1.4.4.3 Skid control; and A.3.4.1.11.3.1/A.4.4.1.11.3.1 Air vehicle stopping and turn-around performance

AFGS-87139: 3.2.3.1 General, 3.2.3.3 Anti-skid brake control and 3.2.4.3 Brakes

MIL-B-8584 Design of Brake Systems

FAA Doc: 14CFR reference: 23.45, 23.55, 23.493, 23.735, 25.187, 25.45, 25.55, 25.493, & 25.735

8.5.8.5 Verify that anti-skid system design can respond to any power interruptions or system malfunctions without compromising the ability of the pilot to control the air vehicle.

Comm'l Doc: SAE ARP-1070

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.4.4.4/A.4.4.1.4.4.4 skid control with power interruption; and A.3.4.1.4.4.5/A.4.4.1.4.4.5 anti-skid engagement and disengagement

AFGS-87139: 3.2.3.3 Anti-skid brake control and 3.2.4.3 Brakes

MIL-B-8584 Design of Brake Systems

8.5.8.6 Verify that the anti-skid system precludes locked wheel/tire occurrences for all normal operating conditions.

Comm'l Doc: SAE ARP-1070

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.4.4.3/A.4.4.1.4.4.3 Skid Control

AFGS-87139: 3.2.3.3 Anti-skid brake control and 3.2.4.3 Brakes

MIL-B-8584 Design of Brake Systems

FAA Doc: 14CFR reference: 23.45, 23.55, 23.493, 23.735, 25.45, 25.55, 25.493, & 25.735

8.5.8.7 Verify that brake control power is equal and proportional to brake pedal movement.

Comm'l Doc: SAE ARP-1070

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.4.4.1/A.4.4.1.4.4.1 Braking Control Interface

MIL-B-8584 Design of Brake Systems

8.5.8.8 Verify that when pedal pressure is removed, pedals return to brakes-off position and that brake control power is not trapped or slow to release at any brake.

Comm'l Doc: SAE ARP-1070

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.4.4.1/A.4.4.1.4.4.1 Braking control interface

MIL-B-8584 Design of Brake Systems

AFGS-87139: 3.2.3.2 Brake actuation system; 3.2.3.3 Anti-skid brake control; and 3.2.4.3 Brakes

8.5.8.9 Verify that all modes of brake operation are safe.

Comm'l Doc: SAE ARP-1070

DoD/MIL Doc: JSSG-2009: 3.2.7.4.4.2/4.2.7.4.4.2 Damage tolerant-fail safe evident subsystems and components; and Appendix A: A.3.4.1.4.3/A.4.4.1.4.3 Emergency directional control; and A.3.4.1.4.4.2/A.4.4.1.4.4.2 Alternative independent braking

MIL-B-8584 Design of Brake Systems

AFGS-87139: 3.2.3.1 General; 3.2.3.2 Brake actuation system; 3.2.3.3 Anti-skid brake control; and 3.2.4.3 Brakes

FAA Doc: 14CFR reference: 11.1-11.2.6

8.5.8.10 Verify that the anti-skid control system is compatible with and continues to function in the installed environment and that heat buildup does not cause locked wheels on touchdown or during the landing roll.

Comm'l Doc: SAE ARP-1070

DoD/MIL Doc: JSSG-2009: 3.2.7.2/4.2.7.2 Environment

MIL-B-8584 Design of Brake Systems

AFGS-87139: 3.2.3.1 General; 3.2.3.2 Brake actuation system; 3.2.3.3 Anti-skid brake control; and 3.2.4.3 Brakes

8.5.8.11 Verify that there is no anti-skid coupling into the landing gear structure.

DoD/MIL Doc: JSSG-2006: 3.4.2.7 Dynamic response during ground/ship-based operations and 4.4.2 Ground loading conditions

JSSG-2009 Appendix A: A.3.4.1.4.4.3/A.4.4.1.4.4.3 Skid Control

AFGS-87139: 3.2.1.4 Damping and 3.2.3.3 Anti-skid brake control

8.5.9 Directional control.

DoD/MIL Doc: AFGS-87139: 3.2.5

JSSG-2009: A.3.4.1.4.2, A.4.4.1.4.2, A.3.4.1.4.5, A.4.4.1.4.5

FAA Doc: 14CFR reference: 23.45, 23.497, 23.499, 23.745, 25.233, 25.45, 25.497, 25.499, & 25.745

8.5.9.1 Verify that there is a primary and emergency (secondary) method to provide directional control during ground operations of the air vehicle for all the operational missions and flight configurations.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.4.2/A.4.4.1.4.2 Directional control; and A.3.4.1.4.3/A.4.4.1.4.3 Emergency directional control

AFGS-87139: 3.2.5.1 General; 3.2.5.2 Nose gear steering system

MIL-S-8812

FAA Doc: 14CFR reference: 23.45, 23.497, 23.499, & 23.745

8.5.9.2 Verify that the steering control system protects against steering failures and that system failures does not cause loss of control of the air vehicle.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.4.5.2/A.4.4.1.4.5.2 Response to nose wheel steering failure; and A.3.4.1.4.5.3/A.4.4.1.4.5.3 Emergency steering

AFGS-87139: 3.2.5.1 General, 3.2.5.2 Nose gear steering system

MIL-S-8812

8.5.9.3 Verify that control of the air vehicle can be maintained during engagement or disengagement of the steering throughout all the operational speed ranges and conditions, even if it occurs from a pilot commanded or a system uncommanded action.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.4.5.1/A.4.4.1.4.5.1 Steering Characteristics

MIL-S-8812

AFGS-87139: 3.2.5.1 General and 3.2.5.2 Nose gear steering system.

8.5.9.4 Verify that the steering control system can detect and correct or prevent steering hardovers.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.4.5.2/A.4.4.1.4.5.2 Response to nose wheel steering failure

MIL-S-8812

8.5.9.5 Verify that steering system operation during taxi, takeoff, and landing is sufficient to accomplish all the required ground maneuvering and parking, and is not sensitive to high-speed, ground rolling effects on directional control.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.4.5.1/A.4.4.1.4.5.1 Steering Characteristics

MIL-S-8812

AFGS-87139: 3.2.5.1 General and 3.2.5.2 Nose gear steering system

FAA Doc: 14CFR reference: 23.45, 23.497, 23.499, 23.745, 25.233, 25.45, 25.497, 25.499, & 25.745

8.5.10 Landing gear actuation control.

DoD/MIL Doc: AFGS-87139: 3.2.6

JSSG-2009: A.3.4.1.5, A.4.4.1.5

FAA Doc: 14CFR reference: 23.729 & 25.729

8.5.10.1 Verify safe operation of landing gear retraction, extension, and emergency extension; and verify that there are adequate clearances and suitable geometry for components having relative motion.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.1.3/A.4.4.1.1.3 Extended clearances; A.3.4.1.1.4/A.4.4.1.1.4 Retraction Clearances; and A.3.4.1.5.1/A.4.4.1.5.1 Retraction and extension actuation interface

AFGS-87139: 3.2.6.1 Retraction-extension system and 3.2.6.2 Actuation system indication

FAA Doc: 14CFR reference: 23.729 & 25.729

8.5.10.2 Verify that loss of doors, reversal of commands, or any single failures in the air vehicle power does not prevent gear extension. Verify that the emergency extension system is independent of the landing gear primary power source(s).

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.5.3/A.4.4.1.5.3 Single failure criteria; A.3.4.1.5.4/A.4.4.1.5.4 Actuation reversal; A.3.4.1.5.6/A.4.4.1.5.6 Operation with loss of door; and A.3.4.1.5.7/A.4.4.1.5.7 Emergency extension

AFGS-87139: 3.2.6.1 Retraction-extension system; and 3.2.6.2 Actuation system indication

FAA Doc: 14CFR reference: 23.729 & 25.729

8.5.10.3 Verify that proper gear position indications are given to the flight crew for all gear sequencing events during any phase of mission operations.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.5.8.1/A.4.4.1.5.8.1 Gear position status indicators; and A.3.4.1.5.4/A.4.4.1.5.4 Actuation reversal

AFGS-87139: 3.2.6.1 Retraction-extension system; and 3.2.6.2 Actuation system indication

FAA Doc: 14CFR reference: 23.729 & 25.729

8.5.10.4 Verify that the gear position warning system operates properly and allows the crew to override the warning systems.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.5.8.1/A.4.4.1.5.8.1 Gear position status indication

AFGS-87139: 3.2.6.1 Retraction-extension system; and 3.2.6.2 Actuation system indication

FAA Doc: 14CFR reference: 23.729 & 25.729

8.5.10.5 Verify that the time to move the gear to the command positions is compatible with air vehicle performance requirements for takeoff, landing, and go-around.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.5.5.1/A.4.4.1.5.5.1 Retraction; and A.3.4.1.5.5.2/A.4.4.1.5.5.2 Extension

AFGS-87139: 3.2.6.3 Retraction-extension time

FAA Doc: 14CFR references: 23.729, 25.729, 25.1515, 25.1583

8.5.10.6 Verify that the emergency extension times are compatible with emergency landing requirements.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.5.7/A.4.4.1.5.7 Emergency extension

AFGS-87139: 3.2.6.3 Retraction-extension time

FAA Doc: 14CFR reference: 23.729, 25.729, 25.1515, 25.1583

8.5.10.7 Verify that the gear is restrained in the final commanded positions for all ground and flight conditions required by all mission profiles.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.5.9.1/A.4.4.1.5.9.1 Gear position restraint and A.3.4.1.5.1/A.4.4.1.5.1 Retraction and extension actuation interface

AFGS-87139: 3.2.6.4 Position restraint

FAA Doc: 14CFR reference: 23.729, 25.729

8.5.10.8 Verify that a positive secondary means is available to lock the gear and doors during ground operations to prevent retraction on the ground. Also verify that visual indicators are provided so the ground retention devices are removed prior to flight.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.5.9.1/A.4.4.1.5.9.1 Gear position restraint and A.3.4.1.5.1/A.4.4.1.5.1 Retraction and extension actuation interface

AFGS-87139: 3.2.6.4 Position restraint

8.5.10.9 Verify that no damage to airframe or gear structure results if power is supplied to retract the gears when secondary ground devices are installed.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.5.10/A.4.4.1.5.10 Ground safety restraint; and A.3.4.1.5.1/A.4.4.1.5.1 Retraction and extension actuation interface

AFGS-87139: 3.2.6.4 Position restraint

8.5.10.10 Verify the downlocking and uplocking fail-safe provisions of the landing gear.

DoD/MIL Doc: JSSG-2009: 3.2.7.4.4.2/4.2.7.4.4.2 Damage tolerant-fail safe evident subsystems and components; and Appendix A: A.3.4.1.5.3/A.4.4.1.5.3 Single failure criteria

AFGS-87139: 3.2.6.1 Retraction-extension system and 3.2.6.2 Actuation system indication

FAA Doc: 14CFR reference: 23.729, 25.729

8.5.11 Auxiliary deceleration devices.

DoD/MIL Doc: AFGS-87139: 3.2.7 Auxiliary deceleration devices

JSSG-2009: A.3.4.1.8, A.4.4.1.8

8.5.11.1 Verify that the arresting system is capable of stopping the air vehicle at all the required design conditions (refused takeoffs (RTOs), fly-in engagements, brake overruns, etc.) without any damage to either the air vehicle or the arresting systems.

Comm'l Doc: SAE ARP-1538

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.8.1.1 thru A.3.4.1.8.1.8/A.4.4.1.8.1.1 thru A.4.4.1.8.1.8 Hook/Arresting system information

MIL-A-18717

MIL-A-83136

8.5.11.2 Verify the safety of the following: hook load, hold-down, and damping forces; engagement probabilities; off-center engagement capabilities; lateral run-outs; barrier compatibility; and any other specific engagement provisions.

Comm'l Doc: SAE ARP-1538

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.8.1.1 thru A.3.4.1.8.1.8/A.4.4.1.8.1.1 thru A.4.4.1.8.1.8 Hook/Arresting system information

MIL-A-18717

MIL-A-83136

AFGS-87139: 3.2.7.1 Arresting hook system

8.5.11.3 Verify that the hook can be deployed from the crew station in a timely manner and that a means is provided in the crew station to determine the position of the hook.

Comm'l Doc: SAE ARP-1538

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.8.5 thru A.3.4.1.8.8/A.4.4.1.8.5 thru A.4.4.1.8.8

MIL-A-18717

MIL-A-83136

AFGS-87139: 3.2.7.1 Arresting hook system.

8.5.11.4 Verify that no part of the landing gear, air vehicle, or stores snags the arresting cable when the air vehicle is rolling on rims after a tire failure.

Comm'l Doc: SAE ARP-1538

DoD/MIL Doc: MIL-A-18717

MIL-A-83136

AFGS-87139: 3.2.7.1 Arresting hook system.

8.5.11.5 Verify that the performance of drag chutes meets the specified deceleration requirements without any adverse loading or damage to air vehicle structure.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.8.2/A.4.4.1.8.2 Drag Chutes; and AFGS-87139 3.2.7.2 Drag Chutes.

8.5.11.6 As applicable to the air vehicle, verify the performance of thrust reversers, speed brakes, and/or other auxiliary deceleration systems; and verify that there is no adverse loading or structural damage to the air vehicle when these devices are used.

DoD/MIL Doc: AFGS-87139: 3.2.7.1 Arresting hook system; and 3.2.7.2 Drag chutes.

8.5.12 Ground handling.

DoD/MIL Doc: AFGS-87139: 3.2.7

JSSG-2009: A.3.4.1.2.2, A.4.4.1.2.2

FAA Doc: 14CFR reference: 23.471-23.511, 25.471-25.519

8.5.12.1 Verify that safe jacking provisions are provided and that they satisfy all specified air vehicle gross weight conditions and environmental conditions.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.2.2.1.1/A.4.4.1.2.2.1.1 Axle jacking; and A.3.4.1.2.2.1.2/A.4.4.1.2.2.1.2 Fuselage jacking

AFGS-87139: 3.2.8.1 Jacking

NATO STANAG 3098

FAA Doc: 14CFR reference: 23.507

8.5.12.2 Verify that the jacking interface meets the defined standards, including appropriate international standards.

DoD/MIL Doc: NATO STANAG

AFGS-87139: 3.2.8.1 Jacking

FAA Doc: 14CFR reference: 23.507, 25.519

8.5.12.3 Verify that the air vehicle is capable of being safely towed in all specified directions, at all mission weights, under the required environmental conditions, on expected operational surfaces.

DoD/MIL Doc: NATO STANAG 3278

NATO STANAG 4101

MIL-STD-805

JSSG-2009 Appendix A: A.3.4.1.2.2.1.3/A.4.4.1.2.2.1.3 Landing gear towing; A.3.4.1.2.2.1.5/A.4.4.1.2.2.1.5 Towing interface

AFGS-87139: 3.2.8.2 Towing

FAA Doc: 14CFR reference: 23.509 & 25.509

8.5.12.4 Verify emergency towing capability of the air vehicle to the maximum weight and load requirements.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.2.2.1.4/A.4.4.1.2.2.1.4 Emergency towing

AFGS-87139: 3.2.8.2 Towing

FAA Doc: 14CFR reference: 23.509 & 25.519

8.5.12.5 Verify that all mooring requirements are met for all mission weights and environmental conditions, and that these requirements address the defined standard arrangements and interface for mooring to ensure safety.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.2.2.1.6/A.4.4.1.2.2.1.6 Mooring provisions

AFGS-87139: 3.2.8.3. Mooring

FAA Doc: 14CFR reference: 25.519, 23.519

8.5.12.6 Verify that any specialized systems requirements and functional characteristics are safe for the operational mission conditions. (Examples of specialized systems are skis, skids, kneeling, crosswind positioning, and in-flight pressure control systems.)

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.10.1 thru A.3.4.1.10.2/A.4.4.1.10.1 thru A.4.4.1.10.2 Flotation and snow ski gear

AFGS-87139: 3.2.9.1 General

FAA Doc: 14CFR reference: 23.737, 25.737

8.5.12.7 Verify all known potential single-point failures are identified and are acceptable.

DoD/MIL Doc: JSSG-2009: 3.2.7.4.4.1/4.2.7.4.4.1 Safety and mission critical functions; and Appendix A: A.3.4.1.3.1.3/A.4.4.1.3.1.3 Failure tolerance

AFGS-87139: 3.5 System safety

FAA Doc: 14CFR reference: 23.471-23.511, 25.471-25.519, 25.1309

8.5.12.8 Verify that the air vehicle does not turnover or ground loop for all mission conditions that produce side-load. All taxi and turn conditions at all gross weights are evaluated for all possible strut/tire conditions and for adversely sloped taxiways and runways.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.1.1/A.4.4.1.1.1 Gear Arrangement; and A.3.4.1.1.2/A.4.4.1.1.2 Pitch Stability

AFGS-87139: 3.2.1.2 Arrangement

FAA Doc: 14CFR reference: 23.473, 23.477, 23.485, 25.473, 25.477, 25.485

8.5.12.9 Verify the landing gear and engine inlet geometry are designed to prevent possible FOD to engines.

DoD/MIL Doc: JSSG-2009 Appendix A: A.3.4.1.2.3/A.4.4.1.2.3 Ground FOD

AFGS-87139: 3.2.1.1 General, 3.2.1.2 Arrangement; and 3.2.1.3 Clearances.

8.5.12.10 Verify that the landing gear systems are compatible with air vehicle structure, weight, and balance, and with any other subsystems that interface with the landing gear system.

Comm'l Doc: Level II Interface and Functional Requirements as stated in contractual interface documentation.

DoD/MIL Doc: AFGS-87139: 3.2.1.1 General; 3.2.1.2 Arrangement; and 3.2.1.3 Clearances.

FAA Doc: 14CFR reference: 23.471-23.511, 25.471-25.519

8.5.12.11 Verify landing gear system's integrity in preventing uncommanded or unsafe effects in the event of single-point failures, dormant failures, or primary system loss. Ensure that the consequences of the failure are eliminated, mitigated, or evaluated to be at a risk level acceptable to the procuring activity.

Comm'l Doc: Level II single point/redundancy requirements.

DoD/MIL Doc: AFGS-87139: Appendix B

FAA Doc: 14CFR reference: 23.471-23.511, 25.471-25.519, 25.1309, 11.1-11.2.6

8.5.12.12 Verify that the system and system components have damage tolerance capability to sustain partial failure or leakage before failure without jeopardizing safety.

Comm'l Doc: Level II Damage Tolerance requirements.

DoD/MIL Doc: AFGS-87139: 3.2.2.1 General; 3.2.2.2 Shock absorption; and 3.2.2.3 Tail bumpers.

FAA Doc: 14CFR reference: 25.1309, 25.571

8.5.12.13 Verify that failures and leakage are evident in flight and/or during routine ground maintenance.

Comm'l Doc: Level II Damage Tolerance requirements and Maintainability requirements.

DoD/MIL Doc: AFGS-87139: 3.2.2.1 General; 3.2.2.2 Shock absorption; and 3.2.2.3 Tail bumpers.

FAA Doc: 14CFR reference: 25.1309, 25.571

8.5.12.14 Verify that adequate and safe lift points are provided for air vehicles that require routine external ground crew movement utilizing hands, mechanical lifts, hoists, etc.

DoD/MIL Doc: JSSG-2001: 3.4.3.2.1.6.1.3, 4.4.3.2.1.6.1.3

8.5.12.15 Verify that adequate crew station information is available to notify the flight crew of the landing and deceleration system operational conditions and state of functionality.

8.5.12.16 Verify that flight and maintenance manuals include normal, back-up, and emergency operating procedures, limitations, restrictions, servicing, and maintenance information for all landing gear and deceleration systems.

8.5.12.17 Verify that all components, either individually or as part of a landing gear and deceleration subsystem, have passed all safety-related qualification tests (e.g., proof, burst, vibration, acceleration, explosive atmosphere, pressure cycling, and temperature cycling as required for airworthy performance).

8.5.12.18 Verify the safe installation of the landing gear and deceleration system and their components.

8.6 Auxiliary/emergency power system(s) (APS/EPS).

This covers auxiliary power units (both ground and in flight use applications), airframe accessory gearboxes, engine starting system components, power-take-off (PTO) shafts, emergency power systems, and ram air turbines (RATs).

DoD/MIL Doc: JSSG-2009 Appendix C

FAA Doc: 14CFR references: 23.901-23.1203, 25.901-25.1207

TSO C77b

AC 20-128, AC 120-42A (Note: 14CFR reference paragraphs listed in the following section are not necessarily sufficient to fully satisfy the corresponding criteria.)

8.6.1 Verify that system components are safe for the intended use and environment.

DoD/MIL Doc: JSSG-2009: 3.2.7 - 3.2.7.6.5, 4.2.7 - 4.2.7.6.5

FAA Doc: TSO C77b

8.6.2 Verify that the APS/EPS operates safely under installed operating conditions over the design envelope.

DoD/MIL Doc: JSSG-2009 Appendix C: C.3.4.3, C.4.4

FAA Doc: 14CFR reference: 23.901, 25.901, 25.903 (f)

TSO C77b 4.4.1 - 4.5.2

8.6.2.1 Verify that protective safety features (auto shutdown, etc.) are available and effective in protecting the equipment against hazardous malfunctions and conditions such as over-speed, over-temperature and inadvertent activation.

DoD/MIL Doc: JSSG-2009 Appendix C: C.3.4.3.12.1, C.4.4.3.12.1

FAA Doc: TSO C77b 4.6.2

8.6.3 Verify that the functional and physical compatibility of the integrated system is safe.

DoD/MIL Doc: JSSG-2009 Appendix C: C.3.4.3, C.4.4.3

FAA Doc: 14CFR references: 23.901, 25.901, 25.903 (f)

TSO C77b 4.4.1 - 4.5.2, Sections 6 and 7

8.6.4 Verify that high-speed rotating components are designed to be damage tolerant, or that there are provisions for containment of failed parts. Also, verify that any potentially uncontained fragments do not damage SOF components or CSIs or injure personnel.

DoD/MIL Doc: JSSG-2009 Appendix C: C.3.4.3.10.1, C.4.4.3.10.1

FAA Doc: 14CFR reference: 23.903 (b), 23.1461, 25.901(c), 25.1461

AC 20-128, TSO C77b: 5.9, 6.6, 6.7, 6.8

8.6.4.1 Verify that containment or other provisions preclude a failed power-take-off (PTO) system from causing secondary damage, due to flailing or whipping, to critical safety items (CSI) or to nearby safety of flight component/systems, including fuel and hydraulic lines.

DoD/MIL Doc: JSSG-2009 Appendix C: C.3.4.3.10.1, C.4.4.3.10.1

FAA Doc: 14CFR reference: 25.901 (c), 25.1167 (a), (c)

8.6.5 Verify that APS/EPS equipment in the installed configuration is free of damaging vibrations at all operating conditions throughout the APS/EPS operational envelope.

DoD/MIL Doc: JSSG-2009 Appendix C: C.3.4.3.10.2, C.4.4.3.10.2

FAA Doc: 14CFR reference: 25.901 (c), 25.903 (f)

TSO C77b 5.10

8.6.5.1 Verify, when applicable, that the PTO system is capable of operating safely when installed at the maximum allowable conditions of misalignment and imbalance.

DoD/MIL Doc: JSSG-2009 Appendix C: C.3.4.3.10.2, C.4.4.3.10.2

FAA Doc:14CFR reference: 25.1167 (a), (c)

8.6.6 Verify that the emergency power system (including the APU or jet fuel starter (JFS) when deemed flight essential) is capable of responding to failures and providing adequate levels of bleed air, shaft, electrical and/or hydraulic power in sufficient time to meet design requirements.

DoD/MIL Doc: JSSG-2009 Appendix C: C.3.4.3.4, C.4.4.3.4

FAA Doc: 14CFR reference: 23.943, 25.901 (f), 25.943

TSO C77b: 4.1, 4.4.1, 4.4.2, 4.4.3, 4.7

8.6.7 Verify that provisions for the following adequately address safety:

a. Structural mounting
b. Wiring and plumbing support, routing, and clearances
c. System/component and compartment drainage
d. System/component and compartment cooling and ventilation
e. System/components designed for appropriate level of fire hardening
f. Accessibility to all required inspection and servicing features and areas

Comm'l Doc: For b. above: ARP994, Tubing/Plumbing Routing - tubing and line support, routing and clearance requirements

SAE AS50881A, Wiring, Aerospace Vehicle - wiring support and routing requirements

DoD/MIL Doc: For a. above: JSSG-2009: 3.2.7, 4.2.7, 3.2.7.4.4, 4.2.7.4.4, 3.2.7.5, 4.2.7.5

For b., c., and d. above: JSSG-2009: 3.3.8, 4.3.8

For e. above: JSSG-2009: 3.3.3, 4.3.3, 3.3.8, 4.3.8; and Appendix G: G.3.4.7, G.4.4.7

For f. above: JSSG-2009: 3.2.6, 4.2.6

FAA Doc: For a. above: 14CFR reference: 25.901 (c), (d); and TSO C77b: 4.8, 5.1.3, 5.2.5

For b. above: 14CFR reference: 23.993, 23.1017, 25.901 (c), 25.993, 25.1017

For c. above: 14CFR reference: 25.1187; and TSO C77b: 5.27, 5.42, 5.52

For d. above: 14CFR reference: 23.1041 - 23.1045, 23.1103 (a), 25.1041 - 25.1045, 25.1103 (a); and TSO C77b Appendix 1, 5.2.7, 5.5.2

For e. above: 14CFR reference: 23.1181 - 23.1203, 25.1181 - 25.1207; and TSO C77b (5.2)

For f. above: 14CFR reference: 23.901, 23.1021, 25.901, 25.1021

8.6.8 Verify that the inlet and exhaust hazards (i.e., velocities, temperatures, acoustics, exhaust by-products, etc.) to the ground/flight/passenger personnel, air vehicle subsystems, and air vehicle structure are acceptable.

DoD/MIL Doc: JSSG-2009 Appendix C: C.3.4.3.11, C.4.4.3.11

FAA Doc: 14CFR reference: 23.1091, 23.1103, 23.1121, 23.1123, 25.1091, 25.1103, 25.1121, 25.1123

TSO C77b: 5.3.1, 5.3.3, 5.6

8.6.9 Verify that personnel hazards are properly documented in the appropriate flight/operator and maintenance manuals (T.O.) with warnings and precautions.

DoD/MIL Doc: JSSG-2009: 3.3.3, 4.3.3

FAA Doc: 14CFR reference: 23.1541, 23.1581 (a) (2), 25.1541, 25.1581 (a) (2)

8.6.10 Verify that compatibility of the accessory drive system with the air vehicle accessories and engine drive system is adequately evaluated for torsional vibrations and loads as well as possible misalignments.

DoD/MIL Doc: JSSG-2009: 3.2.7, 4.2.7, 3.2.7.4.4, 4.2.7.4.4, 3.2.7.5, 4.2.7.5

FAA Doc: 14CFR reference: 25.1167

8.6.11 Verify that all critical failure modes and hazards have acceptable risk levels.

DoD/MIL Doc: JSSG-2009: 3.3.3, 4.3.3

FAA Doc: 14CFR reference: 25.901 (c)

TSO C77b (5.1)

8.6.12 Verify that the crew station provides for adequate control and monitoring of the system.

DoD/MIL Doc: JSSG-2009 Appendix C: C.3.4.3.8, C4.4.3.8

FAA Doc: 14CFR reference: 23.1141 - 23.1142, 23.1549, 25.1141 - 25.1142, 25.1549

8.6.13 Verify that equipment service life, overhaul, and operating limits are safe and that life-limited components have a reliable means of tracking the limiting parameter.

DoD/MIL Doc: JSSG-2009: 3.2.7.4.4, 4.2.7.4.4, 3.2.7.6, 4.2.7.6

FAA Doc: 14CFR reference: 23.1522, 23.1549, G23.3, 25.1522, 25.1549, H25.3

TSO C77b: 4.3, 4.4.1, 4.6.1, 5.7

8.6.14 Verify that the flight/operator and maintenance manuals include normal and emergency operating procedures, limitations, servicing, and maintenance information.

DoD/MIL Doc: JSSG-2000: 3.6.2

FAA Doc: 14CFR reference: 23.1581 - 23.1585, G23.3 - G23.4, 25.1581 - 25.1585, H25.3 - H25.4

8.7 Aerial refueling system.

DoD/MIL Doc: MIL-A-87166(USAF) aerial refueling technical guidance (canceled; use for guidance)

FAA Doc: Note: 14CFR reference paragraphs listed in the following section are not necessarily sufficient to fully satisfy the corresponding criteria.

8.7.1 Verify that aerial refueling operations can be safely and successfully accomplished with the targeted tanker/receiver aerial refueling subsystem(s).

Comm'l Doc: ATP-56

DoD/MIL Doc: JSSG-2001: 3.4.7.2.1, 3.4.7.2.2

JSSG-2009 Appendix F

8.7.1.1 Verify that the operator and maintenance manuals for the air vehicle and the targeted tanker(s)/receiver(s) document safe aerial refueling procedures. The manuals should identify the proper instructions/information and placards noting restrictions and limitations in the use of the air vehicle's aerial refueling system(s) under all operating conditions (ground/in flight; normal/emergency).

DoD/MIL Doc: JSSG-2001: 3.4.7.2.1, 3.4.7.2.2, 3.6.2

FAA Doc: Note: Use 14CFR reference sections corresponding to Structural and Installation requirements. Use all systems 14CFR references as applicable, i.e., Electrical.

8.7.1.2 Verify that there is dimensional, physical, electrical, and material compatibility between each aerial refueling interface and the targeted tanker's/receiver's aerial refueling interface to permit safe engagement.

DoD/MIL Doc: JSSG-2001: 3.4.7.2.1, 3.4.7.2.2

NATO STANAG 3447 for probe or drogue equipped receivers dimensional guidance

NATO STANAG 7191

UARRSI technical exhibit, for boom or receptacle equipped receivers dimensional guidance

8.7.1.2.1 Verify that all structural fastener heads around the receptacle are flush with the surrounding structural surface.

DoD/MIL Doc: JSSG-2006: 3.3.11, 4.3.11JSSG-2010: 3.5.3.3, 4.5.3.3

8.7.1.3 Verify that the aerial refueling system interface, its attachment to airframe structure, and the structure surrounding the interface can withstand the loads experienced during the aerial refueling process (engagement, disengagement, and fuel transfer) with the tanker/receiver interface(s) without being damaged or creating FOD.

DoD/MIL Doc: JSSG-2001: 3.4.7.2.1, 3.4.7.2.2

JSSG-2009 Appendix F: F.3.4.6.2.2.5, F.4.4.6.2.2.5, F.3.4.6.2.3.5, F.4.4.6.2.3.5

JSSG-2006: 3.4.1.7, 4.4.1.7

AFGS-87154 load guidance

MIL-A-8865A: 3.9.1.3.1 and 3.9.2.2 for load guidance

8.7.1.4 Verify that cues (visual or equivalent) are provided on the air vehicle to assist the crewmember(s)/operator(s)/automated system(s) of the targeted tanker(s)/ receiver(s) and the crewmember(s)/operator(s)/automated system(s) of the air vehicle during the aerial refueling process under mission-defined environmental conditions. Likewise, verify that cues (visual or equivalent) provided on the targeted tanker/receiver air vehicle(s) can be viewed/received as intended by the appropriate air vehicle crewmember(s)/operator(s)/automated system(s), during the aerial refueling process under mission-defined environmental conditions.

DoD/MIL Doc: JSSG-2001: 3.4.7.2.1, 3.4.7.2.2

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8.7.1.4.1 Verify that all markings used for aerial refueling are compatible with the expected environmental conditions and fluid exposures (fuel, hydraulic fluid, air vehicle cleaning solvents, etc.).

DoD/MIL Doc: JSSG-2001: 3.4.7.2.1, 3.4.7.2.2

8.7.1.4.2 Verify that exterior aerial refueling lights are provided on the air vehicle to assist the targeted tanker/receiver crewmember(s)/operator(s)/automated system(s) and the air vehicle crewmember(s)/operator(s)/automated system(s) during the aerial refueling process.

DoD/MIL Doc: JSSG-2001: 3.4.7.2.1, 3.4.7.2.2, JSSG-2010: 3.5.3.3, 4.5.3.3

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8.7.1.4.3 Verify that the appropriate air vehicle crewmember(s)/operator(s)/automated system(s) can view/receive exterior aerial refueling lights provided on the targeted tanker/receiver air vehicle(s) , as intended, during the aerial refueling process.

DoD/MIL Doc: JSSG-2001: 3.4.7.2.1, 3.4.7.2.2, JSSG-2010: 3.5.3.3, 4.5.3.3

AFGS-87154

8.7.1.4.4 Verify that the intensity of each exterior aerial refueling light, or light group, can be independently varied to accommodate the needs of the targeted tanker/receiver crewmember(s)/operator(s)/automated system(s)and the air vehicle crewmember(s)/operator(s)/automated system(s).

DoD/MIL Doc: JSSG-2010: 3.5.3.3.1, 4.5.3.3.1, 3.5.3.5, 4.5.3.5

8.7.1.4.5 Verify that the appropriate exterior aerial refueling lights are compatible with night vision imaging systems (NVIS) or automated systems.

DoD/MIL Doc: JSSG-2010: 3.5.3.2.1, 4.5.3.2.1, 3.5.3.3, 4.5.3.3

FAA Doc: 14CFR reference: 23.951-23.1001, 25.951-25.1001

8.7.1.4.6 Verify that all exterior aerial refueling lights are compatible with the expected environmental conditions and fluid exposures (fuel, hydraulic fluid, air vehicle cleaning solvents, etc.).

DoD/MIL Doc: JSSG-2009: 3.2.7.2, 4.2.7.2

FAA Doc: 14CFR reference: 25.1381 (Note: Use 14CFR reference sections corresponding to structural and installation requirements. Use all systems 14CFR reference's as applicable, i.e., electrical.)

8.7.1.5 Verify that a communication system is provided which permits the timely exchange of all identified data/information between the crewmember(s)/operator(s)/ automated system(s) of the air vehicle and the crewmember(s)/operator(s)/automated system(s) of the targeted tanker/receiver air vehicle(s) during the aerial refueling process.

DoD/MIL Doc: JSSG-2001: 3.4.7.2.1, 3.4.7.2.2

NAVAIR 00-80T-110 section 2.4.4 and 3.6.5

8.7.1.6 Verify that the types of fuels to be transferred/received and any allowed deviations are identified.

DoD/MIL Doc: JSSG-2001: 3.4.7.2.1, 3.4.7.2.2

8.7.1.7 Verify that the delivery pressure and flow rate of the transferred/received fuel are identified and are within all applicable tanker/receiver design limits.

Comm'l Doc: ARSAG International, Doc. No. 00-03-01, "Pressure Defs & Terms, Mar '03.doc" (4.7)

DoD/MIL Doc: JSSG-2001: 3.4.7.2.1, 3.4.7.2.2

MIL-A-19736: 3.5.2.1 and 3.8.7

MIL-STD-87166: 3.1.1 and 4.1.1 (canceled; use for guidance)

8.7.1.8 Verify that surge pressures generated during the aerial refueling process do not exceed proof pressure limits for the aerial refueling system(s) of any air vehicle involved in the aerial refueling process.

Comm'l Doc: ARSAG 00-03-01, "Pressure Defs & Terms, Mar '03.doc" (3.5 and 4.7)

DoD/MIL Doc: JSSG-2001: 3.4.7.2.1, 3.4.7.2.2

MIL-A-19736A: 3.5.2.3

8.7.1.8.1 Verify that surge pressure conditions are safe, including, but not limited to:

a. With and without a single failure in the tanker system's pressure regulation feature(s)

b. Pump start-up surges (no flow to receiver)

c. All possible receiver valve closures (manually or automatically activated) which could terminate flow into the receiver

d. Flowing disconnects

Comm'l Doc: ARSAG 00-03-01, "Pressure Definitions & Terms, Mar '03.doc," 3.7 and 4.7

DoD/MIL Doc: JSSG-2001: 3.4.7.2.1, 3.4.7.2.2

MIL-A-19736A: 3.5.2.3

8.7.1.9 Verify that any spray resultant of the aerial refueling process does not negatively affect the safe operation of the air vehicle(s). (Fuel spray is typically created during the engagement and disengagement of the aerial refueling interfaces.)

DoD/MIL Doc: JSSG-2001: 3.2.3

8.7.1.9.1 Verify that any fuel spray entering receiver engine(s), hazardous ignition areas, environmental management systems, and air data systems does not compromise safety.

DoD/MIL Doc: JSSG-2001: 3.2.3, 3.3.10

JSSG-2009 Appendix F: F.3.4.6.2.2.2, F.4.4.6.2.2.2, F.3.4.6.2.3.2, F.4.4.6.2.3.2

8.7.1.9.2 Verify that any fuel spray that covers or contacts lights, optical windows, antennae, and any other sensitive device does not compromise safety.

DoD/MIL Doc: JSSG-2001: 3.2.3, 3.3.10

JSSG-2009 Appendix F: F.3.4.6.2.2.2, F.4.4.6.2.2.2, F.3.4.6.2.3.2, F.4.4.6.2.3.2

8.7.1.10 Verify that satisfactory flight stability and handling qualities are achievable for the tanker/receiver aerial refueling interface within the specified aerial refueling envelope.

DoD/MIL Doc: JSSG-2001: 3.1.1.1.1, 3.3.11.1.1

8.7.2 Verify that each aerial refueling system can be installed and operated (normal and single-failure conditions) without causing loss of the air vehicle or creating a potential hazard to personnel in the identified environment (induced and natural).

DoD/MIL Doc: JSSG-2009: 3.2.7.4.4.1, 4.2.7.4.4.1, 3.2.7.4.4.2, 4.2.7.4.4.2, 3.3.8, 4.3.8

MIL-STD-87166: 3.1.3 and 4.1.3 guidance on expected environments (canceled; use for guidance)

8.7.2.1 Verify that the system has been designed to minimize the hazards from lightning, static electricity, fuel leaks, ignition sources, and ground potential.

DoD/MIL Doc: JSSG-2009 Appendix F: F.3.4.6.1.7, F.4.4.6.1.7

8.7.2.1.1 Verify that the receptacle installation has a fuel- and vapor-proof pressure box below it to collect the fuel spray that may occur during aerial refueling.

DoD/MIL Doc: JSSG-2009: 3.3.8, 4.3.8; and Appendix F: F.3.4.6.2.2.4, F.4.4.6.2.2.4

8.7.2.1.2 Verify that all fluids that collect within the pressure box are capable of being drained safely.

DoD/MIL Doc: JSSG-2009: 3.3.8, 4.3.8; and Appendix F: F.3.4.6.2.2.3, F.4.4.6.2.2.3

8.7.2.1.3 For probe installations (retractable), verify that the probe compartment is fuel- and vapor-proof such that any fuel spray that may collect in this compartment does not migrate.

DoD/MIL Doc: JSSG-2009: 3.3.8, 4.3.8; and Appendix F: F.3.4.6.2.3.3, F.4.4.6.2.3.3

8.7.2.1.4 Verify that the collected fluids within the probe compartment are capable of being drained safely.

DoD/MIL Doc: JSSG-2009: 3.3.8, 4.3.8;and Appendix F: F.3.4.6.2.3.3, F.4.4.6.2.3.3

8.7.2.1.5 For aerial refueling pods, verify that there is adequate air flow/exchange within the pod to preclude the buildup of a flammable vapor within the pod.

DoD/MIL Doc: JSSG-2009: 3.3.8, 4.3.8

8.7.2.1.6 Verify that all fluids that can be collected within the pod are capable of being drained safely.

DoD/MIL Doc: JSSG-2009: 3.3.8, 4.3.8

8.7.2.1.7 Verify that a dry-run condition with an aerial refueling pump does not create a potential ignition source.

DoD/MIL Doc: JSSG-2009: 3.3.3, 4.3.3,Appendix F: 3.4.6.1.7, 4.4.6.1.7, Appendix G: 3.4.7.23, 4.4.7.23

8.7.2.1.8 Verify that there is a secondary liquid- and vapor-tight barrier between the aerial refueling fuel tanks and identified fire hazard areas/inhabited areas.

DoD/MIL Doc: JSSG-2009 Appendix E: E.3.4.5.6.11, E.4.4.5.6.11; and Appendix F: F.3.4.6.1.6, F.4.4.6.1.6, F.3.4.6.1.7, F.4.4.6.1.7

8.7.2.1.9 Verify that each aerial refueling system can withstand the static discharge typically encountered during the engagement of tanker and receiver interfaces.

DoD/MIL Doc: JSSG-2001: 3.2.3

8.7.2.1.10 Verify that each aerial refueling system, in the open/deployed position and in the closed/retracted position, is designed to withstand the appropriate lightning strike criteria.

DoD/MIL Doc: JSSG-2001: 3.2.1, 3.3.10.1.1

JSSG-2009 Appendix G: 3.4.7.6, 4.4.7.6

FAA Doc: 14CFR reference: 23.954, 25.954

8.7.2.2 Verify that the flight control/handling qualities of the air vehicle are not negatively impacted when the aerial refueling system is installed or operating under normal aerial refueling and single-failure conditions.

DoD/MIL Doc: JSSG-2001: 3.3.11.1.1.1

8.7.2.2.1 Verify that the flight control/handling qualities of the air vehicle are not degraded below safe limits, and the air vehicle can safely land when the system interface cannot be returned to its fully stowed configuration.

DoD/MIL Doc: JSSG-2001: 3.3.11.1.1.1

8.7.2.2.2 For aerial refueling pods, verify that any ram air turbine (RAT) failure mode does not degrade flight control/handling qualities of the air vehicle below acceptable limits.

DoD/MIL Doc: JSSG-2009 Appendix F: 3.4.6.1.1, 4.4.6.1.1, 3.4.6.1.2, 4.4.6.1.2

FAA Doc: 14CFR reference: 25.1309

8.7.2.3 Verify that in-flight egress, ground emergency egress, and assisted egress of any crewmember are not affected when the system interface cannot be returned to its fully stowed configuration.

DoD/MIL Doc: JSSG-2009 Appendix F: F.3.4.6.2.2.2, F.4.4.6.2.2.2, F.3.4.6.2.3.2, F.4.4.6.2.3.2

8.7.2.4 Verify that built-in-test (BIT) and fault isolation provisions are available to appropriate crewmember(s)/operator(s)/maintenance personnel to ensure safe ground or in-flight operations under all configuration options.

DoD/MIL Doc: JSSG-2009: 3.2.9, 4.2.9

8.7.3 Verify that the flight control/handling qualities of the air vehicle are not negatively impacted by the removal of hardware associated with an aerial refueling system. For tankers, this may include pods, palletized systems, and fuel tanks that must be removed to reconfigure the tanker for another mission. For receivers, this may include probe installations that are not permanent.

DoD/MIL Doc: JSSG-2001: 3.3.11.1.1.1

8.7.3.1 When aerial refueling hardware is removed, verify that interfaces with other systems (e.g., electrical, hydraulic, and fuel system) are properly covered, sealed, isolated, etc., to preclude providing a new leak or ignition source in the air vehicle.

DoD/MIL Doc: JSSG-2009 Appendix F: F.3.4.6.1.5, F.4.4.6.1.5

8.7.4 Verify that each aerial refueling system, as installed, can meet its design and performance requirements when operated within the specified parameters.

DoD/MIL Doc: JSSG-2009: 3.1, 4.1; and Appendix F: F.3.4.6, F.4.4.6

8.7.4.1 Verify that the plumbing/components in each aerial refueling system (as completely assembled and installed within the air vehicle) can withstand exposure to the specified proof pressure limit without resulting in fuel leakage and system performance degradation.

Comm'l Doc: ARSAG 00-03-01, "Pressure Defs & Terms, Mar '03.doc" 3.5 and 4.7

DoD/MIL Doc: JSSG-2009 Appendix F: F.3.4.6.1.3, F.4.4.6.1.3

8.7.4.2 Verify that critical operational functions and functional modes are provided in the aerial refueling system to ensure the aerial refueling process can be conducted safely.

DoD/MIL Doc: JSSG-2009 Appendix F: F.3.4.6.2.2.7, F.4.4.6.2.2.7, F.3.4.6.2.3.1.2, F.4.4.6.2.3.1.2

8.7.4.3 Verify that controls are provided and properly located for the appropriate crewmember(s)/operator(s) to activate and control the identified functions of the aerial refueling system.

DoD/MIL Doc: JSSG-2009 Appendix F: F.3.4.6.2.1.3, F.4.4.6.2.1.3

JSSG-2010: 3.2.14, 4.2.14

8.7.4.4 Verify that displays are provided and properly located for the appropriate crewmember(s)/operator(s) to indicate the necessary information to conduct the aerial refueling operation safely.

DoD/MIL Doc: JSSG-2010: 3.2.13, 4.2.13

8.7.4.5 Verify that display lights are variable intensity and, if appropriate, NVIS compatible.

DoD/MIL Doc: JSSG-2010: 3.5.2.1.2, 4.5.2.1.2

8.7.5 Verify that the installation and operation of each aerial refueling system (normal/single-failure conditions) does not negatively impact the operation of other systems on the air vehicle or on the targeted tanker(s)/receiver(s) throughout the mission(s) of the air vehicle or the targeted tanker(s)/receiver(s).

DoD/MIL Doc: JSSG-2009 Appendix F: F.3.4.6.1.1, F.4.4.6.1.1

8.7.5.1 Verify that any fuel tank vent system can accommodate the maximum refuel/transfer rate and pressures associated with aerial refueling transfer rates encountered during aerial refueling normal operations and single-failure conditions.

DoD/MIL Doc: JSSG-2009 Appendix F: F.3.4.6.1.6, F.4.4.6.1.6

8.7.5.2 Verify that no ground or flight hazards are created if leakage occurs in the air vehicle fuel system and/or other aerial refueling system plumbing during aerial refueling operations. Consider leakage due to a failure of the sealing mechanism at the single-point refueling adapter, at the pressure defueling adapter, or at the other aerial refueling system interface(s).

DoD/MIL Doc: JSSG-2009 Appendix F: F.3.4.6.1.6, F.4.4.6.1.6

8.7.5.3 For tankers carrying a unique fuel for the designated receiver air vehicle(s), which cannot be utilized by the tanker's propulsion system(s), verify that there is adequate isolation of the aerial refueling system from the tanker's fuel system.

DoD/MIL Doc: JSSG-2009 Appendix F: F.3.4.6.1.6, F.4.4.6.1.6

8.7.5.4 Verify that any data communication system provided on the air vehicle is compatible with (1) the flight control system on the air vehicle, (2) other electrical systems on the air vehicle, and (3) the flight control and electrical systems on the targeted tanker(s)/receiver(s).

DoD/MIL Doc: JSSG-2001: 3.4.7.2.1, 3.4.7.2.2

8.7.5.5 Verify that the field of view of the crew member(s)/operator(s)/automated system(s) is adequate during landing and during other critical flight phases when an aerial refueling system is installed, is operating, or fails to return to the fully stowed configuration.

DoD/MIL Doc: JSSG-2010: 3.3.2.1, 4.3.2.1

8.7.5.6 When the plumbing of the aerial refueling system interfaces with the fuel system plumbing of the air vehicle or of other aerial refueling systems, verify that a leak in the aerial refueling system plumbing does not impact the fuel system's fuel management functions (engine feed, thermal management, center of gravity control, etc.).

DoD/MIL Doc: JSSG-2009 Appendix F: F.3.4.6.1.1, F.4.4.6.1.1, F.3.4.6.1.5, F.4.4.6.1.5

8.7.5.7 Verify that electrical failures within the aerial refueling system do not adversely affect the air vehicle electrical system.

DoD/MIL Doc: JSSG-2009 Appendix F: F.3.4.6.1.1, F.4.4.6.1.1

8.7.5.8 When aerial refueling components interface with the fuel or hydraulic system, verify that pressures and temperatures within the fuel/hydraulic system remain within safe limits under normal aerial refueling operations and single-failure conditions. Typical components for consideration are RAT-driven pumps in aerial refueling pods, aerial refueling pumps, probe door actuation/retraction mechanisms, probe extension/retraction mechanisms, and receptacle door/toggle latch mechanisms.

DoD/MIL Doc: JSSG-2009 Appendix F: F.3.4.6.1.1, F.4.4.6.1.1

8.8 Deleted - Propulsion installations moved to section 7.2.5

8.9 Mechanisms.

(Equipment involved in the securing, fastening, and mechanizing of air vehicle doors, hatches, ramps, weapon launchers, etc.; includes items such as locks, latches, bearings, hinges, linkages, indicators, and actuators.) Mechanical actuation subsystems that provide motion and position locking functions for stowable and deployable surfaces such as folding wing panels, folding rotor blade systems, folding tail rotors/pylons, air scoops, air vents, and weapons bay doors in ground and air applications for both operational and maintenance purposes. Equipment that is mechanical in form, fit, and function, but not covered by any other system-level requirements should be included herein.

DoD/MIL Doc: MIL-M-87222 Mechanical Systems for Aircraft Doors and Canopies - inactive for new design

8.9.1 Verify that all SOF critical mechanisms perform their allocated air vehicle functions under their specified operating environments and conditions.

DoD/MIL Doc: JSSG-2009: Appendix I, 3.4.9.1, 3.4.9.4

MIL-M-87222 Mechanical Systems for Aircraft Doors and Canopies - inactive for new design

8.9.2 Verify that damage or permanent deformation to latches or support structures does not result from the most critical jam load condition.

DoD/MIL Doc: JSSG-2009: Appendix I, 3.4.9.1, 3.4.9.4

MIL-M-87222 Mechanical Systems for Aircraft Doors and Canopies: 3.1.4.9; 3.1.5.9; 4.1.4.9; 4.1.5.9 - inactive for new design

8.9.3 Verify that the failure of any mechanism does not cause the loss of control of the air vehicle or prevent continued safe flight and landing.

DoD/MIL Doc: JSSG-2009: Appendix I, 3.4.9.1, 3.4.9.4

MIL-M-87222 Mechanical Systems for Aircraft Doors and Canopies: 3.1.2.4; 4.1.2.4 - inactive for new design

8.9.4 Verify that inadvertent loosening or opening of air vehicle doors, door latches, locks, or fasteners does not restrict the operation of any flight control system.

DoD/MIL Doc: JSSG-2009: Appendix I, 3.4.9.1.3, 3.4.9.4, 3.4.9.3

MIL-M-87222 Mechanical Systems for Aircraft Doors and Canopies: 3.1.2.6; 4.1.2.6 - inactive for new design

8.9.5 Verify that no single failure allows any latch to open inadvertently.

DoD/MIL Doc: JSSG-2009: Appendix I, 3.4.9.1.3, 3.4.9.4

MIL-M-87222 Mechanical Systems for Aircraft Doors and Canopies: 3.1.5.1; 4.1.4.2 - inactive for new design

8.9.6 Verify that any locking system is incapable of locking or indicating it is locked unless all the latches are properly latched in the fully secured position.

DoD/MIL Doc: JSSG-2009: Appendix I, 3.4.9.1, 3.4.9.4

MIL-M-87222 Mechanical Systems for Aircraft Doors and Canopies: 4.1.5.7 - inactive for new design

8.9.7 Verify that all air vehicle doors, whose inadvertent opening would present a probable hazard to continued safe flight and landing, have provisions to prevent depressurization of the air vehicle to an unsafe level if the doors are not fully closed, latched, and locked.

DoD/MIL Doc: JSSG-2009: Appendix I, 3.4.9.1, 3.4.9.4

MIL-M-87222 Mechanical Systems for Aircraft Doors and Canopies: 3.1.5.8; 4.1.5.8 - inactive for new design

8.9.8 Verify that the indication system continuously monitors and provides an unsafe indication when the door, latching, or locking system is unsecured, and provides a safe indication when the system is secured.

DoD/MIL Doc: JSSG-2009: Appendix I, 3.4.9.1, 3.4.9.4

MIL-M-87222 Mechanical Systems for Aircraft Doors and Canopies: 3.1.7.1; 4.1.7.1 - inactive for new design

8.9.9 Verify that the door control systems are designed for emergency operation by means of manual actuation of the door/drive sequence.

DoD/MIL Doc: JSSG-2009: Appendix I, 3.4.9.1, 3.4.9.4.11

MIL-M-87222 Mechanical Systems for Aircraft Doors and Canopies: 3.1.9.4; 4.1.9.4 - inactive for new design

8.9.10 Verify that all door seals prevent rain or water leakage into the air vehicle during all flight and ground operations and while the air vehicle is parked and depressurized under storm conditions.

DoD/MIL Doc: JSSG-2009: Appendix I: 3.4.9.1.10; 3.4.9.4

MIL-M-87222 Mechanical Systems for Aircraft Doors and Canopies: 3.1.10.2; 4.1.10.2 - inactive for new design

8.9.11 Verify that all actuation subsystems are able to be locked and unlocked, provide for folding, unfolding, and deploying, and can be folded, unfolded, and deployed within a wind environment that encompasses atmospheric and weather-induced conditions, wind-over-deck from carrier vessel movement, and downwash and jetwash conditions caused by other vehicles expected in the operational ground/deck environment.

DoD/MIL Doc: JSSG-2009, Appendix I: 3.4.9.1.10; 3.4.9.4; I.4.4.9.4.1

8.9.12 Verify that mechanisms that provide a structural load path incorporate redundant means of locking the mechanism in position.

DoD/MIL Doc: JSSG-2009, Appendix I: 3.4.9.1.10; 3.4.9.4; 3.4.9.4.2; 4.4.9.4.2

8.9.13 Verify that the locked-or-unlocked condition of mechanisms with sensors is displayed in the cockpit, on aircraft, and in all remote operator control locations during ground operations.

DoD/MIL Doc: JSSG-2009, Appendix I: 3.4.9.4; 3.4.9.4.3; 4.4.9.4.3

8.9.14 Verify that, when applicable, a means is provided for controlling utility actuation. Where possible, include a separate means for "motion" and "locking" control.

DoD/MIL Doc: JSSG-2009, Appendix I: 3.4.9.1.10; 3.4.9.4; 3.4.9.4.4; 4.4.9.4.4

8.9.15 Verify that actuation subsystems that have a provision for manual operation include safety devices to prevent injury to maintainers in case of inadvertent application of power during a manually powered operation, and incorporate a controlled deployment speed at a specified safe rate.

DoD/MIL Doc: JSSG-2009, Appendix I: 3.4.9.1.10; 3.4.9.4; 3.4.9.4.5; 4.4.9.4.5

8.9.16 Verify that utility actuation subsystems are capable of operating from the ground power supplied to the air vehicle as well as air vehicle supplied power.

DoD/MIL Doc: JSSG-2009, Appendix I: 3.4.9.1.10; 3.4.9.4; 3.4.9.4.6; 4.4.9.4.6

8.9.17 Verify that all actuation subsystems are able to perform their specified function within the specified safe time and cycle. Also specify allowable intervals between actuation cycles as well as total cycles expected during the application lifetime.

DoD/MIL Doc: JSSG-2009, Appendix I: 3.4.9.1.10; 3.4.9.4; 3.4.9.4.7; 4.4.9.4.7

8.9.18 Verify that utility actuation subsystems incorporate some means to prevent damage to adjacent movable surfaces (for example, flaps) during folding and unfolding operations.

DoD/MIL Doc: JSSG-2009, Appendix I: 3.4.9.1.10; 3.4.9.4; 3.4.9.4.8; 4.4.9.4.8

8.9.19 Verify that the actuation subsystem attachment is not an integral part of the air vehicle structure, such as a wing rib, but is a replaceable attachment designed so that, in case of an overload or fatigue failure, the attachment fails in lieu of a structural component failure on the primary air vehicle.

DoD/MIL Doc: JSSG-2009, Appendix I: 3.4.9.1.10; 3.4.9.4; 3.4.9.4.9; 4.4.9.4.9

8.9.20 Verify that clearance is provided in the deployed or stowed position and during the deployment operation to prevent damage to the surface, attached equipment, and to other areas of the air vehicle.

DoD/MIL Doc: JSSG-2009, Appendix I: 3.4.9.1.10; 3.4.9.4; 3.4.9.4.10; 4.4.9.4.10

8.9.21 Verify that utility actuation mechanisms used during ground operations have a purely manual backup available for motive power and locking/unlocking purposes if the primary mode of operation is automatic or powered (or both). And verify that subsystems used for purely in-flight applications also have means incorporated to allow cockpit controlled activation for ground maintenance actions.

DoD/MIL Doc: JSSG-2009, Appendix I: 3.4.9.1.10; 3.4.9.4; 3.4.9.4.11; 4.4.9.4.11

8.9.22 Verify that the locked-unlocked condition of mechanisms used during ground operations is displayed visually, externally, by purely mechanical, nonelectric means.

DoD/MIL Doc: JSSG-2009 I: 3.4.9.4.13; 4.4.9.4.13

8.9.23 Verify that for ground operation with power off, means are provided to hold the air vehicle doors in the open or closed position, and that manually operated hold-open latches are provided to secure doors in the open position, incorporate a lock, and are located in an area where personnel can access safely. Also verify that subsequent power operation of the doors, with these means left in place, will not result in damage.

DoD/MIL Doc: JSSG 3.4.9.1.c, 3.4.9.1.13

8.9.24 Verify that the controls automatically stop the sequence in the event a malfunction or failure occurs part way through a cycle, and in the event of a power interruption, doors do not change position, and the door controls go to the stop position and remain in the stop position upon resumption of power.

DoD/MIL Doc: JSSG 3.4.9.1.2, 3.4.9.1.9.a, 3.4.9.1.9.d

8.9.25 Verify that the controls are capable of stopping or reversing door movement at any time in the cycle at the option of the operator by selecting the appropriate control option.

8.9.26 Verify that locking mechanisms incorporate a means of operational command interrupt to prevent in-flight actuation of ground-only operating systems, that all mechanical and powered locks and actuators are designed to prevent undesired surface positioning in

flight, and that the "fold" sequence requires two separate, deliberate actions in the case of flight critical surfaces.

DoD/MIL Doc: JSSG 3.4.9.4.2

8.9.27 Verify that provisions are incorporated to (a) prevent actuation following activation and subsequent relief of safety devices, (b) provide for locking of folding wings, blades, or other surfaces in the folded/stowed position, and (c) ensure locks are positive and do not depend on any power source to remain engaged.

DoD/MIL Doc: JSSG 3.4.9.4.2

8.9.28 Verify that removable surface securing devices, if specifically permitted by the Government, have strength equal to or exceeding that of the air vehicle.

DoD/MIL Doc: JSSG 3.4.9.4.12

8.9.29 Verify that airframe bearings are capable of safely joining mechanical elements; transmitting design loads through the full range of the system operating parameters; permitting rotation, misalignment, or both while maintaining a specified dimensional relationship between the joined elements; and reducing friction and wear more predictably.

DoD/MIL Doc: JSSG-2009 App 1.3.4.9.2

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8.10 External cargo hook systems (rotary wing).

8.10.1 Verify that the cargo hook system operation in normal, automatic, and emergency modes does not adversely affect safety of the air vehicle system.

DoD/MIL Doc: Refer to technical point of contact for this discipline (listed in section A.2)

FAA Doc: 14CFR reference Parts 27 and 29

8.10.2 Verify that the cargo hook system cockpit switches and indicators provide for normal, automatic, and emergency release of cargo.

DoD/MIL Doc: Refer to technical point of contact for this discipline (listed in section A.2)

FAA Doc: 14CFR references: 133 Amendment No. 133-11, 133 Amendment No. 133-9 (Rotorcraft External-Load Operations)

8.10.3 Verify that the cargo can be hooked safely to the hook and that the manuals contain the maximum and minimum loads for safe movement of cargo.

DoD/MIL Doc: Refer to technical point of contact for this discipline (listed in section A.2)

FAA Doc: 14CFR references: 133 Rotorcraft External-Load Operations, subpart D-Airworthiness Requirements, sec.133.45

8.10.4 Verify that the electromagnetic environment of the air vehicle is compatible with safe loading and release of cargo.

DoD/MIL Doc: Refer to technical point of contact for this discipline, listed in section A.2

FAA Doc: 14CFR references: 27.865 (Part 27 Airworthiness Standards: Normal Category Rotorcraft, subpart D-Design and Construction)

14CFR references: 29.865 (Part 29 Airworthiness Standards: Transport Category Rotorcraft, Subpart D-Design and Construction)

8.10.5 Verify that the air vehicle structure can support all loads imposed by the external transport of cargo during operational usage.

DoD/MIL Doc: Refer to the technical point of contact for this discipline (listed in section A.2)

FAA Doc: 14CFR references: 27.865, 29.865

8.10.6 Verify that the external cargo hook and supporting structure limits are defined and are published in all applicable operator and maintenance manuals.

DoD/MIL Doc: Refer to the technical point of contact for this discipline (listed in section A.2)

FAA Doc: 14CFR references: 27.865, 29.865

8.10.7 Verify that air vehicle flight performance/control is not adversely affected by load movement experienced during external load operations and the emergency jettison of external cargo.

DoD/MIL Doc: Refer to the technical point of contact for this discipline (listed in section A.2)

FAA Doc: 14CFR references: 27.865, 29.865

8.11 External rescue hoist (rotary wing).

8.11.1 Verify that the external rescue hoist system does not adversely affect safety to personnel or to the air vehicle system.

DoD/MIL Doc: Refer to technical point of contact for this discipline (listed in section A.2)

8.11.2 Verify that the hoist system operates safely under rated and emergency loading conditions.

DoD/MIL Doc: Refer to technical point of contact for this discipline (listed in section A.2)

8.11.3 Verify that the electromagnetic environment of the air vehicle is compatible with safe operation of the rescue hoist.

DoD/MIL Doc: Refer to technical point of contact for this discipline (listed in section A.2)

8.12 Fast rope insertion/extraction system (FRIES) (rotary wing).

8.12.1 Verify that H-bar and FRIES bar provides for the safe insertion and extraction of personnel into and out of the air vehicle.

DoD/MIL Doc: Refer to technical point of contact for this discipline (listed in section A.2)

8.12.2 Verify that the back-up structure possesses adequate structural margins of safety for the safe insertion and extraction of personnel.

DoD/MIL Doc: Refer to technical point of contact for this discipline (listed in section A.2)

9. CREW SYSTEMS

The crew systems area consists of the following elements: pilot-vehicle interface, aircrew station (accommodations, lighting, furnishings, and equipment), human-machine interface, UAV/ROA control station (operator accommodations, lighting, and equipment), the life support system, the emergency escape and survival system, the transparency system, crash survivability, and air transportability.

TYPICAL CERTIFICATION SOURCE DATA

1. Escape system requirements and validation
2. Crew station layout/geometry review
3. Human factors
4. Failure modes, effects, and criticality analysis (FMECA)
5. Life support system requirements and validation
6. Crash survivability requirements and validation
7. Lighting system design, analysis, test reports
8. Transparency integration
9. Air transportability, cargo, and airdrop systems
10. Load analyses
11. Aeroservoelastic analyses
12. Test plans
13. Test reports
14. Proof test results
15. Simulation test, modeling and results

CERTIFICATION CRITERIA

DoD/MIL Doc: JSSG-2010 Crew Systems

FAA Doc: AC 20-41A, AC 20-60

9.1 Escape and egress system.

This element provides the means whereby the occupant(s) can leave the air vehicle during inflight, water, and ground emergencies. It may include the following equipment and devices: the ejection seat (if equipped), restraint system, escape sequencing system, cartridge actuated or pyrotechnic actuated devices (CAD/PAD), canopy jettison (including thrusters and rockets), escape path clearance, parachute(s), provisions for survival equipment (flares, medicine, radio, sustenance, arms, emergency oxygen, flotation equipment), manual bailout, emergency escape exits, escape paths, life rafts, slides, emergency ground egress provisions, and aeromedical evacuation.

9.1.1 Verify that the escape system is safe for human use and compatible with the aircraft.

DoD/MIL Doc: JSSG-2010-3: 3.3.4

JSSG-2010-7: 3.7.3.5.3

JSSG-2010-11: 3.11.7, 3.11.7.2, 7.3.3.3.5.3

NATO Working Party 61

9.1.1.1 Verify that the systems and subsystems of the escape system have a designed and demonstrated reliability *sufficient for use.*

DoD/MIL Doc: JSSG-2010

MIL-C-83124

MIL-C-83125

MIL-C-83126

9.1.2 Verify that escape exits and escape routes are provided in appropriate sizes and numbers for emergency evacuation, landing or ditching to permit timely and complete egress of occupants.

DoD/MIL Doc: NATO Draft Working Party 61B

JSSG-2010

FAA Doc: 14CFR reference 25.803

9.1.3 Verify that emergency exits have operating instructions and markings, both internally and externally.

DoD/MIL Doc: JSSG-2001: 3.3.10.2.3

JSSG-2010: 3.8, 4.8, 3.9, 4.9, 3.11, 4.11, 3.12, 4.12, 3.13, 4.13, 3.14, 4.14

FAA Doc: 14CFR reference: 23.803-23.815, 25.801-25.819, 23.1411, 23.1415, 25.1411, 25.1415, 25.813, 23.813, 25 Appendix F; 25 Appendix J 25.1423

9.1.4 Verify that devices for ground emergency egress assist (slides, descent reels, life rafts, etc.) and their deployment handles/actuators meet safety requirements.

DoD/MIL Doc: JSSG-2001: 3.3.10.2.3

JSSG-2010: 3.8, 4.8, 3.9, 4.9, 3.11, 4.11, 3.12, 4.12, 3.13, 4.13, 3.14, 4.14

FAA Doc: 14CFR reference: 23.803-23.815, 25.801-25.819, 23.1411, 23.1415, 25.1411, 25.1415

9.1.5 Verify that ground/ditching emergency egress and rescue processes and procedures exist, are incorporated in system documentation, and are implemented in training.

DoD/MIL Doc: JSSG-2001: 3.3.10.2.3, JSSG-2010: 3.8, 4.8, 3.9, 4.9, 3.11, 4.11, 3.12, 4.12, 3.13, 4.13, 3.14, 4.14

FAA Doc: 14CFR reference: 23.803-23.815, 25.801-25.819, 23.1411, 23.1415, 25.1411, 25.1415

9.1.6 Verify that egress equipment exists to aid escape in the event exits are blocked, damaged, or when exit opening actuation fails.

DoD/MIL Doc: No information available in current JSSG. Information to be included in next revision of JSSG.

FAA Doc: 121.309, 121.310

9.2 Crew stations and aircraft interiors.

Aircrew station (accommodations, lighting, furnishings and equipment): This element provides the crewmember with crew station geometry covering workspace size and arrangement as specified by the anthropometric requirements, internal and external visibility necessary to perform the specified missions safely, cockpit illumination (primary, secondary, night vision imaging systems (NVIS), laser eye protection (LEP), utility and emergency lighting), thermal and acoustic protection, and storage facilities. Additionally, for manned air vehicles, other elements include sanitary facilities, cockpit finish and trim, instrument panel and consoles, and protection from cockpit generated reflections (glareshields). It may also cover boarding arrangements such as ropes or ladders. Crew and passenger accommodations may also be covered. This element also covers UAV/ROA control station requirements, where appropriate.

FAA Doc: 14CFR reference: 23.771-23.775, 25.771-25.773, 23.803-23.815, 25.801-25.81923.1411, 23.1415, 25.1411, 25.1415

9.2.1 Verify that all controls and displays are arranged and located so that they are completely functional and visible and that cockpit or operator station geometry (including seats) accommodates the specified multivariate flight and mission crew population.

DoD/MIL Doc: JSSG-2010: 3.1, 4.1, 3.2, 4.2, 3.3, 4.3, 3.4, 4.4, 3.5, 4.5, 3.14, 4.14

JSSG-2001: 3.4.3.1.1, typical anthropometric dimensions and ranges considered acceptable to accommodate the US pilot population

JSSG-2001: 3.4.3.1.5, guidance on controls and displays

MIL-STD-1472, section 5.6, design criteria and features recommended to provide human accommodation

FAA Doc: 14CFR references: 23.777, 25.777

9.2.1.1 Verify that all displays are readable, from all crewmember (or operator/controller) eye positions, under the full range of ambient conditions.

DoD/MIL Doc: JSSG-2010: 3.1, 4.1, 3.2, 4.2, 3.3, 4.3, 3.4, 4.4, 3.5, 4.5, 3.14, 4.14

MIL-STD-1472, section 5.2 addresses visual displays of various types

FAA Doc: 14CFR references: 23.777, 25.777

9.2.1.2 Verify that the interior and exterior fields of view are sufficient to safely perform all flight and mission-critical functions.

DoD/MIL Doc: JSSG-2010: 3.1, 4.1, 3.2, 4.2, 3.3, 4.3, 3.4, 4.4, 3.5, 4.5, 3.14, 4.14

JSSG-2010: 4.3.2, rectilinear plots

JSSG-2010-3: 3.3.2, rectilinear plots

JSSG-2001: 3.4.3.1.7 and 3.4.3.1.8, 2. interior and exterior vision, respectively

FAA Doc: 14CFR references: 23.771-23.781, 25.771-25.781

9.2.2 Verify that all controls are properly designed and can be operated through their complete range of travel without interference with other controls, structures, or crewmembers' bodies; and that all emergency action controls are reachable by the aircrew member

from a restrained shoulder position in all air vehicle attitudes and throughout the complete range of "g" force loads.

DoD/MIL Doc: JSSG-2010: 3.1, 4.1, 3.2, 4.2, 3.3, 4.3, 3.4, 4.4, 3.5, 4.5, 3.14, 4.14

JSSG-2001: 3.4.3.1.1, typical anthropometric dimensions and ranges considered acceptable to accommodate the US pilot population

JSSG-2010-3: 4.3.3, Table VI, definition and application of zones

FAA Doc: 14CFR references: 23.771-23.781, 25.771-25.781

9.2.3 Verify that the master caution and warning systems' displays are 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.

DoD/MIL Doc: JSSG-2010: 3.1, 4.1, 3.2, 4.2, 3.3, 4.3, 3.4, 4.4, 3.5, 4.5, 3.14, 4.14

FAA Doc: 14CFR references: 23.1321-23.1322, 25.1321-25.1322

9.2.4 Verify that emergency action controls are properly marked.

DoD/MIL Doc: JSSG-2010: 3.1, 4.1, 3.2, 4.2, 3.3, 4.3, 3.4, 4.4, 3.9.7, 3.14, 4.14

FAA Doc: 14CFR references: 23.1555, 23.1561, 25.1555, 25.1561

9.2.5 Verify that, if appropriate, the design allows each crewmember, in an emergency, to operate all controls essential for crew survival.

9.2.6 Verify that all interior finishes, components, and equipment, including lavatories, galleys, and areas that are not continuously occupied, are made with flame-resistant materials.

DoD/MIL Doc: JSSG-2010-7: 3.7.3.4

FAA Doc: 14CFR references: 25.791, 23.853, 25.854, 25 Appendix F

9.2.7 Verify that a system exists such that the flight deck can readily communicate with other aircrew.

DoD/MIL Doc: JSSG-2010-4

FAA Doc: 14CFR references: 121.319

9.2.8 Verify that all audio communication systems have speech intelligibility of sufficient quality to ensure safe and effective aircraft operation.

9.3 Air vehicle lighting.

This element involves the following: Lighting environments and mechanisms (e.g., NVIS, LEP) allowing crewmembers to see information from displays and instruments, to operate controls, to move safely throughout and emergency egress the compartment, to see other vehicles in formation and during aerial refueling, and to perform all other mission-critical functions where sight is necessary.

FAA Doc: AC 20-30B, AC 20-30A, 23.1381-23.1401, 25.1381-25.1403

9.3.1 Verify that lighting systems exist to illuminate everything in or on the air vehicle that needs to be seen by crew, wing men, passengers, maintainers, and ground support personnel, regardless of ambient lighting conditions.

DoD/MIL Doc: JSSG-2010-5

MIL-STD-1472F: 5.2.1.2 and 5.8.2.1 thru 5.8.2.3 and Table XVI, criteria for the operator station lighting system

MIL-STD-3009: 4.2.2 table 1, criteria for the operator station lighting system

FAA Doc: 14CFR references: 23.1381-23.1401, 25.1381-25.1403

9.3.2 Verify that the lighting is fully controllable and uniform and does not produce unacceptable glare, shadows, or reflections.

DoD/MIL Doc: JSSG-2010-5

FAA Doc: 14CFR references: 23.1381-23.1401, 25.1381-25.1403

9.3.3 Verify that the lighting allows the air vehicle to operate in commercial airways without restriction.

DoD/MIL Doc: JSSG-2010-5: section 3.5.3 addresses exterior lighting subsystems

FAA Doc: 14CFR references: 23.1381-23.1401, 25.1381-25.1403

9.3.4 Verify that lighting and illumination exists for crewmembers to perform all flight-critical tasks and that lighting systems are NVIS and laser eye protection (LEP) compatible, if applicable.

DoD/MIL Doc: JSSG-2010-5

JSSG-2010: 3.1, 4.1, 3.2, 4.2, 3.3, 4.3, 3.4, 4.4, 3.5, 4.5, 3.14, 4.14

JSSG-2010-5: 3.5.2.1.8, cockpit and crew station lighting

MIL-STD-3009: 5.7.2.2, addresses NVIS compatible aircraft lighting and Visual acuity charts

FAA Doc: 14CFR references: 23.1381-23.1401, 25.1381-25.1403

9.4 Human performance.

This element provides the means for the crewmember to monitor and control the system flight path management, navigation, caution, warning, advisory, communications, identification, propulsion, and mission and utilities subsystems. It covers presentation of emergency checklists and procedures. It encompasses the location and arrangement of the primary flight display suite, crew workload, situation awareness, and spatial disorientation aspects.

DoD/MIL Doc: MIL-STD-1472F: Human Factors Engineering

FAA Doc: 14CFR references: 23.1311-23.1322, 25.1321-25.1322

9.4.1 Verify that all functional operations can be safely performed including tasks performed by aircrew, operators, and maintainers.

DoD/MIL Doc: JSSG-2010: 3.1, 4.1, 3.2, 4.2

JSSG-2010-1 - Handbook 3.2.1 and 4.2.1 for Method of Compliance. Table 2 of the document provides a list of Figures of Merit

FAA Doc: 14CFR references: 23.1311-23.1322, 25.1321-25.1322

9.4.1.1 Verify that the primary flight display suite provides the necessary information to the crewmembers to enable all basic and unique flight maneuvers to be performed safely, in both normal emergency conditions.

DoD/MIL Doc: Air Force Flight Standards Agency white paper (Single Medium Flight Instrument Display Endorsement Process, Jan 01) provides procedures for requesting and getting PFR endorsement

JSSG-2010-3: 3.2, 4.2

MIL-STD-1787: Appendix E, Figures 91, 92, and 93 list the parameters for basic flight performance, unusual attitude and recovery performance, and dynamic maneuvering performance

FAA Doc: 14CFR references: 23.1311-23.1322, 25.1321-25.1322

9.4.2 Verify that all operating instructions, flight handbooks/checklists, flight/performance management and planning systems, and other relevant documentation, are not in conflict with system descriptions and procedures (normal and emergency) and actual system performance; that emergency procedures are clear and corrective actions do not create other hazardous situations; and that all procedures or pilot/vehicle interfaces can be accomplished within acceptable crew workload limits.

DoD/MIL Doc: JSSG-2010: 3.1, 4.1, 3.2, 4.2

MIL-DTL-7700G, Flight manuals/checklists accordance

MIL-HDBK-46855, guidance on human workload assessment techniques

FAA Doc: 14CFR references: 23.1581-23.1589, 25.1581-25.1587

9.4.3 Verify that external visibility, or transmitted visual indications, is sufficient for the aircrew to maintain flight, conduct all necessary flight tasks, and avoid ground or flight obstacles.

DoD/MIL Doc: JSSG-2010: 3.1, 4.1, 3.2, 4.2

JSSG-2010-2: 3.2.13.3 and 3.2.13.5

FAA Doc: 14CFR references: 23.1581-23.1589, 25.1581-25.1587

9.4.4 Verify that the crew system interface is designed to reduce the potential for, and minimize the consequences of, a crew-induced error, and provides a simple means to correct an error.

DoD/MIL Doc: MIL-STD-1472F 5.1 through 5.4 and 5.4.3, guidance for the human factors design of equipment that minimizes the occurrence of human error.

MIL-STD-1472F: 5.1.14, design guidance for human computer interface and associated methods for the minimization of human error.

9.4.5 Verify that technical manuals/technical orders and publications are accurate and complete for all tasks that may have flight safety impacts.

9.5 Life support systems.

This element provides the human with breathing and anti-g provisions, and natural, induced, and combat hazard protection. This includes chemical biological protection, laser protection, cold water immersion protection, head protection, noise protection, altitude protection (pressure suits), protection from rapid decompression, personal services, etc.

9.5.1 Verify that the air vehicle integrated life support systems (for example, high altitude, "g" protection, ocular protection, and breathing) are fully functional and accessible within the flight envelope.

DoD/MIL Doc: JSSG-2010: 3.6, 4.6, 3.9, 4.9, 3.10, 4.10, 3.13, 4.13

JSSG-2010-9 Personal Protective Equipment Handbook 3.9.1, 4.9.1

FAA Doc: 14CFR references: 23.1301, 23.1441, 25.1301, 25.1441

9.5.2 Verify that the system satisfies the physiological requirements of the occupants during mission, escape, and survival.

DoD/MIL Doc: JSSG-2010: 3.6, 4.6, 3.9, 4.9, 3.10, 4.10, 3.13, 4.13

JSSG-2010-9 Personal Protective Equipment Handbook

FAA Doc: 14CFR references: 23.1301, 23.1441, 25.1301, 25.1441

9.5.3 Where the life support system must interface with other air vehicle subsystems, verify that the operation of the life support system is not degraded by, and does not degrade, the normal or failure modes of operation of those subsystems (for example, controls and displays, escape systems, communication, environmental management system (EMS)).

DoD/MIL Doc: JSSG-2010: 3.6, 4.6, 3.9, 4.9, 3.10, 4.10, 3.13, 4.13

JSSG-2010-9 Personal Protective Equipment Handbook

FAA Doc: 14CFR references: 23.1301, 23.1441, 25.1301, 25.1441

9.5.4 Verify that emergency oxygen is available for all occupants of the air vehicle.

DoD/MIL Doc: JSSG-2001: 3.3.10.2.2, JSSG-2010: 3.7, 4.7, 3.13, 4.13

FAA Doc: Refer to technical point of contact for this discipline (listed in section A.2)

9.5.4.1 Verify sufficient emergency oxygen is available during high altitude escape.

9.5.5 Verify that each life raft has obviously marked operating instructions. Ensure that approved survival equipment is marked for identification and method of operation and that emergency flotation and signaling equipment is installed so that it is readily available to the crew and passengers.

DoD/MIL Doc: JSSG-2010-9: 3.11.7.3

FAA Doc: 14CFR references: 25.1561, 23.1561, 23.1415, 121.339

9.5.6 Verify that each life raft to be released automatically or by a crewmember is attached to keep it in place alongside the air vehicle until the raft is afloat on water. Verify that this attachment is sufficiently weak to break away from the air vehicle before submerging the fully occupied life raft to which it is attached.

FAA Doc: 14CFR references: 25.1561, 23.1561, 23.1415, TSO C70a

9.6 Transparency integration.

This element provides the crewmember with exterior vision capability in accordance with system requirements. It may consist of a remote camera system, a flat transparency window, a windscreen, and/or a canopy system. It also may include the transparency/canopy frame, canopy actuator, canopy latch/locking system, etc.

9.6.1 Verify that canopies and associated support structure, as well as the actuation, latching, and locking mechanisms, are compatible with the air vehicle escape system to permit safe egress and escape in the event of an emergency.

Comm'l Doc: For a new transparency in an existing aircraft, it is recommended that reference be made to the existing aircraft specifications.

DoD/MIL Doc: JSSG-2010-14: 3.14, 4.14

JSSG-2010-11

MIL-STD-1474

FAA Doc: 14CFR references: 23.775, 25.775

9.6.2 Verify that the transparency system meets survivability requirements for bird-strike impact.

Comm'l Doc: ASTM F330, Bird Impact Testing of Aerospace Transparent Enclosures

DoD/MIL Doc: JSSG-2010-14: 3.14, 4.14

FAA Doc: 14CFR references: 23.775, 25.775

9.6.3 Verify that the structural/thermal capability of the transparency system is adequate for all loads and flight conditions.

DoD/MIL Doc: JSSG-2010-14: 3.14, 4.14

FAA Doc: 14CFR references: 23.775, 25.775

9.6.4 Verify that the transparency system shape is compatible, and does not interfere, with crewmember and equipment positions and motions used during normal and emergency conditions.

DoD/MIL Doc: JSSG-2010-14: 3.14, 4.14

FAA Doc: 14CFR references: 23.775, 25.775

9.6.5 Verify that the optical characteristics of the transparencies (windshield, canopy, windows, as applicable), including transmissivity, angular deviation, optical distortion, haze, multiple imaging, binocular disparity, birefringence, and minor optical defects are compatible with the safety-critical optical systems used by the aircrew and provide a safe optical environment to the pilot.

DoD/MIL Doc: JSSG-2010-14: 3.14, 4.14

JSSG-2010-14: 3.1.4.1, for additional transparency optical characteristics and recommended values

FAA Doc: 14CFR references: 23.775, 25.775

9.6.6 Verify that necessary deployment power is available under normal and emergency conditions and that there is no interference with manual actuation of the canopy when air vehicle or external power is not available.

DoD/MIL Doc: JSSG-2010-14: 3.14, 4.14

FAA Doc: 14CFR references: 23.775, 25.775

9.6.7 Verify that the environmental management system interface provides necessary defogging, pressurization, heating, cooling, humidity control, and ventilation of the transparency system under normal and emergency conditions.

DoD/MIL Doc: JSSG-2010-14: 3.14, 4.14; JSSG 2010-3: 3.3.2, 4.3.2

FAA Doc: 14CFR references: 23.775, 25.775

9.6.8 Verify that provisions for rain removal, deicing and defogging, and snow and ice removal are adequate for pilot external vision and that these provisions do not cause temporary or permanent optical degradation of the transparencies.

DoD/MIL Doc: JSSG-2010-14: 3.14, 4.14

FAA Doc: 14CFR references: 23.775, 25.775

9.7 Crash survivability.

This element provides the pilot, crew, and passengers with protection/procedures in the event of a crash scenario. It covers crash rescue procedures, fire protection, equipment containment, smoke protection, emergency lighting and seating.

DoD/MIL Doc: JSSG-2001: 3.3.10.2.2

JSSG-2010: 3.7, 4.7, 3.13, 4.13

FAA Doc: 14CFR references: 23.561, 23.562, 25.561, 25.562, 25.563

9.7.1 Verify that seating system load capabilities are commensurate with the air vehicle type for aircrew and passengers 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.

DoD/MIL Doc: JSSG-2001: 3.3.10.2.2

JSSG-2010: 3.7, 4.7, 3.13, 4.13

FAA Doc: 14CFR references: 23.561, 23.562, 25.561, 25.562, 25.563

9.7.2 Verify that the stroke clearance envelope for energy absorbing seats is clear of structures and equipment that could impede seat stroke.

DoD/MIL Doc: Refer to technical point of contact for this discipline (listed in section A.2)

FAA Doc: Refer to technical point of contact for this discipline (listed in section A.2)

9.7.3 Verify that restraint systems are designed to restrain the occupant properly for the escape system environment and the crash loading of the seat.

DoD/MIL Doc: JSSG-2001: 3.3.10.2.2

JSSG-2010: 3.7, 4.7, 3.13, 4.13

FAA Doc: 14CFR references: 23.561, 23.562, 25.561, 25.562, 25.563

9.7.4 Verify 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.

DoD/MIL Doc: JSSG-2001: 3.3.10.2.2

JSSG-2010: 3.7, 4.7, 3.13, 4.13

FAA Doc: 14CFR references: 23.561, 23.562, 25.561, 25.562, 25.563

9.7.5 Verify that the exits are post-crash operational up to the design crash loads.

DoD/MIL Doc: JSSG-2001: 3.3.10.2.2

JSSG-2010: 3.7, 4.7, 3.13, 4.13

FAA Doc: 14CFR references: 23.561, 23.562, 25.561, 25.562, 25.563

9.7.6 Verify that, under emergency landings, ditching, and crash loads, items of mass do not cause serious injury to occupants or prevent escape.

DoD/MIL Doc: JSSG-2001: 3.3.10.2.2

JSSG-2010: 3.7, 4.7, 3.13, 4.13

JSSG-2010-7: 3.7.3.7.3, 3.7.3.2.3

FAA Doc: 14CFR references: 23.561, 23.562, 25.561, 25.562, 25.563, 25.787, 25.789, 23.787, 25.801, 25.1411, 25.1421

9.7.7 Verify that the air vehicle is equipped with breathing and eye protection equipment, fire-fighting equipment, and fire extinguishers appropriate for the expected use.

DoD/MIL Doc: JSSG-2001: 3.3.10.2.2

JSSG-2010: 3.7, 4.7, 3.13, 4.13

JSSG 2010-9: 3.9.3

FAA Doc: 14CFR references: 25.851

9.7.8 Verify that ditching provisions, including flotation devices for all occupants, are installed on all air vehicles without assisted escape systems.

DoD/MIL Doc: JSSG-2001: 3.3.10.2.2

JSSG-2010: 3.7, 4.7, 3.13, 4.13

FAA Doc: 14CFR references: 23.561, 23.562, 25.561, 25.562, 25.563

9.7.9 Verify that pre-crash warning between aircrew and all compartments is possible without aircrew or occupants leaving their seating position.

DoD/MIL Doc: JSSG-2001: 3.3.10.2.2

JSSG-2010: 3.7, 4.7, 3.13, 4.13

9.7.10 Verify that, for rotary wing air vehicles, occupiable volume reduction resulting from design crash loads provides reasonable protection against occupant injury.

DoD/MIL Doc: JSSG-2001: 3.3.10.2.1, 4.3.10.2.1

JSSG-2010-7: 3.7.3.2.1

FAA Doc: 14CFR reference: 27.562

9.7.11 Verify that mechanisms used for emergency crew extraction and for firefighting are properly marked and can be operated while wearing personal protective equipment.

DoD/MIL Doc: MIL-STD-1472: 5.5, 5.6

JSSG-2001: 3.4.3, 4.4.3

JSSG-2010-9: 3.9.5, 4.9.5

JSSG-2010-13: 3.13.6, 4.13.16

FAA Doc: 14CFR reference 25.811

9.8 Air transportability and airdrop.

This element addresses technical requirements in the area of aerial delivery of cargo and personnel with regard to safety of the air vehicle. It may cover cargo restraint, tiedowns, external load equipment, transport of hazardous materials, handling/loading of either problem or unique cargo, and airdrop of cargo and personnel.

9.8.1 Verify that the air vehicle structure can support all loads (internal or external, as applicable) imposed by the transported items during operational usage.

DoD/MIL Doc: JSSG-2000: 3.1.7.2

JSSG-2001: 3.4.5, 3.4.6

9.8.2 Verify that clearance exists for aircrew and passengers during flight-critical and emergency functions.

DoD/MIL Doc: JSSG-2000: 3.1.7.2

JSSG-2001: 3.4.5, 3.4.6

MIL-HDBK-1791 illustrates the minimum acceptable aircrew access clearances for C-130 aircraft

AFI 11-2C-130 Vol 3, addenda A, defines C-130 passenger safety aisle requirements

MIL-STD-1472 defines anthropometric data

9.8.3 Verify that NAVAIR NATOPS/cargo-loading manuals include shear, bending, crushing, or puncture load limits such that the cargo does not impart excessive loads into the air vehicle structure during any phase of the loading process.

DoD/MIL Doc: NATOPS, TO 1C-XX-9, the aircraft loading manuals include cargo loading limits in the desired formats.

JSSG-2000: 3.1.7.2

JSSG-2001: 3.4.5, 3.4.6

9.8.3.1 Verify cargo hook and backup structural load limits and verify that limits are included in applicable operators and maintenance manuals.

9.8.4 Verify that the positioned cargo meets required flight weight and balance requirements.

DoD/MIL Doc: NATOPS, TO 1C-XX-1, TO 1C-XX-9, TO 1C-xx-5 contain approximate permissible cargo center of gravity graphs (chimney curves) for mission equipped aircraft.

JSSG-2000: 3.1.7.2

JSSG-2001: 3.4.5, 3.4.6

9.8.5 With the exception of items designated for airdrop, verify that the loaded item will not change the air vehicle C.G. position during flight.

DoD/MIL Doc: JSSG-2000: 3.1.7.2

JSSG-2001: 3.4.5, 3.4.6

MIL-HDBK-1791, restraint criteria for transported cargo

MIL-A-8865B, restraint criteria for transported cargo

9.8.6 Verify that restraints afford sufficient capacity and are provided in sufficient quantity to restrain the transported items safely.

DoD/MIL Doc: JSSG-2000: 3.1.7.2

JSSG-2001: 3.4.5, 3.4.6

MIL-T-25959, standard restraint devices

MIL-PRF-27260, standard restraint devices

9.8.7 Verify that all operator and maintenance manuals (T.O.'s) are accurate and provide cargo preparation, handling, carriage, and delivery procedures necessary for safe ground and flight operations.

DoD/MIL Doc: JSSG-2000: 3.1.7.2

JSSG-2001: 3.4.5, 3.4.6

9.8.8 Verify that cargo compartment dimensions allow enough room to load, transport, and/or airdrop required items safely.

DoD/MIL Doc: MIL-HDBK-1791: 4.2, 5.2

JSSG-2009: Appendix J

9.8.9 Verify that air vehicle flight performance/control is not hazardously affected by movements in C.G. of airdrop loads or by load and C.G. movement experienced during external load operations.

DoD/MIL Doc: MIL-HDBK-1791: 4.2, 5.2

JSSG-2009: Appendix J

9.8.10 Verify that air vehicle personnel airdrop systems can withstand the loads imposed by personnel during airdrop and possible malfunctions of personnel airdrop equipment.

DoD/MIL Doc: MIL-HDBK-1791: 4.2, 5.2

JSSG-2009: Appendix J

9.8.11 Verify that the air vehicle provides the capability to safely recover a towed jumper.

DoD/MIL Doc: Refer to technical point of contact for this discipline (listed in section A.2)

9.8.12 Verify that, for personnel airdrop, acceptable risk levels exist to avoid paratrooper collision, adverse vortex interaction, and adverse multi-ship formation effects induced by the air vehicles.

DoD/MIL Doc: Refer to technical point of contact for this discipline (listed in section A.2)

9.8.13 Verify for airdrop or jettisonable cargo, that the loaded items can be safely jettisoned during flight.

DoD/MIL Doc: MIL-HDBK-1791: 4.2, 5.2

JSSG-2009: Appendix J

9.8.14 Verify that necessary in-flight movement or operation of transported items and mission equipment does not adversely affect aircraft flight systems or cause injury to aircrew and passengers.

DoD/MIL Doc: MIL-HDBK-1791: 4.2, 5.2

JSSG-2009: Appendix J

9.9 Lavatories, galleys, and areas not continuously occupied.

This element addresses air vehicle compartments, and areas that may be accessible to crew, passengers or maintainers, but that may not be occupied at all times during flight.

9.9.1 Verify that food service carts, refuse carts, and waste containers used to receive any combustible materials contain a fire ignited within.

9.9.2 Verify that all compartments have separate and approved smoke and/or fire detectors to alert the crew at the pilot or flight engineer station for both in-flight and ground operations; that each compartment has dedicated hand fire extinguishers; and that if unoccupied cargo holds are present, fire protection and fire detection/suppression requirements are met.

DoD/MIL Doc: JSSG-2010-7: 3.7.3.4

JSSG-2009 Appendix G: 3.4.7.9

FAA Doc: 14CFR references: 25.855, 25.857, 25.858, 25.859, 25.854

9.9.3 Verify that the fire alarm and intercom/public address system can be heard in all lavatories, galleys, and other compartments.

9.9.4 Verify that the human factors design for operation of installed equipment minimizes the probability of human error that could create a safety hazard in the aircraft.

9.9.5 Verify that all equipment installed in lavatories, galleys, and other areas can be safely operated in the aircraft environment, and is designed to withstand all potential aircraft environmental exposures, including rapid decompression, without creating a safety hazard.

9.9.6 Verify that occupants cannot become trapped in lavatories, galleys, and other compartments during emergency evacuation situations, and that emergency lighting is available to aid egress.

DoD/MIL Doc: MIL-PRF-85676

10. DIAGNOSTICS SYSTEMS

TYPICAL CERTIFICATION SOURCE DATA

1. Failure modes, effects, and criticality analysis (FMECA)
2. Acceptance test procedures
3. Preflight test results
4. Built-in-test software
5. Flight test plan
6. Testability analysis reports
7. BIT demos reports
8. Test & evaluation master plan (TEMP)
9. Failure report and corrective action system (FRACAS) data
10. Test reports
11. System safety analysis report

CERTIFICATION CRITERIA

10.1 Failure modes.

10.1.1 Verify that critical functional failure modes are identified and detection methods incorporated.

Comm'l Doc: SAE AIR 4845 details the FMECA process.

DoD/MIL Doc: JSSG-2000: 3.3.2

JSSG-2001: 3.3.7, 3.3.7.1

FAA Doc: 14CFR references: 23.1301, 23.1309, 23.1351, 25.1301, 25.1309, 25.1351

10.1.2 Verify that all critical functional failures, including built-In-test (BIT) features, are linked to the caution and warning function and message indicators.

DoD/MIL Doc: JSSG-2000: 3.3.2

JSSG-2001: 3.3.7, 3.3.7.1

FAA Doc: 14CFR references: 23.1301, 23.1309, 23.1351, 25.1301, 25.1309, 25.1351

10.2 Operation.

10.2.1 Verify that the operation of air vehicle and ground diagnostic systems is proper for all SOF parameters.

DoD/MIL Doc: JSSG-2000: 3.3.2

JSSG-2001: 3.3.7, 3.3.7.1, 3.4.4.1.6

AFGS 87256, Integrated Diagnostics, 3.1.4.1, 3.2.2.3, address the diagnostic capability needed to support safety decisions

MIL-HDBK-2165 addresses testability and the extent to which a system supports fault

detection and fault isolation

FAA Doc: 14CFR references: 23.1301, 23.1309, 23.1351, 25.1301, 25.1309, 25.1351

10.2.2 Verify that critical parameter values can be measured within the established tolerances and that operation and calibration procedures are defined.

DoD/MIL Doc: JSSG-2000: 3.3.2

JSSG-2001: 3.3.7, 3.3.7.1

FAA Doc: 14CFR references: 23.1301, 23.1309, 23.1351, 25.1301, 25.1309, 25.1351

10.2.3 Verify that measures are taken to ensure the diagnostic system itself does not induce undetected failures or otherwise damage the air vehicle.

DoD/MIL Doc: JSSG-2000: 3.3.2

JSSG-2001: 3.3.7, 3.3.7.1

JSSG-2001 Air vehicle: 3.3.7 Diagnostics

AFGS 87256 Integrated Diagnostics provides general guidance regarding diagnostics

FAA Doc: 14CFR references: 23.1301, 23.1309, 23.1351, 25.1301, 25.1309, 25.1351

10.2.4 Verify functionality of safety systems that provide protection against catastrophic failures prior to potential need of the safety system.

DoD/MIL Doc: JSSG-2000: 3.3.6

JSSG-2001: 3.3.7, 3.4.4.1.6

FAA Doc: 14CFR references: 23.1301, 23.1309, 23.1351, 25.1301, 25.1309, 25.1351

10.2.5 Verify that all operator and maintenance manuals containing diagnostic systems are complete and accurate.

DoD/MIL Doc: JSSG-2000: 3.6.2

FAA Doc: 14CFR references: 23.1301, 23.1309, 23.1351, 25.1301, 25.1309, 25.1351

11. AVIONICS

Avionics certification criteria apply to manned air vehicle avionics, as well as airborne and ground segment avionics for UAV/ROA.

TYPICAL CERTIFICATION SOURCE DATA

1. Design criteria
2. Design studies and analyses
3. Design, installation, and operational characteristics
4. Design approval and system compatibility tests
5. Simulation tests and modeling results
6. Component and system level qualification and certification tests
7. Electromagnetic environmental effects
8. Hazard analysis and certification
9. Failure modes and effects analysis
10. Avionics flight-critical hardware and software
11. Avionics preliminary design review (PDR) and critical design review (CDR) open items
12. Avionics integration tests and results
13. Avionics/electronics integrity program documentation
14. Flight test simulation plan
15. System/subsystem self-test design and capabilities
16. Acceptance test plans, procedures, and results
17. Qualification test plans, procedures, and results
18. Functional configuration audit (FCA) and physical configuration audit (PCA) data
19. Test reports
20. Environmental analysis and test results
21. Diminishing manufacturing sources plan
22. Obsolete parts plan

CERTIFICATION CRITERIA

(Note: For subsystems that use computer resources, see section 15 for additional, specific criteria.)

DoD/MIL Doc: JSSG-2005 Avionics

11.1 Avionics architecture.

11.1.1 Avionics subsystems. Verify that the number and type of sensors, data processors, data buses, controls and displays, and communications devices are adequate for SOF considerations. As a minimum, the following are provided:

a. Air data system, including provisions for displaying primary flight parameters

b. Propulsion system instrumentation, with the ability to monitor performance, fuel status, and integrity of the system

c. Display of other air vehicle or vehicle management system parameters as required for safe flight

d. An installed interoperable communications subsystem capable of supporting SOF operations with the required integrity and continuity of service throughout the intended missions.

e. A navigation subsystem capable of meeting SOF performance, integrity, availability and continuity of service requirements for long range reference, local area reference, and landing/terminal reference

f. An installed surveillance and identification subsystem capable of meeting the SOF performance, integrity, and continuity of service requirements for identification, relative positioning, trajectory, timing, and intent.

Comm'l Doc: For air data system: RTCA DO-236A, guidance on CNS/ATM related air data system requirements

For radio subsystems:

RTCA DO-186A is the civil standard for VHF radio

RTCA DO-219

RTCA SC-189

For navigation subsystems:

RTCA DO-236A, for CNS/ATM related navigation system requirements

RTCA DO-200A: 2.3.2, 2.3.3, 2.3.5, and 2.4.1 (RNP Data Processing)

RTCA DO-236

For surveillance and identification subsystems:

RTCA DC-181C is the civil standard for Mode S

RTCA DO-185A Is the civil standard for TCAS II

RTCA DO-212

DoD/MIL Doc: MIL-HDBK-87213 Sect. 3.1

For air data system:

GATOMC2 Communications, Navigation and Surveillance/Air Traffic Management (CNS/ATM) RVSM, Barometric Vertical Navigation (BARO VNAV), Area Navigation Vertical Navigation (RNAV VNAV), Performance Matrices provide CNS/ATM related air data system safety guidance. Contact GATOMC2 for current applicable performance matrices and current supporting civil documents.

MIL-STD-1787: 4.1.1

For propulsion system instrumentation: MIL-STD-1787: 4.1.1 provides guidance on displayed information

For display system guidance: MIL-HDBK-87213 Sect. 3.1 provides display system guidance.

For radio subsystems:

JSSG-2005: 3.2.1.6 and 4.2.1.6

MIL-STD-188-141B Interoperability and Performance Standards for Medium and High

Frequency Radio System

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

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

MIL-STD-188-181B Interoperability Standard for Single-Access 5-kHz and 25-kHz UHF Satellite Communications Channels

MIL-STD-188-182A Interoperability Standard for 5-kHz UHF DAMA Terminal Waveform

MIL-STD-3005 Analog-To-Digital Conversion of Voice By 2,400 Bit/Second Mixed Excitation Linear Prediction (MELP)

CNS/ATM performance requirements are found in the GATOMC2 CNS/ATM Performance Matrices (8.33 kHz VHF, SATCOM Voice, HFDL, VDL, CPDLC, ADS, AFN, Data Comm, etc.) for military performance requirements necessary for safe access to civil airspace. Contact GATOMC2 for current applicable performance matrices and current supporting civil documents.

IL-STD1472F 5.3.14, guidance in conducting Modified Rhyme Testing

AFI 11-202 Vol 3: 2.6.2

Interoperability and IERs are discussed in CJCSI 6212.01

For navigation subsystems:

GATOMC2 CNS/ATM RNP Top Level, RNP Data Processing, RNP Path Following, RNP Pilot/Vehicle Interface (PVI), RNP-10, RNAV VNAV, BRNAV, and PRNAV Performance Matrices provide CNS/ATM related navigation system safety guidance. Contact GATOMC2 for current applicable performance matrices and current supporting civil documents.

JSSG-2005: 3.2.1.5 and 4.2.1.5

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For surveillance and identification subsystems:

DOD AIMS 97-1000/DOD AIMS 03-1000 provide the requirements for AIMS certification.

GATOMC2 CNS/ATM Performance Matrices (Mode S, TCAS II) for military performance requirements necessary for access to civil airspace. Contact GATOMC2 for current applicable performance matrices and current supporting civil documents.

JSSG-2005: 3.2.1.6 and 4.2.1.6

AFI 11-202 Vol 3: 5.4.2

FAA Doc: AC-23.1301, 23.1309, 25.1301, 25.1309, RTCA DO-200A

AC 27-1B, Certification of Normal Category Rotorcraft

AC 29-2C, Certification of Transport Category Rotorcraft

AC 20-145 Guidance for Integrated Modular Avionics (IMA)

AC 20-130A, Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors

For air data system:

FAA IG 91-RVSM, 7.c(4), 7.C(5), 7.c(8), 7.d, 8.b(5), 8.b(6), 8.b(7), 8.c, and 8.d. (RVSM)

AC-23.1323, 23.1325, 23.1326, 25.1323, 25.1325, 25.1326

AC 90-97 7 (Baro VNAV)

AC 20-129 6 (RNAV VNAV)

For propulsion system instrumentation:

14CFR reference: 23.1301, 13.1305, 23.1309, 25.1301, 25.1305, 25.1309 and FAA AC-1307-1C section 8.5 provide more extensive guidance.

AC-27-1 and AC-29-2 provide guidance on helicopter equipment, primarily in subpart "F"

For display system guidance:

AC 23.1301, 23.1309, 23.1351d, 25.1301, 25.1309, 25.1351d

14CFR reference: 23.1301, 23.1307, 25.1301 and 25.1307 provide additional guidance.

AC-27-1 and AC-29-2 provide guidance on helicopter equipment, primarily in subpart “F”

For radio subsystems:

AC 20-140, Guidelines for Design Approval of Aircraft Data Communications Systems

For navigation subsystems:

AC-25.1303, AC 90-96

AC_90-96 (BRNAV only)

AC_90-96A (Draft containing both BRNAV and PRNAV requirements)

FAAO 8400.12A 10.a-b, & 15a (RNP-10)

AC 20-129 Airworthiness Approval of Vertical Navigation (VNAV) Systems for use in the U.S. National Airspace System (NAS) and Alaska, 9-12-88, 6 (RNAV VNAV)

For surveillance and identification subsystems: TSO C112, AC 20-131A, TSO C151a

11.1.2 Verify that redundancy is incorporated such that failure of any single sensor, connection, processor, or display unit does not result in loss of safety-critical data or display of unsafe or misleading data.

Comm’l Doc: ARP 4761 sections 4.2 FMEA, 4.4 CCA, 4.4.2 PRA, and 4.4.3 CMA

DoD/MIL Doc: JSSG-2005: 3.2.1.4.1, 4.2.1.4.1

FAA Doc: AC-23.1309, 23.1311, 23.1331, 25.1309, 25.1331

14CFR references: 23.1309, 23.1311, 23.1331, 25.1309, 25.1331

AC-27-1 and AC-29-2 provide guidance on helicopter equipment, primarily in subpart "F"

11.1.3 Verify that data buses have sufficient redundancy, reliability, and integrity to meet system safety and flight-critical requirements to preclude

a. Loss of flight-critical functioning
b. Display of unsafe or misleading information to the operator or maintainer
c. Undetected failure modes

DoD/MIL Doc: JSSG-2005: 3.2.2, 4.2.2

FAA Doc: AC-27-1 and AC-29-2 provide guidance on helicopter equipment, primarily in subpart "F"

For prevention of loss of flight critical functioning: AC-23.1301, 23.1309, 25.1301, 25.1309

For prevention of unsafe or misleading information:

AC-23.1301, 23.1309, 23.1311, 25.1301, 25.1309

14CFR references: 23.1301, 23.1309, 23.1311, 25.1301, 25.1309

For prevention of undetected failure modes: AC-23.1301, 23.1309, 25.1301, 25.1309

11.1.4 Verify the overall avionics system operates in a deterministic or bounded manner and limits latency of any time-critical data, including primary flight data, as needed to support all safety-critical functions.

DoD/MIL Doc: JSSG-2005: 3.2.1.3, 4.2.1.3

FAA Doc: AC-23.1301, 23.1309, 23.1331, 25.1301, 25.1309, 25.1331

AC-27-1 and AC-29-2 provide guidance on helicopter equipment, primarily in subpart "F"

11.1.5 Verify that all normal, backup, and emergency modes of operation are safe for the integrated system. Verify the following events do not result in unsafe system operation:

a. Undetected failure modes (failures not automatically detected by diagnostics)
b. Timing or latency anomalies
c. Interface/interconnect failures

DoD/MIL Doc: JSSG-2005: 3.3.5, 4.3.5

For undetected failure modes, and timing or latency anomalies: JSSG-2005: 3.2.1.3.2, 4.2.1.3.2

For interface/interconnect failures: JSSG-2005: 3.2.2.2, 4.2.2.2, 3.2.2.3, 4.2.2.3

FAA Doc: AC-23.1301, 23.1309, 23.1329, 23.1335, 25.1301, 25.1309, 25.1329, 25.1335

AC-27-1 and AC-29-2 provide guidance on helicopter equipment, primarily in subpart "F"

AC 20-145, Guidance for Integrated Modular Avionics (IMA) that Implement TSO-C153 Authorized Hardware Elements.

11.1.6 Verify that the avionics system integrated diagnostics provides the fault coverage, low false alarm rates, fault isolation, and fault detection needed to detect bad data and failed components that would degrade safe operation.

DoD/MIL Doc: JSSG-2005: 3.2.1.3.2, 4.2.1.3.2

FAA Doc: AC-23.1309, 25.1309

14CFR reference 23.1309, 25.1309

AC-27-1 and AC-29-2 provide guidance on helicopter equipment, primarily in subpart "F"

AC 29-2C, Certification of Transport Category Rotorcraft

11.2 Avionics subsystems.

11.2.1 Verify that critical information is provided to the crew as follows:

a. Legibility of primary flight displays. Verify that primary flight information is provided to the crew at all times and is fully legible in all mission environments, including full sunshine on displays, sun in the eyes, and total darkness.

b. Accuracy. Verify that accuracy of flight-critical information meets SOF requirements.

c. Warnings, cautions, and advisories. Verify that cautions and warnings are legible in all mission environments and are provided in an organized, prioritized system, and that the presentation of high-priority information is not masked by older or lower priority warnings and cautions.

d. Symbology. Verify that instruments and symbols used to display flight-critical information employ accepted formats, directions, etc.

e. BIT features. Verify that BIT features of equipment alert the flight crew of flight-critical equipment status.

DoD/MIL Doc: For legibility of primary flight displays:

AFI 11-202 Vol 3: 2.6, 2.6.1, 2.6.1.1, 2.6.1.2, and 2.6.1.2.1 provides Air Force instructions on PFRs.

MIL-HDBK-87213 section 3.1.1 provides guidance on legibility of displays; section 3.2.1.6 provides guidance on verification of displays in high ambient lighting environments.

JSSG-2005: 3.2.1.8, 4.2.1.8, 3.2.1.8.1, and 4.2.1.8.1, provides additional avionics systems requirements guidance.

DoD/MIL Doc: For accuracy: MIL-HDBK-87213: 3.2.1.25.4.1 and App A

DoD/MIL Doc: For warnings, cautions, and advisories:

JSSG-2005: 3.2.1.8.5, 4.2.1.8.5

MIL-HDBK-87213

DoD/MIL Doc: For symbology, primary flight information guidance is provided in:

MIL-STD-1787 section 4.2

MIL-STD-1787 Appendix A

DoD/MIL Doc: For BIT features: JSSG-2005: 3.2.1.3.2, 4.2.1.3.2

FAA Doc: AC-27-1 and AC-29-2 provide guidance on helicopter equipment, primarily in subpart “F”

For legibility of primary flight displays:

AC 23.1301, 23.1309, 23.1351, 25.1301, 25.1309, 25.1351 23.1311, 23.1321, 25.1321

14CFR references: 23.1301, 23.1309, 23.1351, 25.1301, 25.1309, 25.1351, 23.1311, 23.1321, 25.1321 provide related FAA criteria

For accuracy: 14CFR reference 23.1311, 23.1323, 23.1325, 23.1326, 23.1327, 25.1323, 25.1325, 25.1326, 25.1327

For warnings, cautions, and advisories: 14CFR reference 23.1311, 23.1322, 25.1322

For symbology:

AC-1311-1A section 9

14CFR reference 23.1321, 23.1541, 25.1321 and 25.1541

For BIT features: 14CFR reference 23.1309, 25.1309

11.2.2 Verify that controls have adequate redundancy and/or reliability to maintain control of all safety-critical functions.

DoD/MIL Doc: JSSG-2005: 3.2.1.8.6, 4.2.1.8.6

FAA Doc: AC-25.777

AC-27-1 and AC-29-2 provide guidance on helicopter equipment, primarily in subpart “F”

11.2.3 Verify that data links, such as unmanned air vehicle (UAV)/remotely operated aircraft (ROA) command and control data links, manned systems with automatic/semi-automatic (man-in-the-loop) landing, formation, or other control functions with off-board aiding, used for safety- and flight-critical requirements to

a. Preclude loss of flight-critical functioning and ensure SOF integrity and continuity of service throughout the intended missions.

b. Preclude display of unsafe or misleading information to the operator or maintainer, and to satisfy fault-tolerant SOF requirements

DoD/MIL Doc: JSSG-2005: 3.2.2, 4.2.2

FAA Doc: 14CFR reference 23.1301, 23.1309, 25.1301, 25.1309

AC 29-140, Guidelines for Design Approval of Aircraft Data Communications Systems

11.2.4 Verify that each subsystem (including any off-the-shelf equipment) and the overall system operates throughout the required operational environment without imposing a SOF risk. This verification typically includes environmental qualification and/or analysis.

DoD/MIL Doc: JSSG-2005: 3.2.3, 4.2.3

MIL-STD-810 can be used as guidance in selection and tailoring of appropriate requirements for specified environments. MIL-STD-810 provides guidance and test methods for verification.

FAA Doc: AC-23.1309, 25.1309

11.2.5 Verify safe avionics subsystem operation with required power characteristics.

DoD/MIL Doc: JSSG-2005: 3.2.2.5, 4.2.2.5

MIL-STD-704

FAA Doc: AC-23.1351, 25.1351

11.3 Avionics air vehicle installation.

11.3.1 Verify that the avionics equipment installation, including arrangement and crashworthiness, is adequate for SOF.

DoD/MIL Doc: JSSG-2005: 3.2.3, 4.2.3

MIL-HDBK-87213 3.2.3 provides guidance on environmental requirements for cockpit display equipment

MIL-STD-810 provides guidance on environmental qualification

FAA Doc: 14CFR reference 23.1309, 23.1321, 25.1309, 25.1321

11.3.2 Verify that flight manual and maintenance manual limits are adequate to conduct safe flight, including emergency operations.

DoD/MIL Doc: JSSG -2005: 3.2.2, 4.2.2

FAA Doc: 14CFR reference 23.1501, 25.1501

AC 27-1B, Subpart G, Certification of Normal Category Rotorcraft

AC 29-2C, Certification of Transport Category Rotorcraft

11.3.3 Verify that antenna performance and patterns for safety/flight-critical transmitting and receiving systems provide adequate coverage to ensure

a. Flight-critical functioning is retained

b. Unsafe information is not displayed to the operator or maintainer

c. Adequate availability and continuity of service for SOF operations

DoD/MIL Doc: JSSG-2005: 3.3.5, 4.3.5

FAA Doc: 14CFR reference 23.1309

12. ELECTRICAL SYSTEM

TYPICAL CERTIFICATION SOURCE DATA

1. Design criteria
2. Design studies and analyses, including electrical loads analysis
3. Failure modes, effects, and criticality analysis (FMECA)
4. Hazard analyses
5. Functional operations test results
6. Performance test results
7. Installation and operational characteristics
8. Component and system qualifications
9. Flight manual, flight test procedures, and limitations
10. Wiring diagrams, which may include information regarding
    - Wire types, wire sizes and current/voltage carried, wire identification, circuit breaker sizes and part numbers
    - Harness diameters including modified harnesses
    - Connector and accessories part numbers and identification
    - Clamping and part numbers
    - Miscellaneous parts identification and part numbers-nuts, bolts, washers, terminal lugs, environmental splices/shield terminations
11. 3D routing diagrams with several views and pictures
12. Visual assessment of the design implementation and installation
13. Component and system qualifications
14. Installed equipment list
15. Diminishing manufacturing sources plan
16. Obsolete parts plan

CERTIFICATION CRITERIA

(Note: For subsystems that use computer resources, see section 15 for additional specific criteria.)

12.1 Electric power generation system.

Definition: 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.

Comm'l Doc: For guidance/principles regarding aspects of assuring effective and proper electric power generation system design, integration and compatibility:

SAE AS50881

ARINC Report 609

NFPA 70

For electric power quality:

SAE AS1831

DoD/MIL Doc: For guidance/principles regarding aspects of assuring effective and proper electric power generation system design, integration and compatibility:

MIL-E-7016

AFGS-87219

MIL-STD-1683

MIL-STD-7080

MIL-HDBK-299

MIL-HDBK-454

ADS-51-HDBK chapter/section 4-8.6

MIL-STD-464

For electric power quality:

MIL-STD-704

MIL-HDBK-704

MIL-STD-1399-300

12.1.1 Verify that sufficient power is available to meet the power requirements during all modes of operation and failure conditions.

DoD/MIL Doc: For guidance/principles relating to assurance of electrical system capacity:

MIL-E-7016

AFGS-87219

JSSG-2009: Appendix C C.3.4.3.5.2, C.4.4.3.5.2; Appendix H H.3.4.8.2, H.4.4.8.2

FAA Doc: 14CFR references: 23.1351; 25.1351

12.1.2 Verify that the operation of the electric power generation system and its component parts is safe, including adequate implementation of cooling provisions, status/failure indications, and mechanical/thermal disconnect (as applicable) of generators, converters, inverters, batteries, etc.

DoD/MIL Doc: For guidance/principles regarding design and operation of safe electrical generation systems:

AFGS-87219

MIL-G-21480

MIL-HDBK-454

MIL-STD-464

ADS-51-HDBK Chapter/Section 8-7

JSSG-2009: Appendix H H.3.4.8, H.4.4.8, H.3.4.8.4, H.4.4.8.4

FAA Doc: 14CFR references: 23.1351-23.1367, 25.1351-25.1363

12.1.3 Verify that operation of the integrated electrical power system for normal and emergency modes is safe. This includes use of actual or simulated drives and loads, all flight and control configurations, transition between modes, bus switching, load shedding, fault condition operation (detection, clearing, and reconfiguration), and assurance that no single fault affects more than one power source.

DoD/MIL Doc: For guidance/principles regarding/affecting design and operation of safe integrated electrical systems:

AFGS-87219

MIL-STD-464

MIL-E-7016

ADS-51-HDBK Chapter/Section 8-7)

JSSG-2009: Appendix H H.3.4.8, H.4.4.8, H.3.4.8.4, H.4.4.8.4, H.3.4.8.5, H.4.4.8.5

FAA Doc: 14CFR references: 23.1351-23.1367; 25.1351-25.1363

12.1.4 Verify that required power quality is maintained for all operating conditions and load combinations.

Comm'l Doc: SAE AS1831 for guidance/principles regarding/affecting design and operation of electrical systems to provide compatible and predictable electric power quality.

DoD/MIL Doc: For guidance/principles regarding/affecting design and operation of electrical systems to provide compatible and predictable electric power quality:

AFGS-87219

MIL-STD-464

MIL-STD-704

MIL-HDBK-704

MIL-STD-1399-300

ADS-51-HDBK chapter/section 7

JSSG-2009: Appendix H H.3.4.8.1, H.4.4.8.1

MIL-HDBK-704 for test methods and procedures for verification of power quality

FAA Doc: 14CFR references: 23.1351-23.1367; 25.1351-25.1363

12.1.5 Verify that the independent, uninterruptable power sources, including power control panels, are available to satisfy requirements of essential redundancy for flight-critical functions after failure of the primary power system and there is no single-point failure (including circuit boards) anywhere in the power system.

DoD/MIL Doc: For guidance/principles regarding/affecting design and operation of electrical systems for uninterruptible electric power:

AFGS-87219

MIL-E-7016

NAVSEA TM-S9310-AQ-SAF-010

JSSG-2009: Appendix H H.3.4.8, H.4.4.8

FAA Doc: 14CFR references: 23.1351-23.1367; 25.1351-25.1363

12.1.6 Verify that, if batteries are employed for SOF backup power, adequate charging methods and checks are provided and installation provisions for all batteries are safe.

DoD/MIL Doc: For guidance/principles regarding/affecting the integrated design and operation of battery subsystems within aircraft electrical systems:

AFGS-87219

NAVSEA TM-S9310-AQ-SAF-010

JSSG-2009: Appendix H H.6.4.2

FAA Doc: 14CFR references: 23.1351-23.1367; 25.1351-25.1363

12.1.7 Verify that emergency backup electrical power systems provide required power for flight conditions associated with the mission profiles of the platform and for malfunction recovery procedures.

DoD/MIL Doc: For guidance/principles regarding/affecting the integrated design and operation of backup power within aircraft electrical systems:

AFGS-87219

MIL-E-7016

JSSG-2009: Appendix H H.3.4.8, H.4.4.8, H.3.4.8.5, H.4.4.8.5

FAA Doc: 14CFR references: 23.1351-23.1367; 25.1351-25.1363

12.1.8 Verify that any subsystem limitations are defined and included in the appropriate manuals.

DoD/MIL Doc: For guidance/principles affecting/providing awareness of limitations of aircraft electrical systems:

MIL-E-7016

JSSG-2009: Appendix H H.3.4.8, H.4.4.8

FAA Doc: 14CFR references: 23.1301, 23.1309; 25.1301, 25.1309

12.1.9 Verify that suitable normal and emergency operating procedures are included in the flight manual.

DoD/MIL Doc: JSSG-2009: Appendix H H.3.4.8, H.4.4.8 for guidance/principles regarding/providing awareness of operating characteristics and procedures for aircraft electrical systems.

FAA Doc: 14CFR references: 23.1301, 23.1309; 25.1301, 25.1309

12.1.10 Verify that the system powers up in a safe state and, upon loss of power or power transient/fluctuation, the system remains in a known safe state or reverts to a known safe state.

DoD/MIL Doc: For guidance/principles regarding design with knowledge of the states of aircraft electrical systems:

AFGS-87219

MIL-STD-464

JSSG-2009: Appendix H 3.4.8.4, 3.4.8.5

FAA Doc: 14CFR references: 23.1351-23.1367; 25.1351-25.1363, 25.1309, 25.1529

12.2 Electrical wiring system, including power distribution.

This element involves all wiring and wiring components (connectors, circuit breakers, etc.) throughout the air vehicle; and for UAV/ROA, the control station safety of flight-related wiring system.

Comm'l Doc: For guidance/principles regarding design of aircraft electrical wiring systems:

ARINC Report 609

SAE AS50881

SAE ARP1870

NFPA 70

DoD/MIL Doc: For guidance/principles regarding design of aircraft electrical wiring systems:

AFGS-87219

MIL-HDBK-419

MIL-STD-1310

MIL-STD-1683

MIL-STD-7080

MIL-HDBK-299

MIL-HDBK-454

MIL-STD-464

12.2.1 Verify that appropriate electrical wiring (conductor material and coating and insulation system), electrical system components, and support devices in the design are suitable

for the physical environment in each area on the air vehicle. Verify that electrical wiring system installation is safe regarding shock hazard protection for personnel.

Comm'l Doc: For guidance/principles regarding design and selection of aircraft electrical system components:

SAE AS50881

NFPA 70

DoD/MIL Doc: For guidance/principles regarding design and selection of aircraft electrical system components:

MIL-HDBK-299

MIL-HDBK-454

MIL-STD-1683

MIL-STD-7080

JSSG-2009: Appendix H H.6.4.1

FAA Doc: 14CFR references: 23.1365; 25.1353

12.2.2 Verify that wiring is sized properly for the required current handling capability and voltage drop.

Comm'l Doc: For guidance/principles regarding proper selection/sizing of aircraft electrical system wiring components:

SAE AS50881

NFPA 70

DoD/MIL Doc: JSSG-2009: Appendix H H.6.4.1 for guidance/principles regarding proper selection/sizing of aircraft electrical system wiring components:

FAA Doc: 14CFR references: 23.1365; 25.1353

12.2.3 Verify that proper circuit protection is provided for wiring associated with power distribution throughout its entire run, including circuits contained in or exiting from any electronic enclosures performing intermediate power switching or distribution functions.

Comm'l Doc: For guidance/principles regarding design and selection of aircraft wiring protection:

SAE AS50881

NFPA 70

DoD/MIL Doc: For guidance/principles regarding design and selection of aircraft wiring protection:

MIL-HDBK-454

MIL-STD-7080

JSSG-2009: Appendix H H.3.4.8.5, H.4.4.8.5

FAA Doc: 14CFR references: 23.1357; 25.1357

12.2.4 Verify that redundant circuits provided for safety are sufficiently isolated.

Comm'l Doc: For guidance/principles regarding provision of isolation for aircraft electrical circuits:

SAE AS50881

NFPA 70

DoD/MIL Doc: JSSG-2009: Appendix H H.6.4.1 for guidance/principles regarding provision of isolation for aircraft electrical circuits:

FAA Doc: 14CFR references: 23.1301, 23.1309; 25.1301, 25.1309

12.2.5 Verify that design precludes single-point failures related to wiring when redundant functions are integrated within an electronics enclosure.

Comm'l Doc: For guidance/principles relating to design of equipment to minimize single point failures in redundant circuits:

SAE AS50881

NFPA 70

DoD/MIL Doc: For guidance/principles relating to design of equipment to minimize single point failures in redundant circuits:

MIL-HDBK-454, Guideline 69

JSSG-2009: Appendix H H.6.4.1, 6.1

FAA Doc: 14CFR references: 23.1301, 23.1309, 23.1351-23.1367; 25.1301, 25.1309, 25.1351-25.1363, 25.1529

SFAR No. 88--Fuel Tank System Fault Tolerance Evaluation Requirements

12.2.6 Verify that the design of the wiring system installation, including connectors, is adequate for all planned operating conditions.

Comm'l Doc: For guidance/principles regarding good engineering design of wiring system installations:

SAE AS50881

NFPA 70

DoD/MIL Doc: For guidance/principles regarding good engineering design of wiring system installations:

JSSG-2009: 3.3, 3.3.4; Appendix E E.4.4.5.1.3, E.3.4.5.1.11, E.4.4.5.1.11, E.3.4.5.8.7, E.4.4.5.8.7, E.3.4.5.8.12, E.4.4.5.8.12; Appendix G G.3.4.7.2, G.3.4.7.6, G.4.4.7.6; Appendix H H.6.4.1, 6.1

FAA Doc: 14CFR references: 23.1301, 23.1309, 23.1351-23.1367; 25.1301, 25.1309, 25.1351-25.1363, 25.1529

SFAR No. 88--Fuel Tank System Fault Tolerance Evaluation Requirements

AC 43.13-1B CHG 1 - Acceptable Methods, Techniques and Procedures - Aircraft Inspection and Repair

12.2.6.1 Verify that wiring in areas containing explosive vapors is protected to prevent potential ignition sources, including issues with aging and deterioration of the wiring.

Comm'l Doc: For guidance/principles regarding wiring design principles/practice for prevention of ignition sources:

SAE AS50881

NFPA 70

DoD/MIL Doc: For guidance/principles regarding wiring design principles/practice for prevention of ignition sources:

JSSG-2009: 3.3, 3.3.4; Appendix E E.4.4.5.1.3, E.3.4.5.1.11, E.4.4.5.1.11, E.3.4.5.8.7, E.4.4.5.8.7, E.3.4.5.8.12, E4.4.5.8.12; Appendix G G.3.4.7.2, G.3.4.7.6, G.4.4.7.6; Appendix H H.6.1

FAA Doc: 14CFR references: 23.1351-23.1367; 25.1351-25.1363, 25.1309, 25.1529

SFAR No. 88--Fuel Tank System Fault Tolerance Evaluation Requirements

12.2.6.2 Verify that failure (either open circuit fault or shorted/crossed-circuits fault) within a wiring harness that includes safety-critical wiring does not cause loss of, or unacceptable degradation to, any safety-critical functions.

Comm'l Doc: For guidance/principles leading toward good design practice and minimization of loss of safety-critical functions:

SAE AS50881

NFPA 70

DoD/MIL Doc: JSSG-2009: Appendix H H.6.1 for guidance/principles leading toward good design practice and minimization of loss of safety-critical functions:

FAA Doc: 14CFR references: 23.1351-23.1367; 25.1351-25.1363, 25.1309, 25.1529

SFAR No. 88--Fuel Tank System Fault Tolerance Evaluation Requirements

12.2.6.3 Verify that the wiring design and installation procedures maintain positive separation of wiring from all fluid or gas carrying lines and flight controls (taking into account movement caused by dynamic G loading, thermal effects and vibration).

Comm'l Doc: For guidance/principles regarding the fundamentals of sound design for effective separation of wiring from other subsystem components:

SAE AS50881

NFPA 70

DoD/MIL Doc: JSSG-2009: 3.3.8; Appendix B B.3.4.2.1.17; Appendix H H.6.4.1; Appendix M M.6.4.1 for guidance/principles regarding the fundamentals of sound design for effective separation of wiring from other subsystem components

12.2.6.4 Verify that the routing design and installation procedures are such that the installation of wiring is free from chafing conditions.

Comm'l Doc: For guidance/principles regarding the prevention of wire/cable/harness chafing:

SAE AS50881

NFPA 70

DoD/MIL Doc: JSSG-2009: 3.3.8; Appendix A A.3.4.1.5.8.1; Appendix B B.3.4.2.1.17; Appendix H H.6.4.1; Appendix L L.3.4.12; Appendix M M.6.4.1 for guidance/principles regarding the prevention of wire/cable/harness chafing:

12.2.6.5 Verify that wiring design provides primary and secondary support for the wiring throughout the installation.

Comm'l Doc: For guidance/principles regarding the provision of proper support for wiring:

SAE AS50881

NFPA 70

DoD/MIL Doc: For guidance/principles regarding the provision of proper support for wiring:

JSSG-2001: 4.3.10.1.1

JSSG-2009: 3.2.6, 3.2.9.2; Appendix H H.6.4.1, H.6.4.2

12.2.6.6 Verify that maintainability is a factor in the design and installation procedures for wiring and components.

Comm'l Doc: For guidance/principles leading toward maintainable design(s):

SAE AS50881

NFPA 70

DoD/MIL Doc: For guidance/principles leading toward maintainable design(s):

JSSG-2001: 3.1.5, 4.1.5, 3.3.10.2.2, 4.1.8.2.5.1, 4.1.8.2.5.2, 4.4.8

JSSG-2009: Appendix H 6.4.1

12.2.6.7 Verify that all equipment and equipment racks are designed for proper electrical bonding.

Comm'l Doc: SAE ARP1870 for guidance/principles regarding the provision of proper electrical bonding

DoD/MIL Doc: For guidance/principles regarding the provision of proper electrical bonding:

MIL-HDBK-419

MIL-HDBK-454

MIL-STD-464 sections A5.10 and A5.11

MIL-STD-1310

JSSG-2001: 3.2.1, 4.2.1, 3.3.10.1.1, 4.3.10.1.1

JSSG-2009: 3.3, 3.3.4; Appendix E E.4.4.5.1.3, E.3.4.5.1.11, E.4.4.5.1.11, E.3.4.5.8.7, E.4.4.5.8.7, E.3.4.5.8.12, E.4.4.5.8.12; Appendix G G.3.4.7.2, G.3.4.7.6, G.4.4.7.6

13. ELECTROMAGNETIC ENVIRONMENTAL EFFECTS (E^3)

TYPICAL CERTIFICATION SOURCE DATA

1. E^3 design criteria, analysis, and tradeoff studies
2. Results of E^3 modeling and simulation
3. E^3 failure modes, and effects, and criticality analyses
4. Electromagnetic hazard analyses
5. Equipment/subsystem E^3 qualification reports
6. Details of installation and operation
7. System E^3 qualification tests
8. Flight and operational manuals, and flight test procedures, and limitations
9. Safety-of-flight (SOF) certifications
10. Authorized radio frequency allocations

CERTIFICATION CRITERIA

DoD/MIL Doc: MIL-STD-464

13.1 Component/subsystem E^3 qualification.

13.1.1 Verify that all flight-critical equipment complies with all electromagnetic environmental effects requirements, including lightning susceptibility, that are appropriate for the system application; or verify that appropriate flight restrictions are imposed.

Comm'l Doc: RTCA DO-160 sections 18 through 22

SAE ARP5412, section 4

DoD/MIL Doc: MIL-STD-461, section 5

MIL-STD-464, section 5.4

13.1.2 Verify that all non-flight-critical equipment complies with the conducted and radiated emissions and susceptibility requirements (including external electromagnetic environments), and does not impact the safe operation of flight-critical equipment.

Comm'l Doc: RTCA DO-160 sections 18 through 22

DoD/MIL Doc: MIL-STD-461, section 5

13.1.3 Verify that all non-flight critical equipment complies with transient susceptibility requirements that include consideration of indirect effects levels derived from the external lightning environment, and does not impact the safe operation of flight-critical equipment.

Comm'l Doc: RTCA DO-160, section 22

SAE ARP 5412, section 4

DoD/MIL Doc: MIL-STD-464, section 5.4

13.2 System-level E^3 qualification.

13.2.1 Verify that all equipment and subsystems exhibit mutual electromagnetic compatibility.

DoD/MIL Doc: MIL-STD-464, section 5.2

13.2.2 Verify that antenna-connected equipment is compatible with one another and it is not degraded beyond its operational requirements, by any other on-board and off-board equipment to a level that would impact safety.

DoD/MIL Doc: MIL-STD-464, section 5.2

13.2.3 Verify that the system is electromagnetically compatible with its intended external radio frequency (RF) electromagnetic environment.

Comm'l Doc: SAE ARP5583, sections 5 and 7

DoD/MIL Doc: MIL-STD-464, section 5.3

13.2.4 Verify that the system has met all requirements for lightning, either direct (physical) or indirect (electromagnetic) effects and that any potential for ignition of fuel vapors are eliminated.

Comm'l Doc: SAE ARP5412, section 4

DoD/MIL Doc: MIL-STD-464, section 5.4

13.2.5 Verify that the system meets the requirements for electromagnetic pulse (EMP) protection, if applicable.

DoD/MIL Doc: MIL-STD-464,section 5.5

MIL-STD-2169

13.2.6 Verify that the system is able to control and dissipate the build-up of electrostatic charges caused by particle impingement, fluid flow, air flow, and other tribolectric charge-generating mechanisms to avoid ordnance hazards, personnel shock hazards and to control p-static interference or damage to electronics.

DoD/MIL Doc: MIL-STD-464, section 5.7

13.2.7 Verify that sources of electromagnetic radiation pose no hazard to personnel (HERP), fuel (HERF), and ordnance (HERO), and that the appropriate manuals include safe criteria regarding distance from on-board and off-board transmitters to personnel and fuel sources.

Comm'l Doc: SAE ARP5583, sections 5 and 7

SAE ARP5412, section 4

DoD/MIL Doc: MIL-STD-464, sections 5.3 and 5.4

DoDI 6055.11, Protection of DoD Personnel from Exposure to Radiofrequency Radiation and Military Exempt Lasers

TO 31Z-10-4, Electromagnetic Radiation Hazard

NAVSEA OP 3565, Electromagnetic Radiation Hazard

TB MED 523, Control of Hazards to Health from Microwave and Radio Frequency Radiation and Ultrasound

13.2.8 Verify that the system electrical bonding is adequate to ensure safe system operation.

DoD/MIL Doc: MIL-STD-464, section 5.10

13.2.9 Verify that the required safety margins for electroexplosive devices are met.

Comm'l Doc: SAE ARP5583, sections 5 and 7

SAE ARP5412, section 4

DoD/MIL Doc: MIL-STD-464, sections 5.3 and 5.4

13.2.10 Verify that the system meets the electromagnetic spectrum licensing requirements in accordance with DoD, national, and international regulations and has received electromagnetic spectrum certification.

DoD/MIL Doc: DoDD 4650.1, Management and Use of the Radio Frequency Spectrum

DD Form 1494, Application for Frequency Allocation

14. SYSTEM SAFETY

TYPICAL CERTIFICATION SOURCE DATA

1. System safety program plan
2. Preliminary hazard analyses
3. Subsystem hazard analyses (fault hazard analyses or fault tree analyses)
4. System hazard analyses (including hardware, software and human system integration causal factors)
5. Operating and support hazard analyses
6. Test hazard analyses
7. Occupational health hazard assessment
8. Specialized analyses such as a sneak circuit analyses and software hazard analyses
9. Type T-2 modification documentation (for correction of safety deficiencies)
10. Component/system test results (waivers/deviations and equipment conditional usage documents)
11. Minutes of system safety group meetings (open items)
12. Minutes of system safety program reviews (open items)
13. Engineering change proposals (safety related)
14. Hazard identification, evaluation and correction-tracking system files
15. Safety assessment reports
16. SOF test plans and test results
17. Test temporary engineering orders (not previously included in any safety analyses)
18. Failure modes, effects, and criticality analysis (FMECA)
19. Hazard risk index
20. MIL-STD-882, System Safety Program Requirements
21. Test review board reports
22. Safety review board reports
23. Flight readiness review reports
24. Safety requirements traceability matrix (both hardware and software)

CERTIFICATION CRITERIA

14.1 System safety program.

14.1.1 Verify that an effective system safety program is implemented that mitigates risks/hazards attributed to hardware, software, and human system integration and that the safety program documents and tracks the risks/hazards of the design/modification.

DoD/MIL Doc: MIL-STD-882D: 1.1, 4.1, 4.2, 4.3, 4.4, 4.5

DoDI 5000.2 Enclosure 3 Table E3.T1, for details of PESHE content and relation to system safety

FAA Doc: 14CFR references: system safety sections of Parts 23, 25, 27, 29

14.1.1.1 Verify that the system safety program incorporates system safety into all aspects of systems engineering.

DoD/MIL Doc: MIL-STD-882D: 4.1

FAA Doc: 14CFR references: system safety sections of Parts 23, 25, 27, 29

14.1.1.2 Verify that appropriate analysis tasks of MIL-STD-882 are accomplished for all programs, including temporary and permanent modifications.

DoD/MIL Doc: MIL-STD-882D: 4.1, 4.2, 4.3, 4.4, 4.5

JSSG-2001: Sect. 3.3.10 discusses mishap risk baselines

FAA Doc: 14CFR references: system safety sections of Parts 23, 25, 27, 29

14.1.1.3 Verify that hazards/risks are tracked and residual risks documented.

DoD/MIL Doc: MIL-STD-882D: 4.1, 4.2, 4.3, 4.4, 4.5

FAA Doc: 14CFR references: system safety sections of Parts 23, 25, 27, 29

14.1.1.4 Verify that the system safety program addresses the following:

DoD/MIL Doc: MIL-STD-882D: 1.1, 4.1, 4.2, 4.3, 4.4, 4.5

FAA Doc: 14CFR references: system safety sections of Parts 23, 25, 27, 29

a. Flight safety
b. Ground/industrial safety
c. Explosives and ordnance safety; non-nuclear munitions
d. Range safety
e. Nuclear safety
f. Radiation/laser safety
g. Test safety and support
h. Software safety
i. Materials
j. Failure modes and effects testing and built-in-test
k. Fail safe design
l. Support equipment

Comm'l Doc: For f. above: ANSI Z 136.1 for definitions of key laser safety design requirements

DoD/MIL Doc: For c. above: DOD Standard 6055.9-STD and DoD TO-11A-1-47

For e. above: DoD Directive 3150.2, 23 Dec 1996, 4.1 lists the four key design standards.

For f. above: MIL-STD-1425A and MIL-HDBK-828

For h. above: Section 14.3 of this document

14.2 Safety design requirements.

14.2.1 Verify that a systematic process is employed that provides for hazard identification, hazard control requirement generation and implementation, and residual risk assessment.

DoD/MIL Doc: MIL-STD-882D: 4.1, 4.2, 4.3, 4.4, 4.5, Appendix A

FAA Doc: 14CFR references: system safety sections of Parts 23, 25, 27, 29

14.2.2 Verify that the design is free from unacceptable mishap risk.

DoD/MIL Doc: MIL-STD-882D: 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, Appendix C; Appendix A, A.4.3.3.1.1 shows unacceptable conditions; Table A-IV shows mishap risk categories & acceptance levels

FAA Doc: 14CFR references: system safety sections of Parts 23, 25, 27, 29

14.2.3 Verify that no single-point failure unacceptably affects the safety of the system.

DoD/MIL Doc: MIL-STD-882D: 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, Appendix C; Appendix A identifies severity levels

FAA Doc: 14CFR references: system safety sections of Parts 23, 25, 27, 29

14.2.4 Verify that the design adequately protects the power sources, controls, and critical components of redundant subsystems.

DoD/MIL Doc: MIL-STD-882D: 4, Appendix A

FAA Doc: 14CFR references: system safety sections of Parts 23, 25, 27, 29

14.2.5 Verify that all aspects of human factors are addressed and unacceptable human factors safety issues/risks are resolved in the design process.

DoD/MIL Doc: MIL-STD-882D: 4, Appendix A

MIL-STD-1472 gives the human-factor design requirements

FAA Doc: 14CFR references: system safety sections of Parts 23, 25, 27, 29

14.2.6 Verify that the system is produced/manufactured ensuring risk reduction of failures or hazards potentially created by human error during the operation and support of the system.

DoD/MIL Doc: MIL-STD-882D: 4, Appendix A

FAA Doc: 14CFR references: system safety sections of Parts 23, 25, 27, 29

14.2.7 Verify that the system design is within acceptable risk bounds over worst-case environmental conditions.

DoD/MIL Doc: MIL-STD-882D: 4, Appendix A

MIL-STD-810 gives environmental and climatic testing requirements

FAA Doc: 14CFR references: system safety sections of Parts 23, 25, 27, 29

14.2.8 Verify that personnel exposure to hazards during the installation process, including hazards due to locations of systems in the air vehicle, are at an acceptable risk level.

DoD/MIL Doc: MIL-STD-882D: 4, Appendix A

FAA Doc: 14CFR references: system safety sections of Parts 23, 25, 27, 29

14.2.9 Verify that the system design isolates hazardous substances, components, and operations from other activities, areas, personnel, and incompatible material.

DoD/MIL Doc: MIL-STD-882D: 4, Appendix A

FAA Doc: 14CFR references: system safety sections of Parts 23, 25, 27, 29

14.2.10 Verify that a system safety change analysis is accomplished on changed or modified equipment or software.

DoD/MIL Doc: Reference sections 14.3.3, 15.3.3.2, 15.3.3.3 of this document

14.3 Software safety program.

Note: Software safety is additionally verified through Section 15.3

DoD/MIL Doc: MIL-STD-882D: 4, Appendix A

DoD/MIL Doc: Joint Software System Safety Committee, “Software System Safety Handbook: A Technical & Managerial Team Approach,” Dec 1999

FAA Doc: 14CFR references: system safety sections of Parts 23, 25, 27, 29

14.3.1 Verify that a comprehensive software safety program is integrated into the overall system safety program.

Comm’l Doc: DO-178B to establish software integrity levels for commercial aircraft

DoD/MIL Doc: MIL-STD-882 provides mishap severity categories which can lead to establishment of software integrity levels

DoD/MIL Doc: Joint Software System Safety Committee, “Software System Safety Handbook: A Technical & Managerial Team Approach,” Dec 1999

FAA Doc: 14CFR references: system safety sections of Parts 23, 25, 27, 29

14.3.2 Verify the software safety program requires that appropriate software safety-related analyses be performed as part of the software development process.

a. Software safety analyses preparation

b. Software safety requirements analysis

DoD/MIL Doc: MIL-STD-882D: 4, Appendix A

DoD/MIL Doc: Joint Software System Safety Committee, “Software System Safety Handbook: A Technical & Managerial Team Approach,” Dec 1999

FAA Doc: 14CFR references: system safety sections of Parts 23, 25, 27, 29

14.3.3 Verify that the design/modification software is evaluated to ensure controlled or monitored functions do not initiate hazardous events or mishaps in either the on or off (powered) state

Comm'l Doc: DO-178B defines software integrity levels for safety critical functions

DoD/MIL Doc: MIL-STD-882D: 4, Appendix A

DoD/MIL Doc: Joint Software System Safety Committee, "Software System Safety Handbook: A Technical & Managerial Team Approach," Dec 1999

FAA Doc: 14CFR references: system safety sections of Parts 23, 25, 27, 29

15. COMPUTER RESOURCES

TYPICAL CERTIFICATION SOURCE DATA

1. Computer resources utilization
2. Design review/audits/meeting minutes and action items
3. Software requirements specifications (SRS)
4. Software top-level design documents (STLDD)
5. Software development plans (SDP) and/or software development integrity master plans (SDIMP)
6. Software test plans, procedures, and reports
7. Quality assurance and configuration management plans
8. Master test planning documents and scheduling
9. Software regression testing criteria/procedures (all levels)
10. Software development folders
11. Failure modes, effects, and criticality analysis and testing (FMECA/FMET) or equivalent
12. Hazard analyses (software)
13. Test reports
14, Diminishing manufacturing sources plan
15. Obsolete parts plan

CERTIFICATION CRITERIA

DoD/MIL Doc: In addition to VCMS systems, JSSG-2008 provides useful guidance for all airborne computer resources involved in safety critical processing. Consequently in reading the reference information contained in JSSG-2008 it may be useful to interpret VCMS to mean any aircraft system involved in safety critical processing.

15.1 Air vehicle processing architecture.

15.1.1 Verify that the flight-essential configurations are identified and proper levels of redundancy (hardware and software) exist at the system level to preclude loss of critical processing capabilities.

Comm'l Doc: RTCA DO-178B, RTCA DO-254

DoD/MIL Doc: JSSG-2008: 3.1.12, 3.3.1

JSSG-2008 Appendix A: 3.1.7, 3.1.12, 3.3.1 for further guidance concerning redundancy, system and processing architectures

MIL-STD 882D, sections 4.2, 4.7, 4.8 for further guidance concerning identification, review and tracking of safety hazards to establish program safety definitions

JSSG-2008 Appendix A: 3.1.2.1 for establishing safety criticality along with CNS/ATM safety performance references in the ESC developed Generic Performance Matrices (10E-5 to 10E-7 hazard rates depending on flight phase)

FAA Doc: AC 20-115B

15.1.2 Verify that all processing elements of the architecture that interface (physically and functionally) with SOF functions are designed to meet SOF requirements.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.3

JSSG-2008 Appendix A: 3.3 Requirement Guidance and Lessons Learned for additional information concerning processing element selection. 3.1.7.3, 3.1.8, 3.1.11, 3.14.4 and 3.2.2.6 provide guidance for integrating safety critical VCMS systems with non-safety critical processing elements

FAA Doc: AC 20-115B

15.1.3 Verify that all hardware and software safety/flight-critical items are identified and their safety critical functions are allocated to components within the architecture.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.1.16

MIL-STD-882D Appendix A: A.4.4.2 establishes hardware and software analysis in the hazard identification process

FAA Doc: AC 20-115B

15.1.4 Verify that SOF hardware and software interfaces are clearly defined and documented and that control flow and information flow are established.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.3.7

JSSG-2008 Appendix A: 3.1.7.1 provides guidance for identifying subsystem interfaces and ensuring sufficient data communication timing margins. Paragraph 3.5.7 discusses the application of integrity processes in the design of system interfaces from both the hardware and software standpoint

FAA Doc: AC 20-115B

15.1.5 Verify that redundancy (hardware and software) is incorporated to satisfy fault tolerant SOF requirements, including probability of loss of control (PLOC) and reliability numbers.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.3.1

JSSG-2008 Appendix A: Paragraph 3.3.1 provides guidance for fault tolerant processing including fault detection and redundancy; 3.1.2, 3.1.7 and 3.1.5.7 provide guidance for allocating quantitative safety requirements to subsystem level in the context of VCMS and mission avionics allowing for variability factors; 3.1.9 gives guidance on establishing redundancy levels based on control criticality; 3.1.11+ and 3.1.12+ provide detailed guidance on the establishment of proper levels of redundancy

FAA Doc:AC 20-115B

15.1.6 Verify that separate and independent power sources are provided for redundant operations.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.2.2.2.2, 3.2.2.2.5, 3.3

JSSG-2008 Appendix A: 3.2.2.2.2 and 3.2.2.2.5 give extensive guidance on aircraft power system support to safety critical equipment

FAA Doc: AC 20-115B

15.1.7 Verify that single component failure does not impede redundant operations.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.3.1

JSSG-2008 Appendix A: 3.3.1 provides processing architecture design strategies to mitigate component failures; 3.1.9 contains single point failure guidance regarding in-flight hazards and redundancy; 3.1.11.1 addresses safe operation in the case of multiple failures

FAA Doc: AC 20-115B

15.1.8 Verify that physical and functional separation between safety/flight critical and mission critical is accounted for in the computer system architecture.

Comm'l Doc: RTCA DO-178B

RTCA DO-254

DoD/MIL Doc: JSSG-2008: 3.1.7.1

JSSG-2008 Appendix A: 3.1.7.1 provides for basic partitioning of the architecture (hardware and software); 3.1.7.2 gives guidance regarding "system arrangement" (architecture design); 3.1.7.3 directly addresses isolation of less critical elements to prevent their failure from impacting critical functions

FAA Doc: AC 20-115B

15.1.9 Verify that no patches (object code changes not resulting from compilation of source code changes) exist for flight-critical software.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.3.7 contains guidance on Software Change Control

FAA Doc: AC 20-115B

15.2 Functional design integration of processing elements.

15.2.1 Verify that all parameters passed among SOF processing elements are defined and that unnecessary coupling is avoided.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.3.6

JSSG-2008 Appendix A: 3.3.6+ and 3.1.14.6 address software structure, partitioning and CSCI integration; 3.1.5.1 gives guidance on data latency issues; 3.1.7 gives overall architecture design guidance along with specific data latency discussions in Lessons Learned subparagraph l

FAA Doc: AC 20-115B

15.2.2 Verify that level of autonomy achieved by the flight-essential elements is sufficient to preclude loss of flight-critical functions due to failure in mission- or maintenance-related elements.

Comm'l Doc: RTCA DO-178B

RTCA DO-254

DoD/MIL Doc: JSSG-2008: 3.3.1

JSSG-2008 Appendix A: 3.3.1 contains guidance addressing redundant data path management, data validity and reasonableness; 3.1.7.3 and 3.1.8 provide guidance for interfacing between safety and non-safety critical subsystems

FAA Doc: AC 20-115B

15.2.3 Verify that a controlled methodology is established and applied to integrate all safety-critical elements of the processing architecture, including verification coverage.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.3.1

JSSG-2008 Appendix A: 4.3 addresses processing element verification and 3.3.1 addresses integration; 4.1.14.4, 4.2.2.2 and 4.5.7 specify a build up approach in verification and testing

FAA Doc: AC 20-115B

15.3 Subsystem/processing element.

15.3.1 Electronics.

15.3.1.1 Verify that all computer resources hardware components are safe and SOF elements have redundant buses that are physically separated.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.3.1

JSSG-2008 Appendix A: 3.4.1 and 3.4.5 cover components and parts pedigree , 3.1.11.11.2 addresses integrity of signal transmission

FAA Doc: AC 20-115B

15.3.1.2 Verify that all safety/flight-critical electronic components are physically and functionally separated from non-safety-critical items. (This includes items such as processors, memory, internal/external buses, input/output (I/O) management, internal/external power supplies, circuit cards, motherboards, etc.) If not separated, verify that non-safety-critical elements are treated as safety-critical items.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.3.1

JSSG-2008 Appendix A: 3.3.1 lessons learned addresses systems partitioning; 3.1.7.3 addresses isolation of less critical elements to prevent their failure from impacting critical functions

FAA Doc: AC 20-115B

15.3.2 Architecture mechanization.

15.3.2.1 Verify that the executive/control structure execution rates are sufficient and consistently obtainable for SOF requirements given the control structure, priority assignments, and interrupts.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2001: 3.3.3.1

JSSG-2008: 3.3.4

JSSG-2001: 3.3.3.1 provides guidance for establishing adequate computer hardware reserve capacity

JSSG-2008 Appendix A: 3.3.1 establishes timing and control allocations based on operational requirements; 3.3.4 addresses synchronization, deterministic execution and frame rate issues

FAA Doc: AC 20-115B

15.3.2.2 Verify that the software design, timing, control flow, interrupt structure, and data structures meet the required processing capabilities of the SOF subsystem/system real-time architecture.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2001: 3.3.3.1, JSSG-2008: 3.3

JSSG-2001: 3.3.3.1 provides guidance for establishing adequate computer hardware reserve capacity

JSSG-2008 Appendix A: 3.3.4 addresses synchronization, deterministic execution and frame rate issues; 3.1.7 gives overall architecture design guidance along with specific data latency discussions in Lessons Learned subparagraph l; 3.1.5.1 gives guidance on data latency issues

FAA Doc: AC 20-115B

15.3.2.3 Verify that all mode inputs, failure detection techniques, failure management, redundancy management, self-checks, and interfaces operate safely under all dynamic conditions.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.3.1

JSSG-2008 Appendix A: 3.3.1 lessons learned provides guidance regarding fault management and systems partitioning; 3.3.2 provides guidance regarding failure propagation and redundancy; 3.1.4 addresses survivability; 3.1.5.2 addresses mode transitions; 3.1.5.7 addresses sensitivity analysis; 3.1.7.2 discusses overall system arrangement issues impacting invulnerability and failure immunity

FAA Doc: AC 20-115B

15.3.2.4 Verify that embedded SOF software provides acceptable performance and safety.

Comm'l Doc: IEEE STD 12207 provides industry best practice software development guidance.

RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.3.6

JSSG-2008: 3.1.14.6, 3.2.4.6, 3.3.6+ and 3.3.7+ provide guidance regarding software design and development for safety critical systems

ASC Engineering Technical Guide version 1.1 dated 11 October 2002 established an integrity program for software development

FAA Doc: AC 20-115B

15.3.2.5 Verify that the SOF software design has the necessary interrupt, reinitialization, resynchronization, recheck, and reconfiguration provisions to restart or reset safely and quickly in flight.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.3

JSSG-2008 Appendix A: 3.1.12.1 discusses redundancy management support for restart; 3.2.4.6 addresses software support for failure recovery; 3.1.17 provides guidance regarding failure propagation of computational failures; 3.3.2.2 discusses microprocessor timing and synchronization; 3.3.4 details issues surrounding synchronization rates; 4.1.13.2 provides lessons learned in verification of in-flight monitoring capability

FAA Doc: AC 20-115B

15.3.2.6 Verify that the method of SOF software loading and verification is safe and carefully managed. (This includes the software operational flight program (OFP) loaded on individual black boxes or the air vehicle-loadable OFP.)

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.1.16

JSSG-2008 Appendix A: 3.3.2 gives guidance for single point OFP load and verification; 3.3.7 addresses software change control; 3.3.8 addresses software certification of hardware compatibility; 3.1.14.6 discusses system invulnerability to software errors

FAA Doc: AC 20-115B

15.3.2.7 Verify that the SOF software design has adequate self-check, failure monitoring, redundancy management, reconfiguration, voting, transient suppression, overflow protection, anti-aliasing, saturation interlock, memory protection, and techniques for preventing failure propagation to preclude SOF issues.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.3.6

JSSG-2008 Appendix A: 3.1.11.9, 3.1.13, 3.1.17 and 3.3.2.1 provide guidance for integrity and BIT checks often implemented in software; 3.1.12.1 gives detailed guidance for redundancy management; 3.3.6.2 provides guidance for robust integrated CSCI design

FAA Doc: AC 20-115B

15.3.2.8 Verify that there is sufficient throughput margin for both input/output and processor capabilities (including memory) under worst-case mode performance scenarios for both average and peak worst-case loading conditions.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.3.5

JSSG-2008 Appendix A: 3.3.5 contains guidance regarding reserve capacity; 3.1.14.6 contains guidance for worst case throughput and I/O spare; 3.5.7 establishes performance parameters for spare capacity and margin

FAA Doc: AC 20-115B

15.3.2.9 Verify that a controlled methodology is established and applied to integrate all functional elements of a highly coupled, integrated OFP.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.3.6

JSSG-2008 Appendix A: 3.3.6 addresses breaking down complex software into manageable CSCIs; 3.2.2.2 discusses subsystem integration; 4.3 discusses verification of integrated processing capabilities; 3.3.1 provides guidance for integrated architecture design

FAA Doc: AC 20-115B

15.3.3 Processing architecture verification for SOF items.

15.3.3.1 Verify the operation of BIT and redundancy/failure management algorithms.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.3.6.2

JSSG-2008 Appendix A: 3.3.6.2 establishes guidance for CSCI failure detection and execution of BIT; 3.1.13 (Requirement Guidance a. 2.) defines types of BIT and a list of typical items tested; 3.1.12 addresses redundancy management

FAA Doc: AC 20-115B

15.3.3.2 Verify that critical hardware/software discrepancies are identified and corrected or mitigated.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.3.7

JSSG-2008 Appendix A: 3.3.8 provides guidance under lessons learned for tracking and mitigating software discrepancies

FAA Doc: AC 20-115B

15.3.3.3 Verify that adequate configuration management controls are in place to ensure proper/ functionally compatible software loading for the intended use on the air vehicle.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.1.16

JSSG-2008 Appendix A: 3.1.16 provides guidance regarding OFP version control and integrity

FAA Doc: AC 20-115B

15.3.3.4 Verify that all data or communications are secure against unwanted intrusions and that security techniques used are implemented safely.

Comm'l Doc: RTCA DO-178B

DoD/MIL Doc: JSSG-2008: 3.3.7

JSSG-2008 Appendix A: 3.1.14.6.i and 4.1.14.6.d guidance addresses analysis, allocation and verification of security requirements; 3.3.4 directly addresses unauthorized modification and tampering with components; 3.3.7 establishes a place for traceable security requirements

AFPam 63-1701 provides guidance for implementation of Systems Security Engineering

FAA Doc: AC 20-115B

16. MAINTENANCE

TYPICAL CERTIFICATION SOURCE DATA

1. Maintenance manuals/checklists (equivalent or supplement to –2 T.O.'s)
2. Inspection requirements (equivalent or supplement to –6 T.O.'s)
3. Life-limited/time replacement plan/list
4. Subsystem hazard analysis (SSHA)
5. Failure modes, effects, and criticality analysis (FMECA)
6. Maintenance records (including failure report and corrective action system (FRACAS))
7. Air Force Regulation (AFR) 8-2, T.O. 00-5-1
8. Test reports
9. Test plans

CERTIFICATION CRITIERIA

16.1 Maintenance manuals/checklists.

16.1.1 Verify that servicing instructions are provided for all systems that require servicing; for example, fuel, engine oil, hydraulic systems, landing gear struts, tires, oxygen, escape system, etc.

DoD/MIL Doc: JSSG-2000: 3.6.1, 3.6.2

JSSG-2001: 3.1.5

FAA Doc: 14CFR references: 23.1501, 23.1529, 25.1501, 25.1503-25.1533, 25.1529, 25.1541, 25.1543, 25.1557, 25.1563

14CFR reference Part 23, Appendix G and Part 25, Appendix H, Instructions for Continued Airworthiness

16.1.2 Verify that cautions and warnings are included in maintenance manuals, aircrew checklists, and ground crew checklists.

DoD/MIL Doc: JSSG-2000: 3.6.1, 3.6.2

JSSG-2001: 3.1.5

FAA Doc: 23.1501, 23.1529, 25.1501, 25.1503-25.1533, 25.1529, 25.1541, 25.1543, 25.1557, 25.1563

16.1.3 Verify that maintenance checklists are available for critical maintenance tasks, such as fuel and oxygen serving procedures, towing procedures and restrictions, jacking procedures, engine operation during maintenance, lifting procedures, integrated combat turn procedures, etc.

DoD/MIL Doc: JSSG-2000: 3.6.1, 3.6.2

JSSG-2001: 3.1.5

FAA Doc: 23.1501, 23.1529, 25.1501, 25.1503-25.1533, 25.1529, 25.1541, 25.1543, 25.1557,

25.1563

16.1.4 Verify that support equipment does not adversely affect the safety of the air vehicle.

DoD/MIL Doc: JSSG-2000: 3.6.1, 3.6.2

JSSG-2001: 3.1.5

FAA Doc: 23.1501, 23.1529, 25.1501, 25.1503-25.1533, 25.1529, 25.1541, 25.1543, 25.1557, 25.1563

16.1.5 Verify that maintenance manuals incorporate procedures for system/component removal.

DoD/MIL Doc: JSSG-2000: 3.6.1, 3.6.2

JSSG-2001: 3.1.5

FAA Doc: 14CFR reference Part 23, Appendix G and 14CFR reference Part 25, Appendix H

16.1.6 Verify that maintenance manuals require system operational testing for normal/emergency system operation when systems are affected by removal/replacement of components.

DoD/MIL Doc: JSSG-2000: 3.6.1, 3.6.2

JSSG-2001: 3.1.5

FAA Doc: 14CFR reference Part 23 Appendix G and 14CFR reference Part 25, Appendix H

16.1.7 Verify that maintenance manuals provide adequate troubleshooting procedures to correct expected system/component failures.

DoD/MIL Doc: JSSG-2000: 3.6.1, 3.6.2

JSSG-2001: 3.1.5

FAA Doc: 14CFR reference Part 23, Appendix G and 14CFR reference Part 25, Appendix H

16.2 Inspection requirements.

16.2.1 Verify that ground crew work cards for preflight inspection are coordinated with the aircrew checklists.

DoD/MIL Doc: JSSG-2000: 3.6.1, 3.6.2

JSSG-2001: 3.1.5

FAA Doc: 23.1501, 23.1529

16.2.2 Verify that special inspection procedures are available for unusual or specified conditions, such as

a. Exceeding operating limits
b. Severe vibration
c. Engine stall
d. Foreign object damage to engine or structure
e. Excessive loss of oil
f. Conditions requiring oil sampling and analysis
g. Severe braking action, hard landing, and running off runway
h. Air vehicle subject to excessive "g" loads or maneuvers outside the specified flight envelope
i. Lost tools
j. Emergency procedures implemented
k. Dropped objects or parts

DoD/MIL Doc: MIL-PRF-5096: 3.2.2.3.1 gives guidance regarding special inspections after a specific occurrence.

JSSG-2000: 3.6.1, 3.6.2

JSSG-2001: 3.1.5

FAA Doc: 23.1501, 23.1529

16.2.3 Verify that life-limited items and replacement intervals are identified using relevant operational data.

DoD/MIL Doc: 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

FAA Doc: 23.1501, 23.1529

16.2.4 Verify that all required inspection intervals are identified using relevant operational data.

DoD/MIL Doc: 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

FAA Doc: 23.1501, 23.1529

17. ARMAMENT/STORES INTEGRATION

A store is any device intended for internal or external carriage, mounted on air vehicle suspension and release equipment, which may or may not be intended to be for in-flight separation from the air vehicle. Stores include missiles, rockets, bombs, nuclear weapons, mines, fuel and spray tanks (permanently attached and/or detachable), torpedoes, sonobuoys, dispensers, pods (refueling, thrust augmentation, gun, electronic countermeasures, etc.), targets, decoys, chaff and flares, and suspension equipment.

TYPICAL CERTIFICATION SOURCE DATA

1. User requirements and design requirements and validation results
2. Design studies and analyses
3. Design, installation, and operational characteristics
4. Component and functional level SOF, qualification and certification tests
5. Electromagnetic environmental effects
6. Plume ingestion/propulsion compatibility tests and plume/gun gas impingement test.
7. Failure modes, effects, and criticality analysis/testing (FMECA/FMET)
8. Hazard analysis and classification including explosive atmosphere analysis/test
9. Safety certification program
10. Computational, theoretical and/or semi-empirical prediction methods
11. Configuration: aerodynamic design and component location
12. Wind tunnel test results and correction methods
13. Mathematical representation of system dynamics
14. Loads analysis, wind tunnel and flight test results
15. Flutter, mechanical stability, aeroelastic, aeroservoelastic and modal analyses, wind tunnel and flight test results
16. Performance analysis
17. Environmental compatibility analysis and tests including gun fire vibration analysis/test
18. Interface control documents
19. Store separation models, wind tunnel and flight test results
20. Flight manual
21. Flight test plan and test results
22. MIL-HDBK-1763, Aircraft/Stores Compatibility: Systems Engineering Data Requirements and Test Procedures
23. MIL-HDBK-244, Guide to Aircraft/Stores Compatibility
24. MIL-STD-1760, Aircraft/Store Electrical Interconnection System
25. MIL-A-8591, Airborne Stores, Suspension Equipment and Aircraft-Store Interface (Carriage Phase); General Design Criteria for
26. SEEK EAGLE engineering data
27. American National Standard for Safe Use of Lasers (ANSI Z136.1)
28. Nuclear Certification Impact Statement (NCIS)
29. Aircraft monitor and control (AMAC) and surveillance tests

30. Nuclear safety analysis report (NSAR)
31. Mechanical compatibility data
32. Electrical compatibility data
33. Certification requirements plan (CRP)
34. Operational flight program (OFP) source code
35. Systems integration lab data/results
36. Cooling analysis and ground/flight test results
37. MIL-STD-1530 Aircraft Structural Integrity Program
38. ASC/EN Stores Integration practice
39. Human factors to consider
40. Crew egress paths to consider
41. Aircraft weight and balance
42. Environmental analysis and test results
43. Store drawings including store mass properties (STAMP sheet)
44. Safety assessment report
45. Airworthiness qualification plan (AQP) (Army unique)
46. Airworthiness qualification specification (AQS) (Army unique)

CERTIFICATION CRITERIA

17.1 Gun/rocket integration and interface.

DoD/MIL Doc: MIL-HDKB-244A: 5.1.10

MIL-HDBK-1763: 4.1.4.7, 4.1.4.10

MIL-HDBK-1763:Appendix A, Test 161 Gun Firing Test

MIL-HDBK-1763 Appendix A, Test 162 Rocket/Missile Firing Test

MIL-HDBK-1763 Appendix B, Test 272 Launch Test or Weapons Survey and demonstrations

MIL-HDBK-1763 Appendix B, Test 273 Gun Firing Test

MIL-STD-331

FAA Doc: No applicable reference available for any of the criteria in this section.

17.1.1 Verify that environment induced by gun/rocket operation is compatible with the air vehicle's limitations for muzzle blast and overpressure, recoil, vibroacoustics, cooling, egress, human factors, and loads of the air vehicle.

DoD/MIL Doc: MIL-HDBK-244A: 5.1.9.1, 5.1.9.2, 5.1.9.2.4, 5.1.10 inclusive

17.1.2 Verify that gun/rocket gases and plume do not create SOF hazards for the air vehicle, air and ground crew.

17.1.3 Verify that gun/rocket gas impingement does not cause unacceptable erosion of air vehicle structure/skin.

17.1.4 Verify that the gun/rocket gas ventilation/purge system prevents accumulation of explosive gas mixture.

17.2 Stores integration.

DoD/MIL Doc: MIL-HDBK-1763

MIL-HDBK-244A

MIL-STD-1289D

JSSG-2001: 3.3, 10.1.1, 3.4.2.1.5, and 3.4.2.2 for the testing methodology.

MIL-STD-464

MIL-HDBK-1760A

MIL-STD-1760D

MIL-STD-331

17.2.1 Verify that the stores/air vehicle interface does not create unsafe conditions during ground and flight operations and that no unsafe environment is created for maintenance personnel.

17.2.2 Verify that the stores separate safely from the air vehicle throughout the air vehicle/store launch or jettison flight envelope.

17.2.3 Verify that the store or suspension and release equipment and air vehicle are structurally capable of operating safely in the air vehicle/store carriage flight envelope.

DoD/MIL Doc: MIL-HDBK-1763 Test 131 Aircraft Stores Suspension Equipment Structural Integrity Ground Test

17.2.4 Verify that electrical interfaces do not cause unsafe stores operation or interactions with the air vehicle for all required store configurations.

17.2.5 Verify that the environment induced by the stores on the air vehicle, and by the air vehicle on the store during carriage and launch/separation/jettison for the cleared usage, does not adversely affect SOF of the air vehicle.

17.2.6 Verify that the stores operations do not adversely affect any safety aspect of the flight control of the air vehicle.

17.2.7 Verify that all stores configurations for the air vehicle are documented in the flight manuals.

17.2.8 Verify that malfunctioning stores can be turned off or released if required to protect the air vehicle.

DoD/MIL Doc: MIL-STD-1760 for the electrical/logical interface.

MIL-STD-27733, Modification to Aerospace Vehicles

MIL-HDBK-244, Modification and Marking Requirements for Test Equipment in Aerospace

Vehicles and Related Support Equipment

17.3 Laser integration and interface.

17.3.1 Verify that the crew and maintenance personnel are not exposed to laser radiation (direct and reflected) in excess of maximum permissible exposure limits in order to ensure safe conditions.

Comm'l Doc: ANSI Z 136.1, Safe Use of Lasers, for the safety design requirements of laser systems.

DoD/MIL Doc: MIL-STD-1425 for the safety design requirements of laser systems.

AR-11-9, "The Army Radiation Safety Program"

AFOSH STD 48-139, Laser Radiation Protection Program

RCC 316-98, Laser Range Safety

FAA Doc: 21CFR Part 1040, Performance Standards For Light-Emitting Products

17.3.2 Verify that the induced environment resulting from laser operation is compatible with the air vehicle's limitations for vibroacoustics, thermal loads, and structural loads of the air vehicle.

Comm'l Doc: ANSI Z 136.1, Safe Use of Lasers, for the safety design requirements of laser systems

DoD/MIL Doc: MIL-STD-1425 for the safety design requirements of laser systems

AFOSH STD 48-139, Laser Radiation Protection Program

RCC 316-98, Laser Range Safety

FAA Doc: 21CFR Part 1040, Performance Standards for Light-Emitting Products

17.3.3 Verify that laser chemical and exhaust gases do not create SOF hazards for the air vehicle.

Comm'l Doc: ANSI Z 136.1 - Safe Use of Lasers, for the safety design requirements of laser systems.

DoD/MIL Doc: MIL-STD-1425, for the safety design requirements of laser systems

ANZI 136.1 for the safety design requirements of laser systems

AFOSH STD 48-139, Laser Radiation Protection Program

RCC 316-98, Laser Range Safety

FAA Doc: 21CFR Part 1040, Performance Standards for Light-Emitting Products

17.3.4 Verify that a means is provided for the crew to determine when the laser is operating and discern the direction of the beam.

Comm'l Doc: ANSI Z 136.1, Safe Use of Lasers, for the safety design requirements of laser systems

DoD/MIL Doc: Refer to MIL-STD-1425 for the safety design requirements of laser systems

AFOSH STD 48-139, Laser Radiation Protection Program

RCC 316-98, Laser Range Safety

FAA Doc: 21CFR Part 1040, Performance Standards for Light-Emitting Products

17.3.5 Verify that laser operation and direction is controllable only by the crew and does not latch on (radiating).

Comm'l Doc: ANSI Z 136.1, Safe Use of Lasers, for the safety design requirements of laser systems.

DoD/MIL Doc: MIL-STD-1425 for the safety design requirements of laser systems

AFOSH STD 48-139, Laser Radiation Protection Program

RCC 316-98, Laser Range Safety

FAA Doc: 21CFR Part 1040, Performance Standards for Light-Emitting Products

17.3.6 Verify that the laser beam cannot contact any part of the airframe and/or rotor system.

17.3.7 Verify the laser cannot inadvertently lase when the aircraft is on the ground.

17.4 Safety interlocks.

17.4.1 Verify that appropriate safety lockout and interlocks are in place to assure that unsafe store operation does not take place.

DoD/MIL Doc: MIL-HDBK-244A: 5.1.5.1 , 5.1.5.1.2

18. PASSENGER SAFETY

The passenger safety section addresses technical requirements in the area of passenger carrying air vehicles as they pertain to safety. This area covers seat belts, stowage compartments, ditching, emergency exits, emergency evacuation, seating arrangements, emergency lighting, signs, fire extinguishers, smoke detection, lavatories, fire protection, and physiological requirements. Safety requirements for crew stations normally used for aircrew and mission essential personnel are located in section 9, Crew Systems.

TYPICAL CERTIFICATION SOURCE DATA

1. Federal Aviation Regulations
2. FAA Airworthiness Directives and Advisory Circulars
3. Joint Service Specification Guide
4. Cabin/crew station layout/geometry
5. Crash survivability requirements and validation
6. Escape system requirements and validation
7. Life support system requirements and validation
8. Tech data package

CERTIFICATION CRITERIA

18.1 Survivability of passengers.

18.1.1 Verify that seats with restraints are provided for each passenger that do not cause serious injury in an emergency landing. Verify each seat/restraint system is designed to protect each occupant during an emergency landing provided the restraints are used properly.

DoD/MIL Doc: JSSG-2010-7: 3.7.3.2.2

FAA Doc: 14CFR references: 25.785, 23.2, 23.562, 23.785, 25.562

18.1.2 Verify that each restraint system has a single-point release for passenger evacuation.

DoD/MIL Doc: JSSG-2010-7: 3.7.3.2.2

FAA Doc: 14CFR references: 25.785, 23.2, 23.562, 23.785

18.1.3 Verify that, if stowage compartments are present, they are designed to contain the maximum weight of its contents and the critical load conditions in an emergency landing. The contents should not become a hazard to passengers due to shifting, such as under emergency landing conditions.

DoD/MIL Doc: MIL-A-8865B

No information available in current JSSG. Information to be included in next revision of JSSG

FAA Doc: 14CFR references: 25.561, 25.787, 25.789, 23.787

18.1.4 Verify that each passenger carrying area has at least one external door that is operable from the inside and outside, is located to avoid hazardous external areas, and is inspected to ensure it is locked in flight.

DoD/MIL Doc: JSSG-2010-7: 3.7.5.3.1

FAA Doc: 14CFR references: 25.783

18.1.5 Verify that exits are lockable, simple to open, and do not open in flight unless mission requirements necessitate this function.

DoD/MIL Doc: JSSG-2010-7: 3.7.5.3.1

FAA Doc: 14CFR references: 25.813, 25.809, 23.807, 25.813

18.1.6 Verify that each non-over-wing exit higher than 6 feet off the ground has a means to assist passengers to the ground. Provisions should exist for evacuees to be assisted to the ground from the wing when the exit opens to the wing.

DoD/MIL Doc: JSSG-2010-7: 3.7.5.3.2

JSSG-2010-13: 3.13.5 pg 67, 68

FAA Doc: 14CFR references: 25.810, 121.31a

18.1.7 Verify that the weight of each passenger exit, if removable, and its means of opening, is conspicuously marked.

DoD/MIL Doc: JSSG-2010-13: 3.13.5 pg 66

FAA Doc: 14CFR references: 25.811

18.1.8 Verify that an emergency lighting system, independent of the main lighting system, provides sufficient illumination and guidance for passenger and crew emergency evacuation, including illumination of each exit and its exterior surrounding. Verify that energy to supply lighting allows complete egress of all passengers and crew before diminishing.

DoD/MIL Doc: JSSG-2010-13: 3.13.5 pg 62, 65

MIL-PRF-85676

FAA Doc: 14CFR references: 25.812, 23.812, 25.1351, 25.1353, 25.1355, 25.1357, 25.1363

18.1.9 Verify that emergency exit signs are installed and that each seated passenger is able to recognize at least one emergency exit sign.

DoD/MIL Doc: JSSG-2010-13: 3.13.5 pg 68

FAA Doc: 14CFR references: 25.812, 23.812, 25.811

18.1.10 Verify that a public address system is installed that is powerable when the air vehicle is in flight or stopped on the ground, including after the shutdown or failure of all engines and auxiliary power units.

DoD/MIL Doc: No information available in current JSSG. Information to be included in next revision of JSSG.

FAA Doc: 14CFR references: 25.1423

18.1.11 Verify that the public address system is accessible for immediate use by all aircrew, is capable of functioning independently of any required crewmember interphone system, and is intelligible at all passenger seats, aircrew seats, and workstations.

DoD/MIL Doc: JSSG-2010-13: 3.13.5 pg 55

FAA Doc: 14CFR references: 25.1423

18.1.12 Verify that each safety equipment control to be operated in an emergency, such as controls for automatic life raft releases, is plainly marked to show its method of operation.

DoD/MIL Doc: JSSG-2010-11: 3.11.7.3

FAA Doc: 14CFR references: 25.1561, 23.1561, 23.1415

18.1.13 Verify that each location, such as a locker or compartment, that carries fire extinguishing, signaling, or other life saving equipment is marked accordingly. Verify that stowage provisions for required emergency equipment are conspicuously marked to identify the contents and facilitate easy removal of the equipment.

DoD/MIL Doc: JSSG-2010-11: 3.11.7.3

FAA Doc: 14CFR references: 25.1561, 23.1561, 23.1415

18.1.14 Verify that readily accessible individual flotation devices are provided for each occupant if the air vehicle flies missions over water.

FAA Doc: 14CFR references: 25.1411, 25.1415

18.1.15 Verify that the air vehicle is outfitted with equipment to deal with in-flight, ground, and ditching emergencies.

DoD/MIL Doc: JSSG-2010-11

FAA Doc: 14CFR references: 121.309, 121.310

18.2 Fire resistance.

18.2.1 Verify, sources of ignition are located and/or designed to prevent contact with cargo.

DoD/MIL Doc: No information available in current JSSG. Information to be included in next revision of JSSG.

AFMAN 24-204(I) identifies flammability limits for transported cargo.

FAA Doc: 14CFR references: 25.787, 25.789, 23.787

18.2.2 Verify that oxygen equipment and lines are not located in any designated fire zone; are protected from heat that may be generated in, or escape from, any designated fire zone; are not routed with electrical wiring; and are installed so that escaping oxygen cannot cause ignition of grease, fluid, or vapor accumulations present in normal operation or as a result of failure or malfunction of any system.

DoD/MIL Doc: JSSG-2010-7: 3.7.3.4, 3.10, 4.10

FAA Doc: 14CFR references: 25.869

18.3 Physiology requirements of occupants.

18.3.1 Verify that air vehicles flying above 10,000 feet mean sea level (MSL) are capable of providing supplemental oxygen from the air vehicle, or from a stand-alone system, and are capable of delivering it to each passenger.

DoD/MIL Doc: JSSG-2010-10: 3.10.1, 4.10.1

FAA Doc: 14CFR references: 25.1439, 23.1441, 23.1443, 23.1445, 25.1447, 23.1449, 23.1450, 25.1441, 25.1443, 25.1445, 25.1449, 25.1450, 25.1453

18.3.2 Verify that emergency medical kit(s) capable of providing medical support for the designed mission are installed in the air vehicle.

DoD/MIL Doc: No information available in current JSSG. Information to be included in next revision of JSSG.

FAA Doc: 14CFR references: 121.309, 121.339, 121.310

19. MATERIALS

(This section is applicable for Navy and Marine Corps aircraft only. This section is not required for Air Force or Army aircraft. Materials criteria are addressed throughout the MIL-HDBK-516B. If section 19 is used, the using aircraft or rotorcraft system office should tailor out the materials related criteria throughout the rest of the document as nonapplicable since these criteria may be in conflict with section 19.)

Materials comprise the entire flight vehicle including air vehicle structure, air vehicle subsystems, propulsion systems, electrical power systems, mission systems, crew systems, and armament/stores systems.

TYPICAL CERTIFICATION SOURCE DATA

1. Design criteria
2. Materials properties data and analysis
3. Environmental effects data and analysis
4. Galvanic compatibility data and analysis
5. Effects of defects data and analysis
6. Hazardous materials data
7. Material trade study results
8. Design of experiments results
9. Statistical process control data
10. Nondestructive inspection (NDI) criteria
11. NDI plan and records
12. NDI probability of detection data
13. Preproduction verification test data
14. First article destructive test data
15. Wear and erosion data
16. Material specifications
17. Process specifications
18. Finish specifications
19. Metallic materials properties development and standardization (MMPDS)
20. MIL-HDBK-17, Polymer Matrix Composites
21. Material safety data sheets
22. Contractor policies and procedures
23. Quality records
24. Defect/failure data
25. Fracture control plan
26. Fracture critical parts list

CERTIFICATION CRITERIA

19.1 Properties and processes.

19.1.1 Verify that the material property evaluations are performed using a combination of recognized and standardized analyses, tests, inspections, and examinations.

DoD/MIL Doc: JSSG-2006, Appendix A.3.2.19, A.4.2.19

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19.1.2 Verify that the material properties are certified as specification compliant and that specification properties are represented as minimum values achievable using standardized processes.

FAA Doc: MMPDS

14CFR reference: 23.603, 23.613, 25.603, 25.613

19.1.3 Verify that the material design allowable properties are represented as statistical values that account for product form and size, production representative processing, manufacturing variability, effects of defects, final assembly interfaces, environmental exposure, and repair.

DoD/MIL Doc: JSSG-2006: Appendix A.3.2.19.1, A.4.2.19.1

FAA Doc: MMPDS

14CFR reference: 23.603, 23.613, 25.603, 25.613

19.1.4 Verify that the likelihood and consequence of failure are accounted for when a material specification property is less than its corresponding material design allowable property.

FAA Doc: 14CFR reference: 23.613, 25.613

19.1.5 Verify that the material property degradation due to the environment (e.g., moisture absorption; chemical, solvent, fuel, and lubricant exposure; hydrolytic instability; thermal exposure; electromagnetic radiation; wear; and erosion) is accounted for.

DoD/MIL Doc: JSSG-2001: 3.2.2, 4.2.2, 3.2.3, 4.2.3

JSSG-2006: Appendix A.3.2.16, A.4.2.16, A.3.11.1, A.4.11.1.2.1, A.3.11.2, A.4.11.2, A.3.11.3, A.4.11.3, A.3.11.4, A.4.11.4

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FAA Doc: 14CFR reference: 23.609, 23.613, 25.609, 25.613

19.1.6 Verify that critical process capability is demonstrated and that procedures for identifying, monitoring, and controlling critical process variation are in place.

DoD/MIL Doc: JSSG-2006: Appendix A.3.2.19.2, A.4.2.19.2, A.3.11.1, A.4.11.1.2.1

FAA Doc: 14CFR reference: 23.605, 25.605

19.1.7 Verify that critical material and process integrity are established.

DoD/MIL Doc: Jssg-2006: Appendix A.3.2.19.2, A.4.2.19.2

FAA Doc: 14CFR reference: 23.605, 25.605

19.1.8 Verify that the maximum size and severity limits for damage requiring repair do not exceed repair capability.

DoD/MIL Doc: JSSG-2006: Appendix A.3.2.28, A.4.2.28

FAA Doc: 14CFR reference 23.611

19.1.9 Verify that insidious failure modes (e.g., hydrogen embrittlement, crack bifurcation) are understood and accounted for.

FAA Doc: 14CFR reference: 23.609

19.2 Corrosion.

19.2.1 Verify that adequate corrosion prevention and control practices are in place for uniform surface corrosion, pitting, galvanic, crevice, filiform, exfoliation, inter-granular, fretting, high temperature oxidation (hot corrosion), corrosion fatigue, and stress corrosion cracking.

19.2.2 Verify that corrosion prevention systems remain effective during the service life, including the mitigation of environmentally assisted cracking. Specific corrosion prevention and control measures, procedures, and processes are to be identified and established commensurate with the operational and maintenance capability.

19.2.3 Verify that adequate prevention and control practices are in place for non-metallic materials degradation as a result of the degradation processes described in 19.2.1.

19.2.4 Verify that the finish systems provide adequate corrosion protection for specific parts, surfaces of similar and dissimilar materials, and attaching parts and fasteners. Identify/specify all surface treatments, inorganic and organic coatings, and other protective finishes to be used and their application.

DoD/MIL Doc: JSSG-2001: 3.2.3, 4.2.3
JSSG-2006: Appendix A.3.2.20, A.4.2.20, A.3.11.2, A.4.11.2
MIL-HDBK-1568
MIL-STD-7179
MIL-STD-889

FAA Doc: 14CFR references: 23.603, 23.609, 25.603, 25.609

19.3 Nondestructive inspection.

19.3.1 Verify that specific defect types, sizes, and locations critical to material integrity are characterized and assessed for probability of detection.

19.3.2 Verify that nondestructive inspection (NDI) accept/reject criteria are validated and correlated with 'effects of defects' testing.

19.3.3 Verify that the nondestructive inspection manuals are developed and that each of the methods is valid.

19.3.4 Verify that initial and recurring inspection intervals are defined where applicable.

DoD/MIL Doc: JSSG-2006: Appendix A.3.11.6, A.4.11.6

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FAA Doc: 14CFR reference: 23.611

19.4 Wear and erosion.

19.4.1 Verify that adequate wear and erosion practices are in place for wear mechanisms (abrasive, fretting, corrosive, and thermal wear) and erosion mechanisms (impinging fluid, solid particles). Specific wear and erosion prevention practices, measures, procedures, and processes are to be identified and established commensurate with the operational and maintenance capability.

DoD/MIL Doc: JSSG-2006: Appendix A.3.2.28, A.4.2.28, A.3.11.4, A.4.11.4

FAA Doc: 14CFR reference: 23.609

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20. OTHER CONSIDERATIONS

TYPICAL CERTIFICATION SOURCE DATA

1. Design criteria
2. Design studies and analyses
3. Design, installation, and operational characteristics
4. Design approval and system compatibility tests
5. Component and system level qualification and certification tests
6. Electromagnetic environmental effects
7. Hazard analysis and certification
8. Failure modes and effects analysis
9. Avionics integration tests and results
10. System/subsystem self-test design and capabilities
11. Qualification test plans, procedures, and results
12. Ground test results
13. FCA and PCA data
14. Flight manual
15. Software development plan
16. Software development and product specifications
17. Software test plans, test procedures, and test reports
18. Software configuration control/management plan and procedure
19. Flight test reports
20. Environmental analysis and test results

CERTIFICATION CRITERIA

20.1 Mission/test equipment and cargo/payload safety.

20.1.1 Verify that the following items do not adversely affect the primary SOF functionality (such as structural capability, flying and handling qualities, electronic compatibility) of the air vehicle:

a. Special non-SOF mission or test equipment and software including instrumentation and wiring

b. Non-SOF mission-specific equipment and software

c. Nonessential mission equipment (hardware and software)

d. Carry-on/carry-off equipment that will be operated in flight

20.1.2 Verify that carriage of cargo or payload does not adversely affect safety of the air vehicle system.

DoD/MIL Doc: JSSGs corresponding to the appropriate item and/or installations under consideration.

FAA Doc: 14CFR reference sections corresponding to Structural and Installation requirements; and systems as applicable, i.e., Electrical.

20.1.3 Verify that in-flight operation of mission-specific personnel and cargo equipment (e.g., cargo hooks, rescue slings and hoists, H-bar and FRIES bar) does not adversely affect safety of the air vehicle system.

DoD/MIL Doc: Refer to technical point of contact for this discipline (listed in section A.2)

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21. NOTES

21.1 Changes from previous issue.

Revision B of MIL-HDBK-516 contains numerous changes from the previously published issue. Vertical change bars are used in this “Change 1” to indicate where substantive changes were made since the issuance of revision B. A traceability matrix from revision A to revision B may be requested through email to MIL-HDBK-516B@wpafb.af.mil or mail request to ASC/ENSI, 2530 Loop Road West, Wright-Patterson AFB OH 45433-7101.

21.2 Subject term (key word) list.

aerial refueling system
air vehicle subsystems
avionics
computer resources
crew systems
diagnostics systems
electrical power
electromagnetic environmental effects
environmental management system
fire and hazard protection
flight technology
fuel system
hydraulics and pneumatic systems
integration, armament
integration, stores
landing gear and deceleration systems
maintenance
passenger safety
power systems, auxiliary
power systems, emergency
propulsion installations
propulsion
structures
system safety

APPENDIX

AIRWORTHINESS CERTIFICATION CRITERIA

A.1. SCOPE

This appendix provides technical points of contact references for the Airworthiness Certification Criteria. Contact the appropriate member in the list of technical points of contact for additional information or clarification. Also provided is a cross-reference matrix identifying major changes between revision A and revision B of this handbook.

A.2. TECHNICAL POINTS OF CONTACT

POINT OF CONTACT INFORMATION				
Technical Discipline	**Office**	**POC**	**DSN**	**Commercial**
4.0 Systems Engineering	ASC/ENS	Tech Director	785-1799	(937) 255-1799
	NAVAIR 4.0P	Deputy Airworthiness Officer	342-0301	(301) 342-0301
5.0 Structures	ASC/ENFS	Tech Advisor	785-5485	(937) 255-5485
	NAVAIR 4.3.3	Division Head	342-9381	(301) 342-9381
	AMSAM-RD-AE-F	Division Chief	897-2350 X9688	(256) 705-9688
6.0 Flight Technology	ASC/ENFT	Tech Advisor	785-9595	(937) 255-9595
	NAVAIR 4.3.2	Division Head	342-8550	(301) 342-8550
7.0 Propulsion	ASC/ENFP	Tech Expert	785-8604	(937) 255-8604
	NAVAIR 4.4.1	Division Head	757-0457	(301) 757-0457
8.0 Air Vehicle Subsystems	ASC/ENFA	Tech Advisor	785-8596	(937) 255-8596
	NAVAIR 4.3.5	Division Head	342-9363	(301) 342-9363
8.1 Hydraulics and Pneumatic Systems	ASC/ENFA	Tech Specialist	785-8509	(937) 255-8509
	NAVAIR 4.3.5.2	Branch Head	757-2001	(301) 757-2001

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POINT OF CONTACT INFORMATION				
Technical Discipline	**Office**	**POC**	**DSN**	**Commercial**
8.2 Environmental Management System	ASC/ENFA	Tech Specialist	785-8514	(937) 255-8514
	NAVAIR 4.3.5.1	Branch Head	757-2345	(301) 757-2345
8.3 Fuel System	ASC/ENFA	Tech Expert	785-5908	(937) 255-5908
	NAVAIR 4.4.2	Branch Head	757-0511	(301) 757-0511
8.4 Fire and Hazard Protection	ASC/ENFA	Tech Expert	785-5908	(937) 255-5908
	NAVAIR 4.3.5.1	Branch Head	757-2345	(301) 757-2345
8.5 Landing Gear & Deceleration Systems	ASC/ENFA	Tech Specialist	785-8511	(937) 255-8511
	NAVAIR 4.3.5.2	Branch Head	757-2001	(301) 757-2001
8.6 Auxiliary/Emergency Power Systems	ASC/ENFA	Tech Specialist	785-8506	(937) 255-8506
	NAVAIR 4.4.6	Branch Head	342-0806	(301) 342-0806
8.7 Aerial Refueling System	ASC/ENFA	Tech Specialist	785-7267	(937) 255-7267
	NAVAIR 4.3.5	Branch Head	342-9371	(301) 342-9371
8.8 Propulsion Installations	ASC/ENFA	Tech Specialist	785-8506	(937) 255-8506
	NAVAIR 4.4.1	Branch Head	757-0457	(301) 757-0457
9.0 Crew Systems	ASC/ENFC	Tech Advisor	785-5797	(937) 255-5797
	NAVAIR 4.6	Division Head	342-8429	(301) 342-8429
10.0 Diagnostics Systems	ASC/ENS	Tech Director	785-1799	(937) 255-1799
11.0 Avionics	ASC/ENA	Tech Director	785-5153	(937) 255-5153
	NAVAIR 4.5.1.1	Division Head	342-9130	(301) 342-9130
12.0	ASC/ENFA	Tech Specialist	785-5078	(937) 255-5078

APPENDIX

POINT OF CONTACT INFORMATION				
Technical Discipline	**Office**	**POC**	**DSN**	**Commercial**
Electrical Power	NAVAIR 4.4.4	Division Head	342-0803	(301) 342-0803
13.0 Electromagnetic Environmental Effects	ASC/ENAD	Tech Expert	785-8928	(937) 255-8928
	NAVAIR 4.1.7	Division Head	342-7967	(301) 342-7967
14.0 System Safety	ASC/ENSA	Tech Advisor	785-9711	(937) 255-9711
	NAVAIR	Division Head	342-2137	(301) 342-2137
15.0 Computer Resources	ASC/ENFT	Branch Chief	785-4166	(937) 255-4166
	ASC/ENAS	Tech Advisor	785-3999	(937) 255-3999
	NAVAIR 4.1.11	Division Head	342-2102	(301) 342-2102
16.0 Maintenance	ASC/ENSS	Tech Expert	785-9541	(937) 255-9541
17.0 Armament/Stores Integration	ASC/ENSI	Tech Specialist	785-5882	(937) 255-5882
	NAVAIR 4.7.6	Division Head	437-7206	(760) 939-7206
	NAVAIR 4.11.2	Division Head	342-4390	(301) 342-4390
	AMSRD-AMR-AE-S-W	Branch Chief	897-2350 x9765	(256) 705-9765
18.0 Passenger Safety	ASC/ENFC	Tech Advisor	785-8608	(937) 255-8608
	NAVAIR 4.6	Division Head	342-8429	(301) 342-8429
19.0 Materials	NAVAIR 4.9.7	Division Head	342-8001	(301)342-8001
20.0 Other Considerations	ASC/EN	Technical Advisor, Systems Engineering	785-1826	(937) 255-1826

APPENDIX

For commercial derivative aircraft (CDA), contact the FAA Military Certification Office:

FAA Military Certification Office
ACE-100M
8200 East 34th Street North
Building 1000, Suite 1005
Wichita, KS 67226

Phone: 316-350-1580
FAX: 316-350-1592

APPENDIX

A.3. CROSS-REFERENCE TABLE OF MAJOR SECTION CHANGES FROM MIL-HDBK-516A TO MIL-HDBK-516B

MIL-HDBK-516A		MIL-HDBK-516B		
Section or Criteria #	**MIL-HDBK-516A Section Title/Subtitle**	**Section or Criteria #**	**MIL-HDBK-516B Section Title/Subtitle**	**Comments**
1.0	Scope	1.0	Scope	
2.0	Applicable documents	2.0	Applicable documents	
3.0	Definitions and abbreviations	3.0	Definitions and abbreviations	
4.0	Systems engineering	4.0	Systems engineering	
4.1	Design criteria	4.1	Design criteria	
4.2	Tools and databases	4.2	Tools and databases	
4.3	Materials selection	4.3	Materials selection	4.3.2 – 4.3.6 incorporated into 4.3.1
4.4	Manufacturing and quality	4.4	Manufacturing and quality	
4.5	Operator's and maintenance manuals (technical orders).	4.5	Operator's and maintenance manuals/technical orders	
4.6	Configuration identification	4.6	Configuration identification	
4.7	Configuration status accounting	4.7	Configuration status accounting	
5.0	Structures	5.0	Structures	
5.1	Loads	5.1	Loads	
		5.2	Structural dynamics	Previously 5.7
5.2	Strength	5.3	Strength	Previously 5.2
5.3	Materials, processes, corrosion prevention, nondestructive evaluation, and repair			Incorporated into 5.3 and 5.4
5.4	Damage tolerance and durability (Fatigue)	5.4	Damage tolerance and durability	
		5.5	Mass properties	Previously 5.8
5.5	Flight operating limits	5.6	Flight operating limits	

APPENDIX

MIL-HDBK-516A		MIL-HDBK-516B		
Section or Criteria #	**MIL-HDBK-516A Section Title/Subtitle**	**Section or Criteria #**	**MIL-HDBK-516B Section Title/Subtitle**	**Comments**
5.6	Functionality			Incorporated into 5.1, 5.3, and 5.4
5.7	Structural dynamics			Moved to 5.2
5.8	Mass properties interface			Moved to 5.5.
5.9	Stores/armament interface			Incorporated into 5.1, 5.2, 5.3, and 17.0
5.10	Structural Maintenance manuals (T.O.s)			Deleted
5.11	Rotary wing air vehicles			Deleted
6.0	Flight technology	6.0	Flight technology	
7.0	Propulsion	7.0	Propulsion and propulsion installations	
		7.1	Propulsion safety management	
		7.2	Gas turbine engine applications	
7.1	Performance	7.2.1	Performance	Previously 7.1
7.2	Operability	7.2.2	Operability	Previously 7.2
7.3	Engine structures	7.2.3	Structures	Previously 7.3
7.4	Engine control and accessory systems	7.2.4	Engine subsystems, components, computer resources and software	Previously 7.4
7.5	Engine monitoring system			Incorporated into 7.2.4
7.6	Engine bearing and lubrication system			Incorporated into 7.2.4
7.7	Engine installations compatibility	7.2.5	Installations	Previously 7.7
7.8	Failure modes			Incorporated into 7.1
7.9	Flight manual/procedures and			Incorporated into 7.1

APPENDIX

MIL-HDBK-516A		MIL-HDBK-516B		
Section or Criteria #	**MIL-HDBK-516A Section Title/Subtitle**	**Section or Criteria #**	**MIL-HDBK-516B Section Title/Subtitle**	**Comments**
	limitations			
7.10	Engine externals			Incorporated into 7.2.4
7.11	Engine computer resources			Incorporated into 7.2.4
		7.3	Alternate propulsion systems	New
7.12	Propellers and associated subsystem components	7.3.1	Propeller driven systems	Previously 7.12
7.13	Rotors and associated subsystem components.	7.3.2	Rotary wing systems	Previously 7.13
		7.3.3	Reciprocating engines	New
8.0	Air vehicle subsystems	8.0	Air vehicle subsystems	
8.1	Hydraulic and pneumatic systems	8.1	Hydraulic and pneumatic systems	
8.2	Environmental management system (EMS)	8.2	Environmental control system (ECS)	
8.3	Fuel System	8.3	Fuel system	
8.4	Fire and hazard protection	8.4	Fire and hazard protection	
8.5	Landing gear and deceleration systems	8.5	Landing gear and deceleration systems	
8.6	Auxiliary/emergency power system(s) (APS/EPS)	8.6	Auxiliary/emergency power system(s) (APS/EPS)	
8.7	Aerial refueling system	8.7	Aerial refueling system	
8.8	Propulsion Installations	8.8	(Deleted, number reserved)	Incorporated into 7.2.5
8.9	Mechanisms	8.9	Mechanisms	
8.10	External cargo hook systems (rotary wing)	8.10	External cargo hook systems (rotary wing)	
8.11	External rescue hoist (rotary wing)	8.11	External rescue hoist (rotary wing)	

APPENDIX

MIL-HDBK-516A		MIL-HDBK-516B		
Section or Criteria #	**MIL-HDBK-516A Section Title/Subtitle**	**Section or Criteria #**	**MIL-HDBK-516B Section Title/Subtitle**	**Comments**
8.12	Fast rope insertion/extraction system (FRIES) (rotary wing)	8.12	Fast rope insertion/extraction system (FRIES) (rotary wing)	
9.0	Crew systems	9.0	Crew systems	
9.1	Escape and egress system	9.1	Escape and egress system	
9.2	Crew stations and aircraft interiors	9.2	Crew stations and aircraft interiors	
9.3	Air vehicle lighting	9.3	Air vehicle lighting	
9.4	Human performance	9.4	Human performance	
9.5	Life support systems	9.5	Life support systems	
9.6	Transparency integration	9.6	Transparency integration	
9.7	Crash survivability	9.7	Crash survivability	
9.8	Air transportability and airdrop.	9.8	Air transportability and airdrop.	
		9.9	Lavatories, galleys, and areas not continuously occupied	New
10.0	Diagnostic systems	10.0	Diagnostic systems	
11.0	Avionics	11.0	Avionics	
12.0	Electrical system	12.0	Electrical system	
13.0	Electromagnetic environmental effects (E^3)	13.0	Electromagnetic environmental effects (E^3)	
14.0	System safety	14.0	System safety	
15.0	Computer resources	15.0	Computer resources	
16.0	Maintenance	16.0	Maintenance	
17.0	Armament/stores integration	17.0	Armament/stores integration	
18.0	Passenger safety	18.0	Passenger safety	
18.1	Survivability of passengers	18.1	Survivability of passengers	

APPENDIX

MIL-HDBK-516A		MIL-HDBK-516B		
Section or Criteria #	**MIL-HDBK-516A Section Title/Subtitle**	**Section or Criteria #**	**MIL-HDBK-516B Section Title/Subtitle**	**Comments**
18.2	Fire detection, suppression, and resistance	18.2	Fire resistance	
18.3	Physiology requirements of passengers	18.3	Physiology requirements of passengers	
		19.0	Materials	New section added for Navy and Marine Corps aircraft use only
19.0	Other considerations	20.0	Other considerations	
20.0	Notes	21.0	Notes	
A.1	Scope	A.1	Scope	
A.2	Applicable documents			Incorporated into 2.0
A.3	Definitions			Incorporated into 3.0
A.4	Systems engineering			References listed with respective criterion
A.5	Structures			References listed with respective criterion
A.6	Flight technologies			References listed with respective criterion
A.7	Propulsion			References listed with respective criterion
A.8	Air vehicle subsystems			References listed with respective criterion

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MIL-HDBK-516A		MIL-HDBK-516B		
Section or Criteria #	**MIL-HDBK-516A Section Title/Subtitle**	**Section or Criteria #**	**MIL-HDBK-516B Section Title/Subtitle**	**Comments**
A.9	Crew systems			References listed with respective criterion
A.10	Diagnostics			References listed with respective criterion
A.11	Avionics			References listed with respective criterion
A.12	Electrical power			References listed with respective criterion
A.13	Electromagnetic environmental effects (E^3)			References listed with respective criterion
A.14	System safety			References listed with respective criterion
A.15	Computer resources			References listed with respective criterion
A.16	Maintenance			References listed with respective criterion
A.17	Armament/stores integration			References listed with respective criterion
A.18	Passenger safety			References listed with respective

APPENDIX

MIL-HDBK-516A		MIL-HDBK-516B		
Section or Criteria #	**MIL-HDBK-516A Section Title/Subtitle**	**Section or Criteria #**	**MIL-HDBK-516B Section Title/Subtitle**	**Comments**
				criterion
A.19	Other considerations			References listed with respective criterion
A.20	Technical points of contact	A.2	Technical points of contact	Previously A.20
		A.3	Cross-reference: MIL-HDBK-516A to MIL-HDBK-516B	New

Custodians:
Navy – AS
Air Force – 11
Army – AV

Preparing Activity:
Air Force – 11

(Project: SESS-2006-002)

NOTE: The activities listed above were interested in this document as of the date on the cover. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at http://assist.daps.dla.mil.