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PERFORMANCE SPECIFICATION

SYSTEM SPECIFICATION

for the

ADVANCED PILOT TRAINING (APT) PROGRAM

AIRCRAFT SYSTEM

Version 1.0

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1 SCOPE

This System Specification (SS) establishes the performance requirements for the United States Air Force (USAF) Advanced Pilot Training (APT) Aircraft System component of the APT Program. For the purposes of this SS, the "Aircraft System" includes the associated support elements of the aircraft.

1.1 Identification

This SS is for the Aircraft System, Configuration Item (CI) (TBD).

1.2 System Overview

The APT Program will replace the T-38C used in the USAF's Specialized Undergraduate Pilot Training (SUPT) advanced phase fighter and bomber (F/B) track, and in the Introduction to Fighter Fundamentals (IFF) course. The APT Program will provide student pilots with the foundational flying skills and core competencies required to transition into current generation F/B aircraft.

1.3 Document Overview

The performance requirements and verification requirements for the APT Aircraft system are documented in sections 3 and 4. Note the performance requirements and verification requirements for the Ground Based Training Systems (GBTS) are documented in a separate SS. This APT Program SS captures and conveys the minimum requirements for the aircraft system (note that the requirements designated as "trade space" identify threshold and objective requirements to be traded as part of the proposed solution definition). This APT Program SS is developed using guidance from DID DI-IPSC-81431A, System/Subsystem Specification Data Item Description, and Military Standard (MIL-STD)-961E, Department of Defense (DoD) Standard Practice for Defense Specifications. In addition to the six (6) major sections of the SS, additional appendices are included as necessary to define the requirements of the aircraft system.

2 APPLICABLE DOCUMENTS

2.1 General

The documents listed in this section are specified in sections 3, 4, or 5. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of the document list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, and 5, whether or not the documents are listed. Where a revision by supplement, amendment, or notice is called out, the entire document up to and including the revision is being referenced. When a revision letter or date is not shown, the issue in effect on the release date of this specification applies.

2.2 Government Documents

2.2.1 Specifications, Standards, and Handbooks

The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

Document Number	Document Title	Issue Date
AN6287	Valve - Air High Pressure 3/4 Hex	15 JUL 88
FED-STD-595C (1)	Colors Used in Government Procurement	31 JUL 08
JSSG-2006	Aircraft Structures	30 OCT 98
JSSG-2007C	Engines, Aircraft, Turbine	10 JUN 11
MIL-STD-129R	Military Marking for Shipment and Storage	18 FEB 14
MIL-STD-130N (1)	Identification Marking of U.S. Military Property	16 NOV 12
MIL-STD-411F	Aircrew Station Alerting Systems	10 MAR 97
MIL-STD-464C	Electromagnetic Environmental Effects Requirements for Systems	01 DEC 10
MIL-STD-704F	Aircraft Electric Power Characteristics	12 MAR 04
MIL-STD-805B	Towing Fittings and Provisions for Military Aircraft, Design Requirements for	07 SEP 87
MIL-STD-810G (1)	Environmental Engineering Considerations and Laboratory Tests	15 APR 14
MIL-STD-882E	System Safety	11 MAY 12
MIL-STD-1472G	Human Engineering	11 JAN 12
MIL-STD-1474E	Noise Limits	15 APR 15
MIL-STD-1530C	Aircraft Structural Integrity Program	01 NOV 05
MIL-STD-1568D	Materials and Processes for Corrosion Prevention and Control in Aerospace Weapons Systems	31 AUG 15
MIL-STD-1760E	Aircraft/Store Electrical Interconnection System	24 OCT 07
MIL-STD-1787C	Aircraft Display Symbology	05 JAN 01
MIL-STD-1797B	Flying Qualities of Piloted Vehicles	15 FEB 06
MIL-STD-3009	Lighting, Aircraft, Night Vision Imaging System (NVIS) Compatible	02 FEB 01
MIL-STD-3013A	Glossary of Definitions, Ground Rules, and Mission Profiles to Define Air Vehicle Performance Capability	9 SEP 08
MIL-STD-3024 (1)	Propulsion System Integrity Program	13 JUL 2015
MIL-DTL-5624W	Turbine Fuel, Aviation, Grades JP-4 and JP-5	28 MAR 16
MIL-E-7016F (1) NOT 2	Electric Load and Power Source Capacity, Aircraft, Analysis of	12 SEP 14
MIL-PRF-7808L	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base	02 MAY 97

Document Number	Document Title	Issue Date
MIL-STD-8591 (1)	Airborne Stores, Suspension Equipment and Aircraft-Store Interface (Carriage Phase)	16 NOV 12
MIL-DTL-23659F	Initiators, Electric, General Design Specification for	10 JUN 10
MIL-PRF-23699G	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base, NATO Code Numbers: O-152, O-154, O-156, and O-167	13 MAR 14
MIL-PRF-25017H (1)	Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble (NATO S-1747)	04 AUG 11
MIL-DTL-25427B SUP 1	Coupling Assembly, Hydraulic, Self-Sealing, Quick Disconnect, General Specification for	08 DEC 09
MIL-DTL-25677F	Adapter, Cap, and Nozzle, Pressure Lubricating Oil Servicing, Aircraft, General Specification for	03 OCT 14
MIL-A-25896E	Adapter, Pressure Fuel Servicing, Nominal 2.5-Inch Diameter	18 JAN 83
MIL-PRF-32239A	Coating System, Advanced Performance, for Aerospace Applications	01 OCT 14
MIL-D-81980 (1)	Design and Evaluation of Signal Transmission Subsystems, General Specification for	14 AUG 75
MIL-C-83124	Cartridge Actuated Devices/Propellant Actuated Devices General Design Specification for	30 OCT 69
MIL-C-83125	Cartridges for Cartridge Actuated/Propellant Actuated Devices, General Design Specification for	10 MAR 69
MIL-P-83126A	Propulsion Systems, Aircrew Escape, Design Specification for	08 FEB 80
MIL-DTL-83133J	Turbine Fuel, Aviation, Kerosene Type, JP-8 (NATO F-34), NATO F-35, and JP-8+100 (NATO F-37)	16 DEC 15
MIL-DTL-85470B	Inhibitor, Icing, Fuel System, High Flash NATO Code Number S-1745	15 JUN 99
MIL-PRF-87260B	Foam Material, Explosion Suppression, Inherently Electrostatically Conductive, for Aircraft Fuel Tanks	2 NOV 06
STANAG-3098	Aircraft Jacking	14 MAY 14
STANAG-3208	Air Conditioning Connections	09 SEP 09
STANAG-3209	Tyre Valve Couplings	21 OCT 14
STANAG-3237	Aperture of Terminal Ring or Link of Aircraft Lifting Slings	25 NOV 82
STANAG-3278	Aircraft Towing Attachments and Devices	05 NOV 14
STANAG-3315	Aircraft Cabin Pressurizing Test Connections	06 OCT 98
STANAG-3372	Low Pressure Air And Associated Electrical Connections for Aircraft Engine Starting	05 NOV 14
STANAG-3595	Aircraft Fitting for Pressure Replenishment of Gas Turbine Engines with Oil	10 SEP 09
STANAG-3632	Aircraft and Ground Support Equipment Electrical Connections for Static Grounding	20 AUG 14
STANAG-3766	Grease Nipples	08 JUL 97

(Copies of these documents are available online at http://quicksearch.dla.mil)

2.2.2 Other Government Documents, Drawings, and Publications

The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

Document Number	Document Title	Issue Date
AFPD 62-6	USAF Airworthiness	11 JUN 10
AFI 62-601	USAF Airworthiness	11 JUN 10
AFH 63-1402	Aircraft Information Program	19 MAR 01
AFI 91-203	Air Force Consolidated Occupational Safety Instruction	15JUN 12
AFI 91-225	Aviation Safety Programs	26 JAN 15
ATP-3.3.4.2	Air-to-Air Refueling ATP-56	NOV 13

Document Number	Document Title	Issue Date
ATP-3.3.4.5	Air-to-Air (Aerial) Refueling Equipment: Boom-Receptacle System and Interface Requirements	JUN 13
	Corrosion Prevention and Control Planning Guidebook for Military Systems and Equipment, Spiral 4	4 FEB 14
OMSC-TCH-01	Open Mission Systems Definition and Documentation Version 1.1	18 DEC 15
	HQ AFFSA Whitepaper: Primary Flight Reference Endorsement Process	16 OCT 15

2.3 Non-Government Publications

The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

Document Number	Document Title	Issue Date
	Technical Standard for Future Airborne Capability Environment (FACE), Edition 2.1	MAY 14
ARINC 610C	Guidance for Design and Integration of Aircraft Avionics Equipment in Simulators	SEP 09
ASTM-D1655	Standard Specification for Aviation Turbine Fuels	30 OCT 15
NAS411	Materials Hazardous Management Program	30 SEP 13
NAS411-1	Hazardous Material Target List	30 SEP 13
SAE-AS50881F	Wiring, Aerospace Vehicle	29 MAY 15
SAE-ARP5015A	Ground Equipment - 400 Hertz Ground Power Performance Requirements	14 JAN 11
SAE-AS5440A	Hydraulic Systems, Aircraft, Design and Installation Requirements For	3 JAN 11
SAE-ARP5825A	Design Requirements and Test Procedures for Dual Mode Exterior Lights	6 MAY 16
SAE-AS25486B	Connector, Plug, Attachable External Electric Power, Aircraft, 115/200 Volt, 400 Hertz	9 MAR 15
SAE-AS90362A	Connector, Receptacle, External Electric Power, Aircraft, 115/200 Volt, 400 Hertz	21 OCT 10

2.4 Order of Precedence

Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3 REQUIREMENTS

Definitions in section 6.2 help to clarify and form a part of the requirements in sections 3 and 4. "Italicized text" indicates existence of a definition in section 6.2.

3.1 Performance and Structural Characteristics

3.1.1 Performance Ground Rules

Unless otherwise specified, the Performance and Structural Characteristics (section 3.1 and subparagraphs) shall be met using the following performance ground rules:

a. Jet A with military additives fuel grade with a density of 6.8 pounds per US gallon and fuel heating value of 18,400 British Thermal Units per pound.
b. Two-person aircrew (average nude aircrew member weight of 200 pounds each) wearing USAF Standard Personal Flight Equipment weighing 26.3 pounds (see Table 3-16).
c. All *aircraft* systems/subsystems/*components* operating normally.
d. International Standard Atmosphere model as defined by MIL-STD-3013, Appendix A.
e. *Standard Configuration* (SWaP-C margin requirements met).
f. No wind.
g. All load factors measured at the *aircraft* center of gravity (CG).

3.1.2 Performance

3.1.2.1 High G Maneuvering

SEE APPENDIX D.

3.1.2.2 Instantaneous G-onset Rate

The *aircraft* shall perform high G maneuvering with an instantaneous G-onset rate of at least 6 G per second using the following additional performance ground rules: Fuel weight at 50% (relative to maximum fuel capacity), pressure altitude (*PA)* equal to 15,000 feet, Airspeed no greater than 0.9 Mach and Standard Day. The *aircraft* shall immediately start a return to +1.0 G flight by relaxing the stick force/deflection.

3.1.2.2.1 Average G-onset Rate

From a steady +1.5 G trimmed level turn, using an abrupt maximum pitch control step input the *aircraft* shall traverse from +1.5 G and pass through +7.5 G (or the angle-of-attack for CL_{max}) in 1.7 seconds without over-G or departure. The *aircraft* shall immediately start a return to +1.0 G flight by relaxing the stick force/deflection. This shall be achieved using the following additional performance ground rules: Fuel weight at 50% (relative to maximum fuel capacity), *PA* equal to 15,000 feet, symmetric and planned asymmetric loadings, Standard Day, Corner Speed ±50 KEAS.

3.1.2.3 Negative and Zero G Flight

3.1.2.3.1 Negative G Flight

The *aircraft* shall fly in negative gravity for at least 10 seconds with unlimited occurrences and without adverse effects to the *aircraft* and subsystems for all engine thrust levels.

3.1.2.3.2 Zero G Flight

The *aircraft* shall fly in zero gravity for at least 10 seconds with unlimited occurrences and without adverse effects to the *aircraft* and subsystems for all engine thrust levels. (Note: Zero gravity is defined as -0.5 to +0.5 G.)

3.1.2.4 Instantaneous Turn Rate

The *aircraft* shall perform instantaneous turn rate of at least 18° per second using the following additional performance ground rules: Fuel weight at 50% (relative to maximum fuel capacity), *PA* equal to 15,000 feet, Airspeed no greater than 0.9 Mach and Standard Day.

3.1.2.5 Sustained Turn Rate

The *aircraft* shall perform sustained turn rate of at least 12.5° per second using the following additional performance ground rules: level flight, fuel weight at 50% (relative to maximum fuel capacity), *PA* equal to 15,000 feet, airspeed no greater than 0.9 Mach and Standard Day.

3.1.2.6 High Angle-of-Attack (AOA) Maneuvering

SEE APPENDIX D.

3.1.2.7 Flight Endurance

The *aircraft* shall have sufficient fuel capacity to complete the unrefueled training sortie illustrated and defined in section A.2.

3.1.2.8 Takeoff Distance

The *aircraft* (including all Technical Order takeoff and store loadout configurations) shall have a *total takeoff distance* no greater than 6400 feet using an 8000-foot, hard-surface runway and the following worst case weather conditions for performance calculations: 10 knot tailwind, wet runway with Runway Condition Reading (RCR) of 12, zero runway slope, normal takeoff flap setting, *maximum takeoff gross weight*, and *Density Altitude* (*DA*) equal to 7464 feet (*DA* represents 97° F, dew point of 38° F, 4093 feet *PA*).

3.1.2.9 Landing Distance

The *aircraft* (including all Technical Order landing and store loadout configurations) shall have a *landing ground roll distance* no greater than 7,000 feet that provides for flight operations on an 8000-foot, hard-surface runway using the following worst case weather conditions for performance calculations: 10 knot tailwind, wet runway with RCR of 12, zero runway slope, all possible flap settings, 80% fuel weight (relative to maximum fuel capacity), *DA* equal to 7464

feet (*DA* represents 97° F, dew point of 38° F, 4093 feet *PA*), and without the use of drag chute(s).

3.1.2.10 Takeoff and Landing in Crosswinds

3.1.2.10.1 Lateral-Directional Control in Crosswinds

It shall be possible to take off and land (including all Technical Order store loadout configurations) with normal aircrew skill and technique in 90º crosswinds, from either side, of velocities up to 25 knots (to include gusts) with no worse than Level 2 *handling qualities*. Roll control forces shall not be so large or so small as to be *objectionable* to the aircrew.

3.1.2.10.2 Takeoff Run and Landing Rollout in Crosswinds

Yaw and roll control power, in conjunction with other normal means of control, shall be adequate to maintain a straight path on the ground or other landing surface during takeoff run and landing rollout in c*alm air* and in crosswinds up to 25 knots. This requirement applies on dry (RCR of 23) and wet (RCR of 12) runways (including all Technical Order store loadout configurations). Aerodynamic control power alone shall be sufficient to maintain control at all airspeeds above 50 knots**.**

3.1.2.11 Takeoff Climb Gradient Performance

The *aircraft* (including all Technical Order store loadout configurations, and one-engine inoperative situations for two-engine *aircraft*) shall provide a climb gradient of at least 200 feet per nautical mile (NM) using the following additional performance ground rules: 8000-foot runway, Instrument Flight Rules (IFR), no wind, *DA* equal to 7464 feet (*DA* represents 97° F, dew point of 38° F, 4093 feet *PA*).

3.1.2.12 General Handling Characteristics (including all Technical Order store loadout configurations)

3.1.2.12.1 Aircraft Flying Qualities

The *aircraft* shall exhibit *flying qualities* compatible with the performance, mission, flight phases, and tasks of the APT syllabus maneuvers and mission profiles listed in APPENDIX A.

3.1.2.12.2 Flying Qualities in Atmospheric Disturbances

While complying with 3.1.2.12.1, the *aircraft* shall exhibit no worse than Level 1 (*Satisfactory*) *flying qualities* in *calm air* and *common atmospheric disturbances*, and no worse than Level 2 (*Tolerable*) *flying qualities* in *uncommon atmospheric disturbances* and with no *Pilot-in-the-loop Oscillations* (*PIO*).

3.1.2.12.3 Student Skill Level Handling Characteristics

The *aircraft* shall have levels of safety, redundancy, performance, and normal and emergency procedures commensurate with the skill levels of students.

3.1.2.12.4 Student Fault Tolerant Flight Characteristics

The *aircraft* (including all Technical Order landing and store loadout configurations) shall be *tolerant* of common student errors. Common student errors shall include, as a minimum, low-airspeed departures, exceeding maximum operating speed by 20 knots, and delayed and/or misapplied controls.

3.1.2.12.5 Control Margin

Aerodynamic control power, control surface rate, and hinge moment capability shall provide adequate control margins for restoring moments throughout the combined range of all attainable *AOA's* (both positive and negative) and sideslip angles.

3.1.2.12.6 Safe Termination

For all flight conditions, control margins shall be such that all flight phases can be terminated safely and a go-around can be successfully accomplished.

3.1.2.12.7 Warning and Indication of Approach to Dangerous Flight Conditions

When approaching *dangerous flight conditions*, the *aircraft* shall provide clear and unambiguous *warning* and indication of approach to such conditions with sufficient time for the aircrew to recognize the impending dangers and take preventive action.

3.1.2.12.8 Departure Resistance

The *aircraft* shall be *resistant to departure* from controlled flight, *post-stall gyrations* and *spins* while conducting all APT syllabus maneuvers and the mission profiles listed in APPENDIX A. Departure from controlled flight will only occur with a large and reasonably sustained misapplication of pitch, roll, or yaw controls, or a combination thereof.

3.1.2.12.8.1 Recovery from Post-Stall Gyrations and Spins

The proper recovery technique(s) shall be readily apparent to the aircrew, be simple and easy to apply under the motions encountered, and provide prompt recovery from all *post-stall gyrations*, *incipient spins*, and *developed spins*. The recovery techniques for *post-stall gyrations*, *incipient spins*, and *developed spins* shall be the same or at least compatible.

3.1.2.12.9 Stalls

The following stall requirements apply for all allowable *aircraft* loadings and configurations, in straight un-accelerated flight, and in turns and pull-ups with attainable normal accelerations up to the allowable limit load factor.

3.1.2.12.9.1 Approach to Stall

The onset of a stall *warning* shall occur within the speed limits of Table 3-1 for 1-G stalls and within the lift limits of Table 3-2 for accelerated stalls.

Table 3-1, Speed Range for Onset of Stall Warning for 1-G Stalls

Flight Phase	Minimum Speed for Onset of Warning	Maximum Speed for Onset of Warning
Approach	Higher of 1.05 V_s or V_s + 5 knots	Higher of 1.10 V_s or V_s + 10 knots
All Others	Higher of 1.05 V_s or V_s + 5 knots	Higher of 1.15 V_s or V_s + 15 knots
Notes: V_S = Stall velocity		

Table 3-2, Lift Range for Onset of Stall Warning for Accelerated Stall

Flight Phase	Minimum Lift for Onset of Warning	Maximum Lift for Onset of Warning
Approach	82% of $C_{L\ stall}$	90% of $C_{L\ stall}$
All Others	75% of $C_{L\ stall}$	90% of $C_{L\ stall}$
Notes: $C_{L\ stall}$ = Lift coefficient at stall *AOA*		

3.1.2.12.9.2 Tactile/Physical Cues for Stall Warning

The *aircraft* shall *alert* the aircrew of the *aircraft* approach to stall through tactile/physical means (other than aural or visual) consisting of shaking of the cockpit controls or *aircraft* buffeting, or both.

3.1.2.12.9.3 Aural and Visual Stall Warning

3.1.2.12.9.3.1 Aural and Visual Cues for Stall Warning

The *aircraft* shall provide both aural and visual cues (via the *head-up type display*) when the *aircraft* is approaching a stall.

3.1.2.12.9.3.2 Aural and Visual Stall Warning Duration

The *aircraft* shall provide aural and visual stall *warnings* until recovery from approach to stall.

3.1.2.12.9.3.3 Aural and Visual Stall Warning Conditions

The *aircraft* aural and visual stall *warnings* shall be limited to the following:

a. Conditions that replicate landing configurations at all altitudes.
b. Any configurations below 5,000 feet Above Ground Level (AGL).

3.1.2.12.9.4 Stall Recovery

The *aircraft* shall enable the aircrew to prevent and recover from a stall by simple use of the pitch, roll, and yaw controls without excessive control forces, excessive loss of altitude or build-up of speed.

3.1.2.12.10 Buffet

There shall be no *aircraft* buffet that detracts from mission effectiveness except for stall *warning*.

3.1.2.12.11 Pilot-in-the-loop Oscillations (PIO)

The *aircraft* shall have no tendency for *PIO*.

3.1.2.12.12 Failures

No single *failure* of any *component* or combination of single independent *failures* shall result in loss of control or *flying qualities* worse than Level 2 (*Tolerable*); *Special Failure States* are excepted.

3.1.2.13 Flight Control System (including all store loadout configurations)

3.1.2.13.1 Augmentation Systems

3.1.2.13.1.1 Augmentation System Operation

Operation of stability augmentation and control augmentation systems and devices, including any performance degradation due to saturation, shall not introduce any *objectionable* flight or ground *handling characteristics*.

3.1.2.13.1.2 Augmentation System Performance Degradation

Any performance degradation of stability and control augmentation systems due to saturation of *components*, rate limiting, or surface deflections, shall only be momentary, and shall not introduce any *objectionable* flight or ground *handling characteristics*.

3.1.2.13.1.3 Flight Control System Operation

For all normal and failure states, flight control system operation shall not cause excessive transients or oscillations due to configuration and mode changes that may induce *PIO*, flutter, divergence, aeroelastic instabilities or loss of control on the ground and within the flight envelope.

3.1.2.13.2 Control Surface Displacement Rates

Control surface deflection rates shall not limit the ability of the *aircraft* to perform operational maneuvers in *common* and *uncommon atmospheric disturbances*. Control rates shall be adequate to retain stabilization and control in *extraordinary atmospheric disturbances*.

3.1.2.13.3 Cockpit Controller Characteristics

The *aircraft* pitch, roll, and yaw control forces and displacement shall be well balanced, not *objectionable*, and compatible with the aircrew ability to apply simultaneous control in all axes.

3.1.2.13.3.1 Cross-Coupling

No controller (continuous or discrete) that affects the motion of the *aircraft* shall create a secondary response that is *objectionable* (for Levels 1 and 2) or *dangerous* (for Level 3).

3.1.2.13.4 Control Centering

Pitch, roll, and yaw controls shall exhibit positive centering in flight at any normal trim setting.

3.1.2.13.5 Control Free Play

The cockpit controls (stick, rudder pedals, and throttle(s)) deadband and hysteresis shall not result in aircrew/*aircraft* interaction that may cause *PIO* or loss of control.

3.1.2.13.6 Control Linearity

There shall be no non-linearities within the integrated flight control system that may induce a departure, aircrew coupling, or loss of control.

3.1.2.14 Over-G Condition (including all store loadout configurations)

3.1.2.14.1 Warnings of Approaching G Limit

For *aircraft* configurations with an analog flight control system, the *aircraft* shall provide aural *warnings* of approaching the G limit for all *aircraft* configurations and weights.

3.1.2.14.2 G-limiter

The *aircraft* shall have an automatic G-limiter that prevents the aircrew from over-stressing the *aircraft* above limit loads, throughout the flight envelope, for all *aircraft* configurations and weights.

3.1.2.14.3 Over-G Feedback

The *aircraft* shall provide definitive feedback in the form of aural tones and visual cues in the *head-up type display* when an over-G condition occurs.

3.1.3 Structures

3.1.3.1 Design Service Life

The *design service life* of the *aircraft* fleet shall be sufficient for 22 years of operation, assuming a maximum utilization rate of 30.3 hours per month. The airframe *design service life* of each individual *aircraft* shall be 8,000 flight hours for the mission profiles and usage rates contained in APPENDIX A. The takeoff gross weight for each profile shall be at maximum fuel load for the *standard configuration* as noted for the profiles in APPENDIX A. (Note: Downloading of fuel for a particular mission to reduce the takeoff gross weight is not permitted.)

3.1.3.2 Materials, Processes, and Parts

MIL-STD-1530 design process shall be used for the structural design of the *aircraft*. The finish shall be compatible with corrosion control procedures as described in the Contractor-developed Corrosion Prevention and Control Plan, MIL-STD-1530, and MIL-STD-1568.

3.1.3.3 Fasteners

Fastener selection, installation, quality assurance (including screw threads and screw thread quality verification techniques), and joining methods shall be commensurate with the specified airframe operational and support requirements. Fasteners that could result in foreign object damage or loss of the *aircraft* if they separate from the structure shall have provisions to assure they are either retained on the structure or cannot become loose.

3.1.3.4 Corrosion Prevention and Control

The *aircraft system* shall include corrosion prevention and control measures for all *aircraft* structures and *components* as described in both MIL-STD-1530 and MIL-STD-1568 and using the guidance of the Corrosion Prevention and Control Planning Guidebook for Military Systems and Equipment.

3.1.3.4.1 Paint Scheme

The *aircraft* shall be painted in accordance with (IAW) an approved Air Education and Training Command (AETC) paint scheme using a Non-Hexavalent Chromium paint system that meets the current military aerospace applications for advanced performance requirements (in MIL-PRF-32239) for the *outer mold line* surfaces.

3.1.3.5 General Parameters and Conditions

3.1.3.5.1 Airframe Configurations

The airframe configurations shall encompass those applicable to flight and ground conditions of authorized use and usage missions of the *aircraft*.

3.1.3.5.2 Equipment and Stores

The airframe shall support and react the loads and motion of all equipment and stores required and expected to be carried by the *aircraft*.

3.1.3.5.3 Speeds

The ground and flight structural loads of the airframe shall include the *level flight maximum speed (V_H)*, the *limit speed (V_L)*, the *gust limit speed (V_G)*, and all other attainable speeds in conjunction with all configurations, gross weights, centers of gravity, thrust or power settings, altitudes, and usage spectra derived from the mission profiles.

3.1.3.5.4 Altitudes

The ground and flight structural loads of the airframe shall include all attainable altitudes in conjunction with all *aircraft* configurations, gross weights, centers of gravity, power, speeds, type of atmosphere, and usage derived from the mission profiles.

3.1.3.5.5 Limit Loads

The limit loads, to be used in the analysis of elements of the airframe subject to deterministic design criteria, shall be the maximum and most critical combination of loads that can result from ground and flight use of the *aircraft*, including maintenance activity and loads whose frequency of occurrence is greater than or equal to 1×10^{-7} per flight. All loads resulting from the requirements of this specification are limit loads unless otherwise specified.

3.1.3.5.6 Ultimate Loads

Ultimate loads shall be obtained by multiplying limit loads by a factor of safety of 1.5. These ultimate loads shall be used in the design of elements of the airframe and subsystems. The airframe and all subsystems shall not experience catastrophic *failure* when subjected to ultimate loads.

3.1.3.6 Structural Loads

3.1.3.6.1 Flight Loads

The *aircraft* shall perform (without degradation to the *aircraft* structures, *components*, and systems) to the following flight load factors.

3.1.3.6.1.1 Symmetric Maneuver Load Factors

The *aircraft* design limit load factor during symmetric maneuvers shall be -3.0 G to +8.0 G in the *aircraft* body axis for all speeds up to V_L. These load factors apply to the *basic flight design gross weight* and all lesser flight weights. At weights higher than the *basic flight design gross weight*, the design limit load factors shall be those that maintain a constant product of the aforementioned limit load factors and the *basic flight design gross weight*.

3.1.3.6.1.2 Asymmetric Maneuver Load Factors

The *aircraft* design limit load factor during asymmetric maneuvers shall be 67% of the positive symmetric load factor to -1 G for speeds up to V_L and all flight weights up to and including the *basic flight design gross weight*. At weights higher than the *basic flight design gross weight*, the design limit load factors shall be those that maintain a constant product of the aforementioned limit load factors and the *basic flight design gross weight*.

3.1.3.6.1.3 Pressurization

The pressure differentials applied in the pressurized portions of the airframe, including fuel tanks, shall be the maximum pressure differentials attainable during flight within the flight envelope, during ground maintenance, and during ground storage or transportation of the *aircraft*. The following pressurization load factors shall be applied:

a. For normal operations (level flight), the maximum pressure differentials attainable shall be increased by a factor not less than 1.33 when acting separately and when in combination with 1 G level flight loads and fuel inertia. The maximum pressure differentials attainable shall include effects of undetectable and uncontrollable pressure regulation system *failures* occurring with a probability of $>10^{-5}$ per flight.
b. For normal operations (maneuver and gust), the maximum pressure differentials attainable shall be increased by a factor not less than 1.00 when acting separately and when in combination with maximum and minimum flight loads and fuel inertia and shall include effects of undetectable and uncontrollable pressure regulation system *failures* occurring with a probability of $>10^{-5}$ per flight.
c. For normal ground operations including maintenance, the maximum pressure differentials attainable shall be increased by a factor not less than 1.33.

The primary structure shall withstand the effects of sudden release of pressure. The structure (including nonstructural panels, doors, etc.) shall not cause injury to properly restrained aircrew when such a rapid release of pressure occurs. *Failures* shall not degrade, damage, or cause to fail any other *components* of the flight control, fuel, hydraulic, or electrical systems.

3.1.3.6.1.4 Discrete Gust Loads

Discrete gust loads shall be included in the analysis of the structural capability of the *aircraft*. For discrete gust analysis, the *aircraft* shall be considered in straight, level, unyawed flight with the appropriate balancing horizontal tail load and trim vertical tail load. The *aircraft* shall encounter discrete vertical and lateral gust of design velocity at the specified speeds and critical weights. Design gust velocities shall be the following:

a. 66 feet per second (EAS) from 0 to 20,000 feet *PA* at V_G.
b. 50 feet per second (EAS) from 0 to 20,000 feet *PA* at V_H.
c. 25 feet per second (EAS) from 0 to 20,000 feet *PA* at V_L.
d. From 20,000 to 50,000 feet *PA*, reduce the limit gust velocities linearly from 66 feet per second (EAS) to 38 feet per second (EAS), 50 feet per second (EAS) to 25 feet per second (EAS), and 25 feet per second (EAS) to 12.5 feet per second (EAS).

3.1.3.6.1.4.1 Discrete Gust Formulas

Aircraft loads derived from the discrete gust approach shall not include possible benefits that may be derived from a stability augmentation system. Loads on *aircraft components* shall be derived using the gust load formulas specified in section C.2. These loads shall be balanced through the *aircraft* by linear and rotational inertial forces.

3.1.3.6.2 Ground Loads

The *aircraft* shall have sufficient structural integrity to operate, takeoff, and land on the ground under the appropriate parameters and conditions in attainable combinations. Required and expected to be encountered combinations of other applicable parameters of section 3.1.3 shall be considered. Lesser values of the following subsections are applicable in determining attainable combinations.

3.1.3.6.2.1 Landing Sink Speeds

The maximum landing touchdown vertical sink speeds of the *aircraft* center of gravity (CG) for the airframe and landing gear designs shall not be less than 13 feet per second for the *landing design gross weight* and 10 feet per second for the *maximum landing design weight*.

3.1.3.6.2.2 Ground Wind Loads

3.1.3.6.2.2.1 Mooring

The *aircraft* shall withstand a 70 knot wind from any horizontal direction relative to the *aircraft* with the *aircraft* secured in the static attitude using the appropriate equipment (e.g., chocks, gust locks, tie downs) without damage to the *aircraft*, for all *aircraft* weights. The *aircraft* shall be equipped with airworthy permanently installed tie down points. The *aircraft* shall have provisions for control surface gust locks necessary to meet the above mooring wind requirement.

3.1.3.6.2.2.2 Doors, Canopy, and Windshield

The transparency system, storage compartment doors, avionics bay doors, and engine cowling doors shall be capable of being maintained in their open position and shall withstand the loads resulting from a 35-knot steady wind from any horizontal direction combined with a vertical load factor (at the center of gravity) of 1.0 G ±0.5 G and horizontal load factor (in the most critical direction) of 0.5 G's. In addition, operation of the transparency system under the above conditions shall not result in detrimental effects upon the airframe.

3.1.3.6.2.2.3 Crosswinds Loads

The loads due to crosswinds at landing, take-off, or touch-and-go shall be those loads resulting from components of surface winds perpendicular to the runway centerline with the values stated in section 3.1.2.10.

3.1.3.6.3 Repeated Loads

All sources of repeated loads shall be considered and included in the development of the service loads spectra and shall not detract from the airframe *design service life*. Service Loads spectra shall be based on the mission usage profiles in APPENDIX A. Significant sources of repeated loads shall include, but are not limited to, the following six subsections for operational and maintenance conditions.

3.1.3.6.3.1 Maneuvers

The *aircraft* maneuver loads spectra shall be generated and based on a flight segmented mission approach utilizing the mission segment data documented in APPENDIX A. Each segmented mission profile shall be analyzed on the basis of the provided mission segment load factors with a rational distribution of weight, center of gravity, speed, altitude, and other significant parameters included. The spectrum shall be proportioned between symmetrical and asymmetrical maneuvers based on the mission mix and load factor exceedance data documented in APPENDIX A. The roll rate exceedance spectrum for asymmetric maneuvers shall be based on 20% of the symmetric maneuver segment.

3.1.3.6.3.2 Gusts

The gust loads spectra shall be based on the gust environment while flying the specified mission profiles in APPENDIX A and the gust loads spectra shall be determined utilizing the turbulence parameters in Table C-1 and the power spectral technique for developing gust loads as described in section C.3.

3.1.3.6.3.3 Landings

The landing loads shall be based on the number of landings (touch and go and full stop) documented in APPENDIX A. A rational analysis shall be used to determine and distribute (among the landing sink speed cumulative occurrences) the landing weights commensurate with the mission profiles in APPENDIX A.

3.1.3.6.3.4 Other Ground Loads

The taxi, braking, brake release, pivoting, turning, towing, and miscellaneous ground loads spectra shall include vertical, lateral, and longitudinal loads resulting from ground operation at operational weights. These spectra shall include the following items: (1) Braking occurrences per full-stop landings representative of operational usage; (2) Pivoting occurrences of once per ten full stop landings with 0.5 times the torque obtained from the design pivoting conditions; (3) Turning loads based on the occurrences in Figure C-1 with an equal distribution of right and left turns; (4) Taxiway, ramp, takeoff and landing, roll-out vertical loads spectra resulting from operation on prepared surfaces.

Dynamic taxi loads shall be based on the occurrences specified in Table C-2 for all weights up to and including the *maximum takeoff gross weight* (no reductions are permitted for fuel used during taxi and preflight operations). The effects of weight, CG position, mass distribution, ground speed, and landing gear characteristics shall be included.

3.1.3.6.3.5 Pressurization

The number of pressurization cycles shall be developed based on the number of flights documented in APPENDIX A and maintenance ground pressure checks.

3.1.3.6.3.6 Repeated Operation of Movable Structures

Impact, operational, and residual load occurrences to operation of movable structures shall be determined.

3.1.3.7 Bird Strike/Hail Impact

3.1.3.7.1 Transparency System Bird Strike Capability

The transparency system shall withstand the impact of a 4-pound bird with the corresponding *aircraft* speed listed below, in a manner consistent with normal flight without penetration, injury to either aircrew member, and without optical degradation of the transparency system below levels required for safe *aircraft* control and landing. There shall be no bird penetration into the cockpit through the associated support frame(s). If the *aircraft* has no separate windshield, the entire transparency system shall meet the windshield bird strike requirements.

Windshield: 450 KTAS or the *aircraft* maximum operational true airspeed that can be achieved at altitudes up to 7000 feet *PA* whichever is less, without penetration.

Canopy: If the canopy penetration airspeed is less than that of the windshield, it shall not experience material *failures* sufficient to cause incapacitation or injury to either aircrew or degrade *aircraft* performance such as to prevent safe *aircraft* control and landing after impact with a 4-pound bird at the lesser of 450 KTAS or the *aircraft* maximum operational true airspeed that can be achieved at altitudes up to 7000 feet *PA*.

3.1.3.7.2 Airframe and Engine Inlet Bird Strike Capability

The projected airframe frontal area including the engine air duct inlet(s) shall withstand the impact of a 4-pound bird with *aircraft* speeds at the lesser of 450 KTAS or the *aircraft* maximum operational true airspeed that can be achieved at altitudes up to 7000 feet *PA* and at the most adverse temperatures, in a manner consistent with normal flight without loss of the *aircraft* or incapacitation of either aircrew member.

3.1.3.7.3 Hail Impact Protection

The airframe shall withstand hail impact of 0.75-inch diameter on exposed surfaces, without damage while on the ground. (Note: Damage is defined as deformation, delamination, tearing or other structural change that would impair normal mechanical or aerodynamic performance or that, if left unattended, would cause a progressively worsened condition.)

3.1.3.8 Vibroacoustics

All airframe *components*, systems, and subsystems shall operate in the vibroacoustic environments that are commensurate with the required operational and non-operational parameters and all combinations thereof without *failure*. Non-operational environments consist of non-mission related time periods including, but not limited to, all ground operations and maintenance.

3.1.3.8.1 Aeroacoustics

All airframe structure, systems, and subsystems shall withstand the aeroacoustic loads and vibrations induced by the aeroacoustic loads for the service life of the *aircraft* without functional impairment. For design, and uncertainty factor of +3.5 decibel (dB) shall be applied on the predicted aeroacoustic sound pressure levels. For design fatigue life, a factor of 2.0 shall be applied on the exposure time derived from the service life and usage of APPENDIX A.

3.1.3.8.2 Vibration

The airframe structure, systems, and subsystems shall operate in the vibration environments that are commensurate with the required parameters of section 3.1.3 and all combinations thereof. Vibration sources include but are not limited to engine operation and aerodynamic disturbances. The airframe structure, systems, and subsystems shall be designed such that responses to vibratory loads do not result in fatigue cracking, interference, chafing, premature wear, loss of retention, or loss of mission functionality.

3.1.3.8.3 Aeroelastic Stability (Flutter and Divergence)

The *aircraft* shall have no flutter, divergence, and other dynamic aeroelastic or aeroservoelastic instabilities at all speeds up to 1.15 V_L for all conditions. In addition, the total (aerodynamic plus structural) in-flight damping coefficient at all speeds up to V_L, for any critical flutter mode or any significant dynamic response mode, shall be 3% (0.03).

3.2 Avionics

3.2.1 Communications

3.2.1.1 Multi-Band Radios

The *aircraft* shall provide for simultaneous and independent communication on at least two multi-band radios.

3.2.1.2 Ultra-High Frequency (UHF) Communication

The *aircraft* shall provide for simultaneous two-way UHF band communication (non-secured) that is interoperable with military UHF voice systems and concurrent with continuous monitoring of the UHF guard frequency.

3.2.1.3 Very High Frequency (VHF) Communication

The *aircraft* shall provide for simultaneous two-way VHF band communication (non-secured) that is interoperable with VHF voice systems and concurrent with continuous monitoring of the VHF guard frequency.

3.2.1.4 Simultaneous UHF and VHF Communication

The *aircraft* shall provide for simultaneous two-way VHF and UHF band communications (non-secured), interoperable with military and civilian voice systems.

3.2.1.5 Communication System Setup

The *aircraft* radios or mission computer shall provide both aircrew positions for manual setup of and software-driven (from pre-flight mission planning/data transfer device (DTD)) loading of all radio communication modes and radio frequency channel presets (at least 50 channels for each UHF and VHF respectively).

3.2.1.6 Emergency Locator Transmitter (ELT)

The *aircraft* shall have a tri-band ELT.

3.2.2 Navigation

3.2.2.1 Reduced Vertical Separation Minimum (RVSM)

The *aircraft* shall have flight management functions that provide for RVSM.

3.2.2.2 Global Positioning System (GPS)

The *aircraft* shall provide for Global Positioning System (GPS) Standard Positioning Services (SPS).

3.2.2.3 RNP/RNAV Navigation

The *aircraft* shall comply with the following civil aviation standards for departure, en route, terminal, and approach navigation: RNAV-2 / RNP-2 (en route), RNAV-1 / RNP-1 (terminal), RNP-0.3, and RNP Approach (RNAV (GPS)) procedures to LPV, LP, LNAV/VNAV, and LNAV lines of minima.

3.2.2.4 Tactical Air Navigation (TACAN)

The *aircraft* shall conduct TACAN departures, en route navigation, and approaches.

3.2.2.5 Air-to-Air TACAN

The *aircraft* shall conduct air-to-air TACAN ranging with other APT *aircraft* and ranging and bearing with properly equipped aircraft (e.g., tankers) in support of rendezvous and formations.

3.2.2.6 VHF Omni-Directional Range (VOR)/Distance Measuring Equipment (DME)

The *aircraft* shall provide for the conduct of VOR and VOR/DME departures, en route navigation, and approaches.

3.2.2.7 Instrument Landing System (ILS)

The *aircraft* shall provide for ILS Category 1 approaches.

3.2.3 Surveillance

3.2.3.1 Traffic Alert and Collision Avoidance System (TCAS)

The *aircraft* shall provide full TCAS II (Version 7 or later) surveillance functionality to enable operations in RVSM airspace.

3.2.3.2 Automatic Dependent Surveillance-Broadcast (ADS-B) Out

The *aircraft* shall provide for ADS-B Out via 1090 extended squitter (1090ES).

3.2.3.3 ADS-B In

The *aircraft* shall provide for ADS-B In with a Cockpit Display of Traffic Information (CDTI), for Traffic Information Services and include ADS-B In for Flight Information Services-Broadcast (FIS-B) information.

3.2.3.4 Transponder

The *aircraft* shall include a transponder that provides for simultaneous operation of selective identification feature (SIF) modes (Modes 1, 2, 3/A, and C), Mode S, and TCAS.

3.2.3.5 Terrain Warning and Avoidance

SEE APPENDIX D.

3.2.4 Datalink and Network Connectivity

3.2.4.1 Embedded Training Datalink

The *aircraft* shall have a National Telecommunications and Information Administration (NTIA) spectrum-certifiable, two-way, line-of-sight datalink that provides multi-access network connectivity for the *Embedded Training* capability in section 3.6.

3.2.4.2 Connectivity Region (Local Flying Area)

The datalink shall provide sufficient *link margin* and antenna coverage to maintain aircraft-to-aircraft (participant-to-participant) connectivity over a distance of at least 100 NM (line-of-sight) and an envelope of operation from surface to *aircraft service ceiling* (line-of-sight) during all APT syllabus maneuvers and the mission profiles listed in APPENDIX A.

3.2.4.3 Maximum Simultaneous Load

The datalink shall have sufficient *data rate* (throughput) and no *objectionable latency* to support up to 52 *aircraft* operating concurrently in any combination of single-ship and multi-ship (up to 8 participants) missions within the Connectivity Region of the datalink.

3.2.4.4 Multiple Concurrent Missions

The datalink shall provide for the conduct of independent (mutually exclusive) missions being conducted concurrently within the Connectivity Region of the datalink. (Note: Mutually exclusive means there is no interface allowed between missions.)

3.2.4.5 Ground Based Training Systems (GBTS) Connectivity

SEE APPENDIX D.

3.2.4.5.1 GBTS Voice Communication

SEE APPENDIX D.

3.2.4.6 Ground Support Station (GSS) Connectivity

SEE APPENDIX D.

3.2.4.6.1 GSS Voice Communication

SEE APPENDIX D.

3.2.4.6.2 GSS Live Monitoring

SEE APPENDIX D.

Table 3-3, GSS Live Monitoring Functions and Display Presentation

SEE APPENDIX D.

3.3 Propulsion System

3.3.1 Fuel Consumption

The engine(s) shall have a sea-level static, standard day thrust-specific fuel consumption (TSFC), uninstalled in an engine production test cell, less than or equal to the following:

a. Cruise: 0.864 lbm/lbf-hr
b. Max Dry: 0.930 lbm/lbf-hr
c. Max Afterburner: 1.980 lbm/lbf-hr (only for engine configurations with afterburner)

3.3.2 Engine Starts

The engine(s) shall satisfactorily make ground starts/restarts IAW section 3.3.2.4 and air starts/restarts IAW section 3.3.2.5 while complying with requirements in sections 3.3.2.1 through 3.3.2.3 for both ground and altitude air starts.

3.3.2.1 Environmental Conditions for Engine Starts

The engines(s) shall start under the climatic and environmental conditions stated in section 3.9.

3.3.2.2 Fuel and Oils for Engine Starts

The engines(s) shall start using the fuels specified in section 3.11.1 and oils specified in section 3.11.2 unless specified otherwise.

3.3.2.3 Thrust Demand at Start

Within the engine starting limits, the engine(s) shall be capable of starting with the thrust or power demand at idle or above, and within 120 seconds of the initiation of engine start, being accelerated to any power request at any rate without stall and without exceedance of steady-state engine limits beyond the power transient allowance for stable engine operation.

3.3.2.4 Engine Ground Starts

3.3.2.4.1 Ground Start Cycles

The engine(s) shall be capable of three consecutive start cycle attempts with a maximum time interval of 60 seconds between the completion of one cycle and the initiation of the next cycle.

3.3.2.4.2 Altitude Range for Ground Starts

The engine(s) shall ground start at *PA* from -2,000 to 7,000 feet.

3.3.2.4.3 Wind Speed for Ground Starts

The engine(s), installed in the *aircraft*, shall ground start with wind speeds up to 30 knots from any direction.

3.3.2.4.4 Hot Temperature Soak Start

The engine(s) shall ground start after a 12-hour hot soak at an ambient temperature of at least 110° F with inlet air, fuel, and oil temperatures of at least 110° F. Following shutdown, the engine(s) shall start after a re-soak period of 30 minutes with inlet air, fuel, and oil at a temperature of at least 110° F.

3.3.2.4.5 Cold Temperature Soak Start

The engine(s) shall ground start after a 12-hour cold soak at an ambient temperature of -25° F with inlet air, fuel, and oil temperatures at -25° F. Following shutdown, the engine(s) shall start after a re-soak period of 30 minutes with inlet air, fuel, and oil at a temperature of -25° F.

3.3.2.5 Engine Air Starts

The engine(s) shall air start at *PA* from -2,000 to 25,000 feet or *aircraft service ceiling*, whichever is less, and airspeeds within the *aircraft* air start envelope.

3.3.3 Automatic Relight

The engine(s) shall incorporate an automatic relight system that shall detect any flameout that may have occurred and initiate a sequence for automatic recovery anywhere in the engine operating envelope. Successful recovery from flameout conditions at altitudes and air speeds outside of the air start envelope (described in section 3.3.2.5) may require aircrew actions to complete. Once in the air start envelope, the automatic relight system shall recover from any flameouts without aircrew action. The automatic relight system shall not cause engine stalls, hot starts, hung starts, mechanical damage or inhibit a successful aircrew-initiated air start.

3.3.4 Shutdown

3.3.4.1 Fuel Flow Termination

Upon receiving a signal from the *aircraft* for stopping, the engine(s) shall terminate fuel flow in any operating condition.

3.3.4.2 Power Setting at Shutdown

Stopping of the engine from any power setting (including augmentor, if installed) or at any rate shall not:

a. Result in exceedance of any Propulsion System limits.
b. Adversely impact Propulsion System durability, structural integrity or operational capability.
c. Delay a satisfactory start per Technical Order operating procedures.
d. Experience any post shutdown fires.
e. Result in any damage to the engine as a result of shutting off the fuel supply by moving the throttle to the shutdown position or from shutting off the fuel supply to the engine inlet connection during any engine operating condition.

3.3.5 Stall-Free Operation

The engine(s) shall be stall-free throughout the flight envelope and in any combination of the following:

a. Climatic and environmental conditions as stated in section 3.9.
b. *AOA* range.
c. Sideslip range.
d. Steady-state or transient conditions.
e. Engine start and shutdown.

3.3.6 Thrust Control

The engine(s) control system shall prevent the engine from exceeding any aero-thermodynamic and mechanical limits. The control system shall modulate engine(s) thrust in response to *aircraft* thrust request signal from cutoff to maximum power and all positions in between. The relationship between thrust and *aircraft* thrust request signal shall be essentially linear, with no *objectionable* hysteresis for all flight maneuvers (see APPENDIX A). The engine(s) shall remain operable at throttle positions of idle and above and during thrust excursions below idle when the throttle is not in the cutoff position.

3.3.7 Thrust Transients

Thrust or power requests in any sequence and at any rate for both primary and backup control modes shall not result in exceeding any engine operating limit (including over speed and over temperature), result in unstable operation, stall, surge, or flameout of the engine and shall not cause any mechanical damage. Main combustor blowout margins shall be sufficient to protect against blowouts or flameouts during any throttle movements for all operating conditions.

3.3.8 Thrust Stability, Droop and Overshoot

During steady state operating conditions in both the Primary and Secondary Control modes, engine thrust fluctuations shall not exceed ±1.0% of 90% intermediate thrust between idle and 90% intermediate thrust conditions or ±5.0% of the thrust available at the power lever position, whichever is less. During operation above 90% intermediate thrust, fluctuations shall not exceed ±1.0% of the thrust available at that condition. During operation at idle, the engine shall be stable within ±60 rpm fan speed. During transient flight conditions, the engine(s) shall not have a thrust droop below 3% of the flight condition's steady-state thrust.

3.3.9 Thrust Demand and Retention

The engine(s) shall be able to meet all *aircraft* demands without a loss in thrust-rate-of-change and operability between scheduled engine removals for *Depot-Level maintenance*. The engine(s) shall have thrust retention between scheduled engine removals for *Depot-Level maintenance*. (Note: Thrust retention is defined as thrust not reducing below a new engine thrust level.)

3.3.10 Engine Fire/Overheat Indication

The *aircraft* shall provide an indication that warns the aircrew of an engine fire and overheat condition. The engine fire/overheat indication system shall have a separate *warning* per engine

in each cockpit. No single point *failure* of the fire/overheat detection system shall cause the loss of the fire/overheat *warning* system or prevent *warning* of the aircrew of a fire/overheat hazard.

3.3.11 Engine Design Service Life

The engine shall have a *design service life* of at least one-half the *aircraft design service life* of 8,000 hours when subjected to the design usage of APPENDIX A and the engine duty cycle in accordance with MIL-STD-3024. In addition, the engine shall be able to withstand 10 hours of operation at any point in the envelope for both hot and cold parts.

3.3.11.1 Hot Parts Design Service Life

Hot parts shall have a usable life of one-half (0.5) times the engine *design service life* specified in 3.3.11.

3.3.11.2 Cold Parts Design Service Life

Cold parts shall have a usable life of one (1) times the engine *design service life* specified in 3.3.11.

3.3.12 Atmospheric Liquid Water Ingestion

The engine shall start and operate satisfactorily with 5% of the total airflow weight in the form of water (liquid and vapor), with 50% of the liquid water entering the inlet through a segment equivalent to one-third of the inlet area.

3.3.13 Bird Ingestion

The engine shall continue to operate and perform during and after the ingestion of birds as specified in Table 3-4.

Table 3-4, Bird Ingestion

Bird Size	Number of Birds Note 5	Bird Velocity	Thrust/Power Setting	Percent Thrust/Power Retention	Thrust/Power Recovery Time	Damage
100 gm (3.5 oz)	Note 1	Takeoff Speed	Intermediate Power	≥ 90%	≤ 5 Sec	Blendable
100 gm (3.5 oz)	Note 1	Cruise Speed	Intermediate Power	≥ 90%	≤ 5 Sec	Blendable
100 gm (3.5 oz)	Note 1	Low Level Speed	Intermediate Power	≥ 90%	≤ 5 Sec	Blendable
100 gm (3.5 oz)	Note 1	Descent	Intermediate Power	≥ 90%	≤ 5 Sec	Blendable
1 kg (2.2 lbs)	Note 2	Takeoff Speed	Intermediate Power	≥ 75%	5 – 10 Sec	Minor
1 kg (2.2 lbs)	Note 2	Cruise Speed	Intermediate Power	≥ 75%	5 – 10 Sec	Minor
1 kg (2.2 lbs)	Note 2	Low Level Speed	Intermediate Power	≥ 75%	5 – 10 Sec	Minor
1 kg (2.2 lbs)	Note 2	Descent	Intermediate Power	≥ 75%	5 – 10 Sec	Minor
2 kg (4.4 lbs)	Note 3	Takeoff OR Low Level Speed	Intermediate Power	Note 4	N/A	Contain Failure

Notes:

1. One 100 gm (3.5 oz) bird per 300 cm2 (46.5 in2) of inlet area plus any fraction larger than 50% thereof, up to a maximum of 16 birds.
2. One 1 kg (2.2 lb.) bird per 1500 cm2 (232.5 in2) of inlet area plus any fraction larger than 50% thereof.
3. One 2 kg (4.4 lb.), regardless of the size of the inlet, provided the inlet is large enough to admit a 2 kg (4.4 lb.) bird.
4. The 2 kg (4.4lb.) ingestion should not cause an engine failure that results in damage to the *aircraft* or adjacent engines. No bird ingestion should prevent the engine from being safely shutdown.
5. The 100 gm (3.5 oz) birds should be ingested at random intervals and be randomly dispersed over the inlet area. Birds 1 kg (2.2 lb.) and larger should be directed at critical areas of the engine face.

3.3.14 Distortion Intensity Levels

The engine shall not surge, stall, flameout, or incur any damage with the steady-state or time variant inlet pressure distortion levels up to limits at the aerodynamic interface plane throughout the *aircraft* angle-of-attack and sideslip envelope.

3.3.15 Damage Tolerance

Fracture-/safety- and mission-critical engine parts shall be able to maintain adequate damage tolerance in the presence of material, manufacturing, processing, and handling defects for the engine *design service life* and design usage specified in 3.3.11 and APPENDIX A and the engine duty cycle in accordance with MIL-STD-3024.

3.3.16 Ice Ingestion

The engine shall operate and perform per Table 3-5, during and after ingestion of hailstones and sheet ice at the takeoff, cruise, and descent *aircraft* speeds. The engine shall not be damaged beyond field repair capability after ingesting the hailstones and ice.

Table 3-5, Ice Ingestion

Dimensions	Number	Velocity	Thrust/Power Setting	Percent Thrust/Power Retention	Thrust/Power Recovery Time	Specific Gravity
Hailstone Diameter	Note 1	Takeoff, Cruise & Descent Speeds	Takeoff, Cruise & Descent	$\geq$ 95%	$\leq$ 5 Sec	.80 g/cm^3
Sheet Ice Various size/shape	5 pieces Note 2	Takeoff & Cruise Speeds	Takeoff & Cruise	$\geq$ 95%	$\leq$ 5 Sec	.80 g/cm^3

Notes:

1. For inlet capture area of 0.065 m^2 (100 in^2) the engine should be capable of ingesting one 25 mm (1.0 in) diameter hailstone. For each additional 0.065 m^2 (100 in^2) increase of the initial capture area, supplement the first hailstone with one 25 mm (1.0 in) and one 50 mm (2.0 in) diameter hailstone.
2. One piece weighing at least 0.34 kg (0.75 pounds).

3.3.17 Sand and Dust Ingestion

The engine shall meet all requirements of the specification during and after the sand and dust ingestion event specified herein. The engine shall ingest air containing sand and dust particles in a concentration of 53 mg sand/m^3. The engine shall ingest the specified coarse and fine contaminant distribution defined in Table 3-6 for 0.5 and 1.5 hours, respectively. The engine shall operate at intermediate thrust for the specified concentration of sand and dust particles, with no greater than 10% loss in thrust or power, and 10% gain in specific fuel consumption (SFC).

Table 3-6, Particle Size Distribution Guidance

	Particle Size Microns (inches)	Cumulative % by Weight
Coarse Sand*	1,000 (3.94×10^{-2})	100
	707 (2.78×10^{-2})	95-99
	500 (1.97×10^{-2})	89-93
	354 (1.39×10^{-2})	77-81
	250 (9.84×10^{-3})	60-64
	177 (6.97×10^{-3})	38-42
	125 (4.92×10^{-3})	18-22
	88 (3.46×10^{-3})	6-10
	63 (2.48×10^{-3})	1-5
Fine Sand**	1,000 (3.94×10^{-2})	100
	500 (1.97×10^{-2})	85-90
	250 (9.84×10^{-3})	70-75
	125 (4.92×10^{-3})	50-55
	75 (2.95×10^{-3})	25-30
	<75 (2.95×10^{-3})	10-15

* Composition is crushed quartz (SiO_2).
** Composition is 60% quartz (SiO_2), 26% gypsum (hydrated $CaSO_4$), 12% calcite ($CaCO_3$), and 2% soluble salts. Soluble salts shall all be <75 microns in particle size.

3.4 Vehicle Subsystems

3.4.1 Fuel Subsystem

3.4.1.1 Pressure Refuel and Defuel

The *aircraft* shall have single point pressure refueling and single point pressure defueling through MIL-A-25896 servicing adapters.

3.4.1.2 Gravity Refuel and Defuel

The *aircraft* shall be capable of being gravity refueled and gravity defueled.

3.4.1.3 Fuel Transfer

The *aircraft* shall provide for automatic transfer of all the usable fuel to the engine(s) without action by the aircrew to control fuel sequencing while remaining within the allowable range of gross weight, balance, and center of gravity limits.

3.4.2 Aerial Refueling Subsystem Growth Path (Receiver)

The *aircraft* shall provide a growth path and have adequate performance margins for the installation of a fully integrated receptacle aerial refueling system that will enable it to aerial refuel as a receiver during day and night operations from USAF KC-135 and KC-10 tanker boom systems using North Atlantic Treaty Organization (NATO) Allied Tactical Publication (ATP) 3.3.4.2 (Chapter 2) procedures and with the KC-46 tanker boom system. The growth path and adequate performance margins shall include, but are not limited to, sufficient allocations in fuel on-load rate, physical space, added system weight, electrical power demand, hydraulic power

demand, and cooling. The *aircraft* growth path shall permit the *aircraft* to be aerial refueled from 15% fuel capacity to maximum fuel capacity or to its maximum in-flight gross weight (whichever is least) in less than 8 minutes. The installation of a receptacle refueling system shall not require significant structural modifications or movement/redesign of other systems and subsystems. The projected location of the receptacle shall result in the following:

a. *Aircraft handling qualities* shall be adequate to perform the aerial refueling process up to and including the contact-uncoupled position.
b. In *common atmospheric disturbances*, *aircraft* handling quality ratings shall be no worse than Level 1 (*Satisfactory*) and exhibit no *PIO* within the receiver's refueling envelopes/capabilities behind the KC-10, KC-135, and KC-46, defined below for each tanker, for all air vehicle normal states.
c. In c*alm air*, the overall probability of exhibiting Level 2 (*Tolerable*) *flying qualities* due to one or more *failures* shall be less than 10^{-3} per flight hour within the Region of Satisfactory Handling (ROSH), and the overall probability of degrading to Level 3 (Controllable) *handling qualities* due to one or more *failures* shall be less than 10^{-4} per flight hour within the ROSH.
d. In *uncommon atmospheric disturbances*, *flying quality* ratings shall be no worse than Level 2 (*Tolerable*) and *PIO* Rating 2 (as defined in MIL-STD-1797B, Figure 19) within the ROSH for all Air Vehicle States (Normal, Extreme, and Failure States). The overall probability of Level 3 (Controllable) *flying qualities* shall be less than 10^-4 per flight hour in all conditions. If the Failure Mode, Effects and Criticality Analysis (FMECA) shows that a series yaw damper *failure* is critical, then lateral-directional *flying qualities* shall be no worse than Level 2 (*Tolerable*) following *failure*.
e. Each aircrew shall be capable of monitoring the information provided by the tanker's Pilot Director Lights from the pre-contact position to the contact-uncoupled position and when connected, throughout the tanker boom system's disconnect envelope.
f. Receiver shall not cause the tanker's flight stability and control to be inadequate during the aerial refueling process (from pre-contact position, contact position and when connected, throughout the tanker boom system's disconnect envelope).
g. Boom operator visibility of the "receptacle location" and its surrounding area shall be adequate while the *aircraft* is in the contact-uncoupled position.
h. The receiver shall not cause the boom stability to be inadequate such that the tanker boom operator cannot effectively and safely maneuver the boom to and from the receptacle during contact/disconnect sequences in the aerial refueling process.
i. The entire boom envelope for each targeted tanker shall be able to be used while maintaining adequate clearance between the *aircraft* and the tanker/tanker's boom.
j. Noise levels created during aerial refueling process shall not be so excessive as to interfere with aircrew duties.
k. Boom path to/from contact-uncoupled position shall not impact *aircraft* flight control system, engine, and other subsystems.

(Note: Growth path is defined as the designs, plans, margins, and capacities exist for the following: primary structure, Group A *components* and wiring, hydraulic power, pneumatic power, electrical power and cockpit accommodations for controls. For *aircraft* configurations fully integrating aerial refueling capability (3.4.2.1), the intent is that the growth path and

performance margins will be utilized/consumed in the implementation of the objective requirement.)

3.4.2.1 Aerial Refueling Subsystem Full Integration (Receiver)

SEE APPENDIX D.

3.4.3 Environmental Control Subsystem (ECS)

The *aircraft* shall have a self-contained ECS that provides temperature, humidity, ventilation, and pressurization control to cockpit, *components,* and airframe. The ECS shall also meet specified performance during *aircraft* airborne and ground operations, and in the climatic environment in which the *aircraft* is intended to operate (see section 3.9).

3.4.3.1 Heating Performance (Cold Soak)

During ground operations, after a 12-hour cold soak at an ambient temperature of -25° F, with canopy closed, engine(s) running (simultaneous auxiliary power unit (APU) operation is acceptable), outside ambient temperature of -25° F, and ECS set at predefined temperature setting, the ECS shall perform as follows:

a. At 5 minutes of ECS operation, *pilot envelope temperature* shall be at least 5° F.
b. At 10 minutes, *pilot envelope temperature* shall be at least 35° F.
c. At 15 minutes, *pilot envelope temperature* shall be at least 60° F.

3.4.3.2 Cooling Performance (Hot Soak)

During ground operations, after a 12-hour hot soak at an ambient temperature of 110° F, with canopy closed, engine(s) running (simultaneous APU operation is acceptable), outside ambient temperature of 110° F, and ECS set at predefined temperature setting, the ECS shall perform as follows:

a. At 5 minutes of ECS operation, *pilot envelope temperature* shall be less than 90° F.
b. At 8 minutes, *pilot envelope temperature* shall be less than 85° F.
c. At 15 minutes, *pilot envelope temperature* shall be no greater than 80° F.

3.4.3.3 Temperature Range

During airborne operations, *pilot envelope temperature* range shall be maintained between 60° and 80° F.

3.4.3.4 Temperature Variation

During airborne and ground operations, the ECS shall provide sufficient air distribution so that the maximum temperature variation between any two measurement points in the *pilot envelope temperature* is less than 10° F.

3.4.3.5 ECS Controls

The ECS shall have synchronized temperature control (set point) between cockpits and be adjustable at each aircrew position.

3.4.3.6 ECS Alerts

The *aircraft* shall provide visual and audible *warnings/cautions/advisories* when the ECS is operating outside of limits, including the following:

a. Problems with heating/cooling supply air or when operating on alternate cooling
b. When the cockpit *pressure altitude* is out-of-limits for the *aircraft* operating altitude.

3.4.3.7 Anti -Fog -Frost & -Ice

The *aircraft* shall maintain the canopy and windscreen surfaces (interior and exterior) free of fog, frost and ice for all ground and airborne operating conditions and provide provisions to prevent overheat of the transparency surfaces.

3.4.3.8 Equipment Cooling

The ECS shall provide cooling to avionics *components* during maximum ambient temperatures while maintaining cockpit pressurization and cooling requirements. The provided cooling air shall be consistent with equipment design specifications.

3.4.3.9 Alternate Cooling

The ECS shall provide alternate cooling method(s) to the *components* and cockpit in the event of *failure* of the normal cooling method. The alternate cooling method(s) shall provide safe operating temperatures for flight critical *components*.

3.4.3.10 Cockpit Pressurization

During airborne operations, the ECS shall limit the maximum rate of pressure change to 0.2 psi/second during normal operation and 0.5 psi/second during emergency operation. During airborne operations, the ECS shall provide a cockpit pressurization schedule as follows:

a. Unpressurized from sea level to 8.000 feet *PA.*
b. 8,000 feet isobaric *PA* between 8,000 and 23,000 feet *PA.*
c. 5.0 psi differential between atmospheric pressure above 23,000 feet *PA.*

3.4.3.11 Air Contamination

The ECS shall not introduce noxious and toxic contaminants to the cockpit during normal operating conditions (and single *failure* for dual ECS configurations). The *aircraft* shall have provisions to shut off all air flow to prevent excessively hot air, smoke, fumes, toxic gases, and other contaminants from entering the cockpit. Fresh air ventilation for contaminant and odor removal shall be available to each cockpit.

3.4.3.12 Bleed Air Ducting (if utilized)

The bleed air ducting shall withstand *aircraft* structural deflection resulting from maximum G maneuvers. The bleed air ducting shall withstand conditions resulting from maximum thermal expansion. The *aircraft* shall provide bleed air leak detection. The *aircraft* shall provide bleed air shutoff capabilities as close to the pressure source as possible.

3.4.3.13 Moisture Control

The ECS shall control cooling air to prevent condensation and moisture contamination of forced air cooled equipment. The ECS shall control entrained moisture of cooling air to prohibit water droplets and fog from entering the cockpit.

3.4.4 Braking

The *aircraft* shall have an anti-skid braking subsystem with the capability to stop the *aircraft* on an 8,000-foot runway under the conditions defined in section 3.1.2.8 for takeoff and section 3.1.2.9 for landing without the use of a drag chute.

3.4.4.1 Parking Brake

The *aircraft* shall have a parking brake.

3.4.5 Electrical Power Subsystem

The *aircraft* shall have a self-contained primary electrical power subsystem compatible with MIL-STD-704 that provides sufficient power IAW MIL-E-7016 with Amendment 1 (without use of APU) for simultaneous operation of all *aircraft* systems and subsystems required during a given phase of operation, airborne and ground, and in any climatic environment in which the *aircraft* is intended to operate.

3.4.5.1 Power Source Switching

All flight-critical electric utilization *components* shall operate without degradation or re-initialization when supplied power in accordance with MIL-STD-704 during normal, abnormal, emergency, or transfer operation, including transfers from external power. The *embedded training* subsystem shall operate without degradation or re-initialization when supplied power in accordance with MIL-STD-704 during normal or transfer operation, including transfers from external power.

3.4.5.2 External Power Compatibility

The electrical power subsystem shall operate under external power supplied IAW SAE-ARP5015.

3.4.5.3 External Power Receptacle

The *aircraft* shall provide an external power receptacle IAW SAE-AS90362 that is accessible by ground personnel without use of support equipment, to include while the engine(s) is running.

3.4.5.4 Emergency Power

In the event primary power is unavailable, the *aircraft* shall have an emergency power source that provides for continued safe flight operations with power to not less than one multi-band radio, *intercommunications control system (ICS)*, fire *warning* light(s), emergency lighting, and backup flight instruments (airspeed, altitude, vertical velocity, three-axis attitude, and magnetic heading) at both aircrew positions for not less than 30 minutes to enable safe landing under

Instrument Meteorological Conditions (IMC). Power provided to flight-critical equipment shall be uninterruptable when transitioning to emergency power.

3.4.5.5 Aircraft Start-Up

The *aircraft* shall include a power source with sufficient capacity to provide self-energizing of *aircraft* electrical systems and *components* necessary to monitor engine(s) start (as a minimum: engine instrumentation, APU/Jet Fuel Starter (JFS) instrumentation if applicable, *caution* and *warning* indications, and ICS/UHF/VHF communication) and start the *aircraft* engine(s) (at least 2 engine start attempts at 0° F and at least 2 start attempts at 110° F), without the use of external ground support equipment.

3.4.5.5.1 External Electrical Power

The engine(s) shall also be capable of starting with external power connected to the *aircraft*.

3.4.5.6 Electrical Wiring Interconnection

The electrical wiring interconnection system shall be designed and installed in accordance with SAE-AS50881.

3.4.6 Hydraulic Subsystem (if utilized)

The hydraulic system shall be sized to meet the demand resulting from the use of simultaneously operating *components*.

3.4.6.1 Hydraulic System Redundancy

The hydraulic system shall be designed to maintain Level 2 (*Tolerable*) *flying qualities* after any single hydraulic system *failure*.

3.4.6.2 Hydraulic System Integrity

The hydraulic system shall be designed to withstand proof and burst pressures as defined in SAE-AS5440, paragraph 3.6.3.1. The hydraulic system shall be designed to preclude surge pressures as defined in SAE-AS5440, paragraph 3.6.3.

3.5 Crew Systems

3.5.1 Human Performance and Human Engineering

The *aircraft* controls, displays, access panels, and all other human-machine interfaces shall be developed, and designed from a human-centered approach that considers the physical, cognitive and sensory skills, capabilities, and limitations of the personnel who operate, support, maintain, and train on the system, IAW the human engineering criteria of MIL-STD-1472, as applicable. (Note: MIL-STD-1472 tailoring for applicability will be mutually agreed to/approved by the program office and recorded via Contract Data Requirements List (CDRL).)

3.5.2 Cockpit Configuration

Each cockpit shall provide for aircrew to independently operate and control the *aircraft* through all phases of flight, and to individually perform all actions necessary to recover the *aircraft*, to include engine shut down and emergency landing gear extension (e.g., either aircrew incapacitated situation).

3.5.2.1 Cockpit Commonality

The configuration, location, and actuation of all controls and displays that are common between cockpits shall be identical in each cockpit, to the maximum extent possible.

3.5.3 Cockpit Stowage

Each cockpit shall provide storage space that measures a minimum of 4 inches in width, 12 inches in length and 12 inches in height; that is within reach of the aircrew; and that secures personal gear consisting of one empty helmet bag and one flight publications bag, during all expected training maneuvers (see APPENDIX A).

3.5.4 Safety Devices and Streamers

Safety devices (pins, clips, locks, etc.) shall be used to safe critical *components*. All removable safety devices shall have streamers. Stowage for cockpit safety devices shall be provided in each cockpit.

3.5.5 Aircrew Physical Anthropometrics

The cockpit, including the escape, system shall accommodate (see section 3.5.6, Anthropometric Accommodation) the anthropometric range defined in Table 3-7 and Table 3-8, while wearing the USAF-required personal flight equipment listed in Table 3-16. (Note: The anthropometric range is defined as multivariate anthropometric cases 1-7 and will be used for meeting the reach requirements as defined in section 3.5.7.)

Table 3-7, Anthropometric Cases 1-7

Attribute	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Thumb tip reach*	27.0	27.6	33.9	29.7	35.6	36.0	26.1
Buttock-knee length*	21.3	21.3	26.5	22.7	27.4	27.9	20.8
Knee-height sitting*	18.7	19.1	23.3	20.6	24.7	24.8	18.1
Sitting height*	32.8	35.5	34.9	38.5	40.0	38.0	31.0
Eye height sitting*	28.0	30.7	30.2	33.4	35.0	32.9	26.8
Shoulder height *sitting	20.6	22.7	22.6	25.2	26.9	25.0	19.5
Shoulder breadth range*	14.7 - 18.1	16.4 - 20.6	16.2 - 21.2	16.8 - 21.7	16.9 - 22.6	16.8 - 22.5	14.2 - 18.0
Chest depth range*	7.4 - 10.9	6.9 - 10.6	7.2 - 11.3	7.1 - 11.0	7.3 - 12.1	7.4 - 12.2	7.2 - 10.2

Thigh circumference range*	18.5 -25.0	17.1 - 25.0	20.2 - 27.6	17.6 - 26.3	18.6 - 29.2	19.1 - 29.7	17.8 - 25.2
Weight (nude)	103 – 245 lbs.						

*Measured in inches

Table 3-8, Anthropometric Cases 1-7 (Additional Characteristics)

Attribute	Measurement Range
Forearm to forearm breadth (seated)	15.4 - 28.1 inches
Hip breadth (seated)	12.3 - 20.0 inches
Shoulder to elbow length (arm flexed)	11.5 - 16.7 inches
Elbow to fingertip length (arm flexed)	15.0 - 22.6 inches
Buttock to popliteal fossa length (leg flexed)	16.5 - 23.5 inches
Popliteal height sitting	12.8 - 19.9 inches
Boot size (U.S.)	5 - 13
Abdomen Depth	6.4 - 14.8 inches
Hand Length	6.2 - 8.9 inches
Hand Breadth	2.6 - 4.0 inches

3.5.6 Anthropometric Accommodation

The cockpit shall meet the following criteria for anthropometric accommodation, while wearing the USAF-required personal flight equipment listed in Table 3-16:

a. Reach and strength to operate all controls and displays, under the appropriate conditions.
b. Reach, strength, and clearance to achieve the full operational range of the rudders, throttles, brakes, and control stick. Full operational range is defined as the range of control motion required to accomplish all APT syllabus maneuvers and the mission profiles (see APPENDIX A), recover from all common student errors, and recover from all unusual attitudes.
c. Clearance to safely escape or eject without striking cockpit or other *aircraft* structures (reference section 3.5.20.5, Ejection Seat Clearance).
d. Room to allow proper body posture before ejection.
e. Capability to safely eject the specified aircrew weight range and anthropometric cases (Table 3-7, Anthropometric Cases 1-7 and Table 3-8, Anthropometric Cases 1-7 (Additional Characteristics)) while meeting the requirements of section 3.5.20.
f. Room to allow movement for visual checks (e.g., directly behind and above the *aircraft*).
g. Internal vision to perform all flight tasks, including, but not limited to, the ability to see all instruments, displays (including all *head-up type display* symbology with aircrew seated in the *Zone 1 Reach Conditions*), *cautions*, and *warnings*.
h. External vision as described in section 3.5.17.2.

3.5.7 Cockpit Reach

For the anthropometric range of aircrew member population contained in section 3.5.5, the cockpit shall be configured to allow operation and reach to the controls listed in Table 3-9 and Table 3-10 for *Zone 1 Reach Conditions* and *Zone 2 Reach Conditions*, respectively. All other required in-flight operation and reach of controls not contained in *Zone 1 Reach Conditions* and *Zone 2 Reach Conditions* shall be capable of being performed for *Zone 3 Reach Conditions*.

Table 3-9, Zone 1 Required Controls

All primary and secondary in-flight escape system controls
Throttle, Full Operational Range (Idle to Mil Power)
Rudder Pedals, Full Operational Range
Control Stick, Full Operational Range
Inertial lock manual selector
Recoupling Flight Controls Switch (for *aircraft* implementing flight control decoupling function of rear *Hands-On Throttle and Stick (HOTAS) controls*, section 3.5.14.1.4)

Table 3-10, Zone 2 Required Controls

Throttle, Full Operational Range (Idle to Afterburner, if installed)
Flap Controls
Landing gear controls
Life Support Connections
Emergency Ground Egress Controls
Any other control expected to be used during Safety Critical Emergency Procedure(s)

3.5.8 Aircrew Workload

Aircrew workload associated with all aircrew interfaces shall be maintained below a level 7 on the Bedford Workload rating scale under all aircrew tasks to include *embedded training* tasks, and all APT syllabus maneuvers and the mission profiles (see APPENDIX A).

3.5.9 Aircrew Alerting

The *aircraft* shall contain an aircrew alerting system that provides the aircrew at both aircrew positions with identical *warnings*, *cautions*, and *advisories* (WCA) for *component(s) failures*, system degradations, and potentially hazardous changes in system status/position in accordance with MIL-STD-411 and MIL-STD-1472, as applicable. (Note: MIL-STD-1472 tailoring for applicability will be mutually agreed to/approved by the program office and recorded via CDRL.)

3.5.9.1 Prioritization of Alerts

When two or more *alert* situations occur simultaneously, the presentation of audio *alerts* and corresponding visual *alerts* shall be prioritized in accordance with MIL-STD-411, such that

higher priority is given to the situation that requires a more immediate response, to ensure the safety of the *aircraft*.

3.5.9.2 Master Warning/Master Caution

Both aircrew positions shall have identical master *warning* and master *caution* located within a 30° cone of the aircrew's forward line of sight.

3.5.9.3 Aural and Visual Alerts

All aural *alerts* shall contain an associated visual indication of the alerting condition.

3.5.9.4 Aural Signals for Warning Alerts

Warning alerts shall contain a distinctive aural signal differentiating it from other *cautions*, *advisories* or *alerts*.

3.5.10 Intercommunications Control System (ICS)

3.5.10.1 External Communication

The *ICS* shall provide both aircrew positions access to UHF and VHF radio communications during all ground and airborne operations.

3.5.10.2 Aircrew Communication

The *ICS* shall include an *interphone* to allow each aircrew to communicate with one another during all ground and airborne operations.

3.5.10.3 Ground Communication

The *ICS* shall include an *interphone* to allow each aircrew to communicate with ground personnel during all ground operations.

3.5.10.4 Radio Attenuation

The *ICS* shall provide for both aircrew positions to attenuate incoming UHF and VHF communications while maintaining *interphone* communications.

3.5.10.5 ICS Stations

The *ICS* shall include control interfaces at each aircrew position and one external interface accessible by ground personnel for launch and recovery of the *aircraft*.

3.5.10.6 ICS Controls

The *ICS* shall include controls for adjusting volume levels and for microphone operations to include selecting and deselecting internal/external communications and navigation aids.

3.5.10.7 Microphone Operations

The *ICS* shall provide for *hot-mic* and *cold-mic* operations at both aircrew positions.

3.5.10.8 Aircrew and Ground Personnel Acoustic (Speech) Intelligibility

The *aircraft* shall have an *ICS* that provides acceptable aircrew and ground personnel acoustic (speech) intelligibility for all required communications during all phases of flight and *aircraft* configurations. Table 3-11 defines the acceptable percent of speech intelligibility correct scores (adjusted for guessing) for aircrew and ground personnel. (Note: Intelligibility is defined as the ability to hear and understand voice communications in the noise environment as defined by the Modified Rhyme Test (MRT) in accordance with ANSI/ASA S3.2-2009.)

Table 3-11, Speech Intelligibility

External Pink Noise Overall Pressure (dB)	Noise, % Corrected MRT Level, Adjusted for Guessing
95	90
105	85
115	80
>115	80

Table 3-12, below, expands Table 3-11 for listener noise environment sound pressure levels >115 dB for ground personnel environments. Table 3-12 defines the acceptable percent of speech intelligibility correct scores (adjusted for guessing) for ground personnel.

Table 3-12, Additional Speech Intelligibility for Maintainers

Talker External Pink Noise Overall Pressure Level (dB)	Listener External Pink Noise Overall Pressure Level (dB)	% Correct MRT, Adjusted for Guessing
65 or less	120	80
120	65 or less	80

3.5.11 Cockpit Controls

3.5.11.1 Throttle Detent

The *aircraft* shall provide detents representing throttle position to aid in fuel consumption awareness and training.

3.5.11.1.1 Afterburning Aircraft

For *aircraft* utilizing afterburner, there shall be a detent for the mil power position and a full forward stop position to indicate maximum power and afterburner usage.

3.5.11.1.2 Non-afterburning Aircraft

For *aircraft* not utilizing afterburner, there shall be an adjustable detent between midrange and maximum power, representing a mil power setting and a forward stop indicating full maximum power that represents afterburner usage. Advancing the throttle just beyond the mil power detent to simulated min afterburner shall result in a minimum 5% increase in thrust. The detent feedback mechanism shall be adjustable by maintenance personnel.

3.5.11.2 Side-Arm (Side Stick) Control Stick Forearm Support

Side-arm (Side stick) controller configured *aircraft* shall include forearm support with adjustability, if necessary, to meet JPATS Cases 1 - 7, to minimize fatigue and maximize performance.

3.5.11.3 Rudder Control Forces

Within the operational range, the maximum forces that the aircrew member must exert for full control authority of the rudder controls with all systems operating normally shall not exceed 150 lbs. force for temporary rudder application and 20 lbs. force for prolonged rudder application. The operational range is defined as the range of control motion required to perform the APT mission, including all APT Syllabus maneuvers and recovery from all common student errors.

3.5.11.4 Landing Gear Control

The normal and emergency landing gear controls shall be designed in accordance with MIL-STD-203G, paragraph 5.1.9.

3.5.11.5 Emergency Controls

3.5.11.5.1 Accessibility

In addition to the reach requirements in section 3.5.7, all emergency controls shall be readily accessible and shall be contained in each cockpit (i.e., a complete set of emergency controls are contained in both aircrew positions).

3.5.11.5.2 Inadvertent Actuation

The *aircraft* shall include provisions to guard against accidental activation of emergency systems or controls.

3.5.11.5.3 Markings

Emergency control markings shall be in accordance with FED-STD-595.

3.5.12 Interior Finishes, Components and Equipment

3.5.12.1 Dimensional Stability

All interior finishes, *components*, equipment, and materials shall maintain dimensional stability for temperatures specified in section 3.9.1.1 without deforming, warping or distorting.

3.5.12.2 Fire Resistance

All interior finishes, *components*, and equipment shall be made with burn resistant materials.

3.5.13 Thermal Contact Hazards

The *aircraft system* which exposes personnel during normal operations (i.e. with personnel at normal work stations without maintenance access points open) to surface temperatures greater than those shown in Table 3-13, or less than 0° C, shall be guarded.

Table 3-13, Thermal Contact Hazards

Exposure	Metal	Glass	Plastic or wood
Momentary contact	60° C (140° F)	68° C (154° F)	85° C (185° F)
Prolonged contact or handling	49° C (120° F)	59° C (138° F)	69° C (156° F)
Based on an ambient environment at 25° C (77° F)			

3.5.14 Cockpit Displays

3.5.14.1 Large Area Display (LAD)

The *aircraft* shall provide at least one *large area display* (*LAD)* in each cockpit with the same functionality and capability to display the same information.

3.5.14.1.1 Viewable Area

The *LAD* size shall provide a viewable area of at least 150 square inches.

3.5.14.1.2 Configurable Display

The *LAD* shall be configurable, manually and from pre-flight mission planning, to enable the aircrew to place display presentations in aircrew selected locations on the *LAD* screen. Primary flight reference and any safety-of-flight display presentations (e.g., engine monitor displays, fuel quantity displays) shall be non-configurable and when displayed on the LAD, shall be displayed in a dedicated location. The *LAD* shall provide for the aircrew to select and set up a range from two to six, as a minimum, simultaneous display presentations on the *LAD* from the cockpit and from pre-flight mission planning. The *LAD* shall provide for the aircrew to change the size of display presentations manually from the cockpit and from pre-flight mission planning. The display presentations shall be selectable through the *HOTAS controls*.

3.5.14.1.3 Repeater Mode

The *LAD* shall include an aircrew-selectable repeater mode that enables the other cockpit LAD presentation to be displayed.

3.5.14.1.4 Rear-Cockpit Interface

The *aircraft* shall provide for the aircrew at the aft position to interact with the *LAD* (and *Embedded Training* systems display presentations) via *HOTAS controls* without affecting the flight control surfaces. For configurations implementing flight control decoupling, the *aircraft* shall enable recoupling via single action within *Zone 1 Reach Conditions*.

3.5.14.1.5 Integrated Digital Checklists and Electronic Flight Information

The *aircraft* shall provide for the aircrew to select and display normal and emergency checklists on the *LAD* during normal and emergency operations. The *aircraft* shall provide for the aircrew to select and display US instrument approach procedure charts on the *LAD* during normal and emergency operations. The *aircraft* shall provide for the Digital Checklists and Electronic Flight Information to be updated without requiring an *Operational Flight Program/Software Item (OFP/SI)* change. (Note: Paper checklist will be required as a backup.)

3.5.14.1.6 Situational Awareness Display (SAD)/Navigation Display Presentation

The *aircraft* shall provide a SAD/navigation display presentation that depicts, but not be limited to, flight and navigational information per Table 3-14 at both aircrew positions. All presentations shall be selectable during pre-flight mission planning and shall be cockpit selectable at both aircrew positions.

Table 3-14, Situational Awareness Display (SAD)/Navigation Display Presentation

a. Composite presentation fused from on-board information systems (flight management information, NAVAIDS, TCAS, ADS-B, GPS, etc.) for aircrew *situational awareness*.
b. Moving map with north-up and own-ship track-up orientations
c. Own-ship relative position and orientation
d. Own-ship range rings with variable display ranges
e. Own-ship to cursor/cursor to own-ship bearing/range display
f. Slewable cursor
g. Planned routes, route lines, and waypoints (Both pre-planned and in-flight; Turn point, initial point)
h. En route flight Information (NAVAIDS, waypoints, airways, airports, etc.)
i. Airspace boundary lines

3.5.14.2 Glove Compatibility

All electronic display interfaces shall be compatible with the aircrew gloves specified in Table 3-16, Personal Flight Equipment.

3.5.14.3 Display Readability

All electronic displays shall be *readable* under the full range of *operational lighting conditions*.

3.5.14.4 Cockpit Display Luminance

The luminance and contrast of all displays shall support aircrew operations throughout the flight envelope and under all *operational lighting conditions*. Luminance variation of any display shall not exceed 30%.

3.5.14.5 Display Quality and Latency

The information displayed on all displays shall be fully legible, easily interpreted, and free of distracting artifacts such as flicker, jitter, and noise under all environmental and mission conditions. Latency of displayed data shall be limited such that the aircrew does not perceive a delay between control inputs and the system's response.

3.5.14.6 Head-up Type Display (HTD)

The *aircraft* shall provide in the front cockpit one *Head-up Type Display* (*HTD*) and in the rear cockpit either one *HTD* mounted on *aircraft* centerline or a high-definition display repeater positioned not lower than the *LAD* that displays the content of the front *HTD*. (Note: It is acceptable for the high-definition display repeater to be displayed on the *LAD*.)

3.5.14.7 Primary Flight Reference

The Primary Flight Reference presentations on the *LAD*, the *HTD*, and the high-definition display repeater if provided, at both aircrew positions shall be endorsed through the HQ Air Force Flight Standards Agency Whitepaper: Primary Flight Reference Endorsement Process. If the HTD (that is not displayed on the LAD) is designated as the PFR, then a head down, supplementary PFR shall be, as a minimum, selectable with a single control input from the aircrew.

3.5.14.8 Standby Flight Instrument

The *aircraft* shall provide, at both aircrew positions, a dedicated standby flight instrument IAW MIL-STD-1787 that is located such that it can be viewed by the aircrew member with minimal head movement.

3.5.14.9 Aircraft Clock

The *aircraft* shall provide a digital clock in each cockpit (either integrated with the *LAD*, or stand-alone). The clock shall be displayed at all times and provide 24-hour digital display of hours, minutes, and seconds, as well as display local and Zulu time.

3.5.14.9.1 Stopwatch

The *aircraft* shall provide stop watch functionality at each aircrew member position integrated within the *aircraft* clock display. The stopwatch shall be capable of being displayed within one button press and shall consist of an elapsed time counter. The elapsed time counter shall be resettable and shall operate from 1 second to 99 hours and 59 minutes, with the elapsed seconds shown at all times.

3.5.14.10 Symbology

Cockpit displays shall use symbology IAW MIL-STD-1787, MIL-STD-411, and MIL-STD-1472, as applicable. (Note: MIL-STD-1472 tailoring for applicability will be mutually agreed to/approved by the program office and recorded via CDRL.)

3.5.15 Interior Lighting

The *aircraft* interior lighting system shall provide adequate illumination for all operator tasks throughout all *operational lighting conditions*.

3.5.15.1 Night Vision Imaging System (NVIS) Compatibility

The *aircraft* interior lighting, displays, and illuminated indicators and controls shall be compatible with MIL-STD-3009 Type I, Class B or C, as applicable, Night Vision Imaging System (NVIS).

3.5.15.2 Lighting Uniformity

At any given luminance level, lighting *components* within a lighting subsystem (primary instrument panel; secondary instrument panel; primary console; secondary console; *warning*, *caution*, and *advisory* signals; utility; and compartment) shall provide luminance such that the

average luminance ratio between lighted *components*, in each cockpit, is no greater than 2 to 1. Luminance uniformity shall be maintained throughout the entire range of luminance control.

3.5.15.3 Brightness Control

Cockpit displays, panels, and indicators shall be adjustable for all *operational lighting conditions*.

3.5.15.4 Glare and Reflections

Crew station lighting shall not cause direct or indirect glare or reflection that interferes with either aircrew's interior or exterior aided or unaided vision. Glare shields and display lighting shall be used to minimize glare and reflections on the transparencies and other reflective surfaces.

3.5.15.5 Utility/Map light

Each cockpit shall contain a utility/map light.

3.5.16 Exterior Lighting

The *aircraft* shall have dual mode exterior lighting (including strip lighting) that is compatible with MIL-STD-3009 Type I, Class B or C, as applicable, night vision imaging system (NVIS), and provides for day and night formation flight in both IMC and VMC in all phases of flight in accordance with SAE-ARP5825.

3.5.16.1 FAA Interoperability

The *aircraft* exterior lighting shall be dual mode (NVIS friendly and covert) and comply with FAA regulations.

3.5.17 Interior and Exterior Visibility

3.5.17.1 Interior Visibility

In addition to the requirements of section 3.5.6 g, all symbols, graphical and alphanumeric characters, labels, placards, etc., which must be read in-flight shall be visible and *readable* from each respective aircrew position.

3.5.17.2 Exterior Visibility

The *aircraft* shall provide a sufficient exterior field-of-view to permit each aircrew position to safely maneuver and control the *aircraft* in all phases of flight within its operating limits and to perform all flight tasks, including but not limited to the following: visibility over the nose of the *aircraft* at the worst case *AOA* approach, "checking-six" for air-to-air engagements, formation re-join maneuvers, aerial refueling (if implemented), and all APT syllabus maneuvers and the mission profiles (see APPENDIX A), while providing, from the same eye position, an unobstructed interior view of flight instruments and other critical *components* and displays. (Note: Interior visibility is not required for the "checking-six" procedure).

3.5.17.2.1 Visibility for Landings

The *aircraft* forward-azimuth, down-elevation visibility shall be sufficient for both aircrew positions to visually maintain the aim point within the runway touchdown zone on a 3-degree glide path for all *aircraft* landing configurations.

3.5.18 Aircraft Transparency/Canopy System

Transparency system optical characteristics shall permit the aircrew at each aircrew position to maintain sufficient visual capability for all phases of flight and flight tasks and under all relevant *operational lighting conditions* (including NVIS lighting) to maintain vehicle control and safe flight.

3.5.18.1 Transparency Integration with Environmental Conditions

The *aircraft* shall include provisions to sufficiently remove rain, ice, snow, and frost from the canopy for all ground and airborne operating conditions such that sufficient visibility can be maintained at each aircrew position to maintain vehicle control and safe flight.

3.5.18.2 Transparency Shape Compatibility

The *aircraft* transparency shape shall be compatible with (i.e., not interfere with) aircrew motions for the full range of anthropometrically qualified aircrew (see section 3.5.5) for all normal and emergency conditions and seat positions and for all APT syllabus maneuvers and mission profiles (see APPENDIX A), while wearing the personal flight equipment listed in Table 3-16 and any Contractor supplied equipment, if implemented (e.g., helmet mounted devices).

3.5.18.3 Transparency System Thermal Loads

The transparency system shall operate normally at all temperatures consistent with the operational environment of the *aircraft* as defined in section 3.9.

3.5.18.4 Canopy Opening Clearance

The cockpit opening dimensions shall provide adequate clearance for aircrew member ingress and egress with personal flight equipment listed in Table 3-16.

3.5.18.5 Canopy Actuation (Normal Ingress/Egress)

The transparency system shall have the capability to actuate for normal ingress and egress from inside and outside the cockpit, without *aircraft* engine(s) running or external power. Both aircrew members shall have access to actuation or emergency controls.

3.5.18.6 Manual Canopy Operation

For *aircraft* allowing for powered canopy actuation, the transparency system shall provide a manual method that allows for canopy operation from inside and outside the cockpit, without requiring electrical power.

3.5.18.7 Canopy Latching and Locking

The *aircraft* shall contain independent latching and locking mechanisms such that inadvertent activation of one mechanism will not result in the operation or *failure* of the other mechanism. The locking system shall be incapable of locking unless all latches are properly latched in the fully secured position. Positive identification of canopy position and locking condition shall be visible and accessible to both aircrew members. A *warning* light shall be provided that illuminates when the canopy locking system is not fully engaged and locked.

3.5.18.7.1 Canopy Open Lock

The canopy system shall have positive mechanical means for ensuring the canopy remains in the open position when selected.

3.5.19 Aircraft Entry and Exit

The *aircraft* shall provide an entry and exit means that is self-contained to accommodate both cockpits.

3.5.19.1.1 Transparency – Escape System Compatibility

The transparency system shall be compatible with the *aircraft* escape system to permit safe escape in the event of an emergency.

3.5.20 Escape and Egress System

The *aircraft* shall have an escape system that enables both aircrew members to escape and provides a manually initiated automatic method for emergency evacuation during airborne and ground emergencies (ejection) and a manual method for normal and emergency ground egress for the full range of anthropometric cases in section 3.5.5.

3.5.20.1 Escape System Reliability

The minimum demonstrated reliability of the ejection seat shall be 90% at the 90% Lower Confidence Limit (LCL). The minimum demonstrated reliability for escape system integration with the *aircraft* shall be 75% at the 90% LCL. The minimum probability of success for the escape system shall be 98% at the 90% LCL.

3.5.20.2 Manual Emergency Ground Egress

Manual egress shall be provided for normal and emergency ground evacuation. The manual egress system shall allow manual *aircraft* evacuation of both aircrew members within 30 seconds.

3.5.20.2.1 Backup Emergency Ground Egress

A backup method of aircrew initiated emergency ground evacuation (for situations such as canopy stuck-down) shall be through a manually initiated ground egress *escape path clearance system*.

3.5.20.3 Escape Path Clearance System

The *aircraft* shall include an *escape path clearance system*. The *escape path clearance system* shall not cause *Abbreviated Injury Scale 2 (AIS 2)* or greater injury severity or hinder required procedure steps for evacuation.

3.5.20.3.1 Penetrating Injuries

For systems that use an explosive cutting system to clear the escape path, debris caused by functioning of the cutting system shall not penetrate more than 0.5” into ballistic witness gelatin positioned at the distance equal to the distance from the cutting system to the crew’s neck, while seated in the ejection seat.

3.5.20.3.2 Impulse Noise

The *escape path clearance system* shall not expose the aircrew to peak pressure levels of impulse noise greater than 190 dBP of the vector sum of the sound pressure level measurements taken from the x, y, and z directions, outside of the helmet, at each aircrew position. For noise exposures in which the peak pressure level is 140 dBP or greater, as measured at the ear canal (inside the helmet) or external to the helmet using the helmet impulsive peak insertion loss at each aircrew position, the $L_{IAeq100ms}$ shall not exceed 85 dB, as calculated IAW MIL-STD-1474, Section B.5.3.4.1, Equation 3a.

3.5.20.3.3 Thermal Energy Exposure Limits

Aircrew member’s exposure to thermal energy as a result of escape system utilization by the *aircraft* occupants or rescue personnel shall not exceed a burn depth of 100 microns.

3.5.20.3.4 Escape Path Clearance Considerations

Actuation of the manual *escape path clearance system* shall not cause the ejection seat to fire nor inhibit a subsequent emergency ejection.

3.5.20.4 External Controls

Emergency egress system shall include external emergency controls for cockpit access that can be operated by ground personnel during non-crash ground emergencies to allow manual initiation of the ground egress *escape path clearance system*.

3.5.20.5 Ejection Seat Clearance

The cockpit closure shall allow for a clear escape path for the ejection seat and the full range of anthropometric cases in section 3.5.5. There shall be no projections such as the throttle, landing gear control, instrument panel, canopy frame, etc., into the ejection seat envelope that would interfere with the safe ejection of the seat and crew member. The escape path envelope shall comprise a forward minimum clearance line, parallel to the ejection path, and measured perpendicularly to the plane of the seat back that allows for a minimum 2.5 inches clearance between the aircrew’s knees and the nearest forward obstruction for all anthropometric cases and applicable seat positions and a ±15 inch lateral clearance from the seat centerline. The maximum allowable radii of the forward corners of the envelope shall be 6 inches.

3.5.20.6 Safing of Emergency Controls

A means shall be provided to safe the ejection seat and the *escape path clearance system* prior to ingress and egress of each cockpit and while seated in the cockpit. A visual means of determining that the ejection seat and *escape path clearance system*s are safe prior to ingress and egress, and while seated in the cockpit shall be provided.

3.5.20.6.1 Secondary Seat Safety Device

The ejection seat shall include a Safe/Armed lever. The Safe/Armed lever shall be a secondary means to safe the ejection seat for use in cases when installing the primary ejection seat safety device would be impractical or unsafe. The Safe/Armed lever shall be located on each ejection seat and in a location that is readily accessible by the crew and shall be compatible with the full range of anthropometrically qualified aircrew, as specified in section 3.5.5. The Safe/Armed lever shall be prohibited from being put into the ARMED position, when the primary ejection seat safety device is installed. The *aircraft* shall provide a "seat not armed" visual indication (e.g., *caution* light) at the aircrew's own position at all times until the seat is ARMED. The *aircraft* shall provide an aural indication when the throttle is advanced to within 20% of takeoff thrust setting when either seat is not ARMED (when in SOLO configuration the rear seat is removed from the above logic, see section 3.5.20.7.5.1).

3.5.20.7 Manually Initiated Automatic Escape

A manually initiated automated escape system capable of safely ejecting a crew member with a nude weight range of 103 to 245 lbs. with full personal flight gear and survival kit (per section 3.5.21.1 and section 3.5.21.3, respectively) including conditions with and without Helmet Mounted Devices (e.g., Helmet Mounted Display, Night Vision Goggles) shall be provided. The ejection system shall not exceed a 1% chance of a major spinal injury during the ejection catapult stroke (see section 3.5.20.10.1) and a 5% chance of an incapacitating injury during the entire ejection profile (see section 3.5.20.10.2, section 3.5.20.11, and section 3.5.20.12) for the full range of anthropometrically qualified aircrew (see section 3.5.5) over land and water from 0 feet AGL to *aircraft absolute ceiling* and 0 KEAS to 600 KEAS or max speed of the *aircraft*, whichever is less.

3.5.20.7.1 Escape Envelope

Upon actuation of the automated escape system, the escape system shall function properly under all combinations and timing of aircrew-initiated ejections throughout the performance envelope of the *aircraft*. In low altitude and adverse attitude conditions, the automated escape system shall be capable of escape at the conditions shown in Table 3-15, which applies to the full combined CG envelope of the seat and occupant combination; to include a ±2-inch tolerance about each individual CG for the specified aircrew population, as specified in Table 3-7.

Table 3-15, Escape Envelope

Altitude (Feet)	Velocity (Knots)	Attitude	
		Fore and Aft	Roll Angle
20[1]	120	Level	60^{O}
200	150	Level	180^{O}
300[2]	150	Level	0^{O}
500	200	60^{O} Nose down	0^{O}
580	450	30^{O} Nose down	0^{O}
550	200	60^{O} Nose down	60^{O}
600	250	45^{O} Nose down	180^{O}

In all cases the cited conditions are at the initiation of the catapult. Recovery is defined as the aircrew being under an inflated parachute and having decelerated to a total velocity of 30 ft/sec or less for a 50% weight aircrew including maximum weight configuration of flight gear and survival kit. Divergence for all roll angles should be in the adverse direction.

1. Aircraft impact with the ground occurs at instant of seat-aircraft separation.

2. 10,000 foot per minute sink rate.

3.5.20.7.2 Canopy and Escape Path Clearance

The *aircraft* canopy and *escape path clearance system* shall ensure a clear escape path for the aircrew member and ejection seat combination. The escape system shall provide a safe escape path up to and including a maximum *aircraft* yaw at typical approach speed. The *escape path clearance system* shall consist of a primary automatic mode (which either jettisons the canopy or fractures the transparency) and a direct penetration through the transparency backup mode (using transparency breakers). NOTE: A direct penetration through the transparency backup mode is not required for systems where ejection through the canopy is not permitted because of canopy construction. The *failure* of any canopy, canopy fracturing system/jettison, or interseat sequencing mode shall not affect the performance of the remaining canopy, transparency fracturing/canopy jettison system, or ejection seat mode(s). On those *aircraft* where ejection through the canopy is not permitted because of canopy construction, means shall be provided to prevent firing of the rocket catapult until the canopy has been jettisoned. Upon actuation of any ejection seat firing control, the automatic mode(s) shall be activated in accordance with Inter-Seat Sequencing (ISS) mode selection (see section 3.5.20.7.5.1).

3.5.20.7.2.1 Ejection through the Canopy (For Transparency Fracturing Systems in Primary Mode, and Direct Penetration Backup Modes)

The ejection seat and *aircraft* ballistic escape system shall provide a safe escape path. For a primary automatic transparency fracturing system, the aircrew member shall not be used to clear the escape path by breaking away any glass that is not severed from the canopy. Primary contact

between the transparency and the aircrew member, for all combinations of aircrew member size and seat adjustment shall not occur. In the direct penetration backup mode, the aircrew member's shoulders and knees may be used to assist in clearing the escape path. The primary automatic (transparency fracturing) system and the direct penetration backup system shall minimize injury potential due to transparency fragments. Any seat and canopy impact shall not prevent the seat from performing correctly. The Dynamic Response Index (DRI) calculated with the seat mounted instrumentation shall not exceed 16 for a primary automatic (transparency fracturing) system and 22.5 for a direct penetration back-up system. DRI shall be calculated using the method in section B.1.

3.5.20.7.3 Aircraft Clearance

The aircrew members and ejected portions of the escape system shall clear external *aircraft* structure throughout the *aircraft's* performance envelope. The aircrew member and ejection seat combination shall clear the tail by a minimum of 3 feet.

3.5.20.7.4 Initiation

The escape sequence shall be initiated by one complete extension of the ejection control. Interference between the flight controls and the ejection handle shall not be permitted. The motion of the ejection control shall be irreversible. The pull force to operate the ejection handle(s) shall be 40 ±10 lbs. The pull force to operate a center-pull ejection handle shall be 40 ±10 lbs., within a 60° cone with the apex located at the ejection handle housing. Total time from initiation to seat first motion shall not exceed 300 milliseconds.

3.5.20.7.5 Inter-Seat Sequencing

An ejection sequencing system shall be provided. The sequencing system shall result in the fracturing or removal (jettison) of the canopy(s) and the ejection of the seat and aircrew combinations in a manner to minimize total escape time and collision potential. Either seat and aircrew combination shall not collide with the other seat and aircrew combination throughout the entire escape envelope. Flame impingement to either aircrew member in or out of the cockpit shall meet the thermal energy exposure limits of section 3.5.20.3.3.

3.5.20.7.5.1 Inter-Seat Sequencing Mode Selection (for tandem cockpit configured aircraft)

The *aircraft* shall contain a mode select control located in the aft cockpit that has the following sequencing options:

a. Both = Actuation of either the forward or aft seat ejection handle shall immediately start the ejection sequence of the aft seat followed by the forward seat.
b. Solo = Actuation of the forward seat ejection handle shall eject only that seat and eliminate any sequencing delay for aft seat and front seat separation. This shall not prevent aft seat ejection should the mode selector be in the solo position.
c. CMD FWD = Actuation of the forward seat ejection handle shall immediately start the ejection sequence of the aft seat followed by the forward seat. Actuation of the aft seat ejection handle shall eject only the aft seat and eliminate any sequencing delay for aft seat and front seat separation.

3.5.20.7.5.2 Divergence

Seat divergence shall be incorporated to prevent collisions between the front and rear seat and man combinations.

3.5.20.7.6 Seat Aircrew Separation

A positive automatic means shall be provided to affect seat and aircrew separation and prevent seat and aircrew parachute interference.

3.5.20.7.7 Descent Recovery Parachute System

The ejection seat shall incorporate the recovery parachute system. The recovery parachute system shall be equivalent to a qualified military escape recovery system. The recovery parachute shall connect to the torso harnesses listed in Table 3-16. The risers shall incorporate cross connector straps. A positive, fully automatic means of extraction shall be used to deploy the recovery chute after ejection. For the automatic deployment mode, an altitude sensing device shall prevent deployment above 15000 ±1000 feet *PA*. A manually initiated parachute deployment system shall be provided as a backup to the automatic system and allow override of the automatic system.

3.5.20.7.7.1 Recovery Parachute Deployment/Inflation Phase Accelerations

The vector sum of the parachute deployment loads (including line stretch and opening shock) shall not exceed 15 G if the direction of force applied to the body is random and unpredictable as in a typical manual bailout or aircrew mounted parachute system and 25 G if the system is controlled so the force is applied while the body is in an optimum position (inertial resultant in +z to –x direction or “eyeballs out” to “eyeballs down.”).

3.5.20.7.7.2 Descent Rate – Steady State Phase

The steady state vertical descent rate shall not exceed 23 feet per second average vertical velocity and shall not have average oscillations in excess of ±15° from vertical at standard sea level with a suspended weight of 337 lbs. The parachute shall be provided with a maneuvering capability that can be selected by the aircrew member during parachute descent. Performance in the selected maneuverable mode shall have an average turn rate of 21°±5°/sec and an average horizontal (forward) velocity not to exceed 20 feet per second, based on a zero wind condition. Horizontal velocity in the “hands off” non-maneuverable mode shall not exceed 15 feet per second based on a zero wind condition.

3.5.20.8 Personnel Restraint System

The ejection seat shall incorporate a personnel restraint system to interface with the torso harnesses listed in Table 3-16 and shall provide full torso restraint, while allowing operation of required controls during all conditions of flight. The restraint attachments shall provide positive aircrew member retention without injury under all conditions of emergency ejection and crash impacts.

3.5.20.8.1 Limb Restraint System

The seat shall incorporate limb restraints (both arm and leg) to restrain the limbs and prevent flail injuries during the ejection sequence (windblast, free-flight and drogue phases). Leg restraints shall prevent movement of the legs laterally, beyond the sides of the seat. Arm restraints shall prevent movement of arms rearward, beyond the seat back tangent line. Limb restraints shall not interfere with aircrew movements required for *aircraft* control and mission accomplishment during all phases of flight. The limb restraint system shall not require any new special aircrew personal flight equipment (new/modified flyers coveralls, jacket, or any other item not listed in Table 3-16). Limb restraints shall not hinder aircrew ground egress procedures and timing, and shall be compatible with the items listed in Table 3-16.

3.5.20.8.2 Inertia Reel Lock

The seat restraint system shall incorporate an inertial reel in the seat with a manual (with positive lock/unlock provisions) and powered inertia reel lock mechanism. The inertia reel lock shall have standard rate sensitive locking capabilities. The manual inertia reel lock control shall be located on the left side of the seat within easy access of the seat occupant with the restraints locked. Pre-ejection body positioning and upper torso restraint shall be completed in a minimum of 0.15 second and a maximum of 0.3 second after ejection initiation in a 1 G_z environment. The inertia reel lock shall not engage during normal cockpit movement.

3.5.20.9 Energetic Materials and Components

Energetic materials (e.g., cartridges, Cartridge Actuated Devices (CAD), Propellant Actuated Devices (PAD), electrical initiators, Ballistic Signal Transmission Systems (BSTS), and other energetic *components* used in the *aircraft* escape system) shall meet the release to service requirements for safety of flight by military personnel as specified in MIL-C-83125 (cartridges), MIL-C-83124 (CAD), MIL-P-83126 (PAD), MIL-DTL-23659 (electrical initiators), and MIL-D-81980 (BSTS).

3.5.20.9.1 Firing Mechanism

a. Mechanical. The force required to mechanically actuate the mechanisms shall be 15 lbs. minimum and 25 lbs. maximum unless the mechanism is used in a CAD/PAD that is already qualified and in the United States Government inventory. Pre-cocked firing mechanisms shall not be used.
b. Gas-actuated. Gas-actuated firing mechanisms shall have a no-fire and all-fire capability as follows. The firing mechanism shall not actuate upon application of 400, +0, -25 psig gas pressure on the firing pin. The firing pin retention mechanism (e.g., shear pin(s)) shall release within 0.030 second upon application of 600, +25, -0 psig applied at a rate between 10,000 and 50,000 psig/sec inclusive acting on the firing pin.
c. Gas-actuated. Gas-actuated firing mechanisms that are internal to the catapult/ejection gun and are operated by internal catapult/ejection gun pressure shall have a no-fire and all-fire capability as follows: The firing mechanisms shall not actuate upon application of 225, +0, -25 psig gas pressure on the firing pin. The firing pin retention mechanism (e.g., shear pin(s)) shall release within 0.030 seconds upon application of 350, +25, -0

psig applied at a rate between 10,000 and 50,000 psig/sec inclusive acting on the firing pin.

d. Electrical. Electrical firing mechanisms shall be designed IAW MIL-DTL-23659 Electrical Initiators.

3.5.20.10 Acceleration Limits

3.5.20.10.1 Acceleration Limits – Catapult Phase

The acceleration imposed on the seat occupant in the $+G_z$ direction (parallel to the spinal column) by the ejection catapult shall not exceed a DRI of 16 in system level ejection sled or inflight tests at ambient temperatures where the acceleration vector is within 5° of the z axis. For controlled *component* testing, the acceleration imposed on the seat occupant in the $+G_z$ direction (parallel to the spinal column) by the ejection catapult shall not exceed a DRI of 16 at 70° F and 20 at 165° F, with an allowable standard deviation of 1.0. If the acceleration vector is not within 5°of the z axis, or the head rest is greater than one inch in front of the seat back tangent line, the DRI limits at all pre-ignition temperatures are reduced by 2, in order to compensate for the differences. DRI shall be calculated using the method in section B.1.

3.5.20.10.2 Acceleration Limits – Free Flight and Drogue Phase

The acceleration limits after *aircraft* separation (free flight and drogue phase) shall not exceed a MDRC of 1.0 up to 450 KEAS and may increase linearly, over 450 KEAS, not to exceed 1.7 at 600 KEAS. MDRC shall be calculated using the method in section B.2.

3.5.20.11 Head Injury – All Phases

Head injury, as indicated by the probability of a concussion ($P_{concussion}$), shall not exceed 5% during all escape system phases. Head injury shall be calculated using the method in section B.3.

3.5.20.12 Neck Loads - All Phases

3.5.20.12.1 Neck Loads – Speeds up to and including 450 KEAS

For speeds up to and including 450 KEAS, the upper neck forces and moments shall be limited to meet a Multi-Axial Neck Injury Criteria (MANIC) not to exceed 0.47 and a Neck Moment Index about the x-axis (NMI_X) not to exceed 0.56 at the occipital condyles (C0-C1). MANIC and NMIx shall be calculated using their respective methods in section B.4.

3.5.20.12.2 Neck Loads – Speeds greater than 450 KEAS

For speeds greater than 450 KEAS, the MANIC and NMIx limit may increase linearly as a function of speed, but shall not exceed a MANIC of 0.65 and NMIx of 0.86 at the occipital condyles (C0-C1) at 600 KEAS. MANIC and NMIx shall be calculated using their respective methods in section B.4.

3.5.20.13 Environmental Conditions

The escape system shall be capable of satisfactory operation during and following exposure to the extremes of the environmental conditions specified in section 3.9.

3.5.20.14 Center of Gravity (CG) Envelope

The center of gravity (CG) envelope for the ejection seat shall include the seat and aircrew member CG extremes for the specified aircrew members (per section 3.5.5) and a nude aircrew member weight range of 103 to 245 lbs., with full personal flight gear (per section 3.5.21) and for the range of ejection seat adjustments. The rocket center line of thrust shall be located using the dynamic CG to ensure resultant forces associated with the escape process result in a stable aircrew member and seat mass.

3.5.20.15 Stabilization and Deceleration

Provisions shall be incorporated for seat and aircrew member stability during free flight and drogue phase (seat/*aircraft* separation to seat/aircrew separation). Seat stability shall be maintained to align the neutral axis direction of the aerodynamic deceleration parallel to the eyeballs-out (eyeballs-in for backward facing seats) direction and limit excursions and damped oscillations about the neutral axis to ±25° in the pitch plane at all ejection speeds and ±25° in the yaw plane at speeds above 250 KEAS. The stabilization and deceleration system shall do the following:

a. Counteract rotation caused by 1) offset between dynamic CG and the rocket thrust line and 2) aerodynamic forces.
b. Control the application of deceleration forces. The seat shall be stabilized in such a manner that the neutral axis of deceleration is $+G_x$ and the acceleration limits of section 3.5.20.10 are not exceeded.
c. Maintain an optimum attitude for recovery parachute deployment such that deployed elements are assured clearance from rocket exhaust fumes and entanglement of risers and parachute suspension lines is prevented.
d. Stabilize the aircrew member or seat and aircrew member combination during free fall to the altitude aneroid setting for recovery parachute opening following a high altitude ejection.

3.5.20.16 Seat Assembly

The seat assembly shall 1) provide adequate support and retention of the aircrew body and limbs during emergency operation; 2) be fully suited to operational use; 3) accommodate variations in anthropometric dimensions of aircrew members per the range cited in section 3.5.5; and 4) for *aircraft* providing a direct penetration through-the-canopy backup system, allow a minimum of 0.5 inch clearance between the canopy and the closest projection of the canopy breakers with the seat fully raised.

3.5.20.16.1 Headrest

A headrest shall be provided to accommodate the helmeted head of the aircrew. The headrest shall provide support for the full range of aircrew member anthropometric sizes as specified herein.

3.5.20.16.2 Canopy Breakers

For *aircraft* providing a direct penetration through-the-canopy backup system, the seat assembly shall incorporate canopy breakers to fracture the transparency in the direct penetration through the canopy backup mode. Canopy breakers shall make the initial impact with the transparency.

3.5.20.16.3 Cushions

The seat surface (including the aircrew buttocks and back support regions of the seat) shall incorporate cushions.

3.5.20.17 Proof Loads

The seat system shall withstand the following proof loads without permanent deformation:

a. Front edge of seat bucket - 270 lbs. downward, distributed 1.5 inches each side of centerline.
b. Ejection controls - 200 lbs. tension, center of gripping surface.
c. Headrest - 330 lbs. aft, distributed over 2 inch square area at center of headrest.
d. Seat back - 1000 lbs. aft, perpendicular to surface, uniformly distributed below the headrest.

3.5.20.18 Crash Ultimate Loads

The ejection seat system including the restraint system, the ejection seat assembly, the ejection seat attachment fittings, and the ejection seat supporting structure shall meet the dynamic G load capability of 40 Gs for up to ±20° off axis in the forward direction.

3.5.20.19 Redundancy

All system *components*, whose proper functioning is critical to the successful operation of the escape system or to the safety of the aircrew members, shall be provided with redundant actuation means. The escape system interseat signal transmission system (part of the interseat sequencing system) shall be redundant.

3.5.20.20 Safety

The escape system shall include protection of all *components* against damage that would cause system *failure* or release of energy sources that could constitute or contribute to a hazardous situation. The escape system and its subsystems shall be protected against inadvertent actuation including those actuations that could be introduced by foreign object damage (FOD). Links between ejection controls and initiator devices shall not actuate the system with the controls safety locked and with force applied at the linkage. The escape system shall provide a method to

indicate that the system is inoperable when any *component* that can be fired or activated, without an apparent indication, has caused the escape system to become inoperable.

3.5.20.21 Explosive Device Maintainability

Propellant and explosive systems shall not require any type of maintenance during their useful lives.

3.5.20.22 Performance Reliability

Propellant and explosive systems reliability requirements shall be not less than 99.9% at a LCL of 90% over the appropriate temperature range in section 3.9.

3.5.20.23 Component Life and Change-outs

Escape system *components* with a limited life requiring change-outs, refurbishing, or periodic testing shall, to the maximum extent possible, have replacement and/or testing cycles compatible with the *aircraft* overhaul or inspect schedule.

3.5.20.24 Cartridge Actuated Devices/Propellant Actuated Devices

The installed life for a minimum of 90% of CAD/PADs *components* shall be a minimum of 6 years or greater as assigned by the Joint CAD/PAD program office and shall, to the maximum extent possible, have replacement cycles compatible with the *aircraft* overhaul or inspect schedule.

3.5.20.25 Aircraft Integration

The escape system shall be independent from other *aircraft components* and systems except for hardware attachment, seat adjustment, and *warning* displays.

3.5.20.26 Escape System Installation and Removal

With canopy installed, the ejection seat shall be capable of being installed in 15 minutes and removed in 15 minutes, or less.

3.5.20.27 Specialized Tooling or Machinery

Ejection seat parachutes shall be manually packable (by hand) as a minimum. Any specialized tooling or machinery required to pack the parachutes shall be capable of being locally manufactured in the field by using drawings incorporated into the seat maintenance Technical Order.

3.5.21 Aircrew Flight Equipment and Pilot Personal Protection

3.5.21.1 Personal Flight Equipment Compatibility

The *aircraft* shall be compatible with the USAF personal flight equipment per Table 3-16.

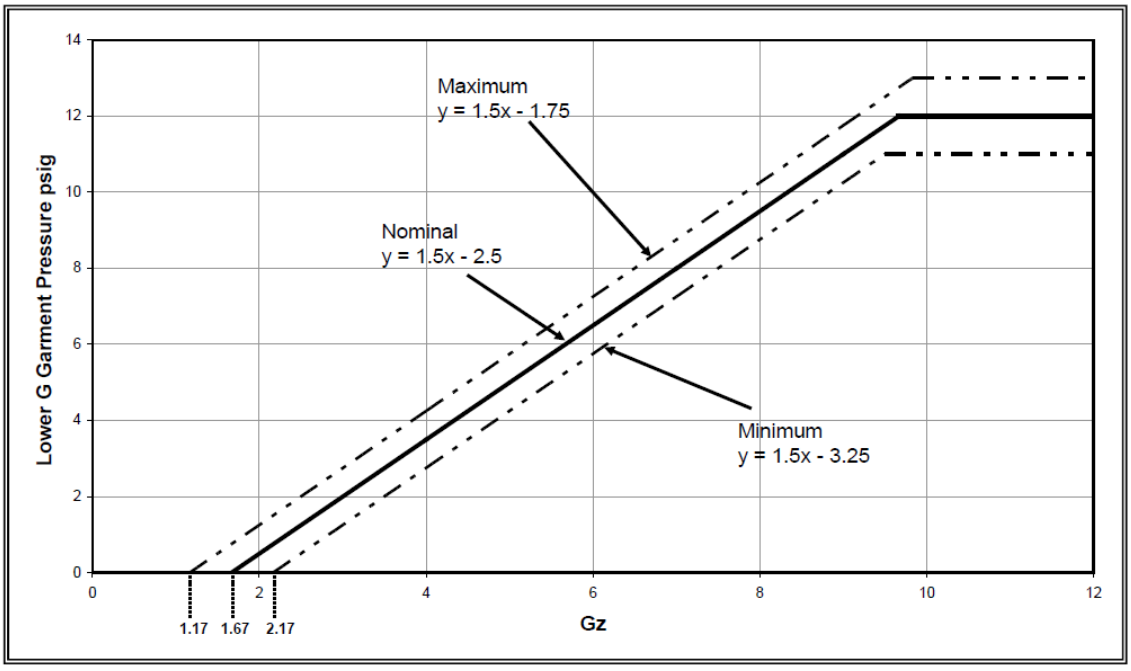
Table 3-16, Personal Flight Equipment

Item Name	Nomenclature
Anti-G Trouser	CSU-22/P or CSU-23/P
Oxygen Mask	MBU-20/P
Oxygen Connector	CRU-60/P
Torso Harnesses	PCU-15A/P and PCU-16A/P with oxygen connector mounting bracket and Koch Modified Gen II Canopy Release
Life Preserver	LPU-38/P
Crew Helmet	HGU-55/P (High Speed)
Night Vision Goggles	AN/AVS 9
Crew Coveralls	CWU-27/P
Crew Gloves	GS/FRP-2
Crew Winter Jacket	CWU-45/P
Crew Summer Jacket	CWU-36/P
Crew Boots	USAF Authorized Safe-to-Fly (Bellville, Daner, Wellco, and McRae Models)
Universal Water Activated Release (UWARS)	PCU-63

3.5.21.2 Anti-G Trouser Pressurized Air Supply

The ECS or bleed air system shall provide pressurized air supply to anti-G trousers at each aircrew position and at pressure levels as defined in Figure 3-1.

Figure 3-1, Anti-G Trouser Pressurized Air Supply



3.5.21.3 Survival Kit Provisions

Each ejection seat shall have one soft sided survival kit. Each survival kit shall have a sufficient volume and shape that accommodates the storage of the mandatory items listed in Table 3-17. Each survival kit shall include the mandatory items listed in Table 3-17. The survival kit shall have automatic and manual aircrew selectable modes of deployment.

Table 3-17, Survival Kit

Item Name	NSN
Compass, Lensatic	6605-01-196-6971
Signal, Smoke and Illumination, MK-124, Mod 0	1370-01-030-8330
Signal Mirror	6350-00-261-9772
First Aid Kit (with Kit Contents) Med Module	6545-01-534-0925
CAT Tourniquet	6515-01-521-7976
Radio, PRC90-2 with Battery	5820-01-238-6603
AN/URT 33/D Beacon with Battery (or Government-approved replacement)	5826-01-419-2926 (or TBD for approved replacement)
Two (2) Flex Pack Waters	8960-01-124-4543
Radio Battery, Lithium, p/n BA-5638/U (Spare)	6135-01-455-7947
Flashlight Mini Maglight	6230-01-259-4495
Whistle, Police Plastic	8465-00-254-8803
Raft Repair Plug	4220-00-763-3766
Life Raft, LRU-23/P	4220-99-297-6688

3.5.21.4 Personnel Emergency Location Transmitter

The personnel emergency location transmitter contained in the survival kit shall be capable of automatically activating during the ejection sequence.

3.5.21.5 Aircrew Acoustic Exposure Tolerance

The *aircraft* shall not expose the aircrew, wearing protective equipment, in the cockpit to noise levels at their ears that exceed a Total Daily Noise Exposure (TDE) of one (1.0). TDE shall be calculated IAW MIL-STD-1474, Section D.4.4.3.2, Equation 1a, using the worst-case nominal mission exposure dose (aircrew) and n=3, for the total number of noise exposure segments in the worst nominal duty day. To determine the worst-case nominal mission exposure (aircrew), individual mission exposure doses shall first be calculated IAW MIL-STD-1474, paragraph D.4.4.3.3, Equation 2, for each mission type. The mission type with the highest individual mission exposure shall be used as the worst-case nominal mission exposure dose (aircrew).

3.5.22 Oxygen System

The *aircraft* shall have an oxygen system that meets the minimum physiological requirements of the aircrew at their stations for the intended/expected normal and emergency missions of the *aircraft*. The oxygen system shall operate and be compatible with the operational environment of the *aircraft* while also being appropriate for the mission requirements of the *aircraft*. Oxygen equipment shall be compatible with military pressure-demand masks, helmets, and other items of personal equipment listed in Table 3-16, along with the restraint and escape systems (section

3.5.20). System *components* shall also meet environmental storage requirements (section 3.9). The aircrew breathing system shall provide altitude protection and contamination protection. The oxygen system shall contain no unacceptable hazards and no undesirable hazards in accordance with MIL-STD-882.

3.5.22.1 Oxygen Supply Quality

The *aircraft* shall have an oxygen system that continuously supplies the aircrew with oxygen breathing gas with adequate oxygen content, flow, and quality during all phases of *aircraft* operations both on the ground and inflight. The oxygen concentrations and Pressure Breathing for Altitude (PBA) schedule shall conform to Figure 3-2. For On-Board Oxygen Generating System (OBOGS), an oxygen concentration monitor shall monitor the OBOGS outlet gas. An oxygen concentration *warning* shall be set at or above the minimum oxygen concentration curve. The *warning* shall alert the aircrew if the oxygen concentration drops to or below the minimum level. The oxygen concentration delivered by the breathing system using OBOGS shall be above the oxygen *warning* threshold at steady-state breathing gas flows from 1) 7 to 60 liters/minute/aircrew member Ambient Temperature and Pressure Dry (ATPD) from Sea Level to a cabin altitude of 7,999 feet; and 2) 7 to 80 liters/minute/aircrew member (ATPD) from a cabin altitude of 8,000 feet to the *aircraft absolute ceiling*. The system shall be capable of achieving the peak inspiratory and expiratory flows in Table 3-18 as applicable, based on cabin altitudes. The breathing gas to the aircrew mask during normal ground and flight operations shall be within +10 ° F and -20 ° F of the ambient *aircraft* cabin temperature. During normal operations the breathing gas shall have no discernible or *objectionable* odor.

Figure 3-2, Oxygen Concentrations and Regulator Pressure Schedule (For aircraft with a 5 psi differential cabin press)

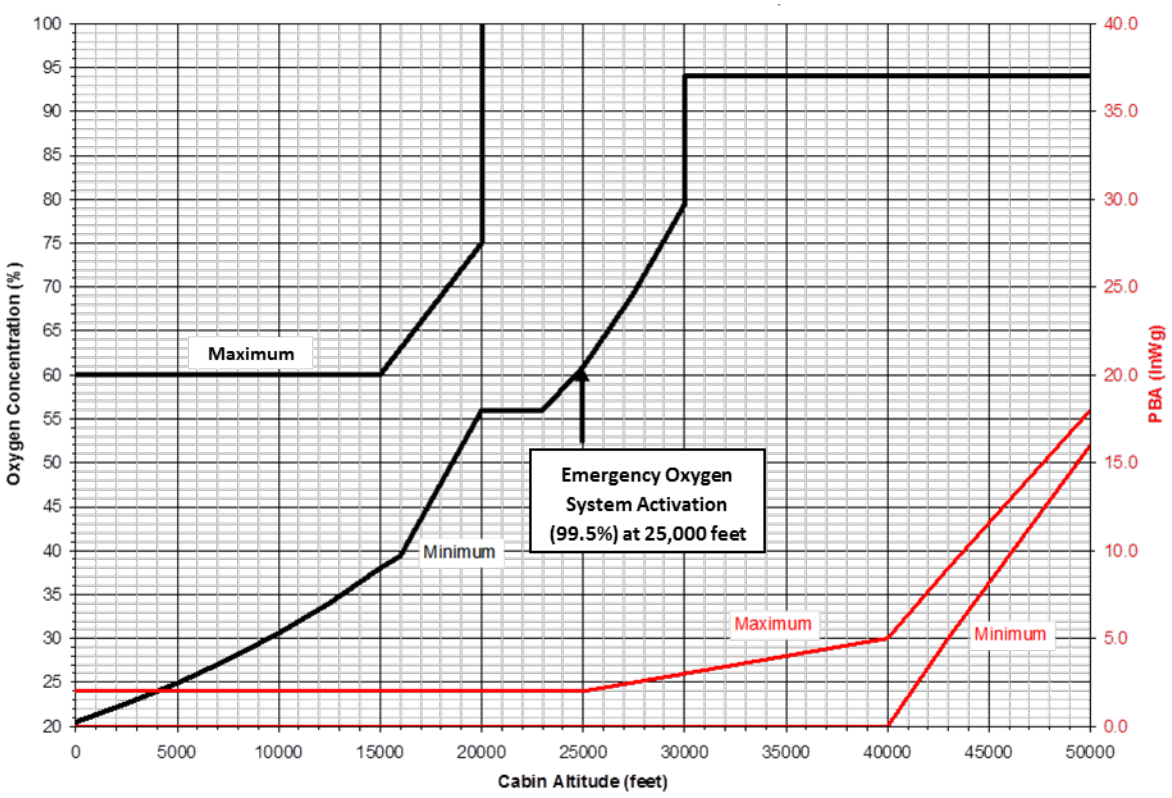


Table 3-18, Peak Inspiratory and Expiratory Flows and Mask Cavity Pressures

Peak Inspiratory and Expiratory Flows (liter ATPD/min)	Mask Cavity Pressure (in Wg)		
	Limits to		
	Minimum	Maximum	Maximum Swing
	Without Safety Pressure		
30*	-1.5	+1.5	2.0
90*	-2.2	+2.6	3.4
150*	-4.5	+4.0	7.0
200*	-7.6	+6.0	12.0
	With Safety Pressure		
30*	+0.1	+3.0	2.0
90*	-0.8	+3.8	3.4
150*	-3.5	+5.0	7.0
200*	-7.0	+6.6	12.0
* Cabin altitude from Sea Level to 38,000 feet.			

3.5.22.1.1 Oxygen Mask Pressures

The minimum and maximum pressures and the total change of pressure in the oxygen mask during the respiratory cycle shall not exceed the limits in Table 3-18. The pressure in the mask cavity during and immediately after a rapid decompression (1 second) shall not exceed the ambient cabin pressure plus 41 mm Hg (22 inches of Water gauge) for longer than 100 milliseconds. The mask pressure shall never exceed 70mm Hg (37.5 inches of Water gauge) above the ambient pressure.

3.5.22.2 Oxygen Quantity

The *aircraft* oxygen supply shall be sufficient for two aircrew members to perform any combination of six missions plus one divert (mission profiles are defined in APPENDIX A) at all altitudes from 1000 feet *PA* up through *aircraft absolute ceiling* at all power settings without re-servicing between missions or flights. If a Liquid Oxygen (LOX) or Gaseous Oxygen (GOX) system is used, LOX quantity or GOX pressure shall be displayed to the aircrew as applicable. For LOX or GOX, low level aural and visual *warnings* shall be provided when the total quantity of oxygen remaining reaches 10%.

3.5.22.3 Uninterrupted Oxygen Supply

The *aircraft* shall continue to supply oxygen breathing gas throughout any periods of ECS anomalies, engine bleed air anomalies and low pressure transients, and without requiring aircrew actions for activation and deactivation. If an OBOGS is implemented, the *aircraft* shall provide the stabilized air flow and pressures required by the OBOGS during engine bleed air and ECS pressure transients, pressure fluctuations, rapid pressure drop-offs, and pressure spikes. The oxygen system shall provide sufficient volume to meet the aircrew's dynamic breathing requirements. The system shall ensure an adequate volume of breathing gas is available at high breathing demands (noted in Table 3-18). Oxygen shall be provided to the aircrew when the OBOGS cannot supply breathing oxygen. Alternate or backup oxygen subsystem(s) required to complement the primary *aircraft* oxygen system shall have duration and physiological performance requirements consistent with the safe recovery of the *aircraft* from the maximum operational altitude to an altitude that does not require oxygen use. The backup oxygen shall be at least 90% oxygen.

3.5.22.3.1 OBOGS Pressure Sensors

The OBOGS shall have a pressure sensor to continuously monitor the real time air inlet pressure. The inlet pressure sensor shall not cause nuisance *warnings* for short transients that will not affect OBOGS operation. The OBOGS shall have a pressure sensor to continuously monitor the OBOGS real time outlet pressure. The outlet pressure sensor shall not cause nuisance *warnings* for short transients that will not affect OBOGS operation. All pressure data shall be recorded and stored within the OBOGS or on-board the *aircraft* and be capable of convenient download by ground maintenance personnel.

3.5.22.4 Emergency Oxygen

The *aircraft* shall have an Emergency Oxygen Source (EOS) in case of an emergency for aircrew ejection and primary oxygen system contamination or *failure*. The emergency oxygen source

shall be independent of and isolated from the primary and backup *aircraft* oxygen supply. The emergency oxygen source shall provide a minimum of 5 minutes supply of physiologically compatible oxygen and allow for a constant rate of descent, from the *absolute ceiling* of the *aircraft* to 10,000 feet *PA* during an emergency descent or until seat and crew member separation during ejection, whichever is longer. A manual control, which can be actuated by each aircrew member in each cockpit as well as automatic activation upon ejection, shall be provided. The manual control shall be on the left side of the ejection seat. The *aircraft* shall alert or provide feedback to the aircrew when emergency oxygen is being provided.

3.5.22.5 Breathing Regulator

The *aircraft* shall have a breathing regulator with performance characteristics equivalent to or better than the parameters in Table 3-18 for each aircrew member. The regulator shall operate properly with the input pressure, concentration level, and oxygen type provided. The regulator shall provide a manually selectable capability to supply increased pressure for decompressions and a test mask function for checking the mask-to-face seal. The regulator shall provide a manually selectable capability to supply maximum oxygen concentration.

3.5.22.6 Oxygen System Controls and Displays

The *aircraft* shall have sufficient oxygen system controls and displays to enable the aircrew to effectively operate and monitor the system. ON, OFF, and Pressure Breathing for G (PBG) controls and an oxygen flow display to verify oxygen flow to the mask shall be provided. For an OBOGS, a product gas quality *failure* status display shall also be provided. Maximum and normal mixtures shall be provided through a single selector in each cockpit. All regulator control functions shall be grouped together for each aircrew. Cabin *PA* shall be displayed to both aircrew members at all times. All displays shall be located at or forward of the seated aircrew member position.

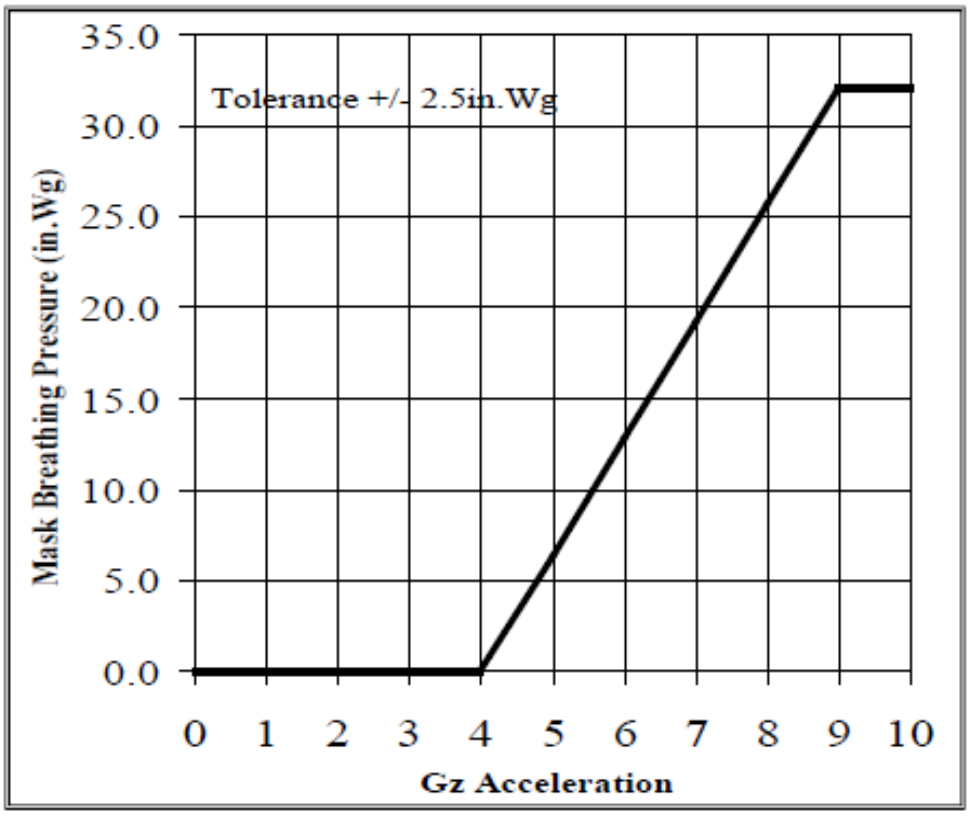
3.5.22.7 Oxygen System Integration

The *aircraft* oxygen system shall be installed such that the operational envelope of the *components* does not violate the operational envelopes of any other *aircraft* subsystem, and the cabling, wiring, and plumbing routing between *aircraft* subsystems. The oxygen system *components* and plumbing shall be installed to minimize fire hazards. The OBOGS air inlet shall be protected from entrained liquid water. The design shall consider cold weather operations and the possibility of freezing. All oxygen controls and displays, hoses, masks, and equipment mounted on the personnel shall be installed such that an effective interface that maximizes mission effectiveness has been provided between personnel using the equipment and the oxygen equipment itself. Where the oxygen system must be integrated with other *aircraft components* or subsystems, the operation and design of the oxygen system shall not be degraded. The oxygen system design shall consider requirements for structural integrity, accessibility, maintainability, serviceability, logistics support, training, quality assurance, survivability, safety, supportability, reliability, human engineering, international standardization, hazards analysis, contamination investigation, and cleaning concerns.

3.5.22.8 Pressure Breathing for G (PBG) Loading

The *aircraft* shall provide PBG loading mask pressures as shown in Figure 3-3. The system shall have a fail-safe design to prevent PBG without G-trouser inflation, a failure mode that could cause a physiological incident. (NOTE: Inflatable torso garments are not required.)

Figure 3-3, Mask Breathing Pressure Schedule vs G Loading



3.5.22.9 Breathing Gas Contamination Limits

The *aircraft* oxygen system shall not contain toxic or corrosive materials (e.g., lead or cadmium). The gaseous contaminants in the aircrew breathing gas shall not exceed the limits noted in Table 3-19. The OBOGS breathing gas shall be filtered and prevent particles larger than 0.4 microns from entering the aircrew's breathing gas. The OBOGS exhaust gas shall be effectively vented. The OBOGS waste gas shall not be allowed to enter the *aircraft* cabin. OBOGS waste gas shall be prevented from back flowing into the ECS and bleed air system during low pressure condition and loss of pressure condition. The breathing system and air source(s) design shall consider conditions in which the *aircraft* engine(s) might ingest jet engine exhaust gas during ground operations and fuel spillage during aerial refueling. Also, the breathing system and air source(s) design shall consider failure modes where *aircraft* fluids (hydraulic fluid, coolant fluid, etc.) might leak into the OBOGS source air.

Table 3-19, Breathing Gas Maximum Allowable Contaminant Concentration

SUBSTANCE	MAXIMUM ALLOWABLE CONCENTRATION (ppmv)
Acrolein	0.05
Aldehydes	0.2
Aromatics	0.1
Carbon Dioxide	500
Carbon Monoxide	10
Ethanol	500
Fluorine (as HF)	0.05
Halogenated Solvents	0.2
Hydrogen Peroxide	0.5
Methyl Alcohol	100
Methyl Bromide	1
Nitrogen Oxides	0.1
Ozone	0.05
Total Remaining Hydrocarbons	25
Unsaturated Hydrocarbons (alkenes, alkynes)	0.2
Nickel	0.125 mg/m^3
Cobalt	0.025 mg/m^3
Oil and Particulate Matter	0.2 mg/m^3

3.5.22.10 OBOGS Monitoring

The OBOGS shall have *built-in test (BIT)* features to check the system's ability to safely operate. The aircrew shall be immediately notified of any *safety critical faults*. The *BIT* information indicating a *failure* parameter of the OBOGS shall be stored within the OBOGS or on-board the *aircraft* for the last ten (10) hours of operation and be capable of convenient download by ground maintenance personnel.

3.5.23 Ground Personnel/Maintainer Specific Considerations

3.5.23.1 Ground Personnel Acoustic Exposure Tolerance

The *aircraft system* shall not expose the ground personnel, wearing protective equipment in the proximity of the *aircraft* to noise levels at their ears that exceed a Total Daily Noise Exposure (TDE) of one (1.0). TDE shall be calculated IAW MIL-STD-1474, paragraph D.4.4.3.2, Equation 1a, and shall take into account the maximum number of exposure doses the ground personnel will experience in a 24-hour period (total number of noise exposure segments in the worst nominal duty day). The TDE is calculated as a summation of the launch, recovery, and maintenance task occurrences the ground personnel will experience in a 24-hour period. For the

purposes of this calculation, the maximum number of exposure doses the ground personnel will experience shall be defined as a total of not less than: four launch, four recovery and eight hours of maintenance tasks involving all noise producing ground support equipment (e.g., bleed air carts, generators, etc., see section 3.8.14.3). The exposure time for the noise exposure segment i (T_i) shall be defined as the maximum A-weighted noise pressure levels for the actual operation duration or the minimum exposure times listed (whichever is greater). This calculation shall be performed for all ground positions (e.g., ground-crew chief, and assistant crew chief) on the flight-line for launch, recovery, and maintenance operations.

3.5.23.2 Maintainer Lifting and Carrying Limits

The *aircraft system* shall be in compliance with the maximum maintainer lifting and carrying limits defined in paragraphs 5.8.6.3.1-5.8.6.3.12 of MIL-STD-1472. The *aircraft system* shall comply with the maximum design weight limits for one person provided in Table 3-20. (Note: The values in Table 3-20 assume that there are no obstacles between the person lifting and the shelf, table, bench, or other surface on which the object is to be placed. Where a lower protruding shelf or other obstacle limits the lifter's approach to the desired surface, the weight limit of the object shall be reduced by 33%.)

Table 3-20, Maintainer Lifting and Carrying Limits

Handling Function	Male and Female Population
Lift an object from the floor, and place it on a surface equal to or greater than 5.0 feet above the floor.	31 lb.
Lift an object from the floor, and place it on a surface not greater than 5.0 feet above the floor.	37 lb.
Lift an object from the floor, and place it on a surface not greater than 3.0 feet above the floor.	44 lb.
Carry an object 33 feet or less	42 lb.

3.6 Embedded Training

The *aircraft* shall have an *Embedded Training* capability that provides both aircrew with switchology, *situational awareness* indicators, and display presentations via the *LAD* and *HTD* as applicable so that aircrew can perform *Cockpit/Crew Resource Management* training. This training consists of the *virtual simulation* of mission systems IAW subparagraphs below.

3.6.1 Radar System Simulation

3.6.1.1 Radar Functions and Modes

The radar system simulation shall provide, but not be limited to, the following functionality, modes, and display presentations per Table 3-21.

Table 3-21, Radar Functionality, Modes, and Display Presentations

a. Air-to-air radar simulating Active Electronically Scanned Array (AESA) capabilities.
b. Simultaneous display of minimum of 20 air-to-air track files (satellite view).
c. Simultaneous display of air-to-air track file vertical distribution/Vertical Situation Display (grandstand view).
d. Synthetic Aperture Radar (SAR) ground mapping mode.
e. Auto Acquisition Modes: Boresight mode 5x5, Vertical Scan 5x 60, Auto Lock Mode 20x 60, Slewable Sensor Search 20x20.
f. Weapons envelope, launch, and fly-out presentations for own-ship and Tactical Datalink (TDL) team members.

3.6.1.2 Air-to-Ground Function

The radar system simulation shall provide an air-to-ground capability against *constructive targets*.

3.6.1.3 Air-to-Air Function

The radar system simulation shall provide an air-to-air capability against *live targets, virtual targets* (if *GBTS* Connectivity is implemented) and *constructive targets*.

3.6.1.4 Synthetic Aperture Radar (SAR) Ground Mapping

The radar system simulation shall provide ground mapping imagery so that aircrew can perform radar navigation and identify turn points, waypoints, land/water interfaces, prominent *cultural and natural features,* and ground targeting.

3.6.1.5 Target Information

The radar system simulation shall provide both aircrew positions with air-to-air and air-to-ground radar display presentations and target information per Table 3-22.

Table 3-22, Target Information

a. Ground target slant range.
b. Ground target bearing.
c. Airborne target aspect angle.
d. Airborne target altitude.
e. Airborne target relative speed.
f. Airborne target heading.
g. Airborne target airspeed.

3.6.1.6 Radar Detection

The radar system simulation shall provide the capability to individually program the detection range of airborne *live targets, virtual targets* (if *GBTS* Connectivity is implemented), and *constructive targets* during pre-flight mission planning. The radar system simulation shall detect and display airborne targets IAW the following detection rules:

a. Probability of detection is 1.0 when the target is at a range equal to or less than the programmed detection range value for the target;
b. Probability of detection is 0.0 when the target is at a range greater than the programmed detection range value for the target.

3.6.1.6.1 Variable Detection Range Profiles

Radar system simulation shall provide the capability to alter the tactical conditions of own-ship radar detectability via the detection range profiles defined below. The detection range profiles shall be generated from pre-flight mission planning and shall be real-time, aircrew-selectable at both aircrew positions such that the *aircraft* (and *GBTS* if GBTS Connectivity is implemented) that is selecting a particular profile dictates the detectability rule that other participant *aircraft* (*live*, *virtual*, and *constructive*) in the mission shall follow.

a. Normal detection range profile (default): Target detection is IAW the programmed detection range values from pre-flight mission planning.
b. Easy detection range profile: Target detection range values defined in the Normal profile are increased by a pre-flight mission planned amount.
c. Difficult detection range profile: Target detection range values defined in the Normal profile are decreased by a pre-flight mission planned amount.
d. Specified detection range profile: Target detection range values defined as specified by aircrew member through pre-flight mission planning and by real-time in-flight modification using 1 NM increments.

(Note: Detection range profiles are intended to enable aircrew to simulate different tactical conditions such as low target radar cross section, target range degradation, contested/degraded operations, etc.)

3.6.1.7 Radar Controls

The radar system simulation shall provide both aircrew positions with sufficient controls to select radar functions and modes defined in Table 3-21, synchronized between aircrew positions and to individually manipulate the radar display presentation per Table 3-23.

Table 3-23, Radar System and Display Controls

a. Radar modes (see Table 3-21)
b. Scan pattern
c. Cursor function
d. Range scale
e. Airborne track file auto population (AESA)
f. Airborne and ground Shoot List/Target designation
g. Primary Next To Shoot/Next To Shoot or Target-to-target quick step
h. Receiver gain
i. Video brightness/contrast
j. Zoom
k. Reset radar system settings to default state

3.6.1.8 Hands on Throttle and Stick (HOTAS)

The radar system simulation shall provide both aircrew positions with radar controls through their respective *HOTAS controls* for all radar controls defined in Table 3-23 except for items h and i.

3.6.2 Defensive Management System (DMS)

The simulated DMS will consist of Radar Warning Receiver (RWR) and expendables systems.

3.6.2.1 RWR Detection

The simulated RWR shall detect and display *live, virtual* (if *GBTS* Connectivity is implemented), and *constructive threats/targets* (airborne and ground Radio Frequency emitters, friendly, enemy and neutral).

3.6.2.2 Threat Display

The DMS shall provide threat display presentations and threat information on both LAD and HTD as applicable, per Table 3-24 at both aircrew positions.

Table 3-24, DMS Display Presentation and Visual Cues

a. Depiction of at least 20 threats simultaneously (including search, track, and launch modes) b. Unclassified threat symbology c. Expendables inventory by type (flares/chaff) and quantity d. Threat bearing relative to own-ship e. Threat range relative to own-ship f. Axis of the indication on the HTD (in the same way the RWR does) to provide *situational awareness* from which direction the threat is originating g. HTD symbology for highest priority threat and Shoot List tracks (including range, aspect angle, altitude, and airspeed of threat next to HTD threat symbol)

3.6.2.3 DMS Controls

The DMS shall provide controls to select system modes and functions per Table 3-25 at both aircrew positions (synchronized between aircrew positions) and to individually manipulate respective display presentations.

Table 3-25, DMS Modes and Functions

a. High and low altitude priority modes b. Threat separation c. Open and priority modes d. Handoff mode

3.6.2.4 Threat Audio

The DMS system shall provide aural warnings to both aircrew members through the *ICS* per Table 3-26.

Table 3-26, DMS/RWR Threat Audio

a. Aural tones for track (air-to-air and surface-to-air) and guidance (surface-to-air) b. New higher priority threat tone c. Aural warning in the form of “missile-missile” upon missile launch

3.6.2.5 Expendables Systems

The DMS shall provide controls and switchology for both aircrew members to employ simulated expendables systems per Table 3-27.

Table 3-27, Expendables Systems

a. Chaff b. Flare c. In-flight reload of chaff and flare d. At least 4 countermeasure dispensing programs (from pre-flight mission planning) e. Dispensing programs are aircrew-activated (expended) via HOTAS throttle switch f. Visual and auditory release cue to own-ship aircrew g. Auditory radio cue to wingman in multi-ship missions (aircrew-selectable to OFF state)

3.6.3 Weapon Systems

The *aircraft* shall provide *situational awareness* indicators, controls, and switchology for aircrew to employ simulated weapon systems per Table 3-28.

Table 3-28, Weapons Systems

Air-to-Air Weapons
a. Gun (up to 6000 feet range)
b. --Lead Computing Optical Sight (LCOS) (aircrew selectable)
c. --Enhanced Envelope Gun Sight (EEGS) (aircrew selectable)
d. High off-boresight missiles (at least 60 degrees)
e. Limited off-boresight missiles (up to 30 degrees)
f. Short range (IR) missiles (.2 to 8 NM)
g. Medium-to-long range missiles (.5 to 35 NM)
Air-to-Ground Weapons
h. Constantly Computed Impact Point (CCIP)
i. CCIP Gun
j. Constantly Computed Release Point (CCRP)
k. Inertial aided munitions (IAMs)
l. General purpose bombs
m. Laser guided bombs (LGBs)
Situational Awareness Indicators
n. Missile envelope display (air-to-air)
o. Shoot cues (air-to-air)
p. Missile fly-out display (air-to-air)
q. Audio tones at weapons release (air-to-air, air-to-ground)
r. Visual release cues (air-to-air, air-to-ground)
s. Impact point display (air-to-ground)
t. Time to impact (air-to-ground)

3.6.3.1 No Drop Weapon Scoring (NDWS)

The *aircraft* shall provide *No Drop Weapons Scoring (NDWS)* accuracy equivalent to the circular error probable of the selected air-to-ground non-guided weapon.

3.6.4 Embedded Training Presentation Overlays on SAD

The *aircraft* shall provide *Embedded Training* presentation overlays on the SAD presentation that depicts simulated tactical information per Table 3-29 at both aircrew positions. All overlays (simulated tactical information) shall be selectable during pre-flight mission planning and shall be cockpit-selectable at both aircrew positions.

1917 **Table 3-29, Simulated Tactical Information for the Overlays on SAD**

a. Composite tactical picture fused from on-board simulated sensors, GSS/*GBTS* if offered, and off-board information from simulated Tactical Datalink overlaid on the SAD/Navigation Display Presentation (see section 3.5.14.1.6)
b. Own-ship bullseye bearing and range
c. Planned routes, route lines, and waypoints (Both pre-planned and in-flight; Turn point, initial point, launch point, target symbols)
d. Bullseye location and symbol
e. Bullseye bearing and range to cursor readout
f. Datalink data
    1. Wingman relative position, orientation, and flight parameters
    2. Other flights relative position, orientation, and flight parameters
    3. Simulated targets
g. Moving map with north-up and own-ship track-up orientations
    1. Ability to manipulate zoom and change map details (e.g., 1: 500,000; 1: 250,000, 1:10 meter)
    2. Range Rings correspond to Map manipulation
h. Identification of friendly, bogey/unknown, and hostile air and ground targets via visual means (e.g., color, geometric presentation)
i. Threat symbols
j. Threat rings or lethality envelopes of simulated pre-planned and airborne threats
k. Air-to-ground weapons employment symbology
    1. Launch acceptability region
    2. Release cues (air-to-ground)
    3. Impact point display (air-to-ground)
    4. Time to impact (air-to-ground)
    5. Impact time (air-to-ground)
l. Weapons data
    1. Desired launch zone
    2. Missile envelope display (air-to-air)
    3. Shoot cues (air-to-air)
    4. Missile fly-out display (air-to-air)
m. Radar cursor
n. Sensor volume (e.g., radar search volume)
o. Wingman/other flight's fuel/weapons state/lock lines when targeted/shot lines displayed during A-A/A-G weapons fly-out
p. Wingman Targeting Pod location Target of Interest (TOI) cue (if Targeting Pod implemented)
q. Own-ship Targeting Pod SAD symbology (if Targeting Pod implemented)
    1. Targeting Pod Display cursor
    2. Targeting Pod Display cursor bearing and range
    3. Own-ship Targeting Pod location TOI cue

3.6.5 Tactical Datalink (TDL) System Simulation

The *aircraft* shall provide controls, displays, and switchology for aircrew to employ simulated Tactical Datalink (TDL) messaging capabilities (UNCLASSIFIED) per Table 3-30.

Table 3-30, TDL Messaging

A. Exchange the following J-series messages relative to non-Command & Control (non-C2) Link 16 participants[1]:

Basic:

a. J2.2 Tx Air PPLI (own-ship identification)
b. J2.x Rx PPLIs (air, ground, surface friendly identification)
c. J7.0 Rx (track management)

Platform Situational Awareness:

d. J3.x - Rx (air, ground, surface, EW tracks)
e. J6.0 Rx (track/point amplification (threat))
f. J10.2 Rx (engagement status)
g. J15.0 Rx (threat warning)

Interceptor/Strike/Bomber Core Mission:

h. J7.7 Rx (association)
i. J12.0 Rx (mission assignment)
j. J12.4 Tx/Rx (controlling unit change)
k. J12.5 Rx (target/track correlation)
l. J12.6 Tx/Rx (target sorting)
m. J12.7 Tx/Rx (target pairing)
n. J28.2(0) Tx/Rx (free text)

B. Exchange the following K-series messages relative to Close Air Support (CAS) Variable Message Format (VMF) airborne participants[1,2]:

a. K02.34 (*aircraft* on-station)
b. K02.57/K02.59 (*aircraft* attack position & target designation)
c. K02.33 (close air support aircrew briefing (i.e., "9/15 line")
d. K02.35 (*aircraft* depart initial point)
e. K02.58 (CAS *aircraft* final attack control)
f. K02.28 (CAS mission battle damage assessment report)

[1] assumes applicable aircrew message receipt/compliance processing is exercised
[2] assumes scenario display is populated with simulated K05.1 position report entries

3.6.6 Targeting Pod System Simulation

SEE APPENDIX D.

Table 3-31, Targeting Pod Functionality

SEE APPENDIX D.

3.6.7 Mission Scenario Inputs

The *aircraft* shall accept and execute pre-planned mission scenarios (see section 3.12.3), real-time scenario inputs (see Table 3-32) by both aircrew positions, real-time scenario inputs from participating *aircraft* (*GBTS* is considered an aircraft for APT configurations if implementing *GBTS* Connectivity) and real-time scenario inputs from a GSS (if GSS Connectivity is implemented).

Table 3-32, Scenario Inputs

a. Flight plan updates b. Simulated Tactical malfunctions (non-emergency) c. Weapons criteria (loadout) d. Simulated threat data (Table 3-39) e. Reset to initial conditions f. J/K-series messages

3.6.8 Synchronized Combat Environment

The *aircraft* shall provide a synchronized mission scenario environment between aircrew positions, and between participating *aircraft* (unique by multi-ship mission) (*GBTS* is considered an *aircraft* for APT configurations if implementing *GBTS* Connectivity).

3.6.8.1 Own-ship Position

The *situational awareness* indicators and display presentations within the mission scenario environment shall be correlated with the own-ship location, altitude, attitude, heading, and airspeed throughout all flight phases, and APT syllabus maneuvers and mission profiles (see APPENDIX A).

3.6.9 Geographical Area

The geographical area supported by the simulation shall be a contiguous, textured, round-earth database(s) covering the entire Continental United States (CONUS) with no breaks in terrain, features, models or imagery.

3.6.9.1 High Resolution Area

The CONUS geographical area database(s) shall include *high resolution areas* as follows:

a. *High resolution areas*: Extend over the *local training area* for each of the following main operating bases and designated bases as defined in Table 3-33.

b. Terrain elevation data: Digital Terrain Elevation Data (DTED) Level 2 or equivalent elevation data for the *high resolution areas*, and DTED Level 0 or equivalent elevation data for the rest of the CONUS.
c. *Cultural and natural features* data: Provide features found on USAF-approved 1:50,000 scale flight charts for *high resolution areas*, and at least 1:1,000,000 scale flight charts for the rest of the CONUS.
d. Imagery data: 10-meter resolution or better for the *high resolution areas* to support air-to-ground targeting; and 1-meter resolution for the *local training area's* low-level routes (extending 5 NM on either side of the route centerline) to support SAR ground mapping mode.

Table 3-33, High Resolution Areas

Main Operating Base	Designated Base
Joint Base San Antonio - Randolph, TX	Creech AFB, NV
Columbus AFB, MS	Luke AFB, AZ
Laughlin AFB, TX	Moody AFB, GA
Sheppard AFB, TX	Tyndall AFB, FL
Vance AFB, OK	

3.6.10 Declutter Function

The *aircraft* shall provide a declutter function to remove all *Embedded Training* presentation overlays (simulated tactical information) on the SAD and HTD via a single-action on the *HOTAS controls* at both aircrew positions.

3.7 Recorded Aircraft Information

The *aircraft* shall digitally record information (cockpit audio and flight data) on non-volatile memory to support data user needs, including but not limited to, operational analyses and integrity programs (Aircraft Structural Integrity Program, Mechanical Equipment and Subsystems Integrity Program, and Propulsion System Integrity Program), mishap investigation, maintenance, and *mission debriefing*.

3.7.1 Military Flight Operations Quality Assurance (MFOQA)

3.7.1.1 Recorded Data

The *aircraft* shall record flight data to support the Military Flight Operations Quality Assurance (MFOQA) program, as established by AFI 91-225 that captures the industry standard for mishap prevention; but, not less than the parameter set (when available) defined by Table 1 in AFH 63-1402 at the Range, Interval, Limits, and Resolution outlined by Table 1 (Geodetic Position parameter is required) for fixed-wing aircraft, plus other Aircraft Information Working Group (AIWG) defined parameters will be included.

3.7.1.1.1 Airframe Tracking

The *aircraft* shall record Individual Aircraft Tracking (IAT) flight data IAW MIL-STD-1530. In addition, all Engineering and Manufacturing Development (EMD) *aircraft* and 20% of the

production *aircraft* (20% of *aircraft* in each production lot) shall have the capability to record Structural Loads/Environment Spectral Survey (L/ESS) data IAW MIL-STD-1530.

3.7.1.2 Data Retrieval

The *aircraft* shall provide for ground personnel to download the flight data used for MFOQA analysis and integrity programs from a single point on the *aircraft* using a Government-approved mobile device with an *open standard* interface or the mission planning-compatible DTD. The *aircraft system* shall provide a method to transfer the downloaded data (from mobile device or DTD) to a standard USAF computer (USAF Standard Desktop Configuration with the most current Windows Operating System). The *aircraft system* shall provide non-proprietary means for Government personnel to decode the downloaded data into interpretable information (engineering units) for MFOQA analysis and integrity programs.

3.7.2 Mishap Investigation Data

3.7.2.1 Aircraft Recorded Data

The *aircraft* shall record cockpit audio (all internal and external communications) and flight data that meets the minimum parameter set defined in AFH 63-1402 for fixed wing aircraft, plus other AIWG-defined parameters. Parameter 3.2 “Geodetic Position (Lat/Long)” in AFH 63-1402 is required and shall be recorded to the maximum resolution at which the installed system is capable of operating.

3.7.2.1.1 Crash Survivable Recorder(s)

The *aircraft* shall have a flight data recorder (FDR) that records and retains at least the last 25 hours of flight data and a cockpit voice recorder (CVR) that records and retains at least the last two hours of acoustic data. The FDR and CVR shall be crash survivable and comply with Technical Standard Orders (TSO)-C124c and TSO-C123c, respectively (TSO requirement for underwater locator beacon applies.) (Note: A combination FDR/CVR is acceptable.)

3.7.2.2 Data Retrieval

In order to ensure the FDR and the CVR are operating correctly, the *aircraft system* shall provide for ground personnel to periodically download recorded data without requiring recorder removal from the *aircraft*. Additionally, the *aircraft system* shall provide the non-proprietary means for Government personnel to decode the downloaded data into interpretable information (engineering units) for mishap investigation.

3.7.2.3 Ejection Seat Recorded Data

In the event of an ejection sequence, the ejection seat shall be capable of recording the event times of seat functions, selected mode, any sensed air pressures, and the linear accelerations about three orthogonal axes, at a minimum. Additionally, the *aircraft system* shall provide the non-proprietary means for Government personnel to decode the downloaded data into interpretable information (engineering units) for mishap investigation.

3.7.3 Maintenance Data

3.7.3.1 Recorded Data

The *aircraft* shall record time-stamped maintenance and engine data that includes discrepancies and health, over-G event/level, actual takeoff and landing times, engine start and stop times, weight on/off-wheels times, *built-in test (BIT)* information, Condition-Based Maintenance Plus (CBM+) information, systems/subsystems/*components* faults, and other AIWG-defined parameters. The *aircraft* shall record at least 18 hours of data without overwriting or otherwise losing unique data. (Note: 18 hours define worst case of three 2-hr sorties/day for three consecutive days for cross country training missions without download until the *aircraft* returns to home station.)

3.7.3.1.1 CBM+ Function

The *aircraft* shall have a CBM+ function to capture and store diagnostic/prognostic information. The CBM+ function shall capture and store all relevant data associated with detected *faults*. The *aircraft system* shall provide for the capability to conduct analysis for CBM+ of all recorded aircraft information including, but not limited to, trending of historical data, identifying emergent failures, and aggregating data (e.g., operational, environmental, system and subsystem condition, etc.) to determine prognostic indicators.

3.7.3.2 Aircraft Turn Data Viewing

The *aircraft* shall provide *fault detection* and *fault isolation* information at the *Line Replaceable Module (LRM) and Line Replaceable Unit (LRU)* level, viewable in the cockpit and at the *aircraft* via a single point location (using a Government-approved mobile device with an *open standard* interface) necessary to repair and turn the *aircraft* for next sortie of that day.

3.7.3.3 End of Fly Day Data Retrieval

The *aircraft* shall provide for downloadable maintenance and engine data (as defined in section 3.7.3.1) and all systems/subsystems/*components faults* from a single point on the *aircraft*, using a Government-approved mobile device with an *open standard* interface. Additionally, the *aircraft system* shall provide the non-proprietary means for Government personnel to decode the downloaded data into interpretable information (i.e., engineering units).

3.7.3.4 Maintenance Data Collection & Management System

The *aircraft* maintenance data recording function shall be compatible with the Integrated Maintenance Data System (IMDS) and the Comprehensive Engine Management System (CEMS) using an XML format, as the electronic data transfer language for both systems, compatible with the USAF Standard Desktop Configuration with the most current Windows Operating System.

3.7.4 Mission Debrief Data

3.7.4.1 Recorded Data

The *aircraft* shall provide for recording and storage (at least 240 minutes of circular memory storage that automatically overwrites oldest recorded data after storage is full) of sufficient data

types to accomplish mission and flight reconstruction during post-flight *mission debriefing* (see section 3.12.4).

3.7.4.1.1 Bookmarks

The *aircraft* shall provide for flagging/marking events (*bookmark*) by both aircrew members as events occur during mission recoding. Additionally, the *aircraft* shall automatically *bookmark* the following mission events during mission execution:

a. Simulated Weapon Release, Trigger Pull, Cage/Uncage (missile, bomb, gun)
b. Master Caution Triggered
c. Landing Gear Change
d. Weight on/off-wheels
e. *Embedded Training* Scenario Start
f. Simulated Master Arm On/Off
g. Simulated Expendables (Chaff /Flare) Dispense
h. Simulated SAM/AAA Launch
i. Stall
j. Over-G
k. Simulated Master Mode Change (air-to-air, air-to-ground, navigation)

3.7.4.2 Data Retrieval

The *aircraft* shall provide for immediate post-flight data retrieval of recorded data via mission planning-compatible DTD.

3.7.4.3 Data Quality

Recorded data (audio and video) shall have sufficient resolution so that it can be replayed without distortion (*readable*) using the intended mission debriefing system defined in 3.12.4.

3.8 Product Support

3.8.1 Operational Availability (A_o)

Operational Availability shall be at least 80%. A_O shall be calculated using the definition of *Mission Capable (MC)* Rate IAW TO 00-20-2 Appendix L, Index 114.

$$A_O = \text{MC Rate} = \frac{(\text{FMC Hours} + \text{PMC Hours})}{\text{Total Possessed Hours}} \times 100$$

3.8.2 Materiel Availability (A_m)

Materiel Availability shall be at least 76%. A_M shall be calculated using the definition of Aircraft Availability (AA) Rate IAW TO 00-20-2 Appendix L, Index 107. (Note: Total Active Inventory includes Primary Aircraft Inventory, Backup Aircraft Inventory, and Attrition Reserve per AFI 16-402.)

$$A_m = AA = \frac{\text{Mission Capable Hours}}{\text{Total Active Inventory Hours}} \times 100$$

3.8.3 Materiel Reliability (R_m)

Materiel Reliability shall be at least 95%, calculated IAW formula given below. Sorties attempted are the sum of sorties flown and ground aborts. *Code 3*'s and ground aborts are defined IAW TO 00-20-2 Appendix L, Index 9 and 4, respectively. Only ground aborts due to maintenance causes (GA_{Mx}) shall be included in the calculation of R_m.

$$R_m = \frac{\text{Sorties Attempted} - Code\ 3's - \text{Ground Aborts}_{Mx}}{\text{Sorties Attempted}} \times 100$$

3.8.4 Mean Time Between Failures (MTBF)

Mean Time Between Failures (MTBF) Type 1 (Inherent) shall be at least 10 hours, calculated IAW TO 00-20-2 Appendix L, Index 92. It includes all Type 1 inherent *failures*. For total *aircraft* roll-ups, the usage factor (UF) and quantity per application (QPA) shall be set to one.

$$\text{MTBF}_{\text{Type 1}} = \frac{\text{Total Flying Hours x QPA x UF}}{\text{Inherent Failures}}$$

3.8.5 Fix Rate

Eight-hour *Fix Rate* shall be at least 75%, calculated IAW TO 00-20-2 Appendix L, Index 14.

$$\text{8 Hour Fix Rate} = \frac{\text{Number of Aircraft Breaks Fixed Within 8 Hours After Landing}}{\text{Total Number of Aircraft Breaks}} \times 100$$

3.8.6 Mean Time Between Maintenance (MTBM)

Mean Time Between Maintenance (MTBM) Total shall be at least 1.5 hours, calculated IAW TO 00-20-2 Appendix L, Index 95. It includes all Type 1 inherent *failures*, Type 2 induced *failures*, and Type 6 no defect actions. For total *aircraft* roll-ups, the UF and QPA shall be set to one.

$$\text{MTBM Total} = \frac{\text{Total Flying Hours x QPA x UF}}{\text{Total Actions (1, 2, and 6)}}$$

3.8.7 Mean Time To Repair (MTTR)

Mean Time To Repair (MTTR) on-equipment shall be less than or equal to 0.75 hours, calculated IAW TO 00-20-2 Appendix L, Index 103.

$$\text{MTTR} = \frac{\text{Repair Hours (On)}}{\text{Repair Actions (On)}}$$

3.8.8 Turn-Around Time

SEE APPENDIX D.

3.8.9 Diagnostics

3.8.9.1 Integrated Diagnostics (ID) Percent Fault Detection (PFD) (Critical Faults)

Using *Integrated Diagnostics* (*ID*), the *Percent of Fault Detection (PFD)* shall be at least 99% for *on-equipment* (*aircraft*) *critical faults*.

$$\text{PFD (critical faults)} = \frac{\text{Number of Correct Detections of Critical Faults}}{\text{Correct Detections of Critical Faults} + \text{Incorrect Detections of Critical Faults}} \times 100$$

3.8.9.2 ID PFD (All Faults)

Using *ID*, the *PFD* shall be at least 95% for all *on-equipment* (*aircraft*) *faults*.

$$\text{PFD (all faults)} = \frac{\text{Number of Correct Detections of All Faults}}{\text{Correct Detections of All Faults} + \text{Incorrect Detections of All Faults}} \times 100$$

3.8.9.3 ID Percent Fault Isolation (PFI) (Critical Faults)

Using *ID*, the *Percent of Fault Isolation (PFI)* shall be at least 99% for *on-equipment* (*aircraft*) *critical faults*.

$$\text{PFI (critical faults)} = \frac{\text{Number of Correct Critical Isolations}}{\text{Total Number of Correct Critical Detections}} \times 100$$

3.8.9.4 ID PFI (All Faults)

Using *ID*, the *PFI* shall be at least 95% for all *on-equipmen*t (*aircraft*) *faults*.

$$\text{PFI (all faults)} = \frac{\text{Number of Correct Isolations}}{\text{Total Number of Correct Detections}} \times 100$$

3.8.9.5 Built-In-Test (BIT) Functions

The *aircraft* shall have *Start-up*, *Continuous*, and *Initiated BIT* functions. *Initiated BIT* shall only be available for execution on the ground.

3.8.9.5.1 BIT Functions Display

The *BIT* system shall display to the aircrew all faults that are determined to be necessary for aircrew notification as defined by the FMECA and Crew Systems Working Group. All faults shall be displayable for maintenance action IAW section 3.7.3.2.

3.8.9.6 Safety Critical (SC) BIT Coverage

The *aircraft BIT* system shall detect all *Safety Critical (SC) faults* (structural faults are excluded).

3.8.9.6.1 BIT PFD (SC Faults)

Using *BIT*, the *PFD* shall be at least 99% for *on-equipment* (*aircraft*) *SC faults*.

$$\text{PFD (SC faults)} = \frac{\text{Number of Correct SC Detections}}{\text{Correct Detections of SC Faults} + \text{Incorrect Detections of SC Faults}} \times 100$$

3.8.9.6.2 BIT PFI (SC Faults)

Using *BIT*, the *PFI* shall be at least 95% for *BIT* detectable *on-equipment* (*aircraft*) *SC faults*.

$$\text{PFI (SC faults)} = \frac{\text{Number of Correct SC Isolations}}{\text{Total Number of Correct SC Detections}} \times 100$$

3.8.9.7 BIT PFD (All Faults)

Using *BIT*, the *PFD* shall be at least 93% for all *BIT* detectable *on-equipment* (*aircraft*) *faults*.

$$\text{PFD (all faults)} = \frac{\text{Number of Correct Detections}}{\text{Correct Detections of All Faults} + \text{Incorrect Detections of All Faults}} \times 100$$

3.8.9.8 BIT PFI (All Faults)

Using *BIT*, the *PFI* shall be at least 80% for all *BIT* detectable *on-equipment* (*aircraft*) *faults*.

$$\text{PFI (all faults)} = \frac{\text{Number of Correct Isolations}}{\text{Total Number of Correct Detections}} \times 100$$

3.8.10 Mean Flight Hours Between Sortie Aborting False Alarms (MFHBSAFA)

The *aircraft Mean Flight Hours Between Sortie Aborting False Alarms (MFHBSAFA)* shall be at least 450 hours. *Sortie aborting false alarms* shall be calculated by counting related *false alarms* of system functions that result in a sortie abort (air and ground).

$$\text{MFHBSAFA} = \frac{\text{Flight Hours}}{\text{Total number of Sortie Aborting False Alarms}}$$

3.8.11 Mean Flight Hours Between False Alarms (MFHBFA)

The *aircraft Mean Flight Hours Between False Alarms* (*MFHBFA)* shall be at least 50 hours. *False alarms* shall be calculated by counting *false alarms* of all system functions.

$$\text{MFHBFA} = \frac{\text{Flight Hours}}{\text{Total Number of False Alarms}}$$

3.8.12 Nameplates and Product Marking

The *aircraft system* shall have nameplates and product identification markings, including Item Unique Identification, IAW MIL-STD-130, and MIL-STD-129.

3.8.13 Maintenance Concept

The *aircraft* shall be compatible with and maintained using a USAF two-level maintenance concept comprised of *Organizational-Level (O-Level) maintenance* and *Depot-Level (D-Level) maintenance*. In addition, the *aircraft* shall be compatible with existing *Intermediate-Level (I-Level) maintenance* capability.

3.8.13.1 Propulsion System Sustainability

The *aircraft* shall provide for ground personnel to accomplish engine *O-Level maintenance* (including removal and replacement of engine *Line Replaceable Units (LRUs)*, scheduled inspections, and dynamic testing at all engine power settings per applicable technical data) with engine(s) installed in the *aircraft*.

3.8.13.2 Engine Start System Sustainability

For *aircraft* with engine start unit(s) (APU or JFS), the start unit shall be considered and maintained as a *Line Replaceable Unit (LRU)* using the two-level maintenance concept (*O-Level to D-Level*). (Note: Besides LRU removal and replacement actions, the *O-Level maintenance* will be limited to removal and replacement of items such as ignitor plugs/leads, fuel controls, start system controllers, etc.)

3.8.14 Support Equipment (SE)

3.8.14.1 Support Equipment Environment

All SE shall be operable, maintainable, transportable, and storable in all operational climatic and environmental conditions (as defined in 3.9.1.1 and 3.9.3 for ground conditions only).

3.8.14.2 Support Equipment/Facility Interfaces

All support equipment and tools shall use only standard USAF electrical, pneumatic, and hydraulic power.

3.8.14.3 Aircraft/Support Equipment Interfaces

The *aircraft* shall interface with USAF common SE as identified in Table 3-34.

Table 3-34, Aircraft/SE Interfaces

Support Equipment Nomenclature	Functional Capability	Status	Standards	Support Equipment Description (Compatibility Requirements)
Air Conditioner	Provides external cool air to *aircraft* interior	Existing	STANAG-3208 ASSE MS33562D	8in is standard for air conditioner side of interface and 4in is standard for aircraft side
Bleed Air	Provides compressed air for engine start or perform MX operations	Existing	STANAG-3372 ASSE MS33740C	Standard AF bleed air hose connection
Nitrogen Cart	Generates nitrogen for MX operations	Existing	AN6287	Standard aircraft high pressure Schrader valve
Generator	Provides external electrical power to activate/test *aircraft* systems	Existing	SAE-AS25486	Standard NATO 6 pin 400 Hz connector
Hydraulic Test Stand	Provides external hydraulic power to activate/test *aircraft* hydraulic systems	Existing	MIL-DTL-25427	#12 and #16 fittings for supply and return
Oil Cart	Service oil in *aircraft* engines	Existing	STANAG-3595 ASSE MIL-DTL-25677	
Tow Bar	Tow *aircraft*		STANAG-3278 ASSE MIL-STD-805	
Cabin Pressure tester	Apply air pressure to *aircraft* cockpit for testing		STANAG-3315 ASSE	
Jacking			STANAG-3098 ASSE	
Lifting Sling Attachment			STANAG-3237 ASSE	
Grease Fittings	Apply grease to *aircraft* components		STANAG-3766 ASSE	
Static Grounding Connections			STANAG-3632 ASSE NATO STANDARD AAEP-02	
Tire Valve Couplings	Service tire with nitrogen		STANAG-3209 ASSE	

3.8.15 Maintenance Work Environment

3.8.15.1 Climatic/Environmental Work Conditions

The *aircraft system* shall provide for personnel to perform all required maintenance tasks in all operational climatic and environmental conditions (as defined in 3.9.1.1 and 3.9.3 for ground conditions only) while complying with AFI 91-203.

3.8.15.2 Maintainer Accommodation

The *aircraft system* shall provide for maintainers, with the anthropometric range as defined in Table 3-35, to perform service, launch, recovery, and Technical Order maintenance tasks that are required to be performed outdoors while wearing applicable PPE and cold weather gear. All remaining maintenance tasks shall accommodate the maintainer while wearing applicable PPE.

Table 3-35, Maintainer Anthropometric Cases

Attribute	Case 1	Case 2	Case 3
Stature (± 1 inch)	58	65	74
Weight (± 10 lbs)	93	211	239

3.8.16 Manpower and Personnel

The *aircraft system* shall be compatible with the current USAF personnel aptitudes, knowledge, and skill levels to support and maintain the *aircraft system* utilizing no more than the current manpower levels.

3.9 Climatic and Environmental Conditions

The *aircraft* shall perform all required missions before, during, and after exposure to operating and non-operating environments specified in 3.9.1, 3.9.2, and 3.9.3.

3.9.1 Natural Climate

3.9.1.1 Operational Conditions

The *aircraft* shall operate continuously, without degradation to mission requirements and ground maintenance activities, in the operational conditions (surface ambient air temperature, solar radiation, and relative humidity) as described in MIL-STD-810, Part One, Annex C, Table C-I, Climatic Design Type, Basic, including worst case corresponding internal temperatures with cockpit closed, and remain fully *mission capable*.

3.9.1.2 Environment Condition Lapse Rates for Non-Standard Days

The *aircraft* shall operate continuously, at all altitudes up to the maximum *absolute ceiling*, without degradation to mission requirements and ground maintenance activities, in Cold Day and Hot Day operational conditions as described in Table 3-36, and remain fully *mission capable*.

Table 3-36, Cold Day and Hot Day Lapse Rates

Cold Day			Hot Day		
H, ft.	°F	°C	H, ft.	°F	°C
0	-25.6	-32.0	0	109.4	43.0
5,000	-6.7	-21.5	5,000	86.6	30.3
10,000	-16.3	-26.8	10,000	66.4	19.1
15,000	-31.0	-35.0	15,000	47.4	8.5
20,000	-46.7	-43.7	20,000	31.1	-0.5
25,000	-61.7	-52.1	25,000	15.9	-9.0
30,000	-72.2	-57.9	30,000	2.9	-16.2
35,000	-79.2	-61.8	35,000	-10.6	-23.7
40,000	-83.5	-64.2	40,000	-25.3	-31.8
45,000	-86.5	-65.8	45,000	-37.8	-38.8
50,000	-96.6	-71.4	50,000	-40	-40
55,000	-102.4	-74.7	55,000	-40	-40
60,000	-99.6	-73.1	60,000	-40	-40
65,000	-98.7	-72.6	65,000	-40	-40

3.9.1.3 Icing Conditions

The *aircraft* shall be capable of safely climbing and descending through at least 5,000 vertical feet of *light rime icing* from sea level to 22,000 feet *PA* using Technical Order-prescribed normal operating procedures and airspeeds with no worse than Level 2 (*Tolerable*) *flying qualities*.

3.9.2 Induced Environment

3.9.2.1 Storage and Transit Conditions

The *aircraft* shall operate after exposure to storage and transit conditions (air temperature and relative humidity) described in MIL-STD-810, Part One, Annex C, Table C-I, Climatic Design Type, Basic.

3.9.2.2 Operating Conditions

The *aircraft* shall operate continuously in *induced environments* generated during *aircraft* operations and maintenance (altitude, thermal, shock, vibration, acceleration, acoustic noise, and explosive atmosphere) IAW MIL-STD-810.

3.9.3 Electromagnetic Environmental Effects (E3)

The *aircraft* shall be electromagnetically compatible within itself, its operational electromagnetic environment, and interfaces as specified in MIL-STD-464 as applicable.

3.10 Architecture and Security

3.10.1 Critical Program Information

The *aircraft system* shall include *anti-tamper* measures to protect *Critical Program Information* identified in the Anti-Tamper Plan.

3.10.2 Cybersecurity

The *aircraft system* shall include *security controls* identified in the Security Requirements Traceability Matrix (SRTM) resulting from the Risk Management Framework and System Security Engineering Working Group activities.

3.10.3 Open Systems Architecture

As a minimum, all *key components and interfaces* for hardware and *Operational Flight Program*(s)*/Software Item*(s) (*OFP/SI*) shall employ open system, service-oriented architecture that utilizes a modular design in which functionality is partitioned into discrete, cohesive and self-contained units with documented, publicly available, non-proprietary, commercial, or industry interfaces and standards to the maximum extent feasible for readily accommodating competitive future system upgrades and modifications. The architecture shall be layered and modular or decoupled and flexible/scalable (e.g., Open Mission Systems (OMS), Future Airborne Capability Environment (FACE)) and maximizes the use of standards-based Commercial-Off-The-Shelf (COTS)/Non-Developmental Item (NDI) hardware, operating systems, and middleware that utilize either non-proprietary or non-vendor-unique module or *component* interfaces. If OMS is offered, the architecture shall include a Tier-2 compliant Mission Package IAW the Open Mission Systems Definition and Documentation (OMS D&D) V1.1. If FACE is offered, the architecture shall comply with the technical standard for FACE, Edition 2.1. Otherwise, the offered architecture shall comply with the requirement as stated and further detailed in the Open Systems Management Plan CDRL. As a minimum, *key components and interfaces* include those associated with the *LAD* subsystem, the central mission processing subsystem, the flight management processing subsystem, the *Embedded Training* processing subsystem, the central maintenance/*BIT* processing subsystem, and the data retrieval and recording processing subsystems. If proprietary standards are used, then full design disclosure and Government Purpose Data Rights will be provided IAW the contract. (Note: See SOW paragraph: Open System, Modular Design for additional definition).

3.10.4 Computing Resources

3.10.4.1 Memory Storage

The *aircraft* shall provide non-volatile memory growth equal to 200% of utilized memory per storage device (measured at System Verification Review (SVR)) for storing the CONUS navigation and terrain databases (including the database(s) for the *Embedded Training* simulations). (Note: Requirement applies to all databases for the *Embedded Training* simulations.)

3.10.4.2 Computer Resources

Each newly developed or modified *component* containing an *OFP/SI* shall have at least 100% installed reserve memory, processor throughput, and data bus throughput (measured at SVR).

3.10.4.3 Operational Flight Program (OFP)/Software Item (SI) Versions

The *aircraft* shall electronically display each of the *OFP/SI* version(s) and any associated databases, using appropriate groupings of *OFP/SI* and data installed on the *aircraft*, by *component* or other discriminator, for both maintenance and aircrew personnel available by user request as well as at system power-up.

3.10.4.4 Operational Flight Program (OFP) / Software Item (SI) Load and Verification

The *aircraft system* shall provide for all loadable *OFP/SI* software and updates, and any associated loadable databases, to be loaded and verified by ground maintenance personnel through standard interface(s) consolidated at a single location within 30 minutes for each *OFP/SI* and each associated database.

3.10.5 ARINC 610 Simulator Compatibility

The *aircraft* shall incorporate ARINC 610 simulator compatibility into the design of newly developed and modified *aircraft components* and software that will also be used in the *GBTS*.

3.11 Utility Attributes

3.11.1 Fuel Standards

The *aircraft* shall use fuel standards as follows:

a. *Primary fuels*:
   ASTM-D1655 Jet A with military additives, ASTM-D1655 Jet A-1with military additives, MIL-DTL-83133 Grade JP-8, and MIL-DTL-83133 Grade JP-8 +100
b. *Alternate fuels*:
   MIL-DTL-5624 Grade JP-5 and ASTM-D1655 Jet A
c. *Emergency fuels*:
   MIL-DTL-5624 Grade JP-4 and ASTM-D1655 Jet-B

Note: The following additives must be injected into the fuel at the concentrations specified in MIL-DTL-5624 or MIL-DTL-83133:

a. Corrosion inhibitor/lubricity improver (CI/LI) (MIL-PRF-25017)
b. Fuel system icing inhibitor (FSII) (MIL-DTL-85470)
c. An approved antioxidant (AO) material listed in paragraph 3 of MIL-DTL-5624 or MIL-DTL-83133
d. An approved Static Dissipater Additive (SDA) listed in paragraph 3 of MIL-DTL-5624 or MIL-DTL-83133

3.11.1.1 Fuel Contaminants

The *aircraft* fuel system shall use and be compatible with fuels containing the following contaminants per Table 3-37.

Table 3-37, Fuel Contaminant Mixture

Contaminant	Particle Size (Microns)*	Quantity (gms per 1000 liters)
Iron Oxide	0 – 5 5 – 10	19 1.0
Sharp Silica Sand	150 – 300 300 – 420	0.7 0.7
ISO 12103-1, A4 Coarse Test Dust	Mixture as provided by ISO document	5.3
Cotton linters	Staple below 7 U.S. Dept. of Agriculture Grading Standards	0.07
Iron Chips Aluminum Chips	150 – 500 150 – 500	10 10
Graphite Epoxy Composite Explosion Suppressant Foam (ESF) Particles** ESF contaminant is defined as foam in compliance with MIL-PRF-87260.	0 – 45 (23%) 45 – 150 (26%) 150 – 300 (8%) 300 – 425 (32%) 425 – 710 (11%) 1 – 100** Distribution is random utilizing method outlined and cut utilizing the methods in section 4.2.4 of MIL-PRF-87260, excluding a hot wire cutter.	5.2 0.75**

Notes:

* The contamination used for testing is graded by the sieve method. Particles considerably larger than 500 microns size can pass through the sieve. Particles in the 700 - 800 micron range have been found in certified test contamination samples.

** For aircraft with fuel tank Explosion Suppressant Foam (ESF) installed in the tanks, OR which may aerial refuel from tankers with ESF.

3.11.2 Lubrication Oil Standards

The *aircraft* shall meet the requirements of this specification using lubricant oils conforming to MIL-PRF-7808 and MIL-PRF-23699.

3.11.3 Space, Weight, Power and Cooling (SWaP-C) Margins

This requirement accommodates future (unplanned) installations of *components*. Space and weight margins are based on the volume of generic classes of *components* that would allow for future installation of *components* without changes to existing structure, mounting location, or other compartment features. Power margins require the allocation of generator and/or battery capacity such that the future capability can be added without changing the electrical system configuration or capacity. Cooling margins require allocation of cooling capacity such that the future capability can be added without changing the ECS configuration or capacity. Margins defined in this section are over and above the growth paths specified for Aerial Refueling (section 3.4.2) and for the WSSP (Table 3-38, Loadout # 3). The *aircraft* will need to meet the performance requirements defined in section 3.1 with SWaP-C margin requirements met.

3.11.3.1 Space

The *aircraft* shall provide excess space to accommodate internally a minimum of 3 additional LRUs each conforming to either 1½-Air Transport Radio (ATR) enclosure size (15.38” W x 19.62” L x 7.62” H) or 12-Modular Concept Unit (MCU) enclosure size (15.37” W x 12.67” L x 7.62” H).

3.11.3.2 Weight

The *aircraft* shall provide capability to accommodate a minimum of 3 additional LRUs, weighing 88 lbs. each (described in section 3.11.3.1).

3.11.3.3 Power

The *aircraft* primary electrical power subsystem shall meet the requirements in section 3.4.5 and have a built-in continuous kilovolt-ampere surplus capacity at least 30% greater than the maximum continuous electrical load of the initial production *aircraft.*

3.11.3.4 Cooling

The *aircraft* ECS shall meet the baseline requirement in section 3.4.3 while maintaining a built-in surplus cooling capacity of not less than 25% for future (unplanned) growth.

3.11.4 Aircraft Maintenance Safety Protection Equipment (MSPE) Stowage

The *aircraft* shall provide for internal stowage (not including cargo/travel pods) that accommodates the minimum flyaway items required for Maintenance Safety and Protection Equipment (e.g., grounding cable, engine covers, gear pins, pitot covers, AOA blocks) as defined in the -21 Technical Order. This stowage space shall be accessible by ground maintenance personnel and shall be external to the cockpit.

3.11.5 External Stores

The *aircraft* shall be capable of carrying the non-jettisonable external stores identified in Table 3-38.

Table 3-38, Loadout Configurations and External Stores

Loadout #	Store Nomenclature and Characteristics	Number Carried	Note
1	MXU Cargo/Travel Pod - P/N 402136-3 - NSN 1680-01-538-0545 - Capacity 300 lbs. - Usable volume 4.75 cubic feet - Load factor 5.0 G in symmetric flight, 4.0 G in asymmetrical loading - Total length 129.6 inches - Max diameter 18.6 inches - Empty weight 104 lbs. - Interface MIL-STD-8591	1	140 lbs. worth of gear will be carried in the pod.
2	Next Generation Cargo Pod - P/N 400850-3 - NSN 1680-01-459-1268 - Capacity 600 lbs. - Usable volume 19 cubic feet - Load factor 7.3 G - Total length 153 inches - Max diameter Elliptical 23.30 x 34.06 inches - Empty weight 320 lbs. - Interface MIL-STD-8591	1	140 lbs. worth of gear will be carried in the pod.
3	Weapon Systems Support Pod (WSSP) - Total length 144.5 inches - Max diameter 10.3 inches (Excluding fins and hardback) - Weight 386 lbs. - Interface MIL-STD-8591 - Power requirements: 3 phase 400 Hz 115/200VAC @ 10A per phase	1	Growth path for future integration of EW Training Pods. (Note: WSSP characteristics are based on the ALQ-167.)

3.11.5.1 Stores Electrical Interfaces

The *aircraft* shall have electrical interface connector(s) and wiring installed that are compatible with MIL-STD-1760, Class II to avoid the cost of adding Group A for a future WSSP integration. (Note: Wiring, at the equipment-bay end, will be capped and stowed.)

3.11.6 Environment, Safety and Occupational Health (ESOH)

3.11.6.1 Safety

Unless otherwise specified, the *aircraft* including systems/subsystems/*components* shall be fail-safe such that no single point *failure* or combination of *failures*, with a *failure* rate greater than $1x10^{-6}$ per flight hour can cause a critical or catastrophic mishap as defined in MIL-STD-882,

paragraph 4.5.1. Fail-safe is defined as a design feature that ensures that the *aircraft* and systems/subsystems/*components* remain safe or in the event of a *failure*, shall cause the *aircraft* and systems to revert to a state that shall not cause a mishap. Any new or peculiar support equipment and procedure procured for the *aircraft* shall be designed in accordance with the Air Force Occupational Safety and Health Standards (AFOSH). In the absence of appropriate AFOSH standards, Occupational Safety and Health Administration (OSHA) standards shall apply.

3.11.6.2 Federal and State Laws

The *aircraft system* shall comply with applicable environmental, pollution control, and occupational health laws and regulations, from federal, state, and local levels.

3.11.6.3 Hazards

The *aircraft system* environmental, safety, and occupational health hazards shall be eliminated, minimized, or controlled, so that mishap risks are acceptable per MIL-STD-882.

3.11.6.4 Energetic Materials

The *aircraft system* shall preclude inadvertent and unintended fire and explosive initiation effects on energetic materials (i.e., cartridge- and propellant-activated devices), caused by unplanned stimuli (i.e., thermal, mechanical, electrical, and electromagnetic sources).

3.11.6.5 Hazardous Materials (HAZMAT)

Hazardous materials shall be minimized in the design, operation, maintenance, and disposal of the *aircraft system* IAW MIL-STD-882 including Task 108, National Aerospace Standard (NAS) 411, NAS 411-1 including listed HAZMAT, and all other applicable laws and regulations. In addition to the prohibited HAZMAT listed in NAS411-1, all Ozone Depleting Substances (ODS) shall be prohibited.

3.11.6.6 Air Force Occupational Safety

The *aircraft system* shall comply with Air Force Consolidated Occupational Safety Instruction, AFI 91-203.

3.11.7 Airworthiness Certification

The *aircraft system* shall meet all USAF airworthiness requirements for achieving a Military Type Certificate. *Aircraft system* design, production, and delivery shall be compliant with the approved USAF certification basis identified in the APT Tailored Airworthiness Certification Criteria and requirements within DoD Directive 5030.61, AFPD 62-6, and AFI 62-601.

3.11.8 Geographic Intelligence (GEOINT)

The *aircraft system* shall use standard National Geospatial-Intelligence Agency (NGA) geographic intelligence (GEOINT) visual and data products that represent the world in the WGS 84 geodetic reference datum.

3.11.9 Barrier Rollover

The *aircraft* shall be capable of taxiing over non-deployed runway arresting systems (e.g., BAK 12/13) without damaging the external stores, landing gear, and doors.

3.12 Mission Support

The *aircraft system* will include mission support functions and systems required for mission planning, mission scenario generation, *mission debriefing,* and data transfer. The mission planning, mission scenario generation, and *mission debriefing* functions and systems shall be compatible with the USAF Standard Desktop Configuration with the most current Windows Operating System.

3.12.1 Data Transfer

The *aircraft* shall provide for data transfer between a mission planning-compatible DTD and the *aircraft* subsystems.

3.12.1.1 DTD Design

The DTD shall be industrial-grade MIL-STD-810 compliant, commercially-based, use non-proprietary software and media, and have the appropriate level of data encryption.

3.12.1.2 On-Board Data Upload

The *aircraft* shall transfer (upload) all required mission planning data and mission scenario data from a single DTD in four minutes or less.

3.12.1.3 DTD Adapter

The *aircraft system* shall provide an off-board DTD interface adapter to transfer mission planning data and mission scenario data onto the DTD as well as to transfer downloaded *aircraft* data to the mission debriefing system. (Note: The intent is to furnish the existing mission planning systems with a stand-alone DTD adapter device. For the new mission debriefing systems, the DTD adapter configuration can be a stand-alone device or be housed in the mission debriefing system itself.)

3.12.2 Mission Planning Interface

The *aircraft* mission planning interface shall be compatible with the Joint Mission Planning System (JMPS), APT Mission Planning Environment (MPE), and accept mission planning data from a JMPS-produced DTD. (Note: The APT MPE consists of the existing JMPS Framework and Common Components (CC), and a new APT Unique Planning Component (UPC) to be developed from the Contractor-developed interface control documentation (e.g., *aircraft* navigation database interface control document) IAW the SOW.)

3.12.3 Mission Scenario Generation

The *aircraft system* shall provide for instructor aircrew to create, modify, review, store, and transfer (to DTD) pre-planned mission scenarios for *Embedded Training* operations (see section 3.6) using unclassified airborne and ground *constructive targets* per Table 3-39. The *aircraft*

system shall provide for instructor aircrew to create, modify, review, store, and transfer (to DTD) *Embedded Training* Presentation Overlays for use on the SAD.

Table 3-39, Constructive Targets

Target Type	
EW/AEW/GCI (Surveillance radars)	Generic friendly
	Generic threat
	Generic neutral
SAMs & AAA (Acquisition, Track, Missile Guidance radars)	Generic friendly
	Generic AAA threat
	Generic threat medium range SAM (12 -25 NM)
	Generic threat short range SAM (2 – 8 NM)
	Generic neutral
Fighters (Targeting radar, Missile Launch indication)	Generic friendly
	Generic threat
	Generic neutral
Identification Friend or Foe	Generic friendly
	Generic threat
	Generic neutral
Range ground targets	*Constructive targets* that correspond to actual ground targets used in the ranges and low level routes within the *Local Training Areas*. (Note: The intent is to provide the capability to geo-position c*onstructive targets* that represent the real-world ground targets used in the range and low level routes, and to reposition the c*onstructive targets* when the real-world ground targets are relocated and without having to wait for a database update or updated imagery.)

3.12.4 Mission Debriefing

The *aircraft system* shall provide for aircrew to meld, replay, and review the mission audio, video, and flight data for a single-ship mission, and for a multi-ship mission of up to eight participating *aircraft* (*GBTS* is considered an aircraft for APT configurations if implementing *GBTS* Connectivity).

3.12.4.1 Debriefing Operation

The *aircraft system* shall replay single-ship, time-synchronized audio, video, and flight data, as defined below, to include switching through multiple displays for instruction:

a. Internal and external communications
b. Flight instruments
c. *HTD* presentation (both aircrew positions if *HTD* is a helmet-mounted display)
d. *LAD* presentation (both aircrew positions)

e. Radar display presentation
f. DMS/RWR display presentation and threat tones
g. DMS/Expendables *situational awareness* indicators and audible cues
h. Weapons *situational awareness* indicators and audio tones
i. SAD presentation
j. Tactical Datalink presentation
k. Targeting Pod display presentation (if Targeting Pod is implemented)
l. Throttle position

3.12.4.2 Multi-Ship Debriefing

The *aircraft system* shall simultaneously replay multi-ship, time-synchronized audio, video, and flight data (melded presentation) to enable joint *mission debriefing* of up to eight participating *aircraft* while providing each participating *aircraft* the functionality in 3.12.4.1.

3.12.4.3 Data Uploading

The *aircraft system* shall provide for uploading recorded data from four participating *aircraft* in five minutes or less combined.

3.12.4.4 Data Melding

The *aircraft system* shall provide for melding recorded data from eight participating *aircraft* in five minutes or less.

3.12.4.5 Two- and Three-Dimensional Perspective Views

The *aircraft system* shall provide three-dimensional mission replay from aircrew (cockpit) perspective, off-aircraft perspective, and overhead “bird’s eye” view so that aircrew can review flight path, maneuvers, and engagements in relation to own-ship and other participating *aircraft*.

3.12.4.6 Playback Controls

The *aircraft system* shall provide the following replay controls:

a. Normal-speed play
b. Slow-speed play
c. Fast-speed play
d. Pause/Freeze
e. Stop
f. Fast Reverse
g. Fast-forward
h. Fast-forward to an event (*bookmark*)
i. Fast-forward to specific time
j. Frame-by-frame playback (minimum 30 frames per second)
k. Zoom in and out
l. Pan through a re-creation of the training mission using planning and recorded data as well as imagery.

4 VERIFICATION

4.0 General

Section 4 (Verification Provisions) contains the methodology for verifying the system's design, operation, and performance to meet all requirements established in Section 3 (System Requirements) herein.

4.0.1 Overview

4.0.1.1 Philosophy of Verifications

The basis of any verification method is the root source that establishes the data used to support requirement compliance (e.g., if analysis of another program's flight test data is used, then the verification method is flight test). The intent of the development verification approach is to maximize the integration of development, airworthiness certification, and operational evaluations, in order to optimize costs, schedule, and performance. Previously accomplished verification methods may be used to satisfy the verification methods in this section if the data is relevant and approved by the Government. The Government reserves the right to deny the use of previously accomplished verification methods.

4.0.1.2 Location of Verifications

Prime contractor-, sub-contractor-, commercial-, and Government-owned facilities that are acceptable to the Government may be utilized for the application(s) intended.

4.0.1.3 Responsibility for Verifications

The prime contractor is responsible for planning, resourcing, performing, successful completion, and reporting for all requirement compliance verifications. The Government formal approval of verification documentation constitutes completion. The Government reserves the right to require additional verification effort within the confines of the required verification methods. The Government reserves the right to participate in or witness any of the requirement verifications.

4.0.1.4 Verification Cross Reference Matrix (VCRM)

The VCRM (Table 4-1) provides the cross reference between each Section 3 requirement, the associated minimum required verification methods (defined below), and the associated verification paragraph numbers.

4.0.2 Verification Methods

The verification methods are defined below. The methods are independent, but are sometimes used as formal complements to other verification methods, to support substantiation or for completeness. The methods can also be used in combination with other verification methods to convert already available data to verification compatible data.

4.0.2.1 Not Applicable (N)

This verification method is usually reserved for Section 3 requirement headers or title paragraphs which do not contain requirements.

4.0.2.2 Inspection (I)

This verification method consists of actual component, system, function, installation non-destructive examination (without special or complex equipment) by sensory means, simple physical manipulation, and simple measurement; including review of authenticated documentation.

4.0.2.3 Analysis (A)

This verification method consists of an evaluation of components or systems interacting with their intended environment, using technical calculations or mathematical modeling based on physical laws and empirical data. Analysis can include design margins. Sensitivity, similarity, and failure effects analyses are forms of this method. Analysis associated with refining test data is not a part of this method.

4.0.2.4 Demonstration (Demo)

This verification method consists of a non-instrumented operation of the actual component or system under specified controlled conditions on the aircraft or in an equivalent environment, where functional success is determined on a qualitative or pass-fail basis. This can be on the ground or in-flight.

4.0.2.4.1 Ground Demonstration (g)

This verification sub-method consists of a demonstration on ground.

4.0.2.4.2 Flight Demonstration (t)

This verification sub-method consists of a demonstration in-flight.

4.0.2.5 Test

This general group of sub-methods consists of quantitative measuring of the characteristics or performance of actual components or systems in controlled intended conditions (real or representative). These sub-methods include analysis of the resulting data. Sub-methods are as follows:

4.0.2.5.1 Laboratory Test (L)

This verification sub-method consists of testing in an off-aircraft ground-based facility with a physical simulation of the operating environment.

4.0.2.5.2 Ground Test (G)

This verification sub-method consists of on-aircraft testing under static ground conditions.

4.0.2.5.3 Flight Test (F)

This verification sub-method consists of on-aircraft testing under dynamic ground, transition-to-flight, and flight envelope conditions.

Table 4-1, Verification Cross Reference Matrix (VCRM)

Legend:

N - Not applicable
I - Inspection
A - Analysis
g - Ground demonstration
f - Flight demonstration
L - Laboratory test
G - Ground test
F - Flight test

Section 3	Section 4	SS Title	N	I	A	g	f	L	G	F
3.1	4.1	Performance and Structural Characteristics	X							
3.1.1	4.1.1	Performance Ground Rules	X							
3.1.2	4.1.2	Performance	X							
3.1.2.1	4.1.2.1	High G Maneuvering			X				X	X
3.1.2.2	4.1.2.2	Instantaneous G-onset Rate			X				X	X
3.1.2.2.1	4.1.2.2.1	Average G-onset Rate			X				X	X
3.1.2.3	4.1.2.3	Negative and Zero G Flight	X							
3.1.2.3.1	4.1.2.3.1	Negative G Flight			X	X		X		X
3.1.2.3.2	4.1.2.3.2	Zero G Flight			X	X		X		X
3.1.2.4	4.1.2.4	Instantaneous Turn Rate			X				X	X
3.1.2.5	4.1.2.5	Sustained Turn Rate			X				X	X
3.1.2.6	4.1.2.6	High Angle-of-Attack (AOA) Maneuvering			X				X	X
3.1.2.7	4.1.2.7	Flight Endurance			X				X	X
3.1.2.8	4.1.2.8	Takeoff Distance			X				X	X
3.1.2.9	4.1.2.9	Landing Distance			X				X	X
3.1.2.10	4.1.2.10	Takeoff and Landing in Crosswinds	X							
3.1.2.10.1	4.1.2.10.1	Lateral-Directional Control in Crosswinds			X					X
3.1.2.10.2	4.1.2.10.2	Takeoff Run and Landing Rollout in Crosswinds			X					X
3.1.2.11	4.1.2.11	Takeoff Climb Gradient Performance			X				X	X
3.1.2.12	4.1.2.12	General Handling Characteristics (including all store loadout configurations)	X							
3.1.2.12.1	4.1.2.12.1	Aircraft Flying Qualities			X				X	X
3.1.2.12.2	4.1.2.12.2	Flying Qualities in Atmospheric Disturbances			X				X	X
3.1.2.12.3	4.1.2.12.3	Student Skill Level Handling Characteristics			X				X	X
3.1.2.12.4	4.1.2.12.4	Student Fault Tolerant Flight Characteristics			X				X	X
3.1.2.12.5	4.1.2.12.5	Control Margin			X					X
3.1.2.12.6	4.1.2.12.6	Safe Termination			X					X
3.1.2.12.7	4.1.2.12.7	Warning and Indication of Approach to Dangerous Flight Conditions			X					X
3.1.2.12.8	4.1.2.12.8	Departure Resistance			X					X
3.1.2.12.8.1	4.1.2.12.8.1	Recovery from Post-Stall Gyrations and Spins			X					X
3.1.2.12.9	4.1.2.12.9	Stalls	X							
3.1.2.12.9.1	4.1.2.12.9.1	Approach to Stall								X
3.1.2.12.9.2	4.1.2.12.9.2	Tactile/Physical Cues for Stall Warning								X
3.1.2.12.9.3	4.1.2.12.9.3	Aural and Visual Stall Warning	X							
3.1.2.12.9.3.1	4.1.2.12.9.3.1	Aural and Visual Cues for Stall Warning			X					X
3.1.2.12.9.3.2	4.1.2.12.9.3.2	Aural and Visual Stall Warning Duration			X					X
3.1.2.12.9.3.3	4.1.2.12.9.3.3	Aural and Visual Stall Warning Conditions			X					X
3.1.2.12.9.4	4.1.2.12.9.4	Stall Recovery								X
3.1.2.12.10	4.1.2.12.10	Buffet								X
3.1.2.12.11	4.1.2.12.11	Pilot-in-the-loop Oscillations (PIO)			X					X
3.1.2.12.12	4.1.2.12.12	Failures			X				X	X
3.1.2.13	4.1.2.13	Flight Control System (including all store loadout configurations)	X							
3.1.2.13.1	4.1.2.13.1	Augmentation Systems	X							
3.1.2.13.1.1	4.1.2.13.1.1	Augmentation System Operation			X	X				X
3.1.2.13.1.2	4.1.2.13.1.2	Augmentation System Performance Degradation			X	X				X
3.1.2.13.1.3	4.1.2.13.1.3	Flight Control System Operation			X				X	X
3.1.2.13.2	4.1.2.13.2	Control Surface Displacement Rates			X					X

Legend:

N - Not applicable
I - Inspection
A - Analysis
g - Ground demonstration
f - Flight demonstration
L - Laboratory test
G - Ground test
F - Flight test

Section 3	Section 4	SS Title	N	I	A	g	f	L	G	F
3.1.2.13.3	4.1.2.13.3	Cockpit Controller Characteristics			X					X
3.1.2.13.3.1	4.1.2.13.3.1	Cross-Coupling			X					X
3.1.2.13.4	4.1.2.13.4	Control Centering			X					X
3.1.2.13.5	4.1.2.13.5	Control Free Play			X					X
3.1.2.13.6	4.1.2.13.6	Control Linearity								X
3.1.2.14	4.1.2.14	Over-G Condition (including all store loadout configurations)	X							
3.1.2.14.1	4.1.2.14.1	Warnings of Approaching G Limit			X					X
3.1.2.14.2	4.1.2.14.2	G-limiter			X					X
3.1.2.14.3	4.1.2.14.3	Over-G Feedback		X	X					
3.1.3	4.1.3	Structures	X							
3.1.3.1	4.1.3.1	Design Service Life			X				X	X
3.1.3.2	4.1.3.2	Materials, Processes, and Parts		X						
3.1.3.3	4.1.3.3	Fasteners		X						
3.1.3.4	4.1.3.4	Corrosion Prevention and Control		X				X		
3.1.3.4.1	4.1.3.4.1	Paint Scheme		X						
3.1.3.5	4.1.3.5	General Parameters and Conditions	X							
3.1.3.5.1	4.1.3.5.1	Airframe Configurations		X						
3.1.3.5.2	4.1.3.5.2	Equipment and Stores			X			X	X	X
3.1.3.5.3	4.1.3.5.3	Speeds								X
3.1.3.5.4	4.1.3.5.4	Altitudes			X					X
3.1.3.5.5	4.1.3.5.5	Limit Loads			X			X		X
3.1.3.5.6	4.1.3.5.6	Ultimate Loads			X			X	X	
3.1.3.6	4.1.3.6	Structural Loads	X							
3.1.3.6.1	4.1.3.6.1	Flight Loads			X				X	X
3.1.3.6.1.1	4.1.3.6.1.1	Symmetric Maneuver Load Factors								X
3.1.3.6.1.2	4.1.3.6.1.2	Asymmetric Maneuver Load Factors								X
3.1.3.6.1.3	4.1.3.6.1.3	Pressurization							X	
3.1.3.6.1.4	4.1.3.6.1.4	Discrete Gust Loads		X						
3.1.3.6.1.4.1	4.1.3.6.1.4.1	Discrete Gust Formulas		X						
3.1.3.6.2	4.1.3.6.2	Ground Loads			X				X	
3.1.3.6.2.1	4.1.3.6.2.1	Landing Sink Speeds			X				X	
3.1.3.6.2.2	4.1.3.6.2.2	Ground Wind Loads	X							
3.1.3.6.2.2.1	4.1.3.6.2.2.1	Mooring		X	X					
3.1.3.6.2.2.2	4.1.3.6.2.2.2	Doors, Canopy, and Windshield			X	X				
3.1.3.6.2.2.3	4.1.3.6.2.2.3	Crosswinds Loads			X					
3.1.3.6.3	4.1.3.6.3	Repeated Loads			X					
3.1.3.6.3.1	4.1.3.6.3.1	Maneuvers			X					
3.1.3.6.3.2	4.1.3.6.3.2	Gusts			X					
3.1.3.6.3.3	4.1.3.6.3.3	Landings			X					
3.1.3.6.3.4	4.1.3.6.3.4	Other Ground Loads			X					
3.1.3.6.3.5	4.1.3.6.3.5	Pressurization			X					
3.1.3.6.3.6	4.1.3.6.3.6	Repeated Operation of Movable Structures			X					
3.1.3.7	4.1.3.7	Bird Strike/Hail Impact	X							
3.1.3.7.1	4.1.3.7.1	Transparency System Bird Strike Capability						X		
3.1.3.7.2	4.1.3.7.2	Airframe and Engine Inlet Bird Strike Capability						X		
3.1.3.7.3	4.1.3.7.3	Hail Impact Protection						X		
3.1.3.8	4.1.3.8	Vibroacoustics			X			X	X	X
3.1.3.8.1	4.1.3.8.1	Aeroacoustics			X			X	X	X
3.1.3.8.2	4.1.3.8.2	Vibration			X				X	
3.1.3.8.3	4.1.3.8.3	Aeroelastic Stability (Flutter and Divergence)			X			X	X	X
3.2	4.2	Avionics	X							
3.2.1	4.2.1	Communications	X							
3.2.1.1	4.2.1.1	Multi-Band Radios		X						
3.2.1.2	4.2.1.2	Ultra-High Frequency (UHF) Communication					X			
3.2.1.3	4.2.1.3	Very High Frequency (VHF) Communication					X			
3.2.1.4	4.2.1.4	Simultaneous UHF and VHF Communication					X			

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3.2.1.5	4.2.1.5	Communication System Setup				X				
3.2.1.6	4.2.1.6	Emergency Locator Transmitter (ELT)				X				
3.2.2	4.2.2	Navigation	X							
3.2.2.1	4.2.2.1	Reduced Vertical Separation Minimum (RVSM)								X
3.2.2.2	4.2.2.2	Global Positioning System (GPS)						X		
3.2.2.3	4.2.2.3	RNP/RNAV Navigation								X
3.2.2.4	4.2.2.4	Tactical Air Navigation (TACAN)								X
3.2.2.5	4.2.2.5	Air-to-Air TACAN								X
3.2.2.6	4.2.2.6	VHF Omni-Directional Range (VOR)/Distance Measuring Equipment (DME)								X X
3.2.2.7	4.2.2.7	Instrument Landing System (ILS)								X
3.2.3	4.2.3	Surveillance	X							
3.2.3.1	4.2.3.1	Traffic Alert and Collision Avoidance System (TCAS)								X
3.2.3.2	4.2.3.2	Automatic Dependent Surveillance-Broadcast (ADS-B) Out						X		X
3.2.3.3	4.2.3.3	ADS-B In								X
3.2.3.4	4.2.3.4	Transponder						X		X
3.2.3.5	4.2.3.5	Terrain Warning and Avoidance								X
3.2.4	4.2.4	Datalink and Network Connectivity	X							
3.2.4.1	4.2.4.1	Embedded Training Datalink	X							
3.2.4.2	4.2.4.2	Connectivity Region (Local Flying Area)					X			
3.2.4.3	4.2.4.3	Maximum Simultaneous Load			X					X
3.2.4.4	4.2.4.4	Multiple Concurrent Missions					X			
3.2.4.5	4.2.4.5	Ground Based Training Systems (GBTS) Connectivity			X		X			
3.2.4.5.1	4.2.4.5.1	GBTS Voice Communication					X			
3.2.4.6	4.2.4.6	Ground Support Station (GSS) Connectivity			X		X			
3.2.4.6.1	4.2.4.6.1	GSS Voice Communication					X			
3.2.4.6.2	4.2.4.6.2	GSS Live Monitoring					X			
3.3	4.3	Propulsion System	X							
3.3.1	4.3.1	Fuel Consumption			X			X		
3.3.2	4.3.2	Engine Starts			X			X	X	X
3.3.2.1	4.3.2.1	Environmental Conditions for Engine Starts			X			X	X	X
3.3.2.2	4.3.2.2	Fuel and Oils for Engine Starts			X			X	X	X
3.3.2.3	4.3.2.3	Thrust Demand at Start			X			X	X	X
3.3.2.4	4.3.2.4	Engine Ground Starts	X							
3.3.2.4.1	4.3.2.4.1	Ground Start Cycles			X	X				
3.3.2.4.2	4.3.2.4.2	Altitude Range for Ground Starts			X	X				
3.3.2.4.3	4.3.2.4.3	Wind Speed for Ground Starts			X	X				
3.3.2.4.4	4.3.2.4.4	Hot Temperature Soak Start			X	X				
3.3.2.4.5	4.3.2.4.5	Cold Temperature Soak Start			X	X				
3.3.2.5	4.3.2.5	Engine Air Starts			X			X		X
3.3.3	4.3.3	Automatic Relight			X			X		X
3.3.4	4.3.4	Shutdown	X							
3.3.4.1	4.3.4.1	Fuel Flow Termination			X			X	X	X
3.3.4.2	4.3.4.2	Power Setting at Shutdown			X			X	X	X
3.3.5	4.3.5	Stall-Free Operation			X			X	X	X
3.3.6	4.3.6	Thrust Control			X			X	X	X
3.3.7	4.3.7	Thrust Transients			X			X	X	X
3.3.8	4.3.8	Thrust Stability, Droop and Overshoot			X			X	X	X
3.3.9	4.3.9	Thrust Demand and Retention			X			X	X	X
3.3.10	4.3.10	Engine Fire/Overheat Indication			X			X	X	
3.3.11	4.3.11	Engine Design Service Life		X	X				X	
3.3.11.1	4.3.11.1	Hot Parts Design Service Life			X				X	
3.3.11.2	4.3.11.2	Cold Parts Design Service Life			X				X	
3.3.12	4.3.12	Atmospheric Liquid Water Ingestion		X	X			X		
3.3.13	4.3.13	Bird Ingestion		X	X			X		

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3.3.14	4.3.14	Distortion Intensity Levels			X					X
3.3.15	4.3.15	Damage Tolerance			X			X		
3.3.16	4.3.16	Ice Ingestion		X	X			X		
3.3.17	4.3.17	Sand and Dust Ingestion		X	X			X		
3.4	4.4	Vehicle Subsystems	X							
3.4.1	4.4.1	Fuel Subsystem	X							
3.4.1.1	4.4.1.1	Pressure Refuel and Defuel				X				
3.4.1.2	4.4.1.2	Gravity Refuel and Defuel				X				
3.4.1.3	4.4.1.3	Fuel Transfer			X				X	X
3.4.2	4.4.2	Aerial Refueling Subsystem Growth Path (Receiver)			X					X
3.4.2.1	4.4.2.1	Aerial Refueling Subsystem Full Integration (Receiver)		X	X				X	X
3.4.3	4.4.3	Environmental Control Subsystem (ECS)		X	X				X	X
3.4.3.1	4.4.3.1	Heating Performance (Cold Soak)							X	
3.4.3.2	4.4.3.2	Cooling Performance (Hot Soak)							X	
3.4.3.3	4.4.3.3	Temperature Range								X
3.4.3.4	4.4.3.4	Temperature Variation							X	X
3.4.3.5	4.4.3.5	ECS Controls		X					X	X
3.4.3.6	4.4.3.6	ECS Alerts			X				X	X
3.4.3.7	4.4.3.7	Anti -Fog -Frost & -Ice							X	X
3.4.3.8	4.4.3.8	Equipment Cooling			X				X	X
3.4.3.9	4.4.3.9	Alternate Cooling			X				X	X
3.4.3.10	4.4.3.10	Cockpit Pressurization			X				X	X
3.4.3.11	4.4.3.11	Air Contamination		X	X	X	X			
3.4.3.12	4.4.3.12	Bleed Air Ducting (if utilized)		X					X	X
3.4.3.13	4.4.3.13	Moisture Control		X					X	X
3.4.4	4.4.4	Braking		X					X	
3.4.4.1	4.4.4.1	Parking Brake		X	X					
3.4.5	4.4.5	Electrical Power Subsystem		X	X			X	X	X
3.4.5.1	4.4.5.1	Power Source Switching		X		X				
3.4.5.2	4.4.5.2	External Power Compatibility		X		X				
3.4.5.3	4.4.5.3	External Power Receptacle		X		X				
3.4.5.4	4.4.5.4	Emergency Power			X	X		X		
3.4.5.5	4.4.5.5	Aircraft Start-Up		X		X				
3.4.5.5.1	4.4.5.5.1	External Electrical Power				X				
3.4.5.6	4.4.5.6	Electrical Wiring Interconnection		X						
3.4.6	4.4.6	Hydraulic Subsystem (if utilized)			X			X	X	X
3.4.6.1	4.4.6.1	Hydraulic System Redundancy			X			X	X	X
3.4.6.2	4.4.6.2	Hydraulic System Integrity		X	X			X		
3.5	4.5	Crew Systems	X							
3.5.1	4.5.1	Human Performance and Human Engineering		X	X	X	X	X	X	X
3.5.2	4.5.2	Cockpit Configuration		X			X			
3.5.2.1	4.5.2.1	Cockpit Commonality		X		X				
3.5.3	4.5.3	Cockpit Stowage		X		X				
3.5.4	4.5.4	Safety Devices and Streamers		X						
3.5.5	4.5.5	Aircrew Physical Anthropometrics							X	
3.5.6	4.5.6	Anthropometric Accommodation							X	X
3.5.7	4.5.7	Cockpit Reach							X	
3.5.8	4.5.8	Aircrew Workload							X	X
3.5.9	4.5.9	Aircrew Alerting		X	X			X		
3.5.9.1	4.5.9.1	Prioritization of Alerts		X	X			X		
3.5.9.2	4.5.9.2	Master Warning/Master Caution		X						
3.5.9.3	4.5.9.3	Aural and Visual Alerts		X				X		
3.5.9.4	4.5.9.4	Aural Signals for Warning Alerts		X				X		
3.5.10	4.5.10	Intercommunications Control System (ICS)	X							
3.5.10.1	4.5.10.1	External Communication		X		X	X			
3.5.10.2	4.5.10.2	Aircrew Communication		X		X	X			

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3.5.10.3	4.5.10.3	Ground Communication		X		X				
3.5.10.4	4.5.10.4	Radio Attenuation		X		X	X			
3.5.10.5	4.5.10.5	ICS Stations		X		X	X			
3.5.10.6	4.5.10.6	ICS Controls		X		X				
3.5.10.7	4.5.10.7	Microphone Operations		X		X	X			
3.5.10.8	4.5.10.8	Aircrew and Ground Personnel Acoustic (Speech) Intelligibility							X	X
3.5.11	4.5.11	Cockpit Controls	X							
3.5.11.1	4.5.11.1	Throttle Detent		X		X	X			
3.5.11.1.1	4.5.11.1.1	Afterburning Aircraft		X		X	X			
3.5.11.1.2	4.5.11.1.2	Non-afterburning Aircraft		X		X	X			
3.5.11.2	4.5.11.2	Side-Arm (Side Stick) Control Stick Forearm Support		X		X				
3.5.11.3	4.5.11.3	Rudder Control Forces			X					X
3.5.11.4	4.5.11.4	Landing Gear Control		X			X			
3.5.11.5	4.5.11.5	Emergency Controls	X							
3.5.11.5.1	4.5.11.5.1	Accessibility		X		X				
3.5.11.5.2	4.5.11.5.2	Inadvertent Actuation		X	X	X				
3.5.11.5.3	4.5.11.5.3	Markings		X						
3.5.12	4.5.12	Interior Finishes, Components and Equipment	X							
3.5.12.1	4.5.12.1	Dimensional Stability			X					
3.5.12.2	4.5.12.2	Fire Resistance						X		
3.5.13	4.5.13	Thermal Contact Hazards							X	
3.5.14	4.5.14	Cockpit Displays	X							
3.5.14.1	4.5.14.1	Large Area Display (LAD)		X		X	X			
3.5.14.1.1	4.5.14.1.1	Viewable Area		X						
3.5.14.1.2	4.5.14.1.2	Configurable Display				X	X			
3.5.14.1.3	4.5.14.1.3	Repeater Mode				X	X			
3.5.14.1.4	4.5.14.1.4	Rear-Cockpit Interface		X	X	X	X			
3.5.14.1.5	4.5.14.1.5	Integrated Digital Checklists and Electronic Flight Information				X	X			
3.5.14.1.6	4.5.14.1.6	Situational Awareness Display (SAD)/Navigation Display Presentation				X	X			
3.5.14.2	4.5.14.2	Glove Compatibility				X				
3.5.14.3	4.5.14.3	Display Readability				X				
3.5.14.4	4.5.14.4	Cockpit Display Luminance				X	X			
3.5.14.5	4.5.14.5	Display Quality and Latency				X	X			
3.5.14.6	4.5.14.6	Head-up Type Display (HTD)		X						
3.5.14.7	4.5.14.7	Primary Flight Reference		X						
3.5.14.8	4.5.14.8	Standby Flight Instrument		X						
3.5.14.9	4.5.14.9	Aircraft Clock		X						
3.5.14.9.1	4.5.14.9.1	Stopwatch		X						
3.5.14.10	4.5.14.10	Symbology		X						
3.5.15	4.5.15	Interior Lighting				X				
3.5.15.1	4.5.15.1	Night Vision Imaging System (NVIS) Compatibility			X				X	
3.5.15.2	4.5.15.2	Lighting Uniformity						X	X	
3.5.15.3	4.5.15.3	Brightness Control			X	X	X			
3.5.15.4	4.5.15.4	Glare and Reflections			X	X	X			
3.5.15.5	4.5.15.5	Utility/Map light		X						
3.5.16	4.5.16	Exterior Lighting		X		X	X			
3.5.16.1	4.5.16.1	FAA Interoperability		X	X	X	X			
3.5.17	4.5.17	Interior and Exterior Visibility	X							
3.5.17.1	4.5.17.1	Interior Visibility		X		X	X			
3.5.17.2	4.5.17.2	Exterior Visibility		X	X	X	X			
3.5.17.2.1	4.5.17.2.1	Visibility for Landings		X	X		X			
3.5.18	4.5.18	Aircraft Transparency/Canopy System				X	X			
3.5.18.1	4.5.18.1	Transparency Integration with Environmental Conditions			X	X	X			
3.5.18.2	4.5.18.2	Transparency Shape Compatibility				X				

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3.5.18.3	4.5.18.3	Transparency System Thermal Loads			X					
3.5.18.4	4.5.18.4	Canopy Opening Clearance				X				
3.5.18.5	4.5.18.5	Canopy Actuation (Normal Ingress/Egress)		X						
3.5.18.6	4.5.18.6	Manual Canopy Operation		X						
3.5.18.7	4.5.18.7	Canopy Latching and Locking		X	X	X				
3.5.18.7.1	4.5.18.7.1	Canopy Open Lock		X		X				
3.5.19	4.5.19	Normal Aircraft Entry and Exit		X		X				
3.5.19.1.1	4.5.19.1.1	Transparency – Escape System Compatibility		X	X	X		X		
3.5.20	4.5.20	Escape and Egress System		X						
3.5.20.1	4.5.20.1	Escape System Reliability			X	X		X		
3.5.20.2	4.5.20.2	Manual Emergency Ground Egress				X				
3.5.20.2.1	4.5.20.2.1	Backup Emergency Ground Egress		X	X				X	
3.5.20.3	4.5.20.3	Escape Path Clearance System		X	X				X	
3.5.20.3.1	4.5.20.3.1	Penetrating Injuries							X	
3.5.20.3.2	4.5.20.3.2	Impulse Noise							X	
3.5.20.3.3	4.5.20.3.3	Thermal Energy Exposure Limits						X		
3.5.20.3.4	4.5.20.3.4	Escape Path Clearance Considerations		X	X	X		X		
3.5.20.4	4.5.20.4	External Controls		X		X				
3.5.20.5	4.5.20.5	Ejection Seat Clearance						X		
3.5.20.6	4.5.20.6	Safing of Emergency Controls		X	X	X				
3.5.20.6.1	4.5.20.6.1	Secondary Seat Safety Device		X	X	X				
3.5.20.7	4.5.20.7	Manually Initiated Automatic Escape		X	X				X	
3.5.20.7.1	4.5.20.7.1	Escape Envelope			X			X		
3.5.20.7.2	4.5.20.7.2	Canopy and Escape Path Clearance		X	X			X		
3.5.20.7.2.1	4.5.20.7.2.1	Ejection through the Canopy (For Transparency Fracturing Systems in Primary Mode, and Direct Penetration Backup Modes)				X		X		
3.5.20.7.3	4.5.20.7.3	Aircraft Clearance			X			X		
3.5.20.7.4	4.5.20.7.4	Initiation			X	X			X	
3.5.20.7.5	4.5.20.7.5	Inter-Seat Sequencing			X			X		
3.5.20.7.5.1	4.5.20.7.5.1	Inter-Seat Sequencing Mode Selection (for tandem cockpit configured aircraft)		X				X		
3.5.20.7.5.2	4.5.20.7.5.2	Divergence						X		
3.5.20.7.6	4.5.20.7.6	Seat Aircrew Separation						X		
3.5.20.7.7	4.5.20.7.7	Descent Recovery Parachute System		X				X		
3.5.20.7.7.1	4.5.20.7.7.1	Recovery Parachute Deployment/Inflation Phase Accelerations						X		
3.5.20.7.7.2	4.5.20.7.7.2	Descent Rate – Steady State Phase						X		X
3.5.20.8	4.5.20.8	Personnel Restraint System		X			X	X		
3.5.20.8.1	4.5.20.8.1	Limb Restraint System		X		X		X		
3.5.20.8.2	4.5.20.8.2	Inertia Reel Lock		X		X			X	X
3.5.20.9	4.5.20.9	Energetic Materials and Components						X		
3.5.20.9.1	4.5.20.9.1	Firing Mechanism						X		
3.5.20.10	4.5.20.10	Acceleration Limits	X							
3.5.20.10.1	4.5.20.10.1	Acceleration Limits – Catapult Phase						X		
3.5.20.10.2	4.5.20.10.2	Acceleration Limits –Free Flight and Drogue Phase						X		
3.5.20.11	4.5.20.11	Head Injury – All Phases						X		
3.5.20.12	4.5.20.12	Neck Loads – All Phases	X							
3.5.20.12.1	4.5.20.12.1	Neck Loads – Speeds up to and including 450 KEAS						X		
3.5.20.12.2	4.5.20.12.2	Neck Loads – Speeds greater than 450 KEAS						X		
3.5.20.13	4.5.20.13	Environmental Conditions			X			X	X	
3.5.20.14	4.5.20.14	Center of Gravity (CG) Envelope			X				X	
3.5.20.15	4.5.20.15	Stabilization and Deceleration						X		
3.5.20.16	4.5.20.16	Seat Assembly						X		
3.5.20.16.1	4.5.20.16.1	Headrest						X		
3.5.20.16.2	4.5.20.16.2	Canopy Breakers		X				X		
3.5.20.16.3	4.5.20.16.3	Cushions		X						
3.5.20.17	4.5.20.17	Proof Loads						X		

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Section 3	Section 4	SS Title	N	I	A	g	f	L	G	F
3.5.20.18	4.5.20.18	Crash Ultimate Loads		X				X		
3.5.20.19	4.5.20.19	Redundancy		X				X		
3.5.20.20	4.5.20.20	Safety		X	X	X	X			
3.5.20.21	4.5.20.21	Explosive Device Maintainability			X					
3.5.20.22	4.5.20.22	Performance Reliability			X			X		
3.5.20.23	4.5.20.23	Component Life and Change-outs			X					
3.5.20.24	4.5.20.24	Cartridge Actuated Devices/Propellant Actuated Devices			X					
3.5.20.25	4.5.20.25	Aircraft Integration		X		X	X	X		
3.5.20.26	4.5.20.26	Escape System Installation and Removal				X				
3.5.20.27	4.5.20.27	Specialized Tooling or Machinery		X	X	X				
3.5.21	4.5.21	Aircrew Flight Equipment and Pilot Personal Protection	X							
3.5.21.1	4.5.21.1	Personal Flight Equipment Compatibility		X		X	X			
3.5.21.2	4.5.21.2	Anti-G Trouser Pressurized Air Supply					X	X		X
3.5.21.3	4.5.21.3	Survival Kit Provisions		X			X			
3.5.21.4	4.5.21.4	Personnel Emergency Location Transmitter				X				
3.5.21.5	4.5.21.5	Aircrew Acoustic Exposure Tolerance							X	X
3.5.22	4.5.22	Oxygen System			X			X	X	X
3.5.22.1	4.5.22.1	Oxygen Supply Quality			X			X	X	X
3.5.22.1.1	4.5.22.1.1	Oxygen Mask Pressures			X			X	X	X
3.5.22.2	4.5.22.2	Oxygen Quantity		X	X					X
3.5.22.3	4.5.22.3	Uninterrupted Oxygen Supply			X			X	X	X
3.5.22.3.1	4.5.22.3.1	OBOGS Pressure Sensors		X				X	X	X
3.5.22.4	4.5.22.4	Emergency Oxygen			X			X	X	X
3.5.22.5	4.5.22.5	Breathing Regulator			X		X			
3.5.22.6	4.5.22.6	Oxygen System Controls and Displays		X		X				
3.5.22.7	4.5.22.7	Oxygen System Integration		X	X	X	X	X	X	X
3.5.22.8	4.5.22.8	Pressure Breathing for G (PBG) Loading		X				X		X
3.5.22.9	4.5.22.9	Breathing Gas Contamination Limits		X	X					
3.5.22.10	4.5.22.10	OBOGS Monitoring				X		X	X	
3.5.23	4.5.23	Ground Personnel/Maintainer Specific Considerations	X							
3.5.23.1	4.5.23.1	Ground Personnel Acoustic Exposure Tolerance							X	
3.5.23.2	4.5.23.2	Maintainer Lifting and Carrying Limits			X					
3.6	4.6	Embedded Training				X	X			
3.6.1	4.6.1	Radar System Simulation	X							
3.6.1.1	4.6.1.1	Radar Functions and Modes				X	X			
3.6.1.2	4.6.1.2	Air-to-Ground Function				X	X			
3.6.1.3	4.6.1.3	Air-to-Air Function				X	X			
3.6.1.4	4.6.1.4	Synthetic Aperture Radar (SAR) Ground Mapping				X	X			
3.6.1.5	4.6.1.5	Target Information				X	X			
3.6.1.6	4.6.1.6	Radar Detection				X	X			
3.6.1.6.1	4.6.1.6.1	Variable Tactical Environment				X	X			
3.6.1.7	4.6.1.7	Radar Controls				X	X			
3.6.1.8	4.6.1.8	Hands on Throttle and Stick (HOTAS)				X	X			
3.6.2	4.6.2	Defensive Management System (DMS)	X							
3.6.2.1	4.6.2.1	RWR Detection				X	X			
3.6.2.2	4.6.2.2	Threat Display				X	X			
3.6.2.3	4.6.2.3	DMS Controls				X	X			
3.6.2.4	4.6.2.4	Threat Audio				X	X			
3.6.2.5	4.6.2.5	Expendables Systems				X	X			
3.6.3	4.6.3	Weapon Systems				X	X			
3.6.3.1	4.6.3.1	No Drop Weapon Scoring (NDWS)				X	X			
3.6.4	4.6.4	Embedded Training Presentation Overlays on SAD				X	X			
3.6.5	4.6.5	Tactical Datalink (TDL) System Simulation				X	X			
3.6.6	4.6.6	Targeting Pod System Simulation				X	X			
3.6.7	4.6.7	Mission Scenario Inputs				X	X			

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3.6.8	4.6.8	Synchronized Combat Environment				X	X			
3.6.8.1	4.6.8.1	Own-ship Position				X	X			
3.6.9	4.6.9	Geographical Area				X				
3.6.9.1	4.6.9.1	High Resolution Area				X				
3.6.10	4.6.10	Declutter Function				X	X			
3.7	4.7	Recorded Aircraft Information		X						
3.7.1	4.7.1	Military Flight Operations Quality Assurance (MFOQA)	X							
3.7.1.1	4.7.1.1	Recorded Data				X				
3.7.1.1.1	4.7.1.1.1	Airframe Tracking				X				
3.7.1.2	4.7.1.2	Data Retrieval				X				
3.7.2	4.7.2	Mishap Investigation Data	X							
3.7.2.1	4.7.2.1	Aircraft Recorded Data				X				
3.7.2.1.1	4.7.2.1.1	Crash Survivable Recorder(s)		X		X				
3.7.2.2	4.7.2.2	Data Retrieval				X				
3.7.2.3	4.7.2.3	Ejection Seat Recorded Data				X				
3.7.3	4.7.3	Maintenance Data	X							
3.7.3.1	4.7.3.1	Recorded Data				X				
3.7.3.1.1	4.7.3.1.1	CBM+ Function			X				X	
3.7.3.2	4.7.3.2	Aircraft Turn Data Viewing				X				
3.7.3.3	4.7.3.3	End of Fly Day Data Retrieval				X				
3.7.3.4	4.7.3.4	Maintenance Data Collection & Management System				X				
3.7.4	4.7.4	Mission Debrief Data	X							
3.7.4.1	4.7.4.1	Recorded Data				X				
3.7.4.1.1	4.7.4.1.1	Bookmarks				X				
3.7.4.2	4.7.4.2	Data Retrieval				X				
3.7.4.3	4.7.4.3	Data Quality				X				
3.8	4.8	Product Support	X							
3.8.1	4.8.1	Operational Availability (Ao)			X			X	X	X
3.8.2	4.8.2	Materiel Availability (Am)			X			X	X	X
3.8.3	4.8.3	Materiel Reliability (Rm)			X			X	X	X
3.8.4	4.8.4	Mean Time Between Failures (MTBF)			X			X	X	X
3.8.5	4.8.5	Fix Rate			X			X	X	X
3.8.6	4.8.6	Mean Time Between Maintenance (MTBM)			X			X	X	X
3.8.7	4.8.7	Mean Time To Repair (MTTR)			X			X	X	X
3.8.8	4.8.8	Turn-Around Time				X				
3.8.9	4.8.9	Diagnostics	X							
3.8.9.1	4.8.9.1	Integrated Diagnostics (ID) Percent Fault Detection (PFD) (Critical Faults)			X	X				
3.8.9.2	4.8.9.2	ID PFD (All Faults)			X	X				
3.8.9.3	4.8.9.3	ID Percent Fault Isolation (PFI) (Critical Faults)			X					
3.8.9.4	4.8.9.4	ID PFI (All Faults)			X					
3.8.9.5	4.8.9.5	Built-In-Test (BIT) Functions						X		
3.8.9.5.1	4.8.9.5.1	BIT Functions Display						X		
3.8.9.6	4.8.9.6	Safety Critical BIT Coverage			X			X		
3.8.9.6.1	4.8.9.6.1	BIT PFD (Safety Critical Faults)			X					
3.8.9.6.2	4.8.9.6.2	BIT PFI (Safety Critical Faults)			X					
3.8.9.7	4.8.9.7	BIT PFD (All Faults)			X					
3.8.9.8	4.8.9.8	BIT PFI (All Faults)			X					
3.8.10	4.8.10	Mean Flight Hours Between Sortie Aborting False Alarms (MFHBSAFA)							X	X
3.8.11	4.8.11	Mean Flight Hours Between False Alarms (MFHBFA)							X	X
3.8.12	4.8.12	Nameplates and Product Marking		X						
3.8.13	4.8.13	Maintenance Concept		X						
3.8.13.1	4.8.13.1	Propulsion System Sustainability		X		X				
3.8.13.2	4.8.13.2	Engine Start System Sustainability		X		X				
3.8.14	4.8.14	Support Equipment (SE)	X							

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3.8.14.1	4.8.14.1	Support Equipment Environment		X		X		X		
3.8.14.2	4.8.14.2	Support Equipment/Facility Interfaces		X		X				
3.8.14.3	4.8.14.3	Aircraft/Support Equipment (SE) Interfaces		X		X				
3.8.15	4.8.15	Maintenance Work Environment	X							
3.8.15.1	4.8.15.1	Climatic/Environmental Work Conditions			X	X				
3.8.15.2	4.8.15.2	Maintainer Accommodation			X	X				
3.8.16	4.8.16	Manpower and Personnel				X				
3.9	4.9	Climatic and Environmental Conditions		X	X			X	X	X
3.9.1	4.9.1	Natural Climate	X							
3.9.1.1	4.9.1.1	Operational Conditions						X	X	X
3.9.1.2	4.9.1.2	Environment Condition Lapse Rates for Non-Standard Days								X
3.9.1.3	4.9.1.3	Icing Conditions								X
3.9.2	4.9.2	Induced Environment	X							
3.9.2.1	4.9.2.1	Storage and Transit Conditions						X	X	X
3.9.2.2	4.9.2.2	Operating Conditions						X	X	X
3.9.3	4.9.3	Electromagnetic Environmental Effects (E3)		X	X			X	X	
3.10	4.10	Architecture and Security	X							
3.10.1	4.10.1	Critical Program Information								
3.10.2	4.10.2	Cybersecurity		X				X		
3.10.3	4.10.3	Open Systems Architecture		X				X		
3.10.4	4.10.4	Computing Resources	X							
3.10.4.1	4.10.4.1	Memory Storage			X	X				
3.10.4.2	4.10.4.2	Computer Resources			X			X		
3.10.4.3	4.10.4.3	Operational Flight Program (OFP)/Software Item (SI) Versions				X		X		
3.10.4.4	4.10.4.4	Operational Flight Program (OFP)/Software Item (SI) Load and Verification				X		X		
3.10.5	4.10.5	ARINC 610 Simulator Compatibility		X						
3.11	4.11	Utility Attributes	X							
3.11.1	4.11.1	Fuel Standards		X			X			
3.11.1.1	4.11.1.1	Fuel Contaminants		X			X			
3.11.2	4.11.2	Lubrication Oil Standards		X						
3.11.3	4.11.3	Space, Weight, and Power with Cooling (SWaP-C) Margins	X							
3.11.3.1	4.11.3.1	Space		X						
3.11.3.2	4.11.3.2	Weight		X			X			
3.11.3.3	4.11.3.3	Power		X						
3.11.3.4	4.11.3.4	Cooling		X	X				X	X
3.11.4	4.11.4	Aircraft Maintenance Safety Protection Equipment (MSPE) Stowage		X		X				
3.11.5	4.11.5	External Stores			X	X				X
3.11.5.1	4.11.5.1	Stores Electrical Interfaces		X						
3.11.6	4.11.6	Environment, Safety and Occupational Health (ESOH)	X							
3.11.6.1	4.11.6.1	Safety		X	X			X	X	X
3.11.6.2	4.11.6.2	Federal and State Laws		X	X					
3.11.6.3	4.11.6.3	Hazards		X	X			X	X	X
3.11.6.4	4.11.6.4	Energetic Materials		X	X			X		
3.11.6.5	4.11.6.5	Hazardous Materials (HAZMAT)		X	X					
3.11.6.6	4.11.6.6	Air Force Occupational Safety		X	X			X	X	X
3.11.7	4.11.7	Airworthiness Certification		X						
3.11.8	4.11.8	Geographic Intelligence (GEOINT)		X						
3.11.9	4.11.9	Barrier Rollover				X				
3.12	4.12	Mission Support				X				
3.12.1	4.12.1	Data Transfer				X				
3.12.1.1	4.12.1.1	DTD Design		X		X				
3.12.1.2	4.12.1.2	On-Board Data Upload							X	

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3.12.1.3	4.12.1.3	DTD Adapter		X						
3.12.2	4.12.2	Mission Planning Interface				X				
3.12.3	4.12.3	Mission Scenario Generation				X				
3.12.4	4.12.4	Mission Debriefing				X				
3.12.4.1	4.12.4.1	Debriefing Operation				X				
3.12.4.2	4.12.4.2	Multi-Ship Debriefing				X				
3.12.4.3	4.12.4.3	Data Uploading						X		
3.12.4.4	4.12.4.4	Data Melding						X		
3.12.4.5	4.12.4.5	Two- and Three-Dimensional Perspective Views				X				
3.12.4.6	4.12.4.6	Playback Controls				X				

4.1 Performance and Structural Characteristics

No requirement to verify.

4.1.1 Performance Ground Rules

No requirement to verify.

4.1.2 Performance

No requirement to verify.

4.1.2.1 High G Maneuvering

The requirement shall be verified by analysis, ground test, and flight test. Ground test shall include evaluation in a 6-Degree of Freedom (DOF) simulation environment. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.2 Instantaneous G-onset Rate

The requirement shall be verified by analysis, ground test, and flight test. Ground test shall include evaluation in a 6-DOF simulation environment. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.2.1 Average G-onset Rate

The requirement shall be verified by analysis, ground test, and flight test. Ground test shall include evaluation in a 6-DOF simulation environment. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.3 Negative and Zero G Flight

No requirement to verify.

4.1.2.3.1 Negative G Flight

The requirement shall be verified by analysis, ground demonstration, laboratory test, and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.3.2 Zero G Flight

The requirement shall be verified by analysis, ground demonstration, laboratory test, and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.4 Instantaneous Turn Rate

The requirement shall be verified by analysis, ground test, and flight test. Ground test shall include evaluation in a 6-DOF simulation environment. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.5 Sustained Turn Rate

The requirement shall be verified by analysis, ground test, and flight test. Ground test shall include evaluation in a 6-DOF simulation environment. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.6 High Angle-of-Attack (AOA) Maneuvering

The requirement shall be verified by analysis, ground test, and flight test. Ground test shall include evaluation in a 6-DOF simulation environment. Flight test shall consist of, at a minimum, Handling Qualities during Tracking tasks, and pitch and roll captures. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.7 Flight Endurance

The requirement shall be verified by analysis, ground test, and flight test. Ground test shall include evaluation in a 6-DOF simulation environment. The analysis shall be based on *aircraft* and installed engine performance models. The analysis shall be verified by flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.8 Takeoff Distance

The requirement shall be verified by analysis, ground test and flight test. Ground test shall include evaluation in a 6-DOF simulation environment. The flight test shall consist of normal takeoffs at forward and aft CG limits from minimum to maximum takeoff speed. The analysis shall include a total braking coefficient of 0.20 for an RCR of 12 unless flight test data substantiates use of other coefficients. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.9 Landing Distance

The requirement shall be verified by analysis, ground test, and flight test. Ground test shall include evaluation in a 6-DOF simulation environment. The flight test shall consist of normal landings throughout the CG range. The analysis shall include a total braking coefficient of 0.20 for an RCR of 12 unless flight test data substantiates use of other coefficients. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.10 Takeoff and Landing in Crosswinds

No requirement to verify.

4.1.2.10.1 Lateral-Directional Control in Crosswinds

The requirement shall be verified by analysis and flight test. The flight test shall consist of normal takeoff and landings in crosswinds at or above 80% of the requirement throughout the CG range with and without stores. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.10.2 Takeoff Run and Landing Rollout in Crosswinds

The requirement shall be verified by analysis and flight test. The flight test shall consist of normal takeoff and landings in crosswinds at or above 80% of the requirement throughout the CG range with and without stores. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.11 Takeoff Climb Gradient Performance

The requirement shall be verified by analysis, ground test, and flight test. Ground test shall include evaluation in a 6-DOF simulation environment. The analysis shall be based on *aircraft* and installed engine performance models. The analysis shall be verified by flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.12 General Handling Characteristics (including all store loadout configurations)

No requirement to verify.

4.1.2.12.1 Aircraft Flying Qualities

The requirement shall be verified by analysis, ground test, and flight test. Ground test shall include evaluation in a 6-DOF simulation environment. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.12.2 Flying Qualities in Atmospheric Disturbances

The requirement shall be verified by analysis, ground test, and flight test. Ground test shall include evaluation in a 6-DOF simulation environment. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.12.3 Student Skill Level Handling Characteristics

The requirement shall be verified by analysis, ground test, and flight test. Ground test shall include evaluation in a 6-DOF simulation environment. The requirement shall be successfully

verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.12.4 Student Fault Tolerant Flight Characteristics

The requirement shall be verified by analysis, ground test, and flight test. Ground test shall include evaluation in a 6-DOF simulation environment. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.12.5 Control Margin

The requirement shall be verified by analysis and flight test. The analysis shall include the effects of *failures* on control margin. The flight test shall include only those *failures* that can readily and safely be simulated in flight. Both analysis and flight test shall encompass the total CG range, nominal trim settings, and any attainable angle of attack and sideslip. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.12.6 Safe Termination

The requirement shall be verified by analysis and flight test.

4.1.2.12.7 Warning and Indication of Approach to Dangerous Flight Conditions

The requirement shall be verified by analysis and flight test. The flight test shall consist of aircrew evaluations of *warning* and indications of approach to *dangerous flight conditions*. The verification shall be considered successful when the aircrew comments indicate that these *warnings* and indications are clear and unambiguous and the aircrew can recognize the impending dangers in time to take preventative action to avoid dangerous conditions. The analysis shall be used to evaluate Failure States if the *failures* are considered too dangerous to test in flight.

4.1.2.12.8 Departure Resistance

The requirement shall be verified by analysis and flight test. Flight test shall include the entire CG envelope, and any *failures* (simulated) that can affect departure. Analysis shall address *failures* considered too dangerous to test in flight. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.12.8.1 Recovery from Post-Stall Gyrations and Spins

The requirement shall be verified by analysis and flight test. Flight test shall include the entire CG envelope, and any *failures* (simulated) that can affect departure. Analysis shall address *failures* considered too dangerous to test in flight. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.12.9 Stalls

No requirement to verify.

4.1.2.12.9.1 Approach to Stall

The requirement shall be verified by flight test. The flight test shall consist of aircrew evaluations and time histories of the stall approaches. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.12.9.2 Tactile/Physical Cues for Stall Warning

The requirement shall be verified by flight test. The flight test shall consist of aircrew evaluations and time histories of the stall approaches. The verification shall be considered successful when aircrew comments indicate tactile/physical cues are adequate for stall *warning*.

4.1.2.12.9.3 Aural and Visual Stall Warning

No requirement to verify.

4.1.2.12.9.3.1 Aural and Visual Cues for Stall Warning

The requirement shall be verified by analysis and flight test. The flight test shall include the entire CG envelope, all stores configurations, and any *failures* (simulated) that may affect stall *warning*. The analysis shall consist of *failures* not addressed in flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.12.9.3.2 Aural and Visual Stall Warning Duration

The requirement shall be verified by analysis and flight test. The flight test shall include the entire CG envelope, all stores configurations, and any *failures* (simulated) that may affect stall *warning*. The analysis shall consist of *failures* not addressed in flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.12.9.3.3 Aural and Visual Stall Warning Conditions

The requirement shall be verified by analysis and flight test. The flight test shall include the entire CG envelope, all stores configurations, and any *failures* (simulated) that may affect stall *warning*. The analysis shall consist of *failures* not addressed in flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.12.9.4 Stall Recovery

The requirement shall be verified by flight test. The flight test shall consist of aircrew evaluations and time histories of the stall recoveries. The flight test shall consist of both stall approaches broken off at stall *warning* and complete stall to an *AOA* great enough to identify V_s. The verification shall be considered successful when aircrew comments indicate stall recoveries

can be accomplished by simple use of cockpit controls without excessive control forces, excessive loss of altitude or build-up of speed.

4.1.2.12.10 Buffet

The requirement shall be verified by flight test. The flight test shall consist of aircrew evaluations of flights over the operational load factor and airspeed ranges and at the minimum and maximum operational altitudes. The verification shall be considered successful when aircrew comments indicate that buffet tendencies of the *aircraft* are not so *objectionable* as to detract from mission effectiveness.

4.1.2.12.11 Pilot-in-the-loop Oscillations (PIO)

The requirement shall be verified by analysis and flight test. The flight test shall consist of aircrew evaluations during a general *handling qualities* evaluation. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.12.12 Failures

The requirement shall be verified by analysis, ground test, and flight test. The analysis shall include a FMECA and Failure Modes and Effects Testing (FMET). For conditions that are considered too dangerous to test in flight, verification shall be shown by analysis. Ground test shall include evaluation in a 6-DOF simulation environment. The verification shall be considered successful when analysis and aircrew comments indicate that no single *failure* of any *component* or system results in dangerous or intolerable *flying qualities*.

4.1.2.13 Flight Control System (including all store loadout configurations)

No requirement to verify.

4.1.2.13.1 Augmentation Systems

No requirement to verify.

4.1.2.13.1.1 Augmentation System Operation

The requirement shall be verified by analysis, ground demonstration, and flight test. The flight test shall include the most common operating conditions, any operating conditions critical to the mission of the *aircraft*, and any conditions determined by analysis or simulation to cause *objectionable* flight characteristics. For conditions that are considered too dangerous to test in flight, verification shall be shown by analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.13.1.2 Augmentation System Performance Degradation

The requirement shall be verified by analysis, ground demonstration, and flight test. The flight test shall include the most common operating conditions, any operating conditions critical to the mission of the *aircraft*, and any conditions determined by analysis or simulation to cause

objectionable flight characteristics. For conditions that are considered too dangerous to test in flight, verification shall be shown by analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.13.1.3 Flight Control System Operation

The requirement shall be verified by analysis, ground test, and flight test. The specific flight conditions to be evaluated shall be the most common operating conditions, any operating conditions critical to the mission of the air vehicle, and those flight conditions where transients due to configuration and mode change are predicted to be at their greatest. The mode changes to be evaluated shall include intentional mode switches by the aircrew, as well as any mode switches caused by the flight control system automatically, with or without the aircrew member conscious intent. Proof of compliance shall consist of time histories of air vehicle response and aircrew inputs, pilot comments, and C-H ratings. The comments and ratings shall indicate that the *flying qualities* are no worse than the required Level of *flying qualities* for each combination of Air Vehicle State and Flight Phase. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.13.2 Control Surface Displacement Rates

The requirement shall be verified by analysis and flight test. The flight test shall consist of aircrew evaluations of flights in the most common operating conditions and any operating conditions critical to the mission of the *aircraft*. For conditions that are considered too dangerous to test in flight, verification shall be shown by analysis. The verification shall be considered successful when aircrew comments indicate that the *flying qualities* are no worse than the required level of *flying qualities*.

4.1.2.13.3 Cockpit Controller Characteristics

The requirement shall be verified by analysis and flight test. The flight test shall consist of aircrew evaluations of flights over the operational load factor and airspeed ranges and at the minimum and maximum operational altitudes. The verification shall be considered successful when aircrew comments indicate the cockpit controller characteristics do not result in *objectionable flying qualities*.

4.1.2.13.3.1 Cross-coupling

The requirement shall be verified by analysis and flight test. The flight test shall consist of all expected *aircraft* maneuvers. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.13.4 Control Centering

The requirement shall be verified by analysis and flight test. The flight test shall consist of aircrew evaluations of flights over the operational load factor and airspeed ranges and at the minimum and maximum operational altitudes. The verification shall be considered successful

when aircrew comments indicate that control centering characteristics do not results in *objectionable flying qualities*.

4.1.2.13.5 Control Free Play

The requirement shall be verified by analysis and flight test. The flight test shall consist of aircrew evaluations of flights over the operational load factor and airspeed ranges and at the minimum and maximum operational altitudes. The verification shall be considered successful when aircrew comments indicate control free play does not result in *objectionable flying qualities*.

4.1.2.13.6 Control Linearity

The requirement shall be verified by flight test. The flight test shall consist of aircrew evaluations of flights over a series of large- and small-amplitude rapid target acquisition and precise tracking maneuvers. The verification shall be considered successful when aircrew comments indicate the cockpit controller characteristics do not result in *objectionable flying qualities*.

4.1.2.14 Over-G Condition (including all store loadout configurations)

4.1.2.14.1 Warnings of Approaching G Limit

The requirement shall be verified by analysis and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.14.2 G-limiter

The requirement shall be verified by analysis and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.2.14.3 Over-G Feedback

The requirement shall be verified by inspection and analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3 Structures

No requirement to verify.

4.1.3.1 Design Service Life

The requirement shall be verified by analysis, ground test, and flight test. Airframe *design service life* shall be verified by review of structural analyses, tests, and flight test programs conducted on the basic and/or production *aircraft*. Durability and damage tolerance analyses shall be conducted to support the *design service life* estimate and establish crack growth characteristics of the airframe. A full-scale durability and damage tolerance test of a production airframe shall be conducted to verify the airframe's operational service life. Minimum durability

test duration shall be two lifetimes. Damage tolerance testing may be performed during a third life of durability testing or on separate *components*. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.2 Materials, Processes, and Parts

The requirement shall be verified by inspection of drawings, material and process specifications, and certification data. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.3 Fasteners

The requirement shall be verified by inspection. The inspection shall include drawings and the *aircraft*. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.4 Corrosion Prevention and Control

The requirement shall be verified by inspection and laboratory test. The inspection shall include drawings, model specifications, finish and sealing specifications, corrosion control plan, and maintenance instructions. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.4.1 Paint Scheme

The requirement shall be verified by inspection of drawings and certification data. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.5 General Parameters and Conditions

No requirement to verify.

4.1.3.5.1 Airframe Configurations

The requirement shall be verified by inspection. The inspection shall include drawings and the *aircraft*. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.5.2 Equipment and Stores

The requirement shall be verified by analysis, laboratory or ground test, and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.5.3 Speeds

The requirement shall be verified by analysis and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.5.4 Altitudes

The requirement shall be verified by analysis and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.5.5 Limit Loads

The requirement shall be verified by analysis, laboratory test, and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.5.6 Ultimate Loads

The requirement shall be verified by analysis and laboratory or ground test. The strength analyses verification shall verify the appropriate factors of safety in section 3.1.3.5.6 have been applied. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.6 Structural Loads

No requirement to verify.

4.1.3.6.1 Flight Loads

The requirement shall be verified by analysis, ground test, and flight test. Analysis and tests shall be of sufficient scope to determine and verify the loads resulting from and commensurate with the flight loading conditions of 3.1.3.6.1. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.6.1.1 Symmetric Maneuver Load Factors

The requirement shall be verified by analysis and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.6.1.2 Asymmetric Maneuver Load Factors

The requirement shall be verified by analysis and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.6.1.3 Pressurization

The requirement shall be verified by analysis and ground test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.6.1.4 Discrete Gust Loads

This requirement shall be verified by inspection of analysis data. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.6.1.4.1 Discrete Gust Formulas

The requirement shall be verified by inspection of analysis data. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.6.2 Ground Loads

The requirement shall be verified by analysis and ground test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.6.2.1 Landing Sink Speeds

The requirement shall be verified by analysis and landing gear drop test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.6.2.2 Ground Wind Loads

No requirement to verify.

4.1.3.6.2.2.1 Mooring

The wind requirement shall be verified by analysis. Installed equipment and provision requirements shall be verified by inspection. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.6.2.2.2 Doors, Canopy, and Windshield

The maintainability requirement shall be verified by ground demonstration. The wind loading requirement shall be verified by analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.6.2.2.3 Crosswinds Loads

The requirement shall be verified by analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.6.3 Repeated Loads

The requirement shall be verified by analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.6.3.1 Maneuvers

The requirement shall be verified by analysis.

4.1.3.6.3.2 Gusts

The requirement shall be verified by analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.6.3.3 Landings

The requirement shall be verified by analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.6.3.4 Other Ground Loads

The requirement shall be verified by analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.6.3.5 Pressurization

The requirement shall be verified by analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.6.3.6 Repeated Operation of Movable Structures

The requirement shall be verified by analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.7 Bird Strike/Hail Impact

No requirement to verify.

4.1.3.7.1 Transparency System Bird Strike Capability

The requirement shall be verified by analysis and laboratory test. Verification tests on production representative complete full scale articles with appropriate backup structure and representative aircrew members in accordance with ASTM F-330, Standard Test Method for Bird Impact Testing of Aerospace Transparent Enclosures shall be conducted. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.7.2 Airframe and Engine Inlet Bird Strike Capability

The requirement shall be verified by analysis and laboratory test. Bird strike requirements shall be verified by analyses and ground tests conducted on critical sections of the wing and empennage. For the forward fuselage and engine inlet, verification shall be accomplished by analyses only. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.7.3 Hail Impact Protection

The requirement shall be verified by analysis and laboratory test. Test articles (such as coupons or *component* mock-ups) representing selected critical sections of the airframe (as determined by analyses and/or previous testing), to include the upper surfaces of the wings, transparency system, fuselage, and empennage, that might be exposed to hail while parked on the ramp shall be subjected to impacts of simulated ice pellets of 0.83 grams/cm^3 density propelled at the test article at a velocity determined by the following equation:

Velocity (meters per second) = 9 ($d^{0.8}$), where d = the diameter in centimeters.

The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.8 Vibroacoustics

The requirement shall be verified by analysis, laboratory test, ground test, and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.8.1 Aeroacoustics

The requirement shall be verified by analysis, laboratory test, ground test, and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.8.2 Vibration

The requirement shall be verified by analysis and ground test consistent with JSSG-2006, A.4.6. Ground vibration tests and on-aircraft inspection of *components* and a complete airframe with and without external stores shall include determination of natural frequencies, mode shapes, and damping of vibration of airframe *components*. The requirement shall be successfully verified

when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.1.3.8.3 Aeroelastic Stability (Flutter and Divergence)

The requirement shall be verified by analysis, laboratory test, ground test, and flight test consistent with JSSG-2006, A.4.7. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.2 Avionics

No requirement to verify.

4.2.1 Communications

No requirement to verify.

4.2.1.1 Multi-Band Radios

This requirement shall be verified by inspection. The inspection shall verify that each of the multi-band radios is capable of providing for simultaneous and independent two-way UHF and VHF band communications (non-secured), interoperable with military and civilian VHF/UHF voice systems. This verification shall be considered successful when the inspection shows that the radios are capable as specified.

4.2.1.2 Ultra-High Frequency (UHF) Communication

This requirement shall be verified by flight demonstration. The flight demonstration shall consist of verifying the UHF Communication system provides for simultaneous two-way UHF band communication (non-secured), interoperable with military UHF voice systems including continuous monitoring of the UHF guard frequency. This verification shall be considered successful when the flight demonstration shows that the radios operate as specified.

4.2.1.3 Very High Frequency (VHF) Communication

This requirement shall be verified by flight demonstration. The flight demonstration shall consist of verifying the VHF Communication system provides for simultaneous two-way VHF band communication (non-secured), interoperable with civilian VHF voice systems including continuous monitoring of the VHF guard frequency. This verification shall be considered successful when the flight demonstration shows that the radios operate as specified and the installed performance conforms to the VHF Tailored Performance Matrix for operation in the 118-137 MHz band for air traffic control (ATC) communications.

4.2.1.4 Simultaneous UHF and VHF Communication

This requirement shall be verified by flight demonstration. The flight demonstration shall consist of verifying that each of the multi-band radios provides simultaneous and independent two-way UHF and VHF band communications (non-secured), interoperable with military and civilian

VHF/UHF voice systems. This verification shall be considered successful when the flight demonstration shows that the radios operate as specified.

4.2.1.5 Communication System Setup

This requirement shall be verified by ground demonstration. The ground demonstration shall consist of verifying the Communication system provides both aircrew for manual setup of and software-driven (from pre-flight planning via data transfer device) loading of all radio communication modes and radio frequency channel presets. This verification shall be considered successful when the ground demonstration shows that the radios can be configured as specified.

4.2.1.6 Emergency Locator Transmitter (ELT)

The requirement shall be verified by ground test. At the FAA designated time of top of the hour to 5 minutes after the hour, the ELT shall be activated per a ground test procedure. The ground test shall consist of verifying the ELT transmits concurrently on 406 MHz, 243 MHz and 121.5 MHz. This verification shall be considered successful when the ELT emergency tones are heard on a VHF receiver on 121.5 MHz, UHF receiver on 243 MHz and SAT receiver on 406 MHz.

4.2.2 Navigation

No requirement to verify.

4.2.2.1 Reduced Vertical Separation Minimum (RVSM)

This requirement shall be verified by flight test. The flight test shall verify that the *aircraft* installed performance conforms to the RVSM Tailored Performance Matrix for operation in RVSM airspace in accordance with Advisory Circular 91-85( ). The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.2.2.2 Global Positioning System (GPS)

This requirement shall be verified by laboratory test. The laboratory test shall consist of showing the ability of the installed GPS to operate in Standard Positioning Service in a static venue. An analysis of laboratory test data shall verify the accuracy of SPS positions. This verification shall be considered successful when the *aircraft* GPS position is confirmed with a known point in the laboratory.

4.2.2.3 RNP/RNAV Navigation

This requirement shall be verified by flight test. The flight test shall consist of showing the flight management system is capable of actual navigation performance (ANP) values less than RNP-0.3 for approaches and landings and maintain a composite navigation position solution with a 95% accuracy level. The flight test shall consist of showing the flight management system is capable of navigating, and providing guidance to the aircrew to fly an LNAV, LP, LNAV/VNAV and LPV approaches as specified. This verification shall be considered successful when the flight test shows that the navigation capabilities are as specified and the

aircraft installed performance conforms to the Lateral Performance Based Navigation (LPBN), VNAV and GPS Precision Landing Tailored Performance Matrices.

4.2.2.4 Tactical Air Navigation (TACAN)

This requirement shall be verified by flight test. The flight test shall consist of showing that the TACAN is capable of being tuned and provides correct indications for navigating in accordance with selected departure, en route navigation, and approach procedures. The flight test shall also show TACAN indications for navigating TO/FROM a selected TACAN ground station as specified. This verification shall be considered successful when the capability specified is shown.

4.2.2.5 Air-to-Air TACAN

This requirement shall be verified by flight test. The flight test shall consist of using air-to-air TACAN in flight to rendezvous with an aircraft equipped with air-to-air TACAN. This verification shall be considered successful when it is shown that the *aircraft* conducts successful rendezvous with air-to-air TACAN equipped aircraft.

4.2.2.6 VHF Omni-Directional Range (VOR)/Distance Measuring Equipment (DME)

This requirement shall be verified by flight test. The flight test shall consist of showing the VOR is capable of being tuned, provides correct indications for navigating in accordance with selected departure and en route navigation procedures, provides indications for navigating TO/FROM a selected VOR ground station, and provides for approaches as specified. The flight test shall show the tuning and the correct indications are provided on the aircrew navigation display commensurate with VOR/DME and localizer DME (LOC/DME) non-precision approaches as specified. The verification shall be considered successful when the flight test shows that the capability is as specified.

4.2.2.7 Instrument Landing System (ILS)

This requirement shall be verified by flight test. The flight test shall consist of showing the ILS (CAT I) and Localizer (LOC) approaches and landings are as specified. This verification shall be considered successful when the flight test shows that the approaches and landings capability is as specified.

4.2.3 Surveillance

No requirement to verify.

4.2.3.1 Traffic Alert and Collision Avoidance System (TCAS)

This requirement shall be verified by flight test. The flight test shall verify that the *aircraft* installed performance conforms to the TCAS II Tailored Performance Matrix. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.2.3.2 Automatic Dependent Surveillance-Broadcast (ADS-B) Out

This requirement shall be verified by laboratory test and flight test. The laboratory test shall consist of showing ADS-B Out transponder operation using a Mode-S transponder test set. The laboratory test shall verify on the test set display parameters such as: lat/long, air speed, Mode 3A code, ICAO 24 bit address, geometric altitude, NACp (Estimate Pos Uncertainty), NACv (Horizontal Velocity Error), call sign. The flight test shall consist of showing full up ADS-B Out operation in an active Mode-S air traffic area. The verification shall be considered successful when the laboratory test and flight test show that the communicated capability is as specified and the installed performance conforms to the ADS-B Out Tailored Performance Matrix.

4.2.3.3 ADS-B In

The requirement shall be verified by flight test. The flight test shall verify that the aircraft installed performance conforms to the ADS-B In Tailored Performance Matrix. The verification shall be considered successful when the flight test shows that the communicated capability is as specified and the installed performance conforms to the ADS-B In Tailored Performance Matrix

4.2.3.4 Transponder

This requirement shall be verified by laboratory test and flight test. The laboratory test shall consist of showing Mode-S/TCAS transponder operation using a Mode-S transponder test set. The test set shall issue an attenuated 1030 MHz interrogation signal to the Mode-S transponder and the 1090 MHz response from the Mode-S transponder shall be directly read off of the test set. The received data contents shall be analyzed against current simulation data. The test set shall then be used to transmit an attenuated 1090 MHZ data signal to the Mode-S transponder. The data displayed on the display shall be verified against the data being transmitted from the test set. The flight test shall consist of showing full up Mode-S operation in an active Mode-S/TCAS air traffic area. The verification shall be considered successful when the laboratory test and flight test show that the communicated capability is as specified and the *aircraft* installed performance conforms to the Mode S Tailored Performance Matrix.

4.2.3.5 Terrain Warning and Avoidance

SEE APPENDIX D.

4.2.4 Datalink and Network Connectivity

No requirement to verify.

4.2.4.1 Embedded Training Datalink

The requirement shall be verified by inspection. The inspection shall consist of inspecting the aircraft drawings. The verification shall be considered successful when it is shown that the *aircraft* has a datalink.

4.2.4.2 Connectivity Region (Local Flying Area)

The requirement shall be verified by flight demonstration. The flight demonstration shall consist of flying multi-ship test missions utilizing a minimum of two test *aircraft*. The test missions

shall include *Embedded Training* system operations between the two *aircraft*. The verification shall be considered successful when flight demonstration shows that the *aircraft* datalink provides the specified performance.

4.2.4.3 Maximum Simultaneous Load

The requirement shall be verified by analysis and flight test. The analysis shall consist of modeling and simulation to evaluate the data link throughput performance under different loading conditions. The flight test shall consist of flying multi-ship test missions utilizing up to five test *aircraft*. The flight test shall collect test data required to validate the analysis verification (modeling and simulation) results. The test missions shall include *Embedded Training* system (most throughput demanding) operations between all test *aircraft.* The verification shall be considered successful when the analysis verification shows that the *aircraft* datalink provides the specified performance and when analysis of flight test data shows validation of the modeling and simulation used in the analysis verification.

4.2.4.4 Multiple Concurrent Missions

The requirement shall be verified by flight demonstration. The flight demonstration shall consist of flying concurrent independent test missions utilizing multiple test *aircraft*. The test missions shall include *Embedded Training* system operations, and single-ship and multi-ship concurrent operations. The verification shall be considered successful when flight demonstration shows that the *aircraft* datalink provides the specified performance.

4.2.4.5 Ground Based Training Systems (GBTS) Connectivity

SEE APPENDIX D.

4.2.4.5.1 GBTS Voice Communication

SEE APPENDIX D.

4.2.4.6 Ground Support Station (GSS) Connectivity

SEE APPENDIX D.

4.2.4.6.1 GSS Voice Communication

SEE APPENDIX D.

4.2.4.6.2 GSS Live Monitoring

SEE APPENDIX D.

4.3 Propulsion System

No requirement to verify.

4.3.1 Fuel Consumption

The requirement shall be verified by analysis, and laboratory test consistent with JSSG-2007C, A.4.2.1.1 Steady-state performance. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.2 Engine Starts

The requirement shall be verified by analysis, laboratory test, ground test and flight test consistent with JSSG-2007C, A.4.2.2.3 (A.4.2.2.3.1-A.4.2.2.3.5). The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.2.1 Environmental Conditions for Engine Starts

The requirement shall be verified by analysis, laboratory test, ground test and flight test consistent with JSSG-2007C, A.4.2.2.3 (A.4.2.2.3.1-A.4.2.2.3.5). The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.2.2 Fuel and Oils for Engine Starts

The requirement shall be verified by analysis, laboratory test, ground test and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.2.3 Thrust Demand at Start

The requirement shall be verified by analysis, laboratory test, ground test and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.2.4 Engine Ground Starts

No requirement to verify.

4.3.2.4.1 Ground Start Cycles

The requirement shall be verified by analysis and ground demonstration consistent with JSSG-2007C, A.4.2.2.3 (A.4.2.2.3.1-A.4.2.2.3.5). The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.2.4.2 Altitude Range for Ground Starts

The requirement shall be verified by analysis and ground demonstration consistent with JSSG-2007C, A.4.2.2.3 (A.4.2.2.3.1-A.4.2.2.3.5). The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.2.4.3 Wind Speed for Ground Starts

The requirement shall be verified by analysis and ground demonstration consistent with JSSG-2007C, A.4.2.2.3 (A.4.2.2.3.1-A.4.2.2.3.5). The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.2.4.4 Hot Temperature Soak Start

The requirement shall be verified by analysis and ground demonstration consistent with JSSG-2007C, A.4.2.2.3 (A.4.2.2.3.1-A.4.2.2.3.5). The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.2.4.5 Cold Temperature Soak Start

The requirement shall be verified by analysis and ground demonstration consistent with JSSG-2007C, A.4.2.2.3 (A.4.2.2.3.1-A.4.2.2.3.5). The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.2.5 Engine Air Starts

The requirement shall be verified by analysis, laboratory test and flight test consistent with JSSG-2007C, A.4.2.2.3 (A.4.2.2.3.1-A.4.2.2.3.5). The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.3 Automatic Relight

The requirement shall be verified by analysis, laboratory test and flight test.

4.3.4 Shutdown

No requirement to verify.

4.3.4.1 Fuel Flow Termination

The requirement shall be verified by analysis, laboratory test, ground test and flight test consistent with JSSG-2007C, A.4.2.2.4 Stopping. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.4.2 Power Setting at Shutdown

The requirement shall be verified by analysis, laboratory test, ground test and flight test consistent with JSSG-2007C, A.4.2.2.4 Stopping. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.5 Stall-Free Operation

The requirement shall be verified by analysis, laboratory test, ground test and flight test consistent with JSSG-2007C, A.3.2.2.11 Inlet airflow distortion and A.4.2.2.11 Inlet airflow distortion. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.6 Thrust Control

The requirement shall be verified by analysis, laboratory test, ground test and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.7 Thrust Transients

The requirement shall be verified by analysis, laboratory test, ground test and flight test consistent with JSSG-2007C, A.4.2.2.7 Transients. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.8 Thrust Stability, Droop and Overshoot

The requirement shall be verified by analysis, laboratory test, ground test and flight test consistent with JSSG-2007C, A.4.2.2.6 Stability. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.9 Thrust Demand and Retention

The requirement shall be verified by analysis, laboratory test, ground test and flight test consistent with JSSG-2007C, A.4.2.1.4 Performance Retention. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.10 Engine Fire/Overheat Indication

The requirement shall be verified by analysis, laboratory test and ground test. The analysis shall show the design provides the required capability. The laboratory test shall show that the system *components* are qualified to perform the capability. The ground tests shall show that the system operates as designed. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.11 Engine Design Service Life

The requirement shall be verified by inspection, analysis and ground test. *Design service life* requirements shall be verified to ensure the desired levels of damage tolerance, durability, functional capability, operability, performance, reliability, and strength are attained by accomplishment of Accelerated Mission Testing. The requirement shall be successfully verified

when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.11.1 Hot Parts Design Service Life

The requirement shall be verified by analysis and ground test. A sensitivity analysis shall be conducted (on selected hot parts) to identify the effect on parts lives that result from a range of usage parameters (above and below the design points). Failure modes (e.g., LCF, creep, stress rupture) analyses shall be conducted to establish design stress levels and lives for engine hot parts based on the design usage. Usage parameters to be considered in the sensitivity analysis shall include airspeed, altitude, ambient temperature, partial throttle cycles, and dwell times at minimum and maximum power levels. Verification of hot part lives can be attained as part of the required mission endurance testing. Pass/fail criteria (i.e., allowable post-test part condition) shall be established for all hot parts life testing. Pass/fail criteria for hot parts life testing shall be quantified through definition of the post-test condition in terms of dimensional tolerances and wear limits. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.11.2 Cold Parts Design Service Life

The requirement shall be verified by analysis and ground test. A sensitivity analysis shall be conducted (on selected cold parts) to identify the effect on parts lives which results from a range of usage parameters (above and below the design points). Failure modes (e.g., LCF, HCF, creep) analyses shall be conducted by the contractor to establish design stress levels and lives for engine cold parts based on the design usage. Usage parameters to be considered in the sensitivity analysis shall include airspeed, altitude, ambient temperature, partial throttle cycles, and dwell times at minimum and maximum power levels. Verification of cold part lives can be attained as part of the required mission endurance testing. Verification of cold parts lives shall also be accomplished via the other verifications in damage tolerance, LCF, strength, etc. Pass/fail criteria (i.e., allowable post-test part condition) shall be established for all cold parts life testing. Pass/fail criteria for cold parts life testing shall be quantified through definition of the post-test condition in terms of dimensional tolerances and wear limits. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.12 Atmospheric Liquid Water Ingestion

The requirement shall be verified by analysis, inspection, and laboratory test consistent with JSSG-2007C, A.4.3.2.5 Atmospheric Liquid Water Ingestion. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.13 Bird Ingestion

The requirement shall be verified by analysis, inspection, and laboratory test consistent with JSSG-2007C, A.4.3.2.1 Bird Ingestion. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.14 Distortion Intensity Levels

The requirement shall be verified by analysis, and flight test. Distortion intensity levels shall be defined in accordance with SAE ARP1420B methodology, as defined in the PSIP Master Plan. SAE AIR 1419B and SAE ARP 1420B methodology shall be used to perform stability audits throughout the operational envelope. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.15 Damage Tolerance

The requirement shall be verified by analysis and laboratory test. Analysis, tests, process documentation, and quality control during production and assembly shall be accomplished IAW MIL-STD-3024 and the PSIP Plan. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.16 Ice Ingestion

The requirement shall be verified by analysis, inspection, and laboratory test consistent with JSSG-2007C, A.4.3.2.3 Ice Ingestion. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.3.17 Sand and Dust Ingestion

The requirement shall be verified by analysis, inspection, and laboratory test consistent with JSSG-2007C, A.4.3.2.4 Sand and Dust Ingestion. The test will be considered satisfactorily completed when the requirement has been met and the teardown inspection reveals no *failure* or evidence of impending *failure*.

4.4 Vehicle Subsystems

No requirement to verify.

4.4.1 Fuel Subsystem

No requirement to verify.

4.4.1.1 Pressure Refuel and Defuel

The requirement shall be verified by ground demonstration.

4.4.1.2 Gravity Refuel and Defuel

The requirement shall be verified by ground demonstration.

4.4.1.3 Fuel Transfer

The requirement shall be verified by analysis, ground test and flight test. The automatic usable fuel transfer requirement shall be verified by ground test and flight test. The *aircraft* gross

weight and center of gravity requirement shall be verified by analysis, ground test and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.2 Aerial Refueling Subsystem Growth Path (Receiver)

The requirement shall be verified by analysis and flight test. The analysis shall include a detailed description of the subsystem and interfaces. It shall show where the proposed location of installed receptacle is and how the "future" receptacle installation will comply with NATO ATP 3.3.4.5, Section II. The analysis will also describe, based upon that proposed location, the following:

a. How the boom operator's visibility (during day/night operations) of the receptacle and its surrounding area will be adequate from the receiver's pre-contact to contact position.
b. How the noise levels created by the boom transitioning to/from the contact position will be adequate.
c. How the boom path to/from contact position will not impact the *aircraft's* flight control system, engine, and other subsystems.
d. How any fuel spray at boom-receptacle contact/disconnect will not create a hazard.
e. How each aircrew will be capable of monitoring the information provided by the tanker's PDLs from the pre-contact position to the contact position and when connected, throughout the tanker boom system's disconnect envelope.
f. What the boom path will be to achieve a contact.
    1) What the clearance from the boom/ice shield and any part of the receiver will be when the boom is following this path.
    2) How the boom *handling qualities* will be adequate when following this path.
g. How much of the tanker's boom disconnect envelope can be utilized.
h. What the clearance from the boom/ice shield and any part of the receiver will be when the boom is in the receptacle and the receiver is positioned within the "utilized" boom disconnect envelope.
i. How the *aircraft* will have adequate power and *handling qualities* to proceed from pre-contact to contact positions.
j. How the tanker's *handling qualities* will be adequate during the AR process with the *aircraft.*
k. What exterior lights on the *aircraft* will be added/redesigned to achieve a night AR capability.
l. What antennae on the *aircraft* will be added/relocated.
m. How personnel egress will not be impacted by the receptacle installation (including if receptacle door fails to fully close).
n. How crew visibility during landing will not be impacted if the receptacle door fails to fully close.
o. How the *aircraft* will maintain adequate *handling qualities*/flight stability when the AR receptacle door fails to fully close.

The analysis shall also identify the type of receptacle (by P/N) planned to be used. It shall explain if an existing receptacle is being proposed or whether the development of a new receptacle must be accomplished for the proposed design.

The analysis shall show design margins for fuel system, electrical power, hydraulic power, weight, and cooling when the fully integrated receptacle system is installed. It shall also show how the existing hydraulic system pressure or power source is adequate for receptacle toggle latch operation and how the existing hydraulic fluid, if applicable, is compatible for receptacle operation. It shall include the routing of new hydraulic/fuel/OBIGGS/ECS lines and electrical wires for the proposed integrated receptacle system modification.

The analysis shall document fuel system impacts to include the following:

a. Changes to tank fill rates/sequences during AR.
b. Vent system capability to accommodate any fill rate changes and tank overfill scenarios during AR.
c. AR/fuel line proof/burst pressure ratings and identify what existing fuel lines will have to be replaced.
d. Fuel management functions.
e. Changes to existing plumbing routing and bracket support.
f. Fuel on-load rates to show ability to refuel from 15% fuel capacity to maximum fuel capacity or to *aircraft's* maximum in-flight gross weight (whichever is least) in less than 8 minutes.

The analysis shall identify the extent of required airframe/structural modifications to account for the following:

a. Loads experienced by receptacle during boom-receptacle aerial refueling.
b. New wiring/plumbing runs.
c. Inadvertent boom strike loads.
d. Relocation of existing *components* and addition of new *components* (including cockpit displays/controls).

The analysis shall show design/location of modified/added cockpit displays/controls necessary to conduct AR operations.

The analysis shall show how the *aircraft* will be capable of conducting AR using standard AR procedures from ATP-3.3.4.2.

The analysis shall identify any changes from the baseline configuration to *aircraft's* Fire Zones classification and show additions/changes to structural drainage provisions.

The analysis shall show compliance with system maintenance requirements.

The analysis shall show how existing Flight Control software will be adequate for AR operations or show why a new AR mode will be required in order to be able to conduct AR operations.

The analysis shall identify what other systems will be on during AR operations.

The analysis shall describe how much overlap there is with the *aircraft's* performance envelope (airspeed/altitude) and the tanker's boom operating envelope (airspeed/altitude). It shall need to show that an operationally adequate aerial refueling envelope for the *aircraft* and tanker pair will be probable.

The analysis shall show how the integrated receptacle system design addresses the following other MIL-HDBK-516 certification issues:

a. E3 compatibility
b. Communication
c. Raised fasteners around receptacle
d. Receptacle Markings
e. Lightning/static electricity compatibility (receptacle door closed/open)
f. Software
g. BIT
h. AR system isolation

The analysis shall show that the *aircraft's* aerial refueling rate (gallons per minute) is adequate to merit having an AR capability (i.e., refuel rate significantly greater than the *aircraft's* SFC during AR process).

Flight test shall be up to and including the contact-uncoupled position behind a KC-135 tanker during day ambient conditions. (Note: A receptacle is not required to accomplish this test. Temporary receptacle markings will suffice.)

The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.2.1 Aerial Refueling Subsystem Full Integration (Receiver)

SEE APPENDIX D.

4.4.3 Environmental Control Subsystem (ECS)

The requirement shall be verified by inspection, analysis, ground test and flight test. ECS analysis shall be conducted to predict cockpit temperatures under the worst case conditions of the mission profiles outlined in APPENDIX A. These predictions shall be verified by ground test and flight test with both aircrew members in the cockpit with all avionics operating and during exposure to the worst case environmental limits. The analysis shall also include a FMECA and System Hazard Analysis (SHA). The FMECA and SHA shall be verified by applicable FMET in the laboratory or on the ground or in-flight. The FMECA and SHA shall also be verified by ground test and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.3.1 Heating Performance (Cold Soak)

The requirement shall be verified by ground test. The ground test shall be accomplished as described in the requirement with both aircrew members in the cockpit and all avionics operating. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.3.2 Cooling Performance (Hot Soak)

The requirement shall be verified by ground test. The ground test shall be accomplished as described in the requirement with both aircrew members in the cockpit and all avionics operating. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.3.3 Temperature Range

The requirement shall be verified by flight test. The flight test shall be conducted to verify cockpit temperatures under the worst case conditions of the mission profiles outlined in APPENDIX A. The flight test shall be accomplished with both aircrew members in the cockpit with all avionics operating and during exposure to the worst case environmental limits. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.3.4 Temperature Variation

The requirement shall be verified by ground test and flight test. The ground test and flight test shall be conducted to verify cockpit temperatures under the worst case conditions of ground operations and the worst case conditions of the mission profiles outlined in APPENDIX A. The ground test and flight test shall be accomplished with both aircrew members in the cockpit with all avionics operating and during exposure to the worst case environmental limits. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.3.5 ECS Controls

The requirement shall be verified by inspection, ground test and flight test. The inspection shall include drawings and the *aircraft*. The ground test and flight test shall be conducted to verify cockpit temperatures can be controlled from both cockpits under the worst case conditions of ground operations and the worst case conditions of the mission profiles outlined in APPENDIX A. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.3.6 ECS Alerts

The requirement shall be verified by analysis, ground test and flight test. The analysis shall show the design provides the appropriate *alerts*. The ground test shall verify that the aircrew members receive the proper *alerts* for the injected *failures* described in the requirement. The flight test shall verify that the aircrew receives the proper *alerts* for any naturally occurring *failures* described in the requirement. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.3.7 Anti -Fog -Frost & -Ice

The requirement shall be verified by ground test and flight test. The ground test and flight test shall be conducted to verify the canopy and interior surfaces remain free of fog, frost and ice

under the worst case conditions of ground operations and the worst case conditions of the mission profiles outlined in APPENDIX A. The ground test and flight test shall be accomplished with both aircrew members in the cockpit with all avionics operating and during exposure to the worst case environmental limits. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.3.8 Equipment Cooling

The requirement shall be verified by analysis, ground test up to and including 110° F and flight test. The ground test and flight test shall be conducted to verify the ECS provides the required cooling to the avionics *components* while maintaining cockpit pressurization and aircrew cooling under the worst case conditions of ground operations and the worst case conditions of the mission profiles outlined in APPENDIX A. The ground test and flight test shall be accomplished with both aircrew members in the cockpit with all avionics operating and during exposure to the worst case environmental limits. The provided cooling air shall be measured and shown to be consistent with equipment design specifications. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.3.9 Alternate Cooling

The requirement shall be verified by analysis, ground test and flight test. The ground test and flight test shall be conducted to verify the alternate cooling method provides the required cooling to the flight critical *components* with a *failure* of the normal cooling method under the worst case conditions of ground operations and the worst case conditions of the mission profiles outlined in APPENDIX A. These tests shall be accomplished with both aircrew members in the cockpit with all flight critical *components* operating at a minimum and during exposure to the worst case environmental limits. The provided cooling air shall be measured and shown to be consistent with equipment design specifications. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.3.10 Cockpit Pressurization

The requirement shall be verified by analysis, ground test and flight test. ECS analysis shall be conducted to predict cockpit pressures under the worst case conditions of the mission profiles outlined in APPENDIX A. These predictions shall be verified by ground test and flight test. The occupied compartment requirements shall be verified by measuring pressures during *aircraft* ground test and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.3.11 Air Contamination

The requirement shall be verified by inspection, analysis, ground demonstration and flight demonstration. The analysis shall include air sampling of the ECS air collected during ground engine runs. As a minimum, ten (10) samples shall be collected and analyzed for contamination. The ground demonstration and flight demonstration shall be conducted to verify the provisions to

shut off all air flow to prevent excessively hot air, smoke, fumes, toxic gases, and other contaminants from entering the cockpit exist and fresh air ventilation for contaminant and odor removal is available to each cockpit. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.3.12 Bleed Air Ducting (if utilized)

The requirement shall be verified by inspection, ground test and flight test. The inspection shall include drawings and the *aircraft* for the leak detection system. The ground test and flight test shall verify the capability to shutoff the bleed air, that the ducting can withstand maximum thermal expansion and the stress of structural deflection during maximum G maneuvers. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.3.13 Moisture Control

The requirement shall be verified by inspection, ground test and flight test. The ground test and flight test shall be conducted to verify the moisture control provides the required cooling air to the forced air cooled equipment under the worst case conditions of ground operations and the worst case conditions of the mission profiles outlined in APPENDIX A. The ground test and flight test shall be accomplished with both aircrew members in the cockpit with all forced air cooled equipment operating and during exposure to the worst case environmental limits. The provided cooling air shall be measured for condensation and humidity and shown to be consistent with equipment design specifications and shown to prohibit water and fog from entering the cockpit. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.4 Braking

The requirement shall be verified by inspection and ground test. The inspection shall include drawings and the *aircraft*. The ground test shall be verified through successful takeoff and landing data verification testing. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.4.1 Parking Brake

The requirement shall be verified by inspection and ground demonstration. The inspection shall include drawings and the *aircraft*. The ground demonstration shall verify that the parking brake can be set and released from the cockpit by the anthropometrically sized aircrew. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.5 Electrical Power Subsystem

The requirement shall be verified by analysis, inspection, laboratory test, ground test and flight test. The analysis shall include an Electrical Loads Analysis (ELA), FMECA, and System

Hazard Analysis. The ELA shall be accomplished in accordance with MIL-E-7016 with Amendment 1. The FMECA and System Hazard Analysis shall be verified by applicable FMET in the laboratory or on the ground or in flight. The analysis shall also be verified by ground test and flight test. The ground test and flight test shall be conducted to verify the electrical system provides the required power to the electrical *components* under the worst case conditions of ground operations and the worst case conditions of the mission profiles outlined in APPENDIX A. The ground test and flight test shall be accomplished with both aircrew members in the cockpit with required electrical *components* operating and during exposure to the worst case environmental limits. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.5.1 Power Source Switching

The requirement shall be verified by inspection and ground demonstration. The inspection shall include drawings and the *aircraft*. The capability of transferring electrical power sources, including both *aircraft* power to external power and external power to *aircraft* power, shall be verified by ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.5.2 External Power Compatibility

The requirement shall be verified by inspection and ground demonstration. The inspection shall include drawings and the *aircraft*. The capability of the electrical power subsystem to operate with external power that meets SAE-ARP5015 requirements for ground operation shall be verified by ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.5.3 External Power Receptacle

The requirement shall be verified by inspection and ground demonstration. The inspection shall include drawings and the *aircraft*. The capability of a connector to accept external power for ground operation and for engine start shall be verified by ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.5.4 Emergency Power

The requirement shall be verified by analysis, laboratory test and ground demonstration. The analysis shall be part of the ELA. The laboratory test shall verify the analysis at the *component* level. The ground demonstration shall show the full system integration and verify the capability and duration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.5.5 Aircraft Start-Up

The requirement shall be verified by inspection and ground demonstration for the multiple start attempts at 0° F and 110° F. The inspection shall include drawings and the *aircraft*. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.5.5.1 External Electrical Power

The requirement shall be verified by ground demonstration. The capability of a connector to accept external power for ground operation and for engine start shall be verified by ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.5.6 Electrical Wiring Interconnection

The requirement shall be verified by inspection of drawings and the *aircraft*. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.6 Hydraulic Subsystem (if utilized)

The requirement shall be verified by analysis, laboratory test, ground test and flight test. The analysis shall include a FMECA and System Hazard Analysis. The FMECA and System Hazard Analysis shall be verified by applicable FMET in the laboratory or on the ground or in flight. The analyses shall also be verified by ground test and flight test. Analysis of steady state and dynamic performance, *component* qualification tests, full-scale mockup/simulator testing and ground test/flight test verify hydraulic systems power requirements. A hydraulic simulation (e.g., iron bird, computer model), capable of performing all normal, back-up and emergency functions, shall demonstrate adequate system fluid capacity. Acceptable fluid loss levels from the system shall be verified by the simulation. All combinations of internal and external environmental conditions within the performance envelope of the *aircraft* (e.g., start up, take off, flight, weapons delivery, return to base, landing) shall be used for the test verifications. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.6.1 Hydraulic System Redundancy

The requirement shall be verified by analysis, laboratory test, ground test and flight test. The analysis shall include a FMECA and System Hazard Analysis. The FMECA and System Hazard Analysis shall be verified by applicable FMET in the laboratory or on the ground or in flight. The analysis shall also be verified by ground test and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.4.6.2 Hydraulic System Integrity

The requirement shall be verified by analysis, inspection and laboratory test. The analysis shall include a FMECA and System Hazard Analysis. The FMECA and System Hazard Analysis shall be verified by applicable FMET in the laboratory. The inspection shall include drawings and the *aircraft*. The laboratory test shall show integrity at the *component* level. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5 Crew Systems

No requirement to verify.

4.5.1 Human Performance and Human Engineering

The requirement shall be verified by inspection of the *aircraft* and drawings, ground demonstration, flight demonstration, laboratory test, ground test and flight test, and by operational and maintenance task analyses. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.2 Cockpit Configuration

The requirement shall be verified through inspection of drawings and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.2.1 Cockpit Commonality

The requirement shall be verified through inspection of drawings and ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.3 Cockpit Stowage

The requirement shall be verified by inspection of the *aircraft* and ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.4 Safety Devices and Streamers

The ability to safety *components* shall be verified by visual inspection of the *components* with the safety devices installed. Stowage of safety devices shall be verified by inspection and ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.5 Aircrew Physical Anthropometrics

The requirement shall be verified through multivariate anthropometric ground testing. The procuring agency shall perform this test. The requirement shall be successfully verified when

the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.6 Anthropometric Accommodation

Reach to operate all controls and displays, reach and clearance to achieve full operational range of the rudder, throttle control, brakes, and control stick, and room to allow proper body posture for ejection shall be verified by multivariate anthropometric testing. Escape and ejection clearance shall be verified by multivariate anthropometric testing and by testing of the escape system. Room to allow movement for visual checks and the sufficiency of internal and external visibility for all flight tasks shall be verified by ground test and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.7 Cockpit Reach

The requirement shall be verified through multivariate anthropometric ground testing. The procuring agency shall perform this test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.8 Aircrew Workload

The requirement shall be verified by ground test in a simulated environment and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.9 Aircrew Alerting

The requirement shall be verified by inspection, analysis, and laboratory test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.9.1 Prioritization of Alerts

The requirement shall be verified by inspection, analysis, and laboratory test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.9.2 Master Warning/Master Caution

The requirement shall be verified by inspection. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.9.3 Aural and Visual Alerts

The requirement shall be verified by inspection, and laboratory test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.9.4 Aural Signals for Warning Alerts

The requirement shall be verified by inspection, and laboratory test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.10 Intercommunications Control System (ICS)

No requirement to verify.

4.5.10.1 External Communication

The requirement shall be verified by inspection, ground demonstration and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.10.2 Aircrew Communication

The requirement shall be verified by inspection, ground demonstration and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.10.3 Ground Communication

The requirement shall be verified by inspection and ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.10.4 Radio Attenuation

The requirement shall be verified by inspection, ground demonstration and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.10.5 ICS Stations

The requirement shall be verified by inspection, ground demonstration and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.10.6 ICS Controls

This requirement shall be verified by inspection and ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.10.7 Microphone Operations

This requirement shall be verified by inspection, ground demonstration and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.10.8 Aircrew and Ground Personnel Acoustic (Speech) Intelligibility

The requirement shall be verified by ground testing and flight testing using the Modified Rhyme Test (MRT) in accordance with ANSI/ASA S3.2-2009 using the worst case audio path in an environment equivalent to worst case cockpit noise under normal operating conditions, including conditions of maximum operational range (100 NM, or maximum radio range, whichever is greater) for voice communications. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.11 Cockpit Controls

No requirement to verify.

4.5.11.1 Throttle Detent

The requirement shall be verified by inspection, ground demonstration and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.11.1.1 Afterburning Aircraft

The requirement shall be verified by inspection, ground demonstration and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.11.1.2 Non-afterburning Aircraft

The requirement shall be verified by inspection, ground demonstration and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.11.2 Side-Arm (Side Stick) Control Stick Forearm Support

The requirement shall be verified by inspection and multivariate anthropometric ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.11.3 Rudder Control Forces

The requirement shall be verified by analysis and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.11.4 Landing Gear Control

The requirement shall be verified by inspection and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.11.5 Emergency Controls

No requirement to verify.

4.5.11.5.1 Accessibility

The requirement shall be verified by inspection and ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.11.5.2 Inadvertent Actuation

The requirement shall be verified by hazard analysis, inspection of the *aircraft*, and ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.11.5.3 Markings

The requirement shall be verified by inspection of drawings and *aircraft*. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.12 Interior Finishes, Components and Equipment

No requirement to verify.

4.5.12.1 Dimensional Stability

The requirement shall be verified by analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.12.2 Fire Resistance

The requirement shall be verified by laboratory test IAW 14 CFR Part 25 Appendix F. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.13 Thermal Contact Hazards

The requirement shall be verified by ground test. The ground test shall turn on all equipment in the operational configuration and measure the exposed temperature of all surfaces to ensure that the thermal contact limits are met. This verification shall be considered successful when the ground test shows that equipment exposed to personnel have surface temperatures lower than those specified or are guarded.

4.5.14 Cockpit Displays

No requirement to verify.

4.5.14.1 Large Area Display (LAD)

The requirement shall be verified by inspection, ground demonstration, and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.14.1.1 Viewable Area

The requirement shall be verified by inspection. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.14.1.2 Configurable Display

The requirement shall be verified by ground demonstration and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.14.1.3 Repeater Mode

The requirement shall be verified by ground demonstration and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.14.1.4 Rear-Cockpit Interface

The requirement shall be verified by analysis, inspection, ground demonstration and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.14.1.5 Integrated Digital Checklists and Electronic Flight Information

The requirement shall be verified by ground demonstration and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.14.1.6 Situational Awareness Display (SAD)/Navigation Display Presentation

The requirement shall be verified by ground demonstration and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.14.2 Glove Compatibility

The requirement shall be verified by ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.14.3 Display Readability

The requirement shall be verified by ground demonstration utilizing a sun lamp capable of generating the daylight condition. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.14.4 Cockpit Display Luminance

The requirement shall be verified by ground test and flight demonstration, which shall involve taking several measurements from the displays at various intensities throughout each crew station, under 0 foot candles (fC) ambient conditions, using a photometer or other appropriate equipment. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.14.5 Display Quality and Latency

The requirement shall be verified by ground demonstration and flight demonstration in day and night ambient lighting conditions. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.14.6 Head-up Type Display (HTD)

The requirement shall be verified by inspection of drawings and *aircraft*. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.14.7 Primary Flight Reference

The requirement shall be verified by shall be verified by inspection endorsement documentation. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.14.8 Standby Flight Instrument

The requirement shall be verified by inspection of drawings and *aircraft*. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.14.9 Aircraft Clock

The requirement shall be verified by inspection of drawings and *aircraft*. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.14.9.1 Stopwatch

The requirement shall be verified by inspection of drawings and *aircraft*. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.14.10 Symbology

The requirement shall be verified by inspection. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.15 Interior Lighting

The requirement shall be verified by ground demonstration utilizing a sun lamp capable of generating the daylight condition. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.15.1 Night Vision Imaging System (NVIS) Compatibility

NVIS compatibility requirements shall be verified by analysis and ground testing IAW MIL-STD-3009. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.15.2 Lighting Uniformity

The requirement shall be verified by laboratory test and ground test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.15.3 Brightness Control

The requirement shall be verified by analysis, ground demonstration, and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.15.4 Glare and Reflections

The requirement shall be verified by analysis, ground demonstration, and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.15.5 Utility/Map light

The requirement shall be verified by inspection. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.16 Exterior Lighting

The requirement shall be verified by inspection, ground demonstration, and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.16.1 FAA Interoperability

The requirement shall be verified by inspection, analysis, ground demonstration, and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.17 Interior and Exterior Visibility

No requirement to verify.

4.5.17.1 Interior Visibility

The requirement shall be verified by inspection, ground demonstration, and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.17.2 Exterior Visibility

The requirement shall be verified by analysis of rectilinear vision plots, inspection, ground demonstration using anthropometric representative aircrew members, and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.17.2.1 Visibility for Landings

The requirement shall be verified by analysis of rectilinear vision plots, inspection, and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.18 Aircraft Transparency/Canopy System

The requirement shall be verified by ground demonstration and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.18.1 Transparency Integration with Environmental Conditions

The requirement shall be verified by analysis, ground demonstration and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.18.2 Transparency Shape Compatibility

The requirement shall be verified by multivariate anthropometric ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.18.3 Transparency System Thermal Loads

The requirement shall be verified by analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.18.4 Canopy Opening Clearance

The requirement shall be verified by ground demonstration of aircrew member ingress/egress for both aircrew member positions using personnel approximating the anthropometric population extremes, with gloves and personal equipment on. This shall also include a demonstration of connection and disconnection from *aircraft* connections (i.e., restraint system, oxygen connections). The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.18.5 Canopy Actuation (Normal Ingress/Egress)

The requirement shall be verified by inspection of drawings and ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.18.6 Manual Canopy Operation

The requirement shall be verified by inspection of drawings and ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.18.7 Canopy Latching and Locking

The requirement shall be verified by inspection, analysis and ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.18.7.1 Canopy Open Lock

The requirement shall be verified by inspection of the system drawings and by ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.19 Normal Aircraft Entry and Exit

The requirement shall be verified by inspection and ground demonstration on an aircraft using anthropometric representative aircrew members. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.19.1.1 Transparency – Escape System Compatibility

The requirement shall be verified by analysis, demonstration, inspection, laboratory test, and ground demonstration. The requirement shall be successfully verified when the Government

confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20 Escape and Egress System

The requirement shall be verified by inspection of drawings and ground test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.1 Escape System Reliability

The minimum reliability requirements of the ejection seat and escape system integration shall be verified by ground demonstration and static and dynamic sled testing using a representative forebody. Demonstrated Reliability numbers are determined from 22 consecutive successful ejection tests (includes minimum 8 full system-level integration tests per *aircraft*). The minimum probability of success for the escape system shall be verified by analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.2 Manual Emergency Ground Egress

The requirement shall be verified by ground demonstration using anthropometric representative aircrew members. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.2.1 Backup Emergency Ground Egress

The requirement shall be verified by analysis, inspection, and ground test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.3 Escape Path Clearance System

The requirement shall be verified by inspection, analysis, and ground test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.3.1 Penetrating Injuries

The requirement shall be verified by ground test through subscale cutting tests of the canopy material with ballistic witness gel placed under the test sample (inside of canopy location) at a distance that is representative of the shortest distance between the canopy cutting system and the neck. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.3.2 Impulse Noise

The requirement shall be verified by ground test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.3.3 Thermal Energy Exposure Limits

The requirement shall be verified by static and dynamic sled test. The measurements shall be made by attaching heat flux sensors to the manikin beneath the standard flight equipment. The placement of these sensors shall be in areas most likely to be exposed to thermal energy, such as the upper torso, thighs, arms and head. The thermal flux measurements obtained shall be analyzed by the procuring organization using the BURNSIM burn depth prediction model version 3.0.2. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.3.4 Escape Path Clearance Considerations

The requirement shall be verified by analysis, inspection of engineering drawings, ground demonstration (nonexplosive) and breadboard testing (explosive) of a production or production representative article. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.4 External Controls

The requirement shall be verified by inspection of the drawings and ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.5 Ejection Seat Clearance

The requirement shall be verified by ground test by static pull tests in a production representative cockpit and canopy frame. Sufficient clearance shall be verified by demonstration during the static and dynamic sled tests with a production representative cockpit and a canopy frame and forebody. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.6 Safing of Emergency Controls

The requirement shall be verified by analysis, inspection, and ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.6.1 Secondary Seat Safety Device

The requirement shall be verified by analysis, inspection, and ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.7 Manually Initiated Automatic Escape

The requirement shall be verified by analysis, inspection and ground test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.7.1 Escape Envelope

The requirement shall be verified by escape system ground testing and analysis. The escape system envelope shall be determined by computer analysis and tested at selected points with the static and dynamic sled tests. The computer model shall be refined and verified by test data. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.7.2 Canopy and Escape Path Clearance

The requirement shall be verified by analysis, inspection of engineering drawings, static tests, and dynamic sled tests. The Contractor shall conduct the following tests, as applicable, prior to the system level sled tests:

a. For canopy jettison systems, a minimum of two dedicated canopy jettison tests (O/O and maximum speed).
b. For active canopy fracturing systems (e.g., detonation chord, shape charge), a minimum of three dedicated canopy fracturing tests (0/0, 0/0 with the canopy heated to simulate maximum operational conditions of the *aircraft*, and maximum speed).
c. For direct penetration through the canopy backup mode (i.e., breakers), a minimum of two static canopy fracturing tests (0/0 and 0/0 with the canopy heated to simulate maximum operational conditions).

The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.7.2.1 Ejection through the Canopy (For Transparency Fracturing Systems in Primary Mode, and Direct Penetration Backup Modes)

The requirement shall be verified by breadboard ballistic, canopy fracturing ground demonstration, and static and dynamic system level sled tests. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.7.3 Aircraft Clearance

The requirement shall be verified by analysis and by static and dynamic sled testing. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.7.4 Initiation

The requirement shall be verified by ground demonstration and pull tests. The total time from initiation shall be verified by analysis and ground test. The requirement shall be successfully

verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.7.5 Inter-Seat Sequencing

The requirement shall be verified by breadboard and static and dynamic sled testing. Spatial separations shall be measured during sled tests and verified by analysis using computer simulation for the full range of *aircraft* speeds. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.7.5.1 Inter-Seat Sequencing Mode Selection (for tandem cockpit configured aircraft)

The requirement shall be verified by inspection, breadboard, static tests, and dynamic sled tests. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.7.5.2 Divergence

The requirement shall be verified by static and dynamic sled tests. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.7.6 Seat Aircrew Separation

The requirement shall be verified by sled testing. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.7.7 Descent Recovery Parachute System

Recovery parachute qualification shall be verified by test. Descent recovery parachute requirements for fittings and cross connector straps, and seat aircrew member integration shall be verified by inspection. Descent recovery parachute provisions and deployment requirements shall be verified by drop tests, live jump tests, and static and dynamic sled tests. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.7.7.1 Recovery Parachute Deployment/Inflation Phase Accelerations

The requirement shall be verified by drop tests, live jump tests, and static and dynamic sled tests. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.7.7.2 Descent Rate – Steady State Phase

The requirement shall be verified by drop tests, live jump tests, and static and dynamic sled tests. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.8 Personnel Restraint System

The requirement shall be verified by inspection of production article, flight demonstrations, and dynamic load tests. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.8.1 Limb Restraint System

Limb restraint system requirements shall be verified by inspection of production article, demonstrations, and laboratory tests. Rapid disconnection from the seat (harnesses and limb restraints) shall be verified by ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.8.2 Inertia Reel Lock

The requirement shall be verified by ground demonstration, inspection, and ground test and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.9 Energetic Materials and Components

The complete *aircraft* escape system energy transmission circuit with all associated *components* shall be operationally verified by breadboard testing. The explosive and/or propellant devices shall be verified by destructive testing. Verification testing shall cover all levels: *component*, subsystem, system and sled testing. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.9.1 Firing Mechanism

The requirement shall be verified by laboratory test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.10 Acceleration Limits

No requirement to verify.

4.5.20.10.1 Acceleration Limits – Catapult Phase

Seat mounted instrumentation shall be used to determine DRI. The requirement shall be verified by static and dynamic system level sled tests. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.10.2 Acceleration Limits –Free Flight and Drogue Phase

Seat mounted instrumentation shall be used to determine MDRC. The requirement shall be verified by static and dynamic system level sled tests. The requirement shall be successfully

verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.11 Head Injury – All Phases

The requirement shall be verified by static and dynamic system level sled tests. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.12 Neck Loads - All Phases

No requirement to verify.

4.5.20.12.1 Neck Loads – Speeds up to and including 450 KEAS

The requirement shall be verified static and dynamic system level sled tests. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.12.1.1 Neck Loads – Speeds greater than 450 KEAS

The requirement shall be verified static and dynamic system level sled tests. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.13 Environmental Conditions

The requirement shall be verified by analysis and laboratory test and ground test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.14 Center of Gravity (CG) Envelope

The requirement shall be verified by analysis and ground test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.15 Stabilization and Deceleration

The requirement shall be verified by static and dynamic sled tests. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.16 Seat Assembly

The requirement shall be verified by static and dynamic sled tests and by multivariate anthropometric testing. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.16.1 Headrest

The requirement shall be verified by static and dynamic sled tests and by multivariate anthropometric testing. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.16.2 Canopy Breakers

The configuration and presence of canopy breakers shall be verified by inspection. The performance of the canopy breakers shall be verified by static and dynamic sled tests. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.16.3 Cushions

The requirement shall be verified by visual inspection. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.17 Proof Loads

The requirement shall be verified by laboratory test prior to sled testing. Visual inspection shall verify there was no permanent deformation. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.18 Crash Ultimate Loads

The requirement shall be verified by laboratory test of the seat and seat structure. Visual inspection of the test article shall verify there was no fracture of materials or *failure* of seat attachments after testing for the defined crash loads. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.19 Redundancy

The requirement shall be verified by inspection of engineering drawings and operationally verified by breadboard and static and dynamic sled testing. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.20 Safety

The requirement shall be verified by analysis, ground demonstration, flight demonstration and visual inspection. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.21 Explosive Device Maintainability

The requirement shall be verified by a maintainability analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.22 Performance Reliability

The requirement shall be verified by laboratory test and analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.23 Component Life and Change-outs

The requirement shall be verified by a maintainability analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.24 Cartridge Actuated Devices/Propellant Actuated Devices

The requirement shall be verified by a maintainability analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.25 Aircraft Integration

The requirement shall be verified by inspection of engineering drawings, ground demonstration, flight demonstration and static and dynamic sled testing. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.26 Escape System Installation and Removal

The requirement shall be verified by ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.20.27 Specialized Tooling or Machinery

The specialized tooling or machinery requirement shall be verified by inspection. The ejection seat parachute packing requirement shall be verified by ground demonstration and a maintainability analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.21 Aircrew Flight Equipment and Pilot Personal Protection

No requirement to verify.

4.5.21.1 Personal Flight Equipment Compatibility

The requirement shall be verified by inspection of the *aircraft* and connectors, ground demonstration, and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.21.2 Anti-G Trouser Pressurized Air Supply

The requirement shall be verified by laboratory test, flight test and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.21.3 Survival Kit Provisions

The requirement shall be verified by inspection of a production survival kit. Automatic and manual deployment of the survival kit shall be verified by demonstration under operational conditions (actual or simulated) of descent rate, relative wind and parachute oscillations. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.21.4 Personnel Emergency Location Transmitter

The requirement shall be verified by ground demonstration of a production article. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.21.5 Aircrew Acoustic Exposure Tolerance

The requirement shall be verified by ground test and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.22 Oxygen System

Physiological compatibility shall be verified by test under standard conditions in a USAF altitude chamber and by flight test. The breathing system shall undergo safe-to-fly testing prior to *aircraft* flight testing. Safe-to-fly testing shall be conducted by a Government agency. The test agency shall prepare the test plan, including success criteria. Prior to testing the test agency shall coordinate the test plan with the contractor and the aircraft program office. Testing shall be conducted at OBOGS nominal inlet air pressure and minimum inlet air pressure specification at altitudes from ground level to the maximum ceiling of the *aircraft*. Unmanned testing phases shall, as a minimum, include steady-state flow testing at minimum and maximum flows, dynamic flow testing at peak flows (as noted in Table 4-2), rapid ascent and descent, full range of G levels, rapid decompression, and the various OBOGS operating modes. Unmanned testing shall be accomplished at various altitudes while the OBOGS inlet pressure is transitioned from 1) nominal inlet pressure to loss of inlet pressure; 2) highest expected inlet air pressure to the minimum specification inlet air pressure and back; and 3) nominal inlet pressure to loss of inlet pressure and back using durations of 5, 10, 15, 20, 25, and 30 seconds. The test agency shall

prepare a safe-to-fly recommendation and final report (if required) discussing the test data/results, pass/fail criteria results, and significant findings. The safe-to-fly recommendation shall state the clearance for flight test and state the system maximum ceiling altitude, maximum G level and document any anomalies found.

Table 4-2, Breathing Simulator Profiles

Profile	Peak Flow (liters/min)	Breathing Rate (breaths/min)	Breath Volume (liters)
1	17	8	0.5
2	90	50	0.6
3	125	40	1.0
4	150	25	2.0
5	188	24	2.5
6	258	50	1.5

Final verification will be satisfied with the issuance of a USAF Flight Test Letter following completion of the flight test program. A minimum of 100 flight hours of dedicated or piggy-back flight testing shall be conducted. A qualified Government agency shall conduct the flight testing. 5 sorties shall be conducted after an aircraft cold soak. Cold soaking shall be defined as *aircraft* exposure to below 32 °F for 12 hours prior to flight. The breathing system and air source/s (i.e., ECS and secondary air source, if used) shall be instrumented. Samples of the OBOGS breathing gas shall be collected during ground engine runs. As a minimum, ten (10) samples shall be collected and analyzed. After the 100 hours of dedicated or piggy-back flight testing a surveillance program shall be initiated to review OBOGS stored flight data on randomly selected flights to assess system performance. If anomalies are found, they shall be reported. The goal is to ensure the breathing system and the air source/s maintains acceptable performance under flight conditions. The flight testing agency shall prepare a flight test letter and final report (if required). The flight test letter shall summarize the results of the flight testing program, assess breathing system performance and suitability, and document any anomalies. If anomalies are noted, the flight test agency shall assess the impact on system safety and effectiveness when the *aircraft* is used in its planned mission role. Oxygen system compatibility shall be verified by demonstration of connection mating and decoupling and test of oxygen flow output. The contractor shall conduct an oxygen system safety analysis of the compatibility of the life support system *components*, including OBOGS, to ensure the *components* are compatible with oxygen at the pressures and temperatures of use. The system safety analysis shall include a fire hazard analysis and FMECA. The oxygen system hazard analysis, shall verify that no unacceptable and no undesirable hazards are contained in the oxygen system. The contractor shall conduct qualification testing of the breathing system *components*, including OBOGS, to include environmental testing, acceleration, vibration, and electromagnetic interference testing. The testing shall comply with MIL-STD-810 but may be tailored to the specific operating conditions. The system *components* shall pass qualification testing prior to initiation of safe-to-fly testing.

The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.22.1 Oxygen Supply Quality

The requirement shall be verified by analysis, laboratory test, ground test and flight test. See Oxygen System – Verification. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.22.1.1 Oxygen Mask Pressures

The requirement shall be verified by analysis, laboratory test, ground test and flight test. See Oxygen System – Verification. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.22.2 Oxygen Quantity

The requirement shall be verified by inspection for OBOGS equipped *aircraft*. The requirement shall be verified by analysis and flight test for LOX or GOX equipped *aircraft*. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.22.3 Uninterrupted Oxygen Supply

The requirement shall be verified by analysis, laboratory test, ground test and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.22.3.1 OBOGS Pressure Sensors

The requirement shall be verified by inspection, laboratory test, ground test and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.22.4 Emergency Oxygen

The emergency oxygen requirements shall be verified by analysis, laboratory test, ground test and flight test. An oxygen consumption analysis shall use multipliers of 1.2 for a single aircrew member, and 1.1 for safety pressure, making the appropriate consumption adjustments for altitude. Automatic and manual actuation requirements shall be verified by laboratory test and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.22.5 Breathing Regulator

The requirement shall be verified by laboratory test and flight demonstration. The laboratory test shall include qualification and performance tests. The flight demonstration shall verify operation

and functionality throughout the flight envelope (see Oxygen System – Verification). The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.22.6 Oxygen System Controls and Displays

The requirement shall be verified by inspection of the *aircraft* and ground demonstration showing that the location and operation of the controls and display are forward of and can be seen by a seated aircrew member. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.22.7 Oxygen System Integration

The requirement of oxygen systems design considerations shall be verified by analysis, inspections, ground demonstration, flight demonstration, laboratory test, ground test and flight test (See Oxygen System – Verification). Design considerations specified shall be provided at the preliminary and critical design reviews. Tests shall be required to validate the hazard analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.22.8 Pressure Breathing for G (PBG) Loading

The requirement shall be verified by inspection, laboratory test and flight test. The inspection shall include drawings and the *aircraft* for the PBG system. The laboratory test shall verify the fail-safe operation. The flight test shall verify the capability to provide the G loading mask pressures during maximum G maneuvers. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.22.9 Breathing Gas Contamination Limits

The requirement for no toxic or corrosive materials in the system shall be verified by inspection of the system drawings and documentation. The level of potential contamination shall be assessed during the safety and verification analysis. New contaminants discovered during sample analysis, shall be identified and reported to the Program Management Office. See Oxygen System – Verification. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.22.10 OBOGS Monitoring

The *BIT* requirement shall be verified by laboratory test and ground test, to include fault insertion to verify proper operation and identification. The maintenance download requirement shall be verified by ground demonstration at the *aircraft.* The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.23 Ground Personnel/Maintenance Specific Considerations

No requirement to verify.

4.5.23.1 Ground Personnel Acoustic Exposure Tolerance

The requirement shall be verified by ground test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.5.23.2 Maintainer Lifting and Carrying Limits

The requirement shall be verified by maintenance analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.6 Embedded Training

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of demonstrating the *Embedded Training* capability off-aircraft. The flight demonstration shall consist of demonstrating the *Embedded Training* capability in-flight. The verification shall be considered successful when the ground demonstration and flight demonstration show that the *Embedded Training* capability requirements, as defined in section 3.6 and subparagraphs, are satisfied.

(Note: Off-aircraft means in an aircraft-equivalent environment using actual *aircraft* systems/subsystems/*components*.)

4.6.1 Radar System Simulation

No requirement to verify.

4.6.1.1 Radar Functions and Modes

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of demonstrating the radar functionality, modes and display presentations off-aircraft. The flight demonstration shall consist of demonstrating the radar functionality, modes and display presentations in-flight. The verification shall be considered successful when the ground demonstration and flight demonstration show that the radar functionality, modes and display presentations requirements, as defined in Table 3-21, are satisfied.

4.6.1.2 Air-to-Ground Function

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of demonstrating the radar air-to-ground capability off-aircraft using ground *constructive targets*. The flight demonstration shall consist of demonstrating the radar air-to-ground capability using ground *constructive targets*. The verification shall be considered successful when the ground demonstration and flight demonstration show that the radar air-to-ground capability is provided.

4.6.1.3 Air-to-Air Function

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of demonstrating the radar air-to-air capability off-aircraft using airborne *constructive targets*. The flight demonstration shall consist of demonstrating the radar air-to-air capability using *live targets, virtual targets* (if *GBTS* Connectivity is implemented) and airborne *constructive targets*. This verification shall be considered successful when the ground demonstration and flight demonstration show that the radar air-to-air capability is provided.

4.6.1.4 Synthetic Aperture Radar (SAR) Ground Mapping

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of demonstrating the SAR ground mapping capability off-aircraft. The flight demonstration shall consist of demonstrating the SAR ground mapping capability in-flight. The verification shall be considered successful when the ground demonstration and flight demonstration show that the SAR ground mapping capability is provided.

4.6.1.5 Target Information

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of verifying the radar display presentation provides the target information defined in Table 3-22. The flight demonstration shall consist of verifying the radar display presentation provides the target information defined in Table 3-22 using *live targets, virtual targets* (if *GBTS* Connectivity is implemented) and *constructive targets*. The verification shall be considered successful when the ground demonstration and flight demonstration show that the specified target information is provided.

4.6.1.6 Radar Detection

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration and flight demonstration shall consist of mission planning the target detection ranges using JMPS and verifying that the targets are detected IAW the specified probability of detection rules. The verification shall be considered successful when the ground demonstration and flight demonstration show that the specified capability is provided.

4.6.1.6.1 Variable Tactical Environment

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration and flight demonstration shall consist of mission planning the detection profiles using JMPS and verifying that the targets are detected IAW the aircrew-selected detection profile. The ground demonstration and flight demonstration shall exercise all specified profiles. The verification shall be considered successful when the ground demonstration and flight demonstration show that the specified capability is provided.

4.6.1.7 Radar Controls

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of interacting with the radar using non-HOTAS radar controls. The flight demonstration shall consist of interacting with the radar using non-HOTAS radar controls. The verification shall be considered successful when the ground demonstration and flight demonstration show the non-HOTAS radar controls are provided.

4.6.1.8 Hands on Throttle and Stick (HOTAS)

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of interacting with the radar using *HOTAS controls*. The flight demonstration shall consist of interacting with the radar using *HOTAS controls*. The verification shall be considered successful when the ground demonstration and flight demonstration show the *HOTAS controls* are provided.

4.6.2 Defensive Management System (DMS)

No requirement to verify.

4.6.2.1 RWR Detection

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of demonstrating (off-aircraft) the RWR detects and display airborne and ground *constructive threats/targets*. The flight demonstration shall consist of demonstrating the RWR detects and display airborne and ground, *live targets, virtual targets* (if *GBTS* Connectivity is implemented) and *constructive targets*. The verification shall be considered successful when the ground demonstration and flight demonstration show that the specified RWR detection capability is provided.

4.6.2.2 Threat Display

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of verifying (off-aircraft) the DMS threat display presentation provides the threat information, as defined in Table 3-24, for airborne and ground *constructive threats/targets*. The flight demonstration shall consist of verifying the DMS threat display presentation provides the threat information, as defined in Table 3-24, for airborne and ground, *live targets, virtual targets* (if *GBTS* Connectivity is implemented) and *constructive targets*. The verification shall be considered successful when the ground demonstration and flight demonstration show that the specified threat information is provided on both LAD and HTD.

4.6.2.3 DMS Controls

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of demonstrating (off-aircraft) the specified DMS controls, modes and functions. The flight demonstration shall consist of demonstrating the specified DMS controls, modes and functions. The verification shall be considered successful when the ground demonstration and flight demonstration show the specified DMS controls, modes and functions are provided.

4.6.2.4 Threat Audio

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of verifying (off-aircraft) the DMS threat audio is provided (audio can be played thru speakers). The flight demonstration shall consist of verifying the DMS threat audio is provided to the aircrew thru the *ICS*. The verification shall be considered successful when the ground demonstration and flight demonstration show that the specified threat audio is provided IAW Table 3-26.

4.6.2.5 Expendables Systems

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of mission planning countermeasures dispensing programs and demonstrating (off-aircraft) the countermeasures dispensing capability (audio can be played thru speakers). The flight demonstration shall consist of mission planning countermeasures dispensing programs and demonstrating the countermeasures dispensing capability using a wingman *aircraft*. The verification shall be considered successful when the ground demonstration and flight demonstration show that the specified countermeasures dispensing capability is provided IAW Table 3-27.

4.6.3 Weapon Systems

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of mission planning weapons criteria (loadout) and demonstrating (off-aircraft) weapons employment against airborne and ground *constructive targets* (audio can be played thru speakers). The flight demonstration shall consist of mission planning weapons criteria (loadout) and demonstrating weapons employment against airborne and ground, *live targets, virtual targets* (if *GBTS* Connectivity is implemented) and *constructive targets*. The verification shall be considered successful when the ground demonstration and flight demonstration show that the specified weapons employment capability is provided IAW Table 3-28.

4.6.3.1 No Drop Weapon Scoring (NDWS)

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of demonstrating (off-aircraft) the air-to-ground non-guided weapons employment and scoring capability. The flight demonstration shall consist of demonstrating the air-to-ground non-guided weapons employment and scoring capability in-flight. The verification shall be considered successful when the ground demonstration and flight demonstration show that the specified non-guided weapons employment and scoring capability is provided.

4.6.4 Embedded Training Presentation Overlays on SAD

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of mission planning SAD presentation (overlays) and demonstrating (off-aircraft) the specified SAD system capability. The flight demonstration shall consist of mission planning SAD presentation (overlays) and demonstrating the specified SAD system capability including the presentation of wingman *aircraft* information. The verification

shall be considered successful when the ground demonstration and flight demonstration show that the specified SAD system capability is provided.

4.6.5 Tactical Datalink (TDL) System Simulation

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of demonstrating (off-aircraft) the specified TDL system capability. The flight demonstration shall consist of demonstrating the specified TDL system capability in-flight. The verification shall be considered successful when the ground demonstration and flight demonstration show that the specified TDL system capability is provided.

4.6.6 Targeting Pod System Simulation

SEE APPENDIX D.

4.6.7 Mission Scenario Inputs

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of executing the pre-planned mission scenario and modifying the scenario real-time by injecting scenario inputs (defined in Table 3-32) from own-ship. The flight demonstration shall consist of executing the pre-planned mission scenario and modifying the scenario real-time by injecting scenario inputs from: own-ship, other *aircraft*, *GBTS* (if *GBTS* Connectivity is implemented) and GSS (if GSS Connectivity is implemented). The verification shall be considered successful when the ground demonstration and flight demonstration show that the mission scenario is modified.

4.6.8 Synchronized Combat Environment

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of demonstrating (off-aircraft) the mission scenario environment (including scenario inputs) is synchronized between aircrew positions. The flight demonstration shall consist of demonstrating the mission scenario environment (including scenario inputs) is synchronized between aircrew positions and between participating *aircraft*, *GBTS* (if *GBTS* Connectivity is implemented) and GSS (if GSS Connectivity is implemented). The verification shall be considered successful when the ground demonstration and flight demonstration show that the mission scenario is synchronized.

4.6.8.1 Own-ship Position

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of demonstrating (off-aircraft) the mission scenario environment maintains real-time correlation with own-ship position. The flight demonstration shall consist of demonstrating the mission scenario environment maintains real-time correlation with own-ship position during actual flight. The verification shall be considered successful when the ground demonstration and flight demonstration show that the mission scenario environment maintains real-time correlation with own-ship position throughout all flight phases and APT syllabus maneuvers and the mission profiles.

4.6.9 Geographical Area

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of positioning the own-ship at different point of interests (pre-selected and randomly selected) throughout the CONUS area and observing the resulting SAR Ground Mapping and Targeting Pod System (if implemented) imagery of the area at the point of interest. The verification shall be considered successful when the observed imagery at each point of interest shows area coverage with no breaks in terrain, features, models or imagery.

4.6.9.1 High Resolution Area

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of positioning the own-ship at different point of interests (pre-selected and randomly selected) throughout the CONUS area and observing the resulting SAR Ground Mapping and Targeting Pod System (if implemented) imagery of the area at the point of interest. The verification shall be considered successful when the observed imagery satisfies the specified data resolutions.

4.6.10 Declutter Function

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of displaying *Embedded Training* tactical information in conjunction with (simulated) flight and navigational information on the LAD and HTD and demonstrating the declutter function. The flight demonstration shall consist of displaying *Embedded Training* tactical information in conjunction with (actual) flight and navigational information on the LAD and HTD and demonstrating the declutter function. The verification shall be considered successful when the ground demonstration and flight demonstration show that the specified declutter functionality is provided.

4.7 Recorded Aircraft Information

The requirement shall be verified by inspection. The inspection shall consist of inspecting the recorded data files (for MFOQA, mishap investigation, maintenance and *mission debriefing*) are in digital format. The verification shall be considered successful when inspection shows the recorded data is in digital format.

4.7.1 Military Flight Operations Quality Assurance (MFOQA)

No requirement to verify.

4.7.1.1 Recorded Data

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of recording test mission data in-flight and verifying the specified data is recorded. The verification shall be considered successful when the specified data is recorded.

4.7.1.1.1 Airframe Tracking

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of recording test mission data in-flight and verifying the specified data is recorded. The verification shall be considered successful when the specified data is recorded.

4.7.1.2 Data Retrieval

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of downloading recorded flight test data using the Government-approved mobile device or the DTD and decoding the downloaded data. The verification shall be considered successful when the downloaded data is decoded.

4.7.2 Mishap Investigation Data

No requirement to verify.

4.7.2.1 Aircraft Recorded Data

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of recording cockpit audio and flight data in-flight and verifying the specified audio and data are recorded. The verification shall be considered successful when the specified cockpit audio and the specified flight data are recorded.

4.7.2.1.1 Crash Survivable Recorder(s)

The requirement shall be verified by ground demonstration and inspection. The ground demonstration shall consist of downloading recorded cockpit audio and flight data from flight test and verifying the specified recording capacity for the recorder(s). The inspection shall consist of inspecting the *aircraft* for the presence of the recorder(s) and inspecting the TSO compliance documentation issued by the data recorder(s) manufacturer(s). The verification shall be considered successful when the specified recording capacity and TSO compliance documentation are provided.

4.7.2.2 Data Retrieval

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of downloading recorded cockpit audio and flight data from recorder(s), and decoding the downloaded data. The verification shall be considered successful when it is shown that the recorded data is downloaded without recorder(s) removal and the downloaded data is decoded.

4.7.2.3 Ejection Seat Recorded Data

The requirement shall be verified by ground demonstration. The demonstration shall consist of recording the specified data during ejection seat ground testing. The verification shall be considered successful when the specified data is recorded and it is shown that the recorded data is downloaded and decoded.

4.7.3 Maintenance Data

No requirement to verify.

4.7.3.1 Recorded Data

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of recording the specified data in-flight and retrieving the recorded data from a single point on the *aircraft* using a Government-approved mobile device. The ground demonstration shall include retrieving the recorded data stored in one *aircraft* after 18 hours of operation. When in-flight recording of data parameters (e.g., *components* faults) is not practical, then laboratory test shall be an acceptable method of verification. The verification shall be considered successful when the specified data is recorded.

4.7.3.1.1 CBM+ Function

The requirement shall be verified by ground test and analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.7.3.2 Aircraft Turn Data Viewing

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of viewing the recorded data (from 4.7.3.1) in the cockpit and at the *aircraft* using a Government-approved mobile device. The verification shall be considered successful when the demonstration successful shows viewing of the specified data.

4.7.3.3 End of Fly Day Data Retrieval

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of retrieving the recorded data stored in one *aircraft* after 18 hours of operation. The verification shall be considered successful when the ground demonstration shows retrieval of the recorded data from a single point on the *aircraft* using a Government-approved mobile device.

4.7.3.4 Maintenance Data Collection & Management System

The requirement shall be verified by ground demonstration. The demonstration shall consist of demonstrating the transfer of recorded data to IMDS and CEMS using an XML format. The demonstration shall be considered successful when the specified data is transferred to IMDS and CEMS.

4.7.4 Mission Debrief Data

No requirement to verify.

4.7.4.1 Recorded Data

The requirement shall be verified by ground demonstration. The demonstration shall consist of retrieving the recorded data from flight using the DTD and playing back the recorded data using the intended mission debriefing system. The verification shall be considered successful when demonstration shows mission and flight reconstruction without distortion (*readable*).

4.7.4.1.1 Bookmarks

The requirement shall be verified by ground demonstration. The demonstration shall consist of retrieving the recorded data from flight using the DTD and playing back the recorded data using the intended mission debriefing system. Recorded data shall include manual *bookmarks* and automatic *bookmarks* for all specified mission events. The verification shall be considered successful when demonstration shows manual *bookmarks* and automatic *bookmarks* were recorded.

4.7.4.2 Data Retrieval

The requirement shall be verified by ground demonstration. The demonstration shall consist of retrieving the recorded data from flight using the DTD and playing back the recorded data using the intended mission debriefing system. The verification shall be considered successful when demonstration shows mission and flight reconstruction without distortion (*readable*).

4.7.4.3 Data Quality

The requirement shall be verified by ground demonstration. The demonstration shall consist of retrieving the recorded data (audio and video) from flight using the DTD and playing back the recorded data using the intended mission debriefing system. The verification shall be considered successful when demonstration shows mission and flight reconstruction without distortion (*readable*) and audio playback is intelligible.

4.8 Product Support

No requirement to verify.

4.8.1 Operational Availability (Ao)

The requirement shall be verified by analysis, laboratory test, ground test, and flight test. The analysis shall consist of a validated Logistics Composite Model (LCOM) simulation model using a Government-approved set of ground rules and assumptions. Data collected during laboratory test, ground test, and flight test will be used to refine and validate input parameters including, but not limited to, failure rates, repair rates, delay times, crew sizes, support equipment availability, turn times, etc. The verification shall be considered successful when the analysis, using the approved model and input data, shows that *Operational Availability* is above the minimum requirement.

4.8.2 Materiel Availability (Am)

The requirement shall be verified by analysis, laboratory test, ground test, and flight test. The analysis shall consist of a validated LCOM simulation model using a Government-approved set of ground rules and assumptions. Data collected during laboratory test, ground test, and flight test will be used to refine and validate input parameters including, but not limited to, failure rates, repair rates, delay times, crew sizes, support equipment availability, turn times, etc. The verification shall be considered successful when the analysis, using the approved model and input data, shows that *Materiel Availability* is above the minimum requirement.

4.8.3 Materiel Reliability (Rm)

The requirement shall be verified by analysis, laboratory test, ground test, and flight test. The analysis shall consist of a calculation of the system level *Material Reliability* using the assessed reliability of all *aircraft components*. Data collected during laboratory test, ground test, and flight test will be used to refine and validate all *component* level reliability assessments. The verification shall be considered successful when the calculation, using the final reliability assessment produced after the completion of all planned flight testing, shows that *Material Reliability* is above the minimum requirement with 80% confidence.

4.8.4 Mean Time Between Failures (MTBF)

The requirement shall be verified by analysis, laboratory test, ground test, and flight test. The analysis shall consist of a calculation of the system level *MTBF* using the assessed reliability of all *aircraft components*. Data collected during laboratory test, ground test, and flight test will be used to refine and validate all *component* level reliability assessments. The verification shall be considered successful when the calculation, using the final reliability assessment produced after the completion of all planned flight testing, shows that *MTBF* is above the minimum requirement with 80% confidence.

4.8.5 Fix Rate

The requirement shall be verified by analysis, laboratory test, ground test, and flight test. The analysis shall consist of a validated LCOM simulation model using a Government-approved set of ground rules and assumptions. Data collected during laboratory test, ground test, and flight test will be used to refine and validate input parameters including, but not limited to, failure rates, repair rates, delay times, crew sizes, support equipment availability, maintenance manpower, etc. The verification shall be considered successful when the analysis, using the approved model and input data, shows that *Fix Rate* is above the minimum requirement.

4.8.6 Mean Time Between Maintenance (MTBM)

The requirement shall be verified by analysis, laboratory test, ground test, and flight test. The analysis shall consist of a calculation of the system level *MTBM* using the assessed reliability of all *aircraft components*. Data collected during laboratory test, ground test, and flight test will be used to refine all *component* level reliability assessments. The verification shall be considered successful when the calculation, using the final reliability assessment produced after the completion of all planned flight testing, shows that *MTBM* is above the minimum requirement with 80% confidence.

4.8.7 Mean Time To Repair (MTTR)

The requirement shall be verified by analysis, laboratory test, ground test, and flight test. The analysis shall consist of a calculation of the system level *MTTR* using the assessed reliability and maintainability of all *aircraft components*. Maintenance data collected during laboratory test, ground test, and flight test will be used to refine and validate all *component* level reliability and maintainability assessments. The verification shall be considered successful when the calculation, using the final reliability and maintainability assessments produced after the

completion of all planned flight testing, shows that *MTTR* is equal to or below the maximum requirement.

4.8.8 Turn-Around Time

The requirement shall be verified by ground demonstration. The demonstration shall consist of government personnel conducted *aircraft* turns using *aircraft* Technical Orders to accomplish all tasks. The initial conditions of the system for all servicing tasks during the demonstration shall be fully depleted. The verification shall be considered successful when the ground demonstration shows that the turn-around time is less than or equal to the maximum requirement in three (3) out of five (5) demonstration trials.

4.8.9 Diagnostics

No requirement to verify.

4.8.9.1 Integrated Diagnostics (ID) Percent Fault Detection (PFD) (Critical Faults)

The requirement shall be verified by ground demonstration and analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.8.9.2 ID PFD (All Faults)

The requirement shall be verified by ground demonstration and analysis. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.8.9.3 ID Percent Fault Isolation (PFI) (Critical Faults)

The requirement shall be verified by analysis. The analysis shall consist of collecting and reviewing all *BIT* logs and maintenance data (e.g., maintenance actions, repair actions, aircrew reported discrepancies) associated with *critical faults* to determine if the fault was isolated to the correct *LRU/LRM* using *ID* and the fault was corrected. The verification shall be considered successful when the calculation, using the *BIT* reported faults and maintenance data collected during all ground and flight operations of the *aircraft*, shows that the *ID PFI* for *critical faults* is greater than or equal to the minimum requirement.

4.8.9.4 ID PFI (All Faults)

The requirement shall be verified by analysis. The analysis shall consist of collecting and reviewing all *BIT* logs and maintenance data (e.g., maintenance actions, repair actions, aircrew reported discrepancies) associated with all faults to determine if the fault was isolated to the correct *LRU/LRM* using *ID* and the fault was corrected. The verification shall be considered successful when the calculation, using the *BIT* reported faults and maintenance data collected during all ground and flight operations of the *aircraft*, shows that the *ID PFI* for all faults is greater than or equal to the minimum requirement.

4.8.9.5 Built-In-Test (BIT) Functions

The requirement shall be verified by laboratory test. The laboratory test shall consist of running each *BIT* function (*start-up*, *continuous*, and *initiated*) and reviewing the *BIT* log to confirm. The verification shall be considered successful when test results show (i) *start-up BIT* automatically begins when power is applied to the *aircraft*; (ii) *continuous BIT* runs without interruption both on the ground and during flight; and (iii) *initiated BIT* can be run on the ground only. (Note: This test shall require each subsystem to be in a state of which it believes it is in flight.)

4.8.9.5.1 BIT Functions Display

The requirement shall be verified by laboratory test. The laboratory test shall consist of fault injection and reviewing *BIT* logs to verify the proper display of *BIT* faults. The verification shall be considered successful when the laboratory test and any associated software verification testing results show that (i) all necessary aircrew notifications are displayed and (ii) the *BIT* displays all faults to the ground maintenance personnel.

4.8.9.6 Safety Critical (SC) BIT Coverage

The requirement shall be verified by analysis and laboratory test. The analysis shall consist of conducting and reviewing the FMECA. The verification shall be considered successful when the analysis shows that all *SC faults* have an associated *BIT* indication. The laboratory test shall consist of *safety critical fault* injections as defined by the test plan and procedures and agreed to by the Government. The verification shall be considered successful when the laboratory test and any associated software verification testing results shows that the *safety critical fault* injections had *BIT* indications recorded in the *BIT* log.

4.8.9.6.1 BIT PFD (SC Faults)

The requirement shall be verified by analysis. The analysis shall consist of collecting and reviewing all *BIT* logs and maintenance data (e.g., maintenance actions, repair actions, aircrew reported discrepancies) from all test and demonstration events to determine if *SC faults* were detected correctly. The verification shall be considered successful when the calculation, using the *BIT* reported faults collected during all test and demonstration events, shows that the *BIT PFD* for *SC faults* is greater than or equal to the minimum requirement.

4.8.9.6.2 BIT PFI (SC Faults)

The requirement shall be verified by analysis. The analysis shall consist of collecting and reviewing all *BIT* logs and maintenance data (e.g., maintenance actions, repair actions, aircrew reported discrepancies) from all test and demonstration events to determine if *SC faults* were isolated to the correct LRU/LRM. The verification shall be considered successful when the calculation, using the *BIT* reported faults and repair data collected during all test and demonstration events, shows that the *BIT PFI* for *SC faults* is greater than or equal to the minimum requirement.

4.8.9.7 BIT PFD (All Faults)

The requirement shall be verified by analysis. The analysis shall consist of collecting and reviewing all *BIT* logs and maintenance data (e.g., maintenance actions, repair actions, aircrew reported discrepancies) from all test and demonstration events to determine if the faults were detected correctly. The verification shall be considered successful when the calculation, using the *BIT* reported faults collected during all test and demonstration events, shows that the *BIT PFD* for all faults is greater than or equal to the minimum requirement.

4.8.9.8 BIT PFI (All Faults)

The requirement shall be verified by analysis. The analysis shall consist of collecting and reviewing all *BIT* logs and maintenance data (e.g., maintenance actions, repair actions, aircrew reported discrepancies) associated with faults to determine if the fault was isolated to the correct *LRU/LRM*. The verification shall be considered successful when the calculation, using the *BIT* reported faults and repair data collected during all test events, shows that the *BIT PFI* for all faults is greater than or equal to the minimum requirement.

4.8.10 Mean Flight Hours Between Sortie Aborting False Alarms (MFHBSAFA)

The requirement shall be verified by ground test and flight test. Maintenance data collected during ground test and flight test will be used to calculate *MFHBSAFA*; to include all *sortie aborting false alarms* that result in a sortie abort (air and ground). The verification shall be considered successful when the calculation, maintenance data collected during ground test and flight test, shows that *MFHBSAFA* is above the minimum requirement.

4.8.11 Mean Flight Hours Between False Alarms (MFHBFA)

The requirement shall be verified by ground test and flight test. Maintenance data collected during ground test and flight test will be used to calculate *MFHBFA*; to include all *false alarms* (air and ground). The verification shall be considered successful when the calculation, maintenance data collected during ground test and flight test, shows that *MFHBFA* is above the minimum requirement.

4.8.12 Nameplates and Product Marking

The requirement shall be verified by inspection. The inspection shall consist of reviewing technical documentation (e.g., drawings) and hardware to verify proper marking. The verification shall be considered successful when the inspection shows that the hardware is marked with nameplates and product identification markings, to include Item Unique Identification, IAW MIL-STD-130 and MIL-STD-129.

4.8.13 Maintenance Concept

The requirement shall be verified by inspection. The inspection shall consist of reviewing Technical Orders to determine if the scope of work identified corresponds to the USAF two-level maintenance concept with limited *I-Level* capability. The verification shall be considered successful when the inspection shows that the scope of work identified in all Technical Orders is appropriate for the defined maintenance concept.

4.8.13.1 Propulsion System Sustainability

The requirement shall be verified by inspection and ground demonstration. The inspection shall consist of reviewing *aircraft* Technical Order documentation. The verification shall be considered successful when the inspection shows that all engine *O-level* maintenance is accomplished with engine(s) installed on the *aircraft*. The ground demonstration shall consist of performing *O-level* engine maintenance tasks in accordance with *aircraft* Technical Orders procedures. The verification shall be considered successful when the ground demonstration shows that all maintenance tasks have been completed successfully with the engine installed on *aircraft*.

4.8.13.2 Engine Start System Sustainability

The requirement shall be verified by inspection and ground demonstration. The inspection shall consist of reviewing *aircraft* Technical Order documentation. The verification shall be considered successful when the inspection shows that engine start unit(s) is maintainable at the *O-level*. The ground demonstration shall consist of performing *O-level* engine start unit maintenance tasks in accordance with *aircraft* Technical Orders procedures. The verification shall be considered successful when the ground demonstration shows that all maintenance tasks have been completed successfully at the *O-level*.

4.8.14 Support Equipment (SE)

No requirement to verify.

4.8.14.1 Support Equipment Environment

The requirement shall be verified by inspection, laboratory test and ground demonstration. The laboratory test shall consist of performing environmental quality testing on SE. This verification shall be considered successful when it is shown that SE is operable, maintainable, transportable, and storable under the ground conditions identified in 3.9.1.1 and 3.9.3. The ground demonstration shall consist of performing the maintenance tasks using SE in accordance with *aircraft* maintenance procedures. The verification shall be considered successful when the ground demonstration shows that SE is operable, maintainable, transportable, and storable under the ground conditions identified in 3.9.1.1 and 3.9.3.

4.8.14.2 Support Equipment/Facility Interfaces

The requirement shall be verified by inspection and ground demonstration. The inspection shall consist of reviewing technical documentation (e.g., Support Equipment Recommendation Data) to identify the SE facility power requirements. The verification shall be considered successful when the inspection shows that the SE facility power requirements are within USAF standards. The ground demonstration shall consist of performing maintenance tasks using SE in a USAF facility in accordance with *aircraft* maintenance procedures. The verification shall be considered successful when the ground demonstration shows that the SE functions appropriately.

4.8.14.3 Aircraft/Support Equipment Interfaces

The requirement shall be verified by inspection and ground demonstration. The inspection shall consist of reviewing technical documentation (e.g., drawings). The verification shall be considered successful when the inspection shows that the *aircraft* interface and connection points meet the standards as listed in Table 3-34. The ground demonstration shall consist of connecting the *aircraft* to the SE identified in Table 3-34. The verification shall be considered successful when the ground demonstration shows that the *aircraft* can interface with the SE identified in Table 3-34.

4.8.15 Maintenance Work Environment

No requirement to verify.

4.8.15.1 Climatic/Environmental Work Conditions

The requirement shall be verified through maintenance task analysis and ground demonstration of maintenance tasks using the specified anthropometric cases. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.8.15.2 Maintainer Accommodation

The requirement shall be verified through maintenance task analysis and ground demonstration of maintenance tasks using the specified anthropometric cases. Maintenance task analysis shall be performed and reported via CDRL to identify critical maintainer tasks/subtasks. Additionally, tasks considered high risk shall be demonstrated, as necessary, using logical combinations of anthropometric attributes, or the specified maintainer anthropometric cases, whichever is most appropriate. Logical combinations of anthropometric attributes, if used, shall be identified through multivariate analysis of the 2015 USAF Anthropometric Maintainer Database (i.e., bivariate plots). The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.8.16 Manpower and Personnel

The requirement shall be verified by ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.9 Climatic and Environmental Conditions

The requirement shall be verified by inspection, analysis, laboratory test, ground test and flight test IAW MIL-STD-810 and MIL-STD-464, and shall include the worst case conditions. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.9.1 Natural Climate

No requirement to verify.

4.9.1.1 Operational Conditions

The requirement shall be verified by laboratory test, ground test, and flight test IAW MIL-STD-810 and shall include the worst case conditions. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.9.1.2 Environment Condition Lapse Rates for Non-Standard Days

The requirement shall be verified by analysis and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.9.1.3 Icing Conditions

The requirement shall be verified by flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.9.2 Induced Environment

No requirement to verify.

4.9.2.1 Storage and Transit Conditions

The requirement shall be verified by laboratory test, ground test, and flight test IAW MIL-STD-810 and shall include the worst case conditions. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.9.2.2 Operating Conditions

The requirement shall be verified by laboratory test, ground test, and flight test IAW MIL-STD-810 and shall include the worst case conditions. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.9.3 Electromagnetic Environmental Effects (E3)

The electromagnetic environmental effects requirement shall be verified by analysis, inspection, laboratory test and ground test IAW MIL-STD-464. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.10 Architecture and Security

No requirement to verify.

4.10.1 Critical Program Information

The requirement shall be verified by the method(s) identified in the Verification and Validation section of the Anti-Tamper Plan (reference SOW paragraph: Anti-Tamper). The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.10.2 Cybersecurity

The requirement shall be verified by inspection and laboratory test. The inspection shall consist of inspecting equipment and wiring to verify the system security architecture installation. The verification shall be considered successful when the inspection shows that the required equipment and wiring are as defined in the system security architecture. The laboratory test shall consist of verifying the *aircraft* systems provide cybersecurity controls listed in the approved Security Requirements Traceability Matrix (SRTM). The verification shall be considered successful when the test shows that the required cybersecurity controls are in place.

4.10.3 Open Systems Architecture

The requirement shall be verified by inspection and if applicable by laboratory test. The inspection shall consist of reviewing various documents (e.g., spreadsheets, drawings and test reports) as defined in the SOW. The verification shall be considered successful when the documents show compliance to the "as designed" architecture and allocated requirements to the LRU/SRU level. If a specific method or standard (e.g., OMS-like) is used in satisfying the *Open Systems Architecture* requirement, then the test report shall show successful compliance in meeting the method/standard.

4.10.4 Computing Resources

No requirement to verify.

4.10.4.1 Memory Storage

The requirement shall be verified by analysis and ground demonstration. The analysis shall consist of providing estimates of the overall size of the CONUS navigation and terrain database supported by the current memory allocation considering data compression and loading techniques. The verification shall be considered successful when the analysis shows that the current memory allocation allows for unused memory of at least the amount specified in the requirement for memory storage. The ground demonstration shall consist of loading all required databases three successive times (each as a unique allocation). The verification shall be considered successful when all three successive loads occur without a memory load error.

4.10.4.2 Computer Resources

The requirement shall be verified by analysis and laboratory test. The analysis shall be a worst case utilization analysis that identifies the worst case operating conditions that maximizes system utilization of a given embedded computer resource. The analysis shall determine worst case operating conditions based upon real world conditions that the system could potentially experience within the system's expected envelope of operation, including *failure* scenarios that

could occur within that envelope. Testing shall be performed that tests all embedded computer resources in the system with test cases that stress a given resource under the specific conditions identified in the worst case utilization analysis. The program office shall approve the set of test cases that will be utilized to measure resource reserve capacity. The percent of reserve resource available shall be calculated as follows:

For a given resource “N”

% Reserve "N" = ((Total Installed "N" – Worst Case Utilization "N")/ Total Installed "N")) x 100

The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.10.4.3 Operational Flight Program (OFP)/Software Item (SI) Versions

The requirement shall be verified by laboratory test and ground demonstration. The laboratory test shall consist of loading the *OFP/SI* and any associated databases and evaluate the load and verify capability to ensure that the *OFP/SI* was loaded correctly and displays the version number of the *OFP/SI* and any associated databases upon operator command, using appropriate groupings of *OFP/SI* and data installed on the *aircraft*, by *Line Replaceable Unit (LRU)* or other discriminator. The verification shall be considered successful when each *OFP/SI* version and any associated databases are displayed upon operator command, using appropriate groupings of *OFP/SI* and data installed on the *aircraft*, by LRU or other discriminator. The ground demonstration shall consist of the operator commanding the *OFP/SI* and any associated database to be displayed, using appropriate groupings of *OFP/SI* and data installed on the *aircraft*, by LRU or other discriminator. The verification shall be considered successful when each *OFP/SI* version and any associated databases are displayed upon operator command, using appropriate groupings of *OFP/SI* and data installed on the *aircraft*, by LRU or other discriminator.

4.10.4.4 Operational Flight Program (OFP)/Software Item (SI) Load and Verification

This requirement shall be verified by laboratory test and ground demonstration. The laboratory test shall consist of loading *OFP/SI* and any associated databases on *components*, and then corroborating that the *OFP/SI* and any associated databases were loaded correctly. The ground demonstration shall consist of loading *OFP/SI* and any associated databases on the *aircraft*, and then corroborating that the *OFP/SI* and any associated databases were loaded correctly. This verification shall be considered successful when it is shown that each loadable *OFP/SI* and each loadable database are individually loaded and verified within 30 minutes.

4.10.5 ARINC 610 Simulator Compatibility

The requirement shall be verified by inspection. The inspection shall consist of showing that the capability for simulator compatibility is present in the code. The verification shall be considered successful when the inspection shows that the design of newly developed *aircraft* equipment and software incorporates ARINC 610 simulator compatibility.

4.11 Utility Attributes

No requirement to verify.

4.11.1 Fuel Standards

The requirement shall be verified by inspection of drawings and flight demonstration. The fuel system performance for individual parameters shall be demonstrated with the designated *primary fuel* which is most critical for that parameter. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.11.1.1 Fuel Contaminants

The requirement shall be verified by inspection and flight demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.11.2 Lubrication Oil Standards

The requirement shall be verified by inspection. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.11.3 Space, Weight, Power and Cooling (SWaP-C) Margins

No requirement to verify.

4.11.3.1 Space

The requirement shall be verified by inspection of drawings and *aircraft*. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.11.3.2 Weight

The requirement shall be verified by inspection and flight demonstration. The inspection shall consist of inspecting the Weight and Balance documentation. The flight demonstration shall consist of the verification of the performance requirements (4.1) with ballast installed. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.11.3.3 Power

The requirement shall be verified by inspection. The inspection shall consist of inspecting the Electrical Load Analysis documentation and inspecting the *aircraft* drawings for electrical installations. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.11.3.4 Cooling

The requirement shall be verified by analysis, inspection, ground test and flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.11.4 Aircraft Maintenance Safety Protection Equipment (MSPE) Stowage

The requirement shall be verified by inspection and ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.11.5 External Stores

The requirement shall be verified by analysis, ground demonstration and flight test. Analysis shall include all three pods. Ground demonstration and flight test shall include the MXU Cargo/Travel Pod and Next Generation Cargo Pod. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.11.5.1 Stores Electrical Interfaces

The requirement shall be verified by inspection of drawings and *aircraft*. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.11.6 Environment, Safety and Occupational Health (ESOH)

No requirement to verify.

4.11.6.1 Safety

The requirement shall be verified by analysis, inspection, laboratory test, ground test and flight test. The analysis shall include a Failure Modes Effect Analysis (FMEA)/FMECA and a System Hazard Analysis. The FMEA/FMECA and System Hazard Analysis shall be verified by applicable FMET in the laboratory or on the ground or in flight. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.11.6.2 Federal and State Laws

The requirement shall be verified by analysis and inspection. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.11.6.3 Hazards

The requirement shall be verified by analysis, inspection, laboratory test, ground test and flight test. The analysis shall include a FMEA/FMECA and a System Hazard Analysis. The FMEA/FMECA and System Hazard Analysis shall be verified by applicable FMET in the laboratory or on the ground or in flight. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.11.6.4 Energetic Materials

The requirement shall be verified by analysis, inspection and laboratory test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.11.6.5 Hazardous Materials (HAZMAT)

The requirement shall be verified by analysis and inspection. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.11.6.6 Air Force Occupational Safety

The requirement shall be verified by analysis, inspection, laboratory test, ground test and flight test. The analysis shall include a FMEA/FMECA and a System Hazard Analysis. The FMEA/FMECA and System Hazard Analysis shall be verified by applicable FMET in the laboratory or on the ground or in flight. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.11.7 Airworthiness Certification

The requirement shall be verified by inspection. The inspection shall consist of inspecting the airworthiness assessment and determination made by the USAF Technical Airworthiness Authority (TAA). The verification shall be considered successful when the inspection shows the TAA approves a Military Type Certificate for APT production and production-representative *aircraft.*

4.11.8 Geographic Intelligence (GEOINT)

The requirement shall be verified by inspection. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.11.9 Barrier Rollover

The requirement shall be verified by ground demonstration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

4.12 Mission Support

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of executing the required mission support functions on systems that are compatible with the USAF Standard Desktop Configuration. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

(Note: In this section and subordinate sections the term “off-aircraft” means in an aircraft-equivalent environment using actual *aircraft* systems/subsystems/*components*.)

4.12.1 Data Transfer

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of loading test missions to the *aircraft* subsystems via the on-board data transfer system and a single DTD and verifying the missions were correctly loaded. The test missions shall be built and loaded onto the DTD using the JMPS. The verification shall be considered successful when it is shown that the test missions were loaded.

4.12.1.1 DTD Design

The requirement shall be verified by inspection and ground demonstration. The inspection shall consist of reviewing DTD documentation and verifying the DTD design is commercially-based and industrial-grade MIL-STD-810 compliant. The ground demonstration shall consist of recording information on the DTD and verifying the information is protected with the appropriate level of data encryption. The verification shall be considered successful when it is shown that the DTD design requirements are satisfied.

4.12.1.2 On-Board Data Upload

The requirement shall be verified by ground test. The ground test shall consist of loading test missions to the *aircraft* subsystems via the data transfer system and a single DTD and verifying the time to load the test mission (all data required for the mission) is no more than 4 minutes. The test missions shall be built and loaded onto the DTD using the JMPS. The verification shall be considered successful when it is shown that the test missions are loaded within the time specified.

4.12.1.3 DTD Adapter

The requirement shall be verified by inspection. The inspection shall consist of inspecting the DTD Adapter (and documentation) to confirm the presence of the necessary interfaces with JMPS to load the DTD with mission data from JMPS. The inspection shall also consist of inspecting the mission debriefing system to confirm the presence of the DTD Adapter. The verification shall be considered successful when it is shown that DTD Adapters (and documentation) are provided.

4.12.2 Mission Planning Interface

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of loading test missions to the *aircraft* subsystems via the data transfer system and a single DTD and verifying the missions were correctly loaded. The test missions shall be built and loaded onto the DTD using the JMPS. The verification shall be considered successful when it is shown that the *aircraft* mission planning interface is compatible with JMPS.

4.12.3 Mission Scenario Generation

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of creating, modifying, reviewing, storing, and transferring (to DTD) test mission

scenarios and SAD overlays for *Embedded Training* operations. The ground demonstration shall also consist of running each newly created or modified test mission scenario off-aircraft and verifying the mission executes correctly. The mission scenarios shall incorporate up to 20 airborne and ground *constructive targets* each. The *constructive targets* within the scenario shall include every target type as defined in Table 3-39. The test mission scenarios shall be built and loaded onto the DTD using the JMPS. The verification shall be considered successful when it is shown that the Mission Scenario Generation requirements are satisfied.

4.12.4 Mission Debriefing

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of playing back recorded test missions using the intended mission debriefing system. The test missions shall include single-ship and multi-ship missions recorded off-aircraft and in-flight. The multi-ship test missions shall include recorded missions from the *GBTS* (if GBTS Connectivity is implemented). The verification shall be considered successful when demonstration shows the Mission Debriefing requirements are satisfied.

4.12.4.1 Debriefing Operation

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of playing back recorded test missions using the intended mission debriefing system and verifying the mission replay is complete, correct and accurate. The test missions shall be single-ship missions recorded off-aircraft and in-flight. The verification shall be considered successful when demonstration shows the Debriefing Operation requirements are satisfied.

4.12.4.2 Multi-Ship Debriefing

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of playing back recorded test missions using the intended mission debriefing system. The test missions shall be multi-ship missions recorded in-flight. The multi-ship test missions shall include recorded missions from the *GBTS* (if *GBTS* Connectivity is implemented). The verification shall be considered successful when demonstration shows the Multi-Ship Debriefing requirements are satisfied.

4.12.4.3 Data Uploading

The requirement shall be verified by laboratory test. The ground test shall consist of transferring the recorded test missions from four participating *aircraft* DTDs to the mission debriefing system within five minutes (combined) using the intended DTD Adapter. Each participating *aircraft* DTD shall contain all required audio, video and flight data IAW section 3.12.4.1. The recorded test missions shall be representative of missions that produce the largest amount of recorded data to be transferred. The ground test shall also cover multi-ship missions between *aircraft* and *GBTS* (if *GBTS* Connectivity is implemented). The verification shall be considered successful when it is shown that the test missions are transferred within the specified time.

4.12.4.4 Data Melding

The requirement shall be verified by laboratory test. The ground test shall consist of melding the recorded test missions from eight participating *aircraft* within five minutes (combined) using the

intended mission debriefing system. Each recorded test mission shall contain all required audio, video and flight data IAW section 3.12.4.1. The recorded test missions shall be representative of missions that produce the largest amount of recorded data to be melded. The ground test shall also cover multi-ship missions between *aircraft* and *GBTS* (if *GBTS* Connectivity is implemented). The verification shall be considered successful when it is shown that the test missions are melded within the specified time.

4.12.4.5 Two- and Three-Dimensional Perspective Views

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of playing recorded test missions and verifying the two-dimensional and three-dimensional perspective views. The recorded test missions shall include single-ship and multi-ship missions. The ground test shall also cover multi-ship missions between *aircraft* and *GBTS* (if *GBTS* Connectivity is implemented). The verification shall be considered successful when it is shown that the Two- and Three-Dimensional Perspective Views requirements are satisfied.

4.12.4.6 Playback Controls

The requirement shall be verified by ground demonstration. The ground demonstration shall consist of playing recorded test missions and verifying all required replay controls. The recorded test missions shall include single-ship and multi-ship missions. The ground test shall also cover multi-ship missions between *aircraft* and *GBTS* (if *GBTS* Connectivity is implemented). The verification shall be considered successful when it is shown that the Playback Controls requirements are satisfied.

5 PACKAGING

For acquisition purposes, the packaging requirements shall be as specified in the contract or order. When actual packing of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military DoD Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6 NOTES

6.1 Acronyms

AA	Aircraft Availability
AAA	Anti-Aircraft Artillery
ADS-B	Automatic Dependent Surveillance - Broadcast
AESA	Active Electronically Scanned Array
AETC	Air Education and Training Command
AEW	Airborne Early Warning
AFB	Air Force Base
AFFSA	Air Force Flight Standards Agency
AFH	Air Force Handbook
AFPD	Air Force Policy Directive
AFI	Air Force Instruction
AFLCMC	Air Force Life Cycle Management Center
AGL	Above Ground Level
AIS	Abbreviated Injury Scale
AIWG	Aircraft Information Working Group
A_m	Materiel Availability
A_o	Operational Availability
AOA	Angle-of-Attack
APT	Advanced Pilot Training
APU	Auxiliary Power Unit
ARINC	Aeronautical Radio Incorporated
ATP	Allied Tactical Publication
ATR	Air Transport Radio
BFM	Basic Fighter Maneuvers
BIT	Built-In Test
C	Celsius
CAS	Close Air Support
CC	Common Components
CCIP	Constantly Computed Impact Point
CCRP	Constantly Computed Release Point
CG	Center of Gravity
CNS/ATM	Commercial Navigation System/Air Traffic Management
CONUS	Continental United States
CVR	Cockpit Voice Recorder

DA	Density Altitude
D-Level	Depot-Level
DME	Distance Measuring Equipment
DMS	Defensive Management System
DOD	Department of Defense
DoDI	Department of Defense Instruction
DOF	Degree of Freedom
DTD	Data Transfer Device
DTED	Digital Terrain Elevation Data
E3	Electromagnetic Environmental Effects
ECS	Environmental Control System
EEGS	Enhanced Envelope Gun Sight
EMD	Engineering Manufacturing Development
EW	Early Warning
F	Fahrenheit
F/B	Fighter/Bomber
FAA	Federal Aviation Administration
FDR	Flight Data Recorder
fC	Foot Candles
FMC	Fully Mission Capable
FMEA	Failure Modes Effect Analysis
FMECA	Failure Modes, Effects, and Criticality Analysis
GBTS	Ground Based Training System
GCI	Ground Control Intercept
GEOINT	Geospatial-Intelligence
GHz	Gigahertz
GPS	Global Positioning System
GSS	Ground Support Station
HAZMAT	Hazardous Materials
HOTAS	Hands-On Throttle and Stick
HTD	Head-up Type Display
Hz	Hertz
IAT	Individual Aircraft Tracking
IAW	In Accordance With
ICS	Intercommunication System
ID	Integrated Diagnostics
IFF	Introduction to Fighter Fundamentals

IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
IMDS	Integrated Maintenance Data System
JMPS	Joint Mission Planning System
JP	Jet Propellant
JSSG	Joint Service Specification Guide
KEAS	Knots Equivalent Airspeed
KIAS	Knots Indicated Airspeed
KTAS	Knots True Airspeed
L	Laboratory Test
LAD	Large Area Display
LBM/LBF-HR	Pounds of Fuel per Hour-Pound of Thrust
LCOM	Logistics Composite Model
LCOS	Lead Computing Optical Sight
L/ESS	Loads/Environment Spectral Survey
LNAV	Lateral Navigation
LP	Localizer Performance
LPV	Localizer Performance With Vertical Guidance
LRM	Line Replaceable Module
LRU	Line Replaceable Unit
LWC	Liquid Water Content
MC	Mission Capable
MCU	Modular Concept Unit
MFHBFA	Mean Flight Hours Between False Alarms
MFHBSAFA	Mean Flight Hours Between Sortie Aborting False Alarms
MFOQA	Military Flight Operational Quality Assurance
MIL-HDBK	Military Handbook
MIL-PRF	Military Performance
MIL-STD	Military Standard
MHz	Megahertz
MOA	Military Operating Area
MPE	Mission Planning Environment
MRT	Modified Rhythm Test
MTBF	Mean Time Between Failures
MTBM	Mean Time Between Maintenance
MTTR	Mean Time To Repair

NATO	North Atlantic Treaty Organization
NGA	National Geospatial-Intelligence Agency
NM	Nautical Mile
NVIS	Night Vision Imaging System
OBOGS	On-Board Oxygen Generating System
ODS	Ozone Depleting Substances
OFP	Operational Flight Program
OFT	Operational Flight Trainer
O-Level	Organizational-Level
OMS	Open Mission Systems
PA	Pressure Altitude
PFD	Percent of Fault Detection
PFI	Percent of Fault Isolation
PIO	Pilot-in-the-loop Oscillations
PMC	Partially Mission Capable
QPA	Quantity per Application
RBGM	Real Beam Ground Map
RCR	Runway Condition Reading
R_m	Materiel Reliability
RNAV	Area Navigation
RNP	Required Navigation Performance
ROSH	Region of Satisfactory Handling
RVSM	Reduced Vertical Separation Minima
RWR	Radar Warning Receiver
SA	Situational Awareness
SAM	Surface-to-Air Missile
SAR	Synthetic Aperture Radar
SE	Support Equipment
SHA	System Hazard Analysis
SC	Safety Critical
SI	Software Item
SIF	Selective Identification Feature
SOW	Statement of Work
SRD	System Requirements Document
SRTM	Security Requirements Traceability Matrix
SSEWG	System Security Engineering Working Group
STT	Single Target Track

SUPT	Specialized Undergraduate Pilot Training
SVR	System Verification Review
SWaP-C	Space, Weight, Power and Cooling
t	Flight Demonstration
TA	Target Acquisition
TAA	Technical Airworthiness Authority
TACAN	Tactical Air Navigation
TCAS	Traffic Collision and Avoidance System
TDL	Tactical Datalink
TO	Technical Order
TSO	Technical Standard Order
TWS	Track While Scan
UF	Usage Factor
U.S.	United States
UHF	Ultra-High Frequency
UPC	Unique Planning Component
USAF	United States Air Force
UTD	Unit Training Device
VAC	Volts Alternating Current
VCRM	Verification Cross Reference Matrix
V_G	Gust Limit Speed
V_H	Level Flight Maximum Speed
VHF	Very High Frequency
V_L	Limit Speed
VMC	Visual Meteorological Conditions
VMF	Variable Message Format
VNAV	Vertical Navigation
VOR	Very High Frequency Omni-directional Radio-range
WSSP	Weapon Systems Support Pod
WST	Weapon System Trainer
WUC	Work Unit Code
XML	Extensible Markup Language

6.2 Definitions

Term	Definition
Abbreviated Injury Scale 2	The Abbreviated Injury Scale was developed by Association for Advancement of Automobile Medicine. The AIS Scale is a used for ranking injury severity and represents the “threat to life” associated with a single traumatic injury. An AIS code of 2, as described in this document as “AIS 2,” is defined as "moderate" on a scale of 1-6 with 1 being "minor" and 6 being "maximal (currently untreatable)." Examples of AIS 2 injuries include head concussion with brief loss of consciousness, shoulder, knee, hip joint dislocations and most simple type bone fractures. Reference: Abbreviated Injury Scale 2005, Update 2008 by Association for the Advancement of Automotive Medicine, Barrington, IL.
Absolute Ceiling	It is the highest altitude at which the maximum steady-state rate-of-climb potential is 0 feet per minute, for a specified configuration, weight, speed, and thrust (power) setting. (MIL-STD-3013)
Advisory	Aircrew *alert* that visually and/or aurally indicates a safe or normal configuration, condition of performance or operation of essential equipment, or attracts attention and imparts information for routine action purposes.
Aircraft	The air vehicle portion of the APT *Aircraft System*.
Aircraft System	Air vehicle, all ground support equipment, mission support systems (mission planning, mission scenario generation, and mission debriefing), technical data, and external stores necessary to meet the requirements of this specification. Ground support station (GSS) is included, if GSS Connectivity is implemented.
Alert	Visual or aural or tactile/physical cue that indicates the existence of a *warning*, *caution* or *advisory* condition.
Alternate Fuel	Fuels on which the *aircraft* can be flown without operational restrictions but which can have long term durability or maintainability impact if used for continuous operation (multiple flights). They are used only on an occasional or intermittent basis. Use will cause no adverse effect on the *aircraft* mission(s). (JSSG-2001)
Angle-of-Attack	The angle between the true velocity vector projected onto the air vehicle plane of symmetry and the body X-axis as depicted in MIL-STD-3013, Figure 1.
Area Navigation (RNAV)	A method of navigation that permits the *aircraft* operation on any desired flight path within the coverage of ground or space based navigation aids or within the limits of the capability of self-contained aids, or a combination of these. FAA AC 90-100A provides operational and airworthiness guidance for operation on U.S. Area Navigation (RNAV) airspace.

Anti-Tamper	Measures, techniques, and features intended to prevent and/or delay exploitation of resident *Critical Program Information* in U.S weapon systems.
Basic Weight	It is the *weight empty* plus all oils, unusable fuel, survival kits, oxygen, ballast, etc. installed.,
Basic Flight Design Gross Weight	The highest flight weight required for the maximum positive and minimum negative load factors of maneuvering flight and is specified as the *operating weight* plus the primary mission payload and fuel weight of 50% (relative to maximum fuel capacity).
Bookmark	A place in the mission recording that, during mission debriefing system playback/review, can be selected as a "go to" or "jump to" position for mission playback. Bookmarks may be created automatically based on various mission events. Bookmarks may also be created manually, as desired by the aircrew.
Built-In Test	Portion of the integrated diagnostic capability that is an integral part of the *aircraft*. An integral capability of the item which provides an automated test capability to detect, diagnose, and isolate item *failures*. It includes: *Start-up BIT*, *Continuous BIT* and *Initiated BIT*. (AFGS-87256)
Calm Air	No wind, no turbulence, no gusts, and no shears. (MIL-STD-1797)
Caution	Aircrew *alert* that visually and/or aurally indicates the existence of a condition requiring immediate attention of the aircrew, but not immediate action.
Cockpit/Crew Resource Management	The effective use of all available resources (people, weapons, sensors, flight instruments, and communications) by individuals or aircrews to safely and efficiently accomplish an assigned mission or task.
Code 3	The *aircraft* has major discrepancies in *mission-essential systems* that may require extensive repair or replacement prior to further mission assignment. The discrepancy may not affect safety-of-flight and the *aircraft* may be NMC flyable.
Cold-Mic	Microphone operating mode where aircrew communications require keying a microphone switch before speaking.
Common Atmospheric Disturbance	Levels of atmospheric disturbances which may be encountered commonly in operations (i.e., probability of exceeding these levels is approximately 1×10^{-2}). (MIL-STD-1797)
Component	A part or combination of parts having a specific function, which can be installed or replaced only as an entity (e.g., a *Line Replaceable Unit*, a *Line Replaceable Module* and Group A items).
Constructive Constructive Simulation Constructive Targets Constructive Threats	Models and simulations that involve simulated people operating simulated systems. Real people stimulate (make inputs to) such simulations, but are not involved in determining the outcomes.

	Synthetic (computer generated) airborne and ground forces that actively participate in the simulated air combat environment.
Continuous Built-In-Test	An *aircraft* Built-In-Test mode which is non-interruptive that continually monitors item operation for errors.
Critical Faults	*Faults* that can result in or resulted in *Code 3s* or ground aborts that require an *on-equipment maintenance* action. They can be hardware or software.
Critical Program Information	Elements or *components* of a program that, if compromised, could cause significant degradation in mission effectiveness; shorten the expected effective life of the system; reduce technological advantage; significantly alter program direction; or enable an adversary to defeat, counter, copy, or reverse engineer the technology or capability.
Cultural and Natural Features	A feature is a static element of the synthetic (computer generated) environment that exists but does not actively participate in synthetic (computer generated) environment interactions. Cultural features are man-made elements such as roads, buildings, dams, runways, etc. Natural features are elements such as rivers, lakes, mountains, islands, etc.
Dangerous Flight Conditions	A flight condition in which loss of control, loss of the air vehicle, or death or injury to the aircrew is probable. (MIL-STD-1797)
Data Rate	The rate at which a communications link is capable of carrying data, usually measured in bits per second.
Density Altitude	It is defined as *Pressure Altitude* corrected for nonstandard temperature variations.
Depot-Level Maintenance	Maintenance consisting of those on- and off-equipment tasks performed using the highly specialized skills, sophisticated shop equipment, or special facilities of a supporting command; commercial activity; or inter service agency at a technology repair center, centralized repair facility, or, in some cases, at an operating location. Maintenance performed at a depot may also include organizational or intermediate level maintenance. (AFI 21-101) For example: major overhaul, rebuild of parts, assemblies, and end items, including the manufacture of parts, modification, testing, and reclamation.
Design Service Life	It is the period of time (e.g., years, flight cycles, hours, landings) established at design, during which the structure is expected to maintain its structural integrity when flown to the design loads/environment spectrum. (MIL-STD-1530)
Developed Spin	The phase during which it is possible to identify the spin mode.
Embedded Training	A capability that provides the *aircraft system* with *virtual simulations* and *constructive simulations* of systems, weapons and threats allowing student pilots to build *Cockpit/Crew Resource Management* proficiency in a simple or complex simulated air combat environment/mission scenario. Pre-planned scenarios are created in pre-flight planning and transferred to the

	aircraft and/or *GBTS*. A data link is used to synchronize the combat environment for multi-ship missions (joint training between multiple *aircraft* (and *GBTS* components if *GBTS* Connectivity implemented). Datalink also enables time, space and position information exchanges, real-time kill notifications, and (if GSS Connectivity is implemented) real-time monitoring from the GSS. It allows instructor pilots to change the scenario variables in-flight. It also includes on-board mission recording and off-board *mission debriefing* capabilities which allow the student and instructor to reconstruct the mission for post-fight review.
Emergency Fuel	Fuels which significantly compromises the performance and durability of the *aircraft*. Use may cause significant damage. Use ought to be limited to one flight and only for emergency evacuation or aerial refueling or countering emergency action. (JSSG-2001)
Escape Path Clearance System	A capability of the *aircraft* that either removes (jettisons) the canopy or fractures the transparency using an explosive cutting system during either the automated escape sequence or during the emergency ground egress process.
Extraordinary Atmospheric Disturbances	Levels of atmospheric disturbances which may be encountered only under extraordinary circumstances in operations (i.e., probability of exceeding these levels is approximately 1 x 10-5). (MIL-STD-1797)
Failure	The state of inability of an item to perform its required function; the functional manifestation of a *fault*. (AFGS-87256)
False Alarm	A *fault* indicated by *BIT* or other monitoring device where no *fault* exists. (AFGS-87256)
Fault	A physical condition that causes an item to not perform in a required or designed manner. (AFGS-87256)
Fault Detection	A process which discovers the existence of *faults*. (AFGS-87256)
Fault Isolation	Identifying the *fault* in a unit-under-test (UUT) to the specified *fault* resolution level of the item. (AFGS-87256) For the purposes of calculating *PFI*, the specified fault resolution level is to a single *LRU/LRM*.
Fix Rate	It is a measure of the percentage of *aircraft* that return as *Code 3* and must be returned to *Mission Capable* status within a specified amount of time. The specified time includes direct maintenance time and downtime associated with administrative and logistics delays.
Flying Qualities	The stability and control characteristics that have an important bearing on the safety of flight and on the pilots' impressions of the ease of flying the *aircraft* in steady flight and in maneuvers.
Ground Based Training System	In the context of this specification, it refers to the Weapon System Trainer (WST) simulator and the Operational Flight Trainer (OFT) simulator.

Gust Limit Speed (V_G)	The maximum authorized speed for continued operation in turbulent air.
Handling Characteristics Handling Qualities	Those qualities or characteristics of an *aircraft* that govern the ease and precision with which a pilot is able to perform the tasks required in support of the *aircraft's* role.
Handoff Mode	During normal operation, system is in floating diamond mode - the diamond automatically moves to highest priority emitter currently detected and composite, new threat, and missile launch audio can be heard. Momentarily pressing and releasing HANDOFF button puts system in Alert mode. In this mode, diamond remains floating, but only new guy and ML audio are heard. Pressing and holding HANDOFF button causes diamond to cycle through emitter symbols in descending threat priority order. Releasing HANDOFF button puts system in Latch mode, which causes diamond to stop on current emitter symbol. In this mode, audio of current diamond emitter, new guy audio, and ML audio are heard. Latch mode is indicated by diamond legend being illuminated. Momentarily pressing and releasing the HANDOFF button returns the system to normal Floating Diamond mode. The H indicator legend is illuminated when the RWR is powered on.
Head-up Type Display	Either a head-up display or helmet-mounted display.
High and Low Altitude Priority Modes	Toggles RWR between high and low altitude modes, which changes threat priority selection process.
High Resolution Area	Geo-specific, high feature (cultural and natural) density areas that are inserted into a contiguous, CONUS database. These areas also require high resolution terrain elevation data and high resolution imagery data. Geo-specific: A model used to represent a real-world feature. For example, a geo-specific model for the White House would look exactly like the White House and be used to represent the White House in a database of Washington, D.C.
Hands On Throttle and Stick controls	Unless otherwise stated, it refers to the switches, buttons, and other user input methodologies incorporated into the control stick grips and throttle grips.
Hot-Mic	Microphone operating mode where aircrew communications are enabled by speaking without keying a microphone switch.
Incipient Spin	The initial, transient phase of the motion during which it is not possible to identify the spin mode, usually followed by the *developed spin*.
Induced Environment	Any man-made or equipment-made environment which directly or indirectly affects the performance of man or *component*.
Initiated BIT	An *aircraft Built-In-Test* mode which is that is interruptive and executed only after the occurrence of an action by an element outside the system (operator, fault manager, test equipment, etc.).

Integrated Diagnostics	A structured process that maximizes the effectiveness of diagnostics by integrating pertinent elements, such as *Built-In-Test*, automatic and manual test/support equipment, maintenance aids, and technical data, as a means for providing a capability to detect and isolate unambiguously all *faults* known or expected to occur in systems/subsystems/*components* in order to satisfy mission requirements. (AFGS-87256)
Intercommunications Control System	An internal communication system that allows connection to external communication sources.
Intermediate-Level Maintenance	Maintenance consisting of those off-equipment tasks normally performed using the resources of the operating command at an operating location or at a centralized intermediate repair facility. (AFI 21-101). Intermediate level maintenance includes but is not limited to off-equipment tasks for systems such as egress, ground/support equipment, structural maintenance, metals technology, non-destructive inspection (NDI), tires and wheels, electro-environmental, hydraulics, *aircraft* fuels and propulsion.
Interphone	Part of the *ICS* used for internal *aircraft* communications only.
Key Components and Interfaces	Those *Line Replaceable Units (LRUs)/Line Replaceable Modules (LRMs)*, subsystems and interfaces (both internal and external) that define and/or control the Pilot Vehicle Interfaces (PVIs) that are likely to change in the future as a result of Block Upgrades (e.g., corrective, perfective and adaptive changes) or expanded mission/capability (e.g., Red Air, Aerial Refueling).
Landing Design Gross Weight	It is the *maximum design gross weight* minus all payload items expected to be expended, all external fuel, and 25% internal fuel.
Landing Ground Roll Distance	The horizontal distance to decelerate from touchdown speed to a full stop for the specified weight, altitude, and configuration. Ground roll is divided into two segments - transition and braking. The transition segment is the ground roll that immediately follows touchdown, which allows for the change from the touchdown attitude to the taxi attitude. During transition, the air vehicle is brought from the landing configuration to the braking configuration. (Mil-STD-3013)
Large Area Display	A primary display consisting of a single piece of glass in front of the aircrew.
Latency	The delay between the time the data is sent from its origin and received at its destination. It determines how responsive the link will be.
Level Flight Maximum Speed (V_H)	The maximum authorized continuous level flight speed required and otherwise attainable by the *aircraft*. The *aircraft* will not be operated at low-level airspeeds greater than specified for the bird strike capability of the *aircraft*.
Limit Speed (V_L)	The maximum allowable speed of the *aircraft* commensurate with operational use considering shallow and steep dive angles, thrust, and inadvertent upsets from gusts.

Light Rime Icing	Icing encountered with liquid water content (LWC) greater than or equal to 0.1 grams/m^3 and less than 0.7 grams/m^3.
Line Replaceable Module Line Replaceable Unit	An essential *component* removed and replaced at *O-Level* to restore an end item to an operationally ready condition.
Link Margin	Ratio of the received signal power to the minimum required by the receiver. (IEEE glossary)
Live Aircraft Live Target Live Threat	A real *aircraft* participating in a multi-ship training mission.
Local Training Area	It is defined by a 150 NM-radius circle centered on the Main Operating Base/Designated Base (with the exception of Creech AFB where it is defined by a 150 NM-radius semi-circle covering the Nellis Range Complex and centered on Creech AFB) and includes all military operating areas (MOA) and ranges, and the local area instrument routes and visual routes low levels.
Materiel Availability	It is a measure of the percentage of the total inventory of a system operationally capable (ready for tasking) of performing an assigned mission at a given time, based on materiel condition. It provides availability percentages from a USAF corporate, fleet-wide perspective.
Material Reliability	It is a measure of the probability that the system will perform without mission-degrading *failure* during a scheduled training sortie.
Maximum Design Gross Weight	It is the weight of the *aircraft* with maximum internal and maximum external load for which provision is required, with no reductions permitted for fuel used during taxi, warmup, or climb-out. This weight applies to: a) Ground maneuvering, ground handling and miscellaneous ground loads. b) Takeoff loads. c) In-flight refueling conditions. d) Flight loads at *maximum takeoff gross weight*. e) Wheel jacking. (For wing and fuselage jacking, if such jacking is required for changing wheels and tires.) f) Flutter, divergence and other aeroelastic testability prevention, and vibration and aeroacoustics.
Maximum Landing Design Weight	It is the *maximum design gross weigh*t less the following: assist takeoff fuel, droppable fuel tanks, items expended during routine take-off, and fuel consumed or dumped during one go-around or 3.0 minutes, whichever results in the minimum amount of fuel.
Maximum Takeoff Gross Weight	It is the highest weight authorized at liftoff. (MIL-STD-3013)
Mean Flight Hours Between False Alarms	It is a measure of the average flight hours between *false alarms* for all *faults*.

Mean Flight Hours Between Sortie Aborting False Alarms	It is a measure of the average time between *Sortie Aborting False Alarms*.
Mean Time Between Failures	It is a measure of the average flight hours between *failures*.
Mean Time Between Maintenance	It is a measure of the average flying hours between maintenance events, both scheduled and unscheduled.
Mean Time To Repair	It is a measure of the average on-equipment corrective maintenance time in an operational environment, regardless of aircrew size.
Mission Capable	A materiel condition such that the *aircraft* is capable of performing at least one of its assigned missions. (AFI 21-103)
Mission Debriefing	Reviewing and discussing mission accomplishment looking at what was achieved, what barriers were encountered and how the mission could be accomplished better next time. It reinforces training.
Mission-Essential Systems	Systems, subsystems, and *components* that must function on an *aircraft* for it to perform assigned mission. (AFI 21-103)
No Drop Weapons Scoring	It provides the ability to simulate air-to-ground non-guided weapons and determine the real-world point of impact and splash points. The associated scoring of the point of impact in relation to the targets is provided. It includes guns, bombs and rockets.
Objectionable	An annoyance, distraction, or discomfort so great as to interfere with task performance. (MIL-STD-1797)
On-Equipment Maintenance	Maintenance tasks that are or can be effectively performed on or at the weapon system or end-item of *component*.
Open and Priority Modes	In Open mode, up to 10 threats may be displayed on the azimuth indicator. In Priority mode, up to 5 threats are displayed on the azimuth indicator.
Open Systems Architecture	A technical architecture that adopts open, consensus based standards supporting a modular, loosely coupled and highly cohesive system structure. This includes the identification of key interfaces within the system and full design disclosure/data rights. Open Architecture technical practices will apply, at a minimum, to the key interfaces. They are: - Modular architectures with *open standards* and published interfaces; - Separation of hardware and software through middleware; - Maximized reuse of assets to limit unique development; - Full Design disclosure; and - Limited use of well-defined proprietary solutions.
Operating Weight	It is the *basic weight* plus aircrew and all nonexpendable items not covered under *basic weight*.
Operational Availability	It is a measure of the percentage of time the *aircraft* within a unit are operationally capable (ready for tasking) of performing an

	assigned mission. It provides availability percentages from an operational unit perspective.
Operational Flight Program/Software Item	An aggregation of software, such as a computer program or database, that satisfies an end-use function and is designated for purposes of specification, qualification, testing, interfacing, configuration management, or other purposes. Also they may be designated as a Computer Software Configuration Item.
Operational Lighting Conditions	The ambient lighting from complete darkness to direct sunlight. For this program it is defined as the following lighting conditions: a. Night - 0 foot candles (fC) ambient lighting. b. Daylight (sun over the shoulder) - 10,000 fC ambient diffuse lighting on the face of the display, and 2,000 foot Lambert (fL) ambient specular lighting.
Organizational-Level Maintenance	Maintenance consisting of those on-equipment tasks normally performed using the resources of an operating command at an operating location (Ref. AFI 21-101). For example: sortie launch and recovery, maintain and repair material coded for organizational level repair.
Open Standard	It means widely accepted and supported standards set by recognized standards organizations or the marketplace. These standards support interoperability, portability, and scalability and are equally available to the general public at no cost or with a moderate license fee.
Outer Mold Line	All surfaces exposed with landing gear up, gear & access doors closed, and control surfaces fully extended except for windows, lights, and other surfaces that must remain uncoated for proper functionality (i.e., antennas, etc.).
Percent of Fault Detection	It is the measure of the percentage of correct on-equipment *fault detections*, given the total number of detections (false and actual).
Percent of Fault Isolation	Given correct detection, it is the measure of the percentage of correct on-equipment *fault isolations*. For the purposes of calculating *PFI*, the specified fault resolution level is to a single *LRU/LRM*.
Pilot Envelope Temperature	The arithmetical average of temperature measurements taken about the space occupied by the aircrew and includes measurements taken at the following points: ankles, knees, hips, chest, shoulders, and head.
Pilot-in-the-loop Oscillation	An unintentional sustained or uncontrollable oscillation that results from the efforts of the aircrew to control the *aircraft*
Post-Stall Gyration	Uncontrolled motions about one or more air vehicle axes following departure from controlled flight. While this type of air vehicle motion involves angles of attack higher than stall angle, lower angles may be encountered intermittently in the course of the motion. (MIL-STD-1797)

Pressure Altitude	It is the altitude in a given atmosphere at which the pressure corresponds to the pressure in the Standard Day atmosphere. It is also the altitude read from an altimeter set at 29.92 in Hg. (MIL-STD-3031)
Primary Fuel	Fuels the *aircraft* is designed to operate continuously without restrictions and are also used to demonstrate contract compliance for complete steady-state and transient operating conditions. (JSSG-2001)
Readable	Able to be read/deciphered without the use of additional aids.
Resistant to Departure	Departure from controlled flight will only occur with a large and reasonably sustained misapplication of pitch and roll and yaw controls. (MIL-STD-1797)
Safety Critical Fault	A *fault* indication of any failure mode that has a severity classification category of I (catastrophic) or II (critical) as identified through the FMECA process.
Satisfactory Flying Qualities	*Flying qualities* clearly adequate for the mission Flight Phase. Desired performance is achievable with no more than minimal pilot compensation.
Security Controls	The management, operational, and technical controls (i.e., safeguards or countermeasures) prescribed for an information system to protect the confidentiality, integrity, and availability of the system and its information.
Service Ceiling	It is the highest altitude at which the maximum steady-state rate-of-climb potential is 100 feet per minute, for a specified configuration, weight, speed, and thrust (power) setting. (MIL-STD-3013)
Situational Awareness	In flying, it refers to an aircrew member's continuous perception of self and *aircraft* in relation to the dynamic environment of flight, threats, and mission, and the ability to forecast, then execute, tasks based upon that perception. (AFI 11-290)
Sortie Aborting False Alarm	A *false alarm* that causes either a ground or air abort of an attempted sortie.
Special Failure States	Air Vehicle Failure States which have extremely remote probabilities of *failure* ($1x10^{-9}$) during a given flight. (MIL-STD-1797)
Standard Configuration	Required *aircraft* configuration for accomplishing SUPT and IFF training missions. It includes external store(s) required to accomplish SUPT and IFF training missions. SWaP-C margin requirements met. It excludes external stores identified in Table 3-38 except as noted in the profiles in APPENDIX A.
Start-up BIT	An aircraft Built-In-Test mode which is exercised each time power is applied to the item and prior to normal functional operation.
Threat Separation	Function used to separate co-located symbols on azimuth indicator.

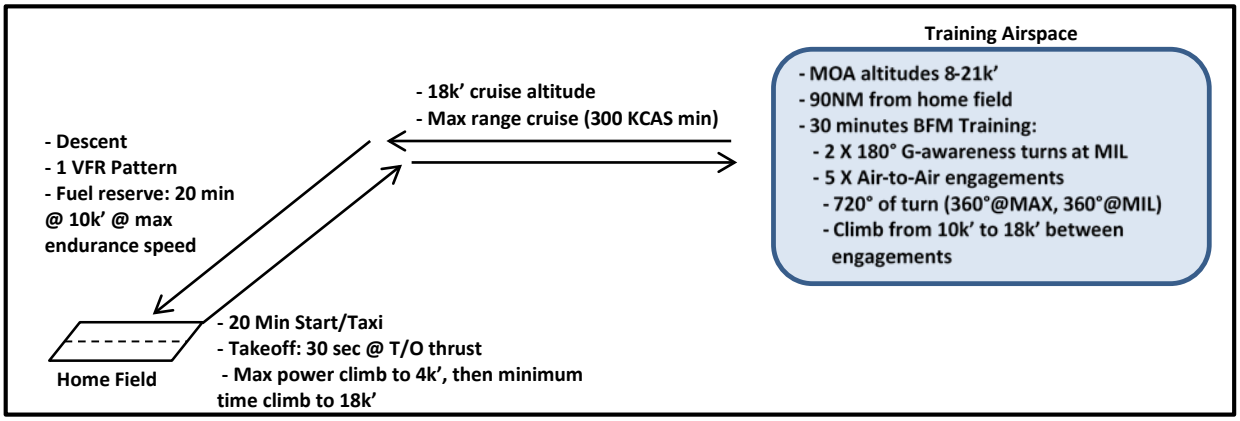
Tolerable Flying Qualities	*Flying qualities* adequate to accomplish the mission Flight Phase, but some increase in pilot workload or degradation in mission effectiveness, or both, exists.
Tolerant	It means the *aircraft* will not get into an unrecoverable flight condition.
Total Takeoff Distance	The horizontal distance required for the *aircraft*, with the landing gear extended, to clear a 50-foot obstacle height above the runway for a specified altitude, weight, configuration, and thrust (power) setting. It is the sum of the Ground Run Distance (defined below) plus the airborne distance needed to accelerate and climb to clear the 50-foot height. Ground Run Distance: The distance from brake release (zero velocity) to main wheel liftoff for the specified altitude, weight, configuration, and thrust (power) setting. It is measured from the location of the nose wheel at brake release (zero velocity) to the main wheel liftoff point. (MIL-STD 3013)
Uncommon Atmospheric Disturbances	Levels of atmospheric disturbances which may be encountered infrequently in operations (i.e., probability of exceeding these levels is approximately 1×10^{-3}). (MIL-STD-1797)
Virtual Simulation	A simulation involving real people operating simulated systems. Virtual simulations inject human-in-the-loop in a central role by exercising motor control skills, decision skills, or communication skills.
Virtual Aircraft Virtual Target Virtual Threat	A *GBTS* component virtually participating in a multi-ship training mission with *live aircraft*.
Warning	Aircrew *alert* that visually and/or aurally indicates the existence of a hazardous condition requiring immediate action of the aircrew to prevent loss of life, *component* damage, or abortion of the mission.
Weight Empty	It is the weight of the *aircraft* configured with the permanent *components* required herein. It includes the SWaP-C margins and growth path provisions.
Zone 1 Reach Conditions	Zone 1 Reach Conditions are with the restraint locked and without stretch of arm or shoulder muscles.
Zone 2 Reach Conditions	Zone 2 Reach Conditions are with the restraint locked, but with the aircrew member free to strain against the harness and reach as far as possible.
Zone 3 Reach Conditions	Zone 3 Reach Conditions are with the restraint on but unlocked and the aircrew member free to move to reach the control.

APPENDIX A - APT SYLLABUS MANEUVERS AND MISSION PROFILES

A.1 High G Maneuvering

The high G maneuver shall be flown with a *Standard Configuration*, at 80% fuel weight (relative to maximum fuel capacity) and Standard Day conditions. The maneuver shall begin in level flight (flight path angle no lower than zero and no higher than two degrees nose high), wings level (±5 degrees of bank), at 15,000 feet *PA*, and at or below 0.9Mach. From this point, the aircrew will immediately initiate bank and back pressure to achieve the highest maintainable G-loading. The G-loading shall be maintained for a minimum of 140 continuous degrees. The aircrew may begin reducing the load factor and rolling out after a minimum of 140 degrees in order to roll out at approximately 180 degrees of turn. The flight path angle shall be no lower than 15 degrees nose low and the *aircraft* shall descend to no lower than 13,000 feet *PA* during any portion of the entire 180-degree maneuver. There is no power setting specified for this maneuver. The *aircraft* shall lose no more than 10% of the initial airspeed during the 180-degree maneuver. There are no specified degrees of turn for roll in or roll out. "Approximately 180 degrees of turn" is meant to describe a recognizable maneuver without mandating exactly 180 degrees. There is no specified length of time for the 140-degree portion of the maneuver or for the 180-degree maneuver as a whole. Minimum acceptable load factor will be 6.5 sustained for a minimum of 140 degrees. The lowest load factor registered during the 140-degree period will establish G-loading for the maneuver. For example, if the *aircraft* maintains 7.2Gs for less than 140 degrees and then drops to 6.9Gs by the end of the 140-degree period, 6.9Gs will be used as the maximum G-loading. There is no requirement to exceed 7.5Gs.

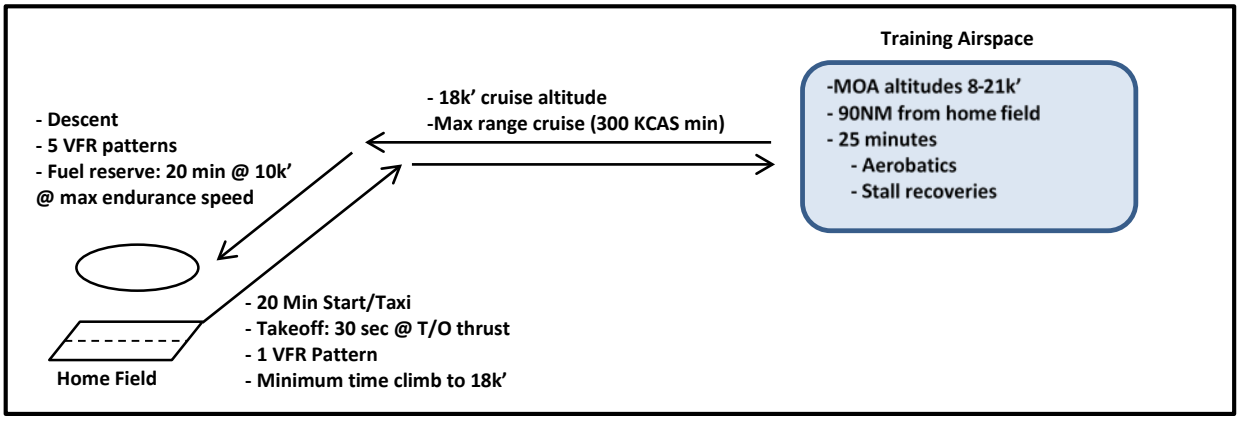
5305 A.2 Flight Endurance Mission Profile



	SEGMENT	FUEL	TIME	DISTANCE	SPEED	ALTITUDE	POWER
A	WARM-UP, TAXI, TAKEOFF, AND ACCELERATE TO CLIMB SPEED	FUEL FOR 20 MIN @ GROUND IDLE + 30 SEC @ TAKEOFF/MAXIMUM POWER (A/B IF REQUIRED) + FUEL TO ACCELERATE FROM OBSTACLE CLEARANCE TO CLIMB SPEED @ MILITARY/INTERMEDIATE RATED THRUST. NO DISTANCE CREDIT.					
B	CLIMB			(1)	MINIMUM TIME CLIMB SCHEDULE	SL TO 4,000 FEET	MAX
C	CLIMB			(1)	MINIMUM TIME CLIMB SCHEDULE	4,000 TO 18,000 FEET	INTERMEDIATE
D	CRUISE			90 NM (1)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
E	MANEUVER	2 x 180 DEGREE G-AWARENESS TURNS @ MILITARY POWER					
F	CLIMB				MINIMUM TIME CLIMB SCHEDULE	13,000 TO 18,000 FEET	INTERMEDIATE
G	MANEUVER (2)	5 x 720 DEGREE TURN (3)					
H	CLIMB				MINIMUM TIME CLIMB SCHEDULE	10,000 TO 18,000 FEET	INTERMEDIATE
I	CRUISE			90 NM (1)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
J	DESCENT			(1)		18,000 TO 1,000 FEET	
K	1 VFR PATTERNS	ONE PATTERN FROM INITIAL CONSISTING OF FUEL FOR 13 NM @ 1,000 FEET PA @ PATTERN SPEED. NO DISTANCE CREDIT. (4)					
L	FULL STOP AND TAXI	NO FUEL USAGE PENALTY					
	RESERVES		20 MIN	NO CREDIT	MAX ENDURANCE	10,000 FEET	

NOTES:
(1) 90 NM INCLUDES CLIMB/DESCENT DISTANCE
(2) MINIMUM TIME CLIMB FROM 10,000 FEET TO 18,000 FEET TO START EACH OF THE LAST 4 MANEUVERS OF SEGMENT G
(3) FOR AUGMENTED AIRCRAFT, THE POWER SETTING FOR THE FIRST 360 DEGREES OF EACH ENGAGEMENT SHALL BE MAX POXER ; THE SECOND 360 DEGREES SHALL BE MILITARY POWER. POWER SETTING FOR NON-AUGMENTED AIRCRAFT SHALL BE MIL POWER FOR THE DURATION
(4) PATTERN SPEED IS 300 KCAS

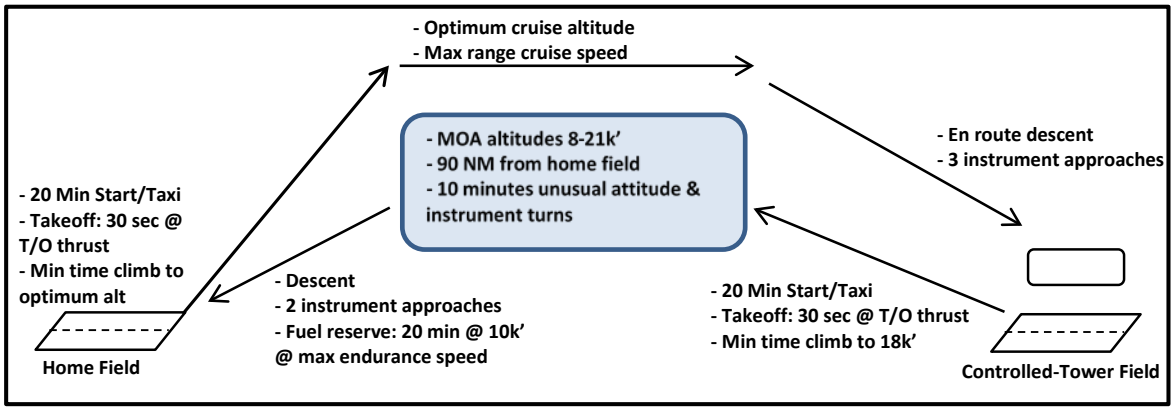
5306 A.3 Specialized Undergraduate Pilot Training (SUPT) Profile 1, Transition



	SEGMENT	FUEL	TIME	DISTANCE	SPEED	ALTITUDE	POWER
A	WARM-UP, TAKEOFF, AND ACCELERATE TO PATTERN SPEED	FUEL FOR 20 MIN @ GROUND IDLE + 30 SEC @ TAKEOFF/MAXIMUM POWER (A/B IF REQUIRED) + FUEL TO ACCELERATE TO PATTERN SPEED AND CLIMB FROM SL TO 1,000 FEET @ MAX THRUST. NO DISTANCE CREDIT. (1)					
B	1 VFR PATTERN	ONE PATTERN CONSISTING OF FUEL FOR 13 NM @ 1,000 FEET PA @ PATTERN SPEED + FUEL TO ACCELERATE TO PATTERN SPEED AND CLIMB FROM SL TO 1,000 FEET @ MIL THRUST. ONE TOUCH & GO. NO DISTANCE CREDIT. (1)					
C	CLIMB			(2)	MINIMUM TIME CLIMB SCHEDULE	SLTO 18,000 FEET	INTERMEDIATE
D	CRUISE			90 NM (2)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
E	MANEUVER		25 MIN		350 KCAS	8,000-21,000 FEET BLOCK (3)	
F	CLIMB				MINIMUM TIME CLIMB SCHEDULE	14,000 TO 18,000 FEET	INTERMEDIATE
G	CRUISE			90 NM (2)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
H	DESCENT			(2)		18,000 TO 1,000 FEET	
I	5 VFR PATTERNS	FIVE PATTERNS EACH CONSISTING OF FUEL FOR 13 NM @ 1000 FEET PA @ PATTERN SPEED + FUEL TO ACCELERATE TO PATTERN SPEED AND CLIMB FROM SL TO 1000 FEET @ MIL THRUST. FOUR TOUCH & GO'S. TAKEOFF SEGMENT MAY BE ELIMINATED FOR PATTERN ENDING IN FULL STOP. NO DISTANCE CREDIT. (1)					
J	FULL STOP AND TAXI	NO FUEL USAGE PENALTY					
K	RESERVES		20 MIN	NO CREDIT	MAX ENDURANCE	10,000 FEET	

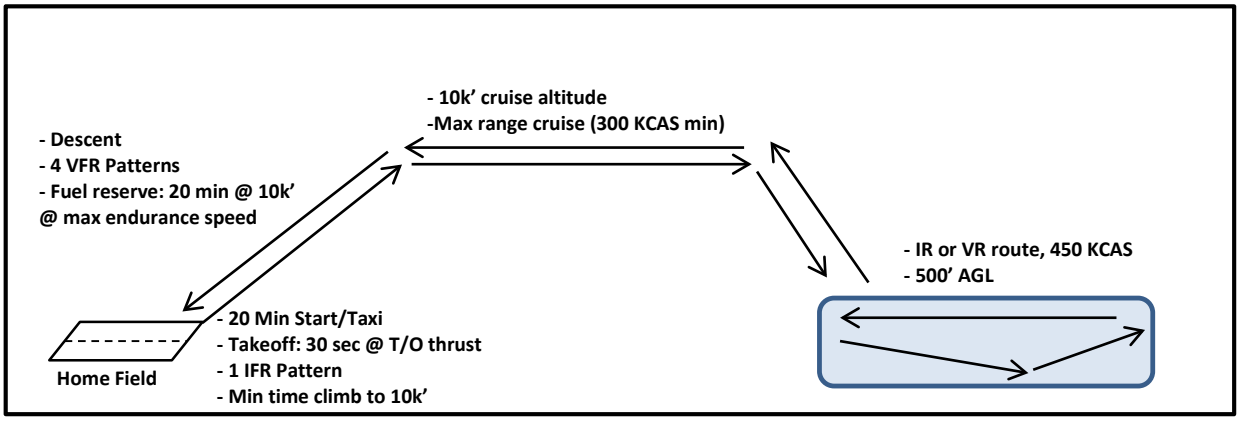
NOTES:
(1) PATTERN SPEED IS 300 KCAS
(2) 90 NM INCLUDES CLIMB/DESCENT DISTANCE
(3) MANEUVER IS CALCULATED AT THE AVERAGE ALTITUDE AS THE AIRCRAFT OPERATES THROUGH THE ALTITUDE BAND FROM 8,000 TO 21,000 FEET

5307 A.4 Specialized Undergraduate Pilot Training (SUPT) Profile 2, Instruments/Navigation



	SEGMENT	FUEL	TIME	DISTANCE	SPEED	ALTITUDE	POWER
A	WARM-UP, TAKEOFF, AND ACCELERATE TO CLIMB SPEED	FUEL FOR 20 MIN @ GROUND IDLE + 30 SEC @ TAKEOFF/MAXIMUM POWER (A/B IF REQUIRED) + FUEL TO ACCELERATE FROM OBSTACLE CLEARANCE TO CLIMB SPEED @ MILITARY/INTERMEDIATE RATED THRUST. NO DISTANCE CREDIT.					
B	CLIMB			(1)	MINIMUM TIME CLIMB SCHEDULE	SL TO OPTIMUM CRUISE ALTITUDE	INTERMEDIATE
C	CRUISE			250 NM (1)	MAX RANGE CRUISE	OPTIMUM CRUISE ALTITUDE	
D	DESCENT			(1)		OPTIMUM TO 3,000 FEET	
E	3 IFR PATTERNS	THREE PATTERNS EACH CONSISTING OF FUEL FOR 50 NM @ 3000 FEET PA @ PATTERN SPEED + FUEL TO ACCELERATE TO PATTERN SPEED AND CLIMB FROM SL TO 1000 FEET @ MIL THRUST. TWO TOUCH & GO'S. TAKEOFF SEGMENT MAY BE ELIMINATED FOR PATTERN ENDING IN FULL STOP. NO DISTANCE CREDIT. (2)					
F	FULL STOP AND TAXI (3)	NO FUEL USAGE PENALTY					
G	RESERVES		20 MIN	NO CREDIT	MAX ENDURANCE	10,000 FEET	
H	WARM-UP, TAKEOFF, AND ACCELERATE TO CLIMB SPEED	FUEL FOR 20 MIN @ GROUND IDLE + 30 SEC @ TAKEOFF/MAXIMUM POWER (A/B IF REQUIRED) + FUEL TO ACCELERATE FROM OBSTACLE CLEARANCE TO CLIMB SPEED @ MILITARY/INTERMEDIATE RATED THRUST. NO DISTANCE CREDIT.					
I	CLIMB			(1)	MINIMUM TIME CLIMB SCHEDULE	SL TO 25,000 FEET	INTERMEDIATE
J	CRUISE			160 NM (1)	MAX RANGE CRUISE	25,000 FEET	
K	MANUEVER		10 MINS		350 KCAS	8-21,000 FEET BLOCK (4)	
L	CLIMB			(1)	MINIMUM TIME CLIMB SCHEDULE	14,000 TO 18,000 FEET	INTERMEDIATE
M	CRUISE			90 NM (1)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
N	DESCENT			(1)		18,000 TO 3,000 FEET	
O	2 IFR PATTERNS	TWO PATTERNS EACH CONSISTING OF FUEL FOR 50 NM @ 3000 FEET PA @ PATTERN SPEED + FUEL TO ACCELERATE TO PATTERN SPEED AND CLIMB FROM SL TO 1000 FEET @ MIL THRUST. ONE TOUCH & GO. TAKEOFF SEGMENT MAY BE ELIMINATED FOR PATTERN ENDING IN FULL STOP. NO DISTANCE CREDIT. (2)					
P	FULL STOP AND TAXI	NO FUEL USAGE PENALTY					
Q	RESERVES		20 MIN	NO CREDIT	MAX ENDURANCE	10,000 FEET	
	NOTES:	(1) INCLUDES CLIMB/DESCENT DISTANCE (2) PATTERN SPEED IS 300 KCAS (3) REFUEL AFTER SEGMENT F (4) MANEUVER IS CALCULATED AT THE AVERAGE ALTITUDE AS THE AIRCRAFT OPERATES THROUGH THE ALTITUDE BAND FROM 8,000 TO 21,000 FEET					

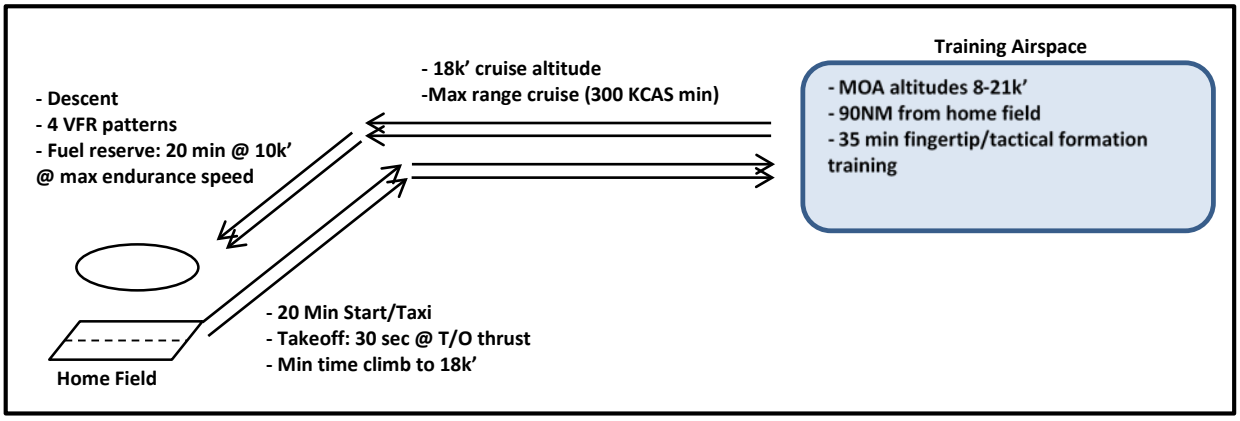
5308 A.5 Specialized Undergraduate Pilot Training (SUPT) Profile 3, Low-Level Navigation



	SEGMENT	FUEL	TIME	DISTANCE	SPEED	ALTITUDE	POWER
A	WARM-UP, TAKEOFF, AND ACCELERATE TO CLIMB SPEED	FUEL FOR 20 MIN @ GROUND IDLE + 30 SEC @ TAKEOFF/MAXIMUM POWER (A/B IF REQUIRED) + FUEL TO ACCELERATE TO CLIMB SPEED AND CLIMB FROM SL TO 1,000 FEET @ MAX THRUST. NO DISTANCE CREDIT.					
B	1 IFR PATTERN	ONE PATTERN CONSISTING OF FUEL FOR 50 NM @ 3000 FEET PA @ PATTERN SPEED + FUEL TO ACCELERATE TO PATTERN SPEED AND CLIMB FROM SL TO 1000 FEET @ MIL THRUST. ONE TOUCH & GO. NO DISTANCE CREDIT. (2)					
C	CLIMB			(1)	MINIMUM TIME CLIMB SCHEDULE	1,000 FEET TO 10,000 FEET	INTERMEDIATE
D	CRUISE			30 NM (1)	GREATER OF MAX RANGE OR 300 KCAS	10,000 FEET	
E	DESCENT			(1)		10,000 FEET TO 500 FEET	
F	PENETRATION			50 NM	450 KCAS	500 FEET	
G	WITHDRAWAL			50 NM	450 KCAS	500 FEET	
H	CLIMB			(1)	MINIMUM TIME CLIMB SCHEDULE	500 FEET TO 10,000 FEET	INTERMEDIATE
I	CRUISE			30 NM (1)	GREATER OF MAX RANGE OR 300 KCAS	10,000 FEET	
J	DESCENT			(1)		10,000 FEET TO 1,000 FEET	
K	4 VFR PATTERNS	FOUR PATTERNS EACH CONSISTING OF FUEL FOR 13 NM @ 1000 FEET PA @ PATTERN SPEED + FUEL TO ACCELERATE TO PATTERN SPEED AND CLIMB FROM SL TO 1000 FEET @ MIL THRUST. THREE TOUCH & GO'S. TAKEOFF SEGMENT MAY BE ELIMINATED FOR PATTERN ENDING IN FULL STOP. NO DISTANCE CREDIT. (2)					
L	FULL STOP AND TAXI	NO FUEL USAGE PENALTY					
M	RESERVES		20 MIN	NO CREDIT	MAX ENDURANCE	10,000 FEET	

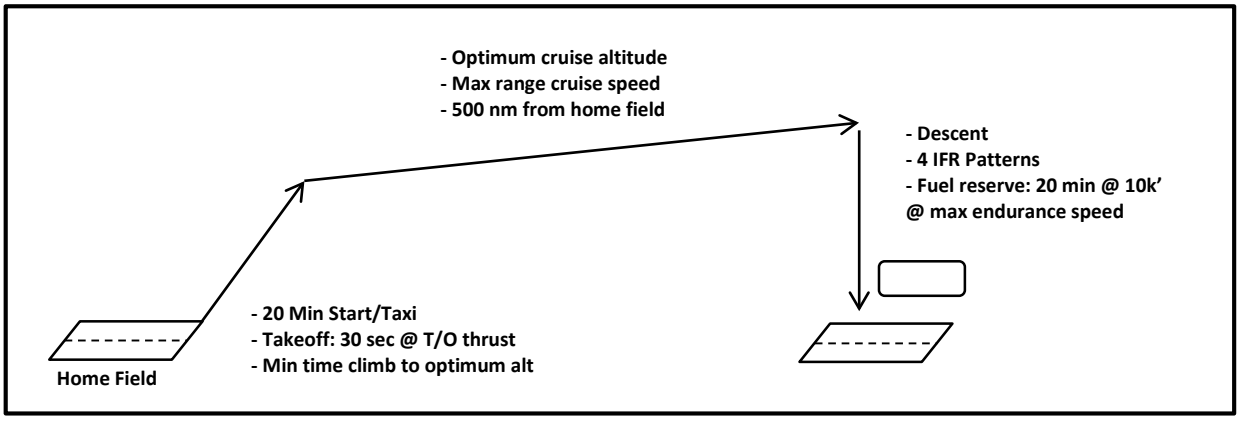
NOTES: (1) 30 NM INCLUDES CLIMB/DESCENT DISTANCE
(2) PATTERN SPEED IS 300 KCAS

5309 A.6 Specialized Undergraduate Pilot Training (SUPT) Profile 4, Formation



	SEGMENT	FUEL	TIME	DISTANCE	SPEED	ALTITUDE	POWER
A	WARM-UP, TAKEOFF, AND ACCELERATE TO CLIMB SPEED	FUEL FOR 20 MIN @ GROUND IDLE + 30 SEC @ TAKEOFF/MAXIMUM POWER (A/B IF REQUIRED) + FUEL TO ACCELERATE FROM OBSTACLE CLEARANCE TO CLIMB SPEED @ MILITARY/INTERMEDIATE RATED THRUST. NO DISTANCE CREDIT.					
B	CLIMB			(2)	MINIMUM TIME CLIMB SCHEDULE	SL TO 18,000 FEET	INTERMEDIATE
C	CRUISE			90 NM (2)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
D	MANEUVER		35 MINS		350 KCAS	8,000 TO 21,000 FEET BLOCK (3)	
E	CLIMB				MINIMUM TIME CLIMB SCHEDULE	14,000 TO 18,000 FEET	INTERMEDIATE
F	CRUISE			90 NM (2)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
G	DESCENT			(2)		18,000 FEET TO 1,000 FEET	
H	4 VFR PATTERNS	FOUR PATTERNS EACH CONSISTING OF FUEL FOR 13 NM @ 1000 FEET PA @ PATTERN SPEED + FUEL TO ACCELERATE TO PATTERN SPEED AND CLIMB FROM SL TO 1000 FEET @ MIL THRUST. THREE TOUCH & GO'S. TAKEOFF SEGMENT MAY BE ELIMINATED FOR PATTERN ENDING IN FULL STOP. NO DISTANCE CREDIT. (1)					
I	FULL STOP AND TAXI	NO FUEL USAGE PENALTY					
J	RESERVES		20 MIN	NO CREDIT	MAX ENDURANCE	10,000 FEET	
	NOTES:	(1) PATTERN SPEED IS 300 KCAS (2) 90 NM INCLUDES CLIMB/DESCENT DISTANCE (3) MANEUVER IS CALCULATED AT THE AVERAGE ALTITUDE AS THE AIRCRAFT OPERATES THROUGH THE ALTITUDE BAND FROM 8,000 TO 21,000 FEET					

5310 A.7 Specialized Undergraduate Pilot Training (SUPT) Profile 5, Cross-Country

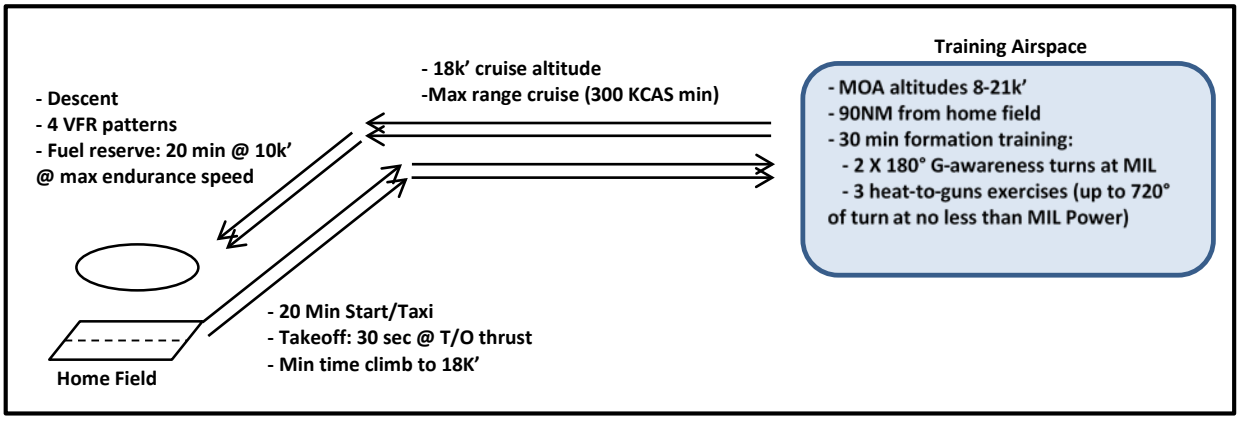


	SEGMENT	FUEL	TIME	DISTANCE	SPEED	ALTITUDE	POWER
A	WARM-UP, TAKEOFF, AND ACCELERATE TO CLIMB SPEED	FUEL FOR 20 MIN @ GROUND IDLE + 30 SEC @ TAKEOFF/MAXIMUM POWER (A/B IF REQUIRED) + FUEL TO ACCELERATE FROM OBSTACLE CLEARANCE TO CLIMB SPEED @ MILITARY/INTERMEDIATE RATED THRUST. NO DISTANCE CREDIT.					
B	CLIMB			(1)	MINIMUM TIME CLIMB SCHEDULE	SL TO OPTIMUM CRUISE ALTITUDE	INTERMEDIATE
C	CRUISE			500 NM (1)	MAX RANGE CRUISE	OPTIMUM CRUISE ALTITUDE	
D	DESCENT			(1)		OPTIMUM TO 3,000 FEET	
E	4 IFR PATTERNS	FOUR PATTERNS CONSISTING OF FUEL FOR 50 NM @ 3000 FEET PA @ PATTERN SPEED + FUEL TO ACCELERATE TO PATTERN SPEED AND CLIMB FROM SL TO 1000 FEET @ MIL THRUST. THREE TOUCH & GO'S. TAKEOFF SEGMENT MAY BE ELIMINATED FOR PATTERN ENDING IN FULL STOP. NO DISTANCE CREDIT. (2)					
F	FULL STOP AND TAXI	NO FUEL USAGE PENALTY					
G	RESERVES		20 MIN	NO CREDIT	MAX ENDURANCE	10,000 FEET	

NOTES: (1) 500 NM INCLUDES CLIMB/DESCENT DISTANCE
(2) PATTERN SPEED IS 300 KCAS

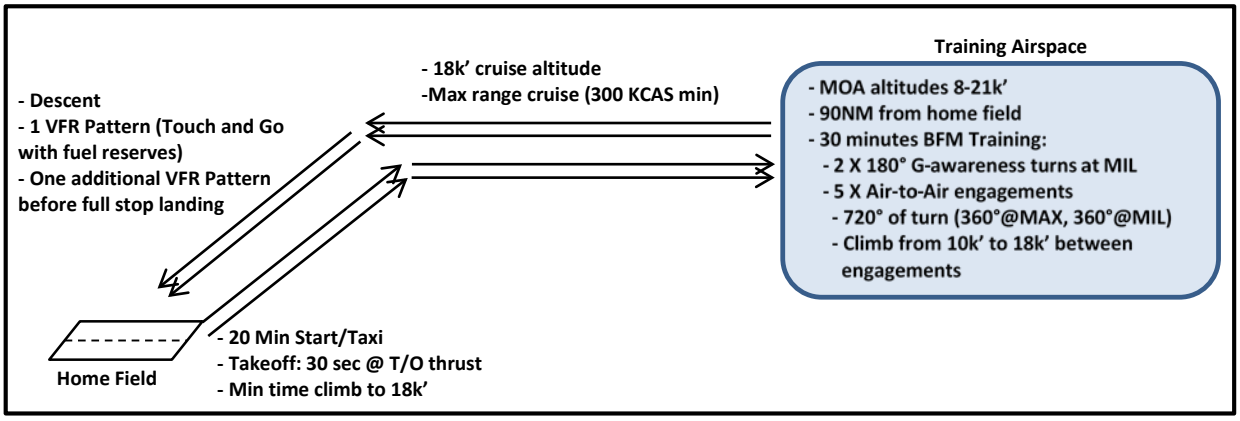
*A/C CONFIGURED WITH TRAVEL POD

5311 A.8 Introduction to Fighter Fundamentals (IFF) Profile 1, Formation



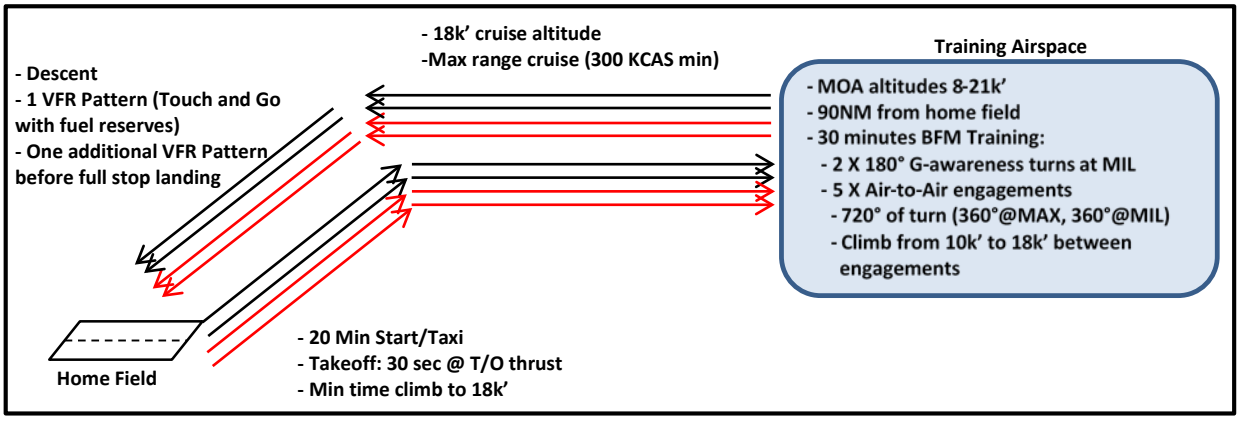
	SEGMENT	FUEL	TIME	DISTANCE	SPEED	ALTITUDE	POWER
A	WARM-UP, TAKEOFF, AND ACCELERATE TO CLIMB SPEED	FUEL FOR 20 MIN @ GROUND IDLE + 30 SEC @ TAKEOFF/MAXIMUM POWER (A/B IF REQUIRED) + FUEL TO ACCELERATE FROM OBSTACLE CLEARANCE TO CLIMB SPEED @ MILITARY/INTERMEDIATE RATED THRUST. NO DISTANCE CREDIT.					
B	CLIMB			(2)	MINIMUM TIME CLIMB SCHEDULE	SL TO 18,000 FEET	INTERMEDIATE
C	CRUISE			90 NM (2)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
D	MANEUVER (3)	2 x 180 DEGREE G-AWARENESS TURNS @ MILITARY POWER					
E	MANEUVER (3)	3 RUNS EACH CONSIST OF A 720 DEGREE TURN @ NO LESS THAN MIL POWER					
F	CLIMB				MINIMUM TIME CLIMB SCHEDULE	14,000 TO 18,000 FEET	INTERMEDIATE
G	CRUISE			90 NM (2)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
H	DESCENT			(2)		18,000 FEET TO 1,000 FEET	
I	4 VFR PATTERNS	FOUR PATTERNS EACH CONSISTING OF FUEL FOR 13 NM @ 1000 FEET PA @ PATTERN SPEED + FUEL TO ACCELERATE TO PATTERN SPEED AND CLIMB FROM SL TO 1000 FEET @ MIL THRUST. THREE TOUCH & GO'S. TAKEOFF SEGMENT MAY BE ELIMINATED FOR PATTERN ENDING IN FULL STOP. NO DISTANCE CREDIT. (1)					
J	FULL STOP AND TAXI	NO FUEL USAGE PENALTY					
K	RESERVES		20 MIN	NO CREDIT	MAX ENDURANCE	10,000 FEET	
	NOTES:	(1) PATTERN SPEED IS 300 KCAS (2) 90 NM INCLUDES CLIMB/DESCENT DISTANCE (3) TOTAL TIME FOR SEGMENTS D&E IS 30 MINUTES, ALTITUDE BLOCK OF 8,000 TO 21,000 FEET					

5312 A.9 Introduction to Fighter Fundamentals (IFF) Profile 2, Basic Fighter Maneuvers (BFM)



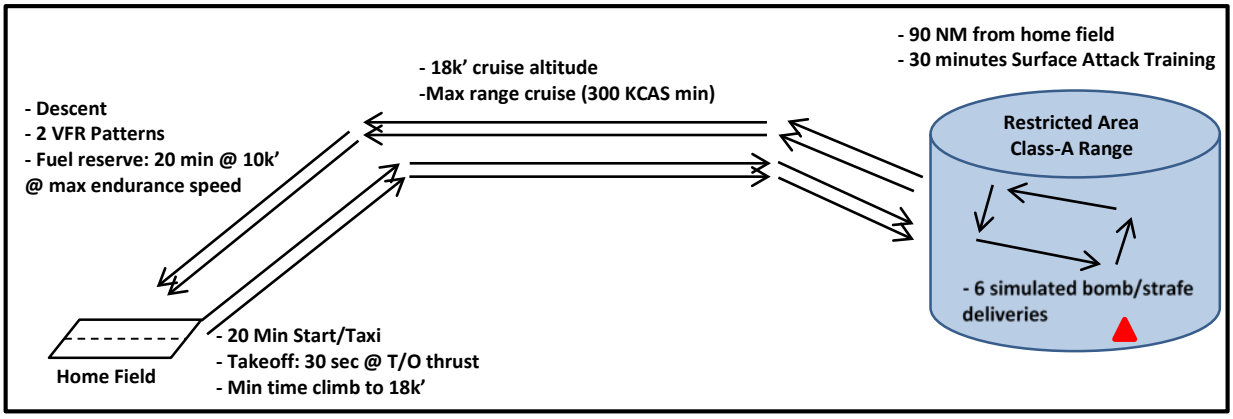
	SEGMENT	FUEL	TIME	DISTANCE	SPEED	ALTITUDE	POWER
A	WARM-UP, TAXI, TAKEOFF, AND ACCELERATE TO CLIMB SPEED	FUEL FOR 20 MIN @ GROUND IDLE + 30 SEC @ TAKEOFF/MAXIMUM POWER (A/B IF REQUIRED) + FUEL TO ACCELERATE FROM OBSTACLE CLEARANCE TO CLIMB SPEED @ MILITARY/INTERMEDIATE RATED THRUST. NO DISTANCE CREDIT.					
B	CLIMB			(1)	MINIMUM TIME CLIMB SCHEDULE	SLTO 18,000 FEET	INTERMEDIATE
C	CRUISE			90 NM (1)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
D	MANEUVER	2 x 180 DEGREE G-AWARENESS TURNS @ MILITARY POWER					
E	CLIMB				MINIMUM TIME CLIMB SCHEDULE	13,000 TO 18,000 FEET	INTERMEDIATE
F	MANEUVER (2)	5 x 720 DEGREE TURN (3)					
G	CLIMB				MINIMUM TIME CLIMB SCHEDULE	10,000 TO 18,000 FEET	INTERMEDIATE
H	CRUISE			90 NM (1)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
I	DESCENT			(1)		18,000 TO 1,000 FEET	
J	1 VFR PATTERN	ONE PATTERN CONSISTING OF FUEL FOR 13 NM @ 1,000 FEET PA @ PATTERN SPEED + FUEL TO ACCELERATE TO PATTERN SPEED AND CLIMB FROM SL TO 1,000 FEET @ MIL THRUST. ONE TOUCH & GO. (4)					
K	RESERVES		20 MIN	NO CREDIT	MAX ENDURANCE	10,000 FEET	
L	1 VFR PATTERN	ONE PATTERN CONSISTING OF FUEL FOR 13 NM @ 1,000 FEET PA @ PATTERN SPEED. NO DISTANCE CREDIT. (4)					
M	FULL STOP AND TAXI	NO FUEL USAGE PENALTY					
	NOTES:	(1) 90 NM INCLUDES CLIMB/DESCENT DISTANCE (2) MINIMUM TIME CLIMB FROM 10,000 FEET TO 18,000 FEET TO START EACH OF THE LAST 4 MANEUVERS OF SEGMENT F (3) FOR AUGMENTED AIRCRAFT, THE POWER SETTING FOR THE FIRST 360 DEGREES OF EACH ENGAGEMENT SHALL BE MAX POXER ; THE SECOND 360 DEGREES SHALL BE MILITARY POWER. POWER SETTING FOR NON-AUGMENTED AIRCRAFT SHALL BE MIL POWER FOR THE DURATION (4) PATTERN SPEED IS 300 KCAS						

5313 A.10 Introduction to Fighter Fundamentals (IFF) Profile 3, Air Combat Maneuvering



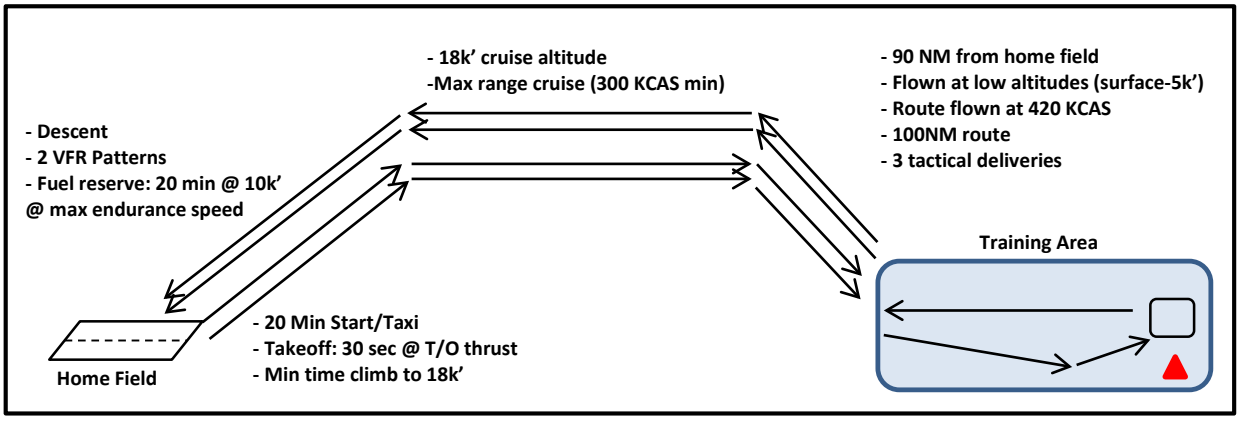
	SEGMENT	FUEL	TIME	DISTANCE	SPEED	ALTITUDE	POWER
A	WARM-UP, TAXI, TAKEOFF, AND ACCELERATE TO CLIMB SPEED	FUEL FOR 20 MIN @ GROUND IDLE + 30 SEC @ TAKEOFF/MAXIMUM POWER (A/B IF REQUIRED) + FUEL TO ACCELERATE FROM OBSTACLE CLEARANCE TO CLIMB SPEED @ MILITARY/INTERMEDIATE RATED THRUST. NO DISTANCE CREDIT.					
B	CLIMB			(1)	MINIMUM TIME CLIMB SCHEDULE	SLTO 18,000 FEET	INTERMEDIATE
C	CRUISE			90 NM (1)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
D	MANEUVER	2 x 180 DEGREE G-AWARENESS TURNS @ MILITARY POWER					
E	CLIMB				MINIMUM TIME CLIMB SCHEDULE	13,000 TO 18,000 FEET	INTERMEDIATE
F	MANEUVER (2)	5 x 720 DEGREE TURN (3)					
G	CLIMB				MINIMUM TIME CLIMB SCHEDULE	10,000 TO 18,000 FEET	INTERMEDIATE
H	CRUISE			90 NM (1)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
I	DESCENT			(1)		18,000 TO 1,000 FEET	
J	1 VFR PATTERN	ONE PATTERN CONSISTING OF FUEL FOR 13 NM @ 1,000 FEET PA @ PATTERN SPEED + FUEL TO ACCELERATE TO PATTERN SPEED AND CLIMB FROM SL TO 1,000 FEET @ MIL THRUST. ONE TOUCH & GO. (4)					
K	RESERVES		20 MIN	NO CREDIT	MAX ENDURANCE	10,000 FEET	
L	1 VFR PATTERN	ONE PATTERN CONSISTING OF FUEL FOR 13 NM @ 1,000 FEET PA @ PATTERN SPEED. NO DISTANCE CREDIT. (4)					
M	FULL STOP AND TAXI	NO FUEL USAGE PENALTY					
	NOTES:	(1) 90 NM INCLUDES CLIMB/DESCENT DISTANCE (2) MINIMUM TIME CLIMB FROM 10,000 FEET TO 18,000 FEET TO START EACH OF THE LAST 4 MANEUVERS OF SEGMENT F (3) FOR AUGMENTED AIRCRAFT, THE POWER SETTING FOR THE FIRST 360 DEGREES OF EACH ENGAGEMENT SHALL BE MAX POXER ; THE SECOND 360 DEGREES SHALL BE MILITARY POWER. POWER SETTING FOR NON-AUGMENTED AIRCRAFT SHALL BE MIL POWER FOR THE DURATION (4) PATTERN SPEED IS 300 KCAS						

5314 A.11 Introduction to Fighter Fundamentals (IFF) Profile 4, Basic Surface Attack



	SEGMENT	FUEL	TIME	DISTANCE	SPEED	ALTITUDE	POWER
A	WARM-UP, TAKEOFF, AND ACCELERATE TO CLIMB SPEED	FUEL FOR 20 MIN @ GROUND IDLE + 30 SEC @ TAKEOFF/MAXIMUM POWER (A/B IF REQUIRED) + FUEL TO ACCELERATE FROM OBSTACLE CLEARANCE TO CLIMB SPEED @ MILITARY/INTERMEDIATE RATED THRUST. NO DISTANCE CREDIT.					
B	CLIMB			(1)	MINIMUM TIME CLIMB SCHEDULE	SL TO 18,000 FEET	INTERMEDIATE
C	CRUISE			90 NM (1)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
D	MANEUVER (3)	6 BOX PATTERNS WITH MAX G TURNS @ 420 KCAS					
E	CLIMB			(1)	MINIMUM TIME CLIMB SCHEDULE	12,000 TO 18,000 FEET	INTERMEDIATE
F	CRUISE			90 NM (1)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
G	DESCENT			(1)		18,000 TO 1,000 FEET	
H	2 VFR PATTERNS	TWO PATTERNS CONSISTING OF FUEL FOR 13 NM @ 1,000 FEET PA @ PATTERN SPEED + FUEL TO ACCELERATE TO PATTERN SPEED AND CLIMB FROM SL TO 1,000 FEET @ MIL THRUST. ONE TOUCH AND GO. TAKEOFF SEGMENT MAY BE ELIMINATED FOR PATTERN ENDING IN FULL STOP. NO DISTANCE CREDIT. (2)					
I	FULL STOP AND TAXI	NO FUEL USAGE PENALTY					
J	RESERVES		20 MIN	NO CREDIT	MAX ENDURANCE	10,000 FEET	
	NOTES:	(1) 90 NM INCLUDES CLIMB/DESCENT DISTANCE (2) PATTERN SPEED IS 300 KCAS (3) BLOCK ALTITUDE FROM SL TO 25,000 FEET, 30 MINUTES TOTAL TIME					

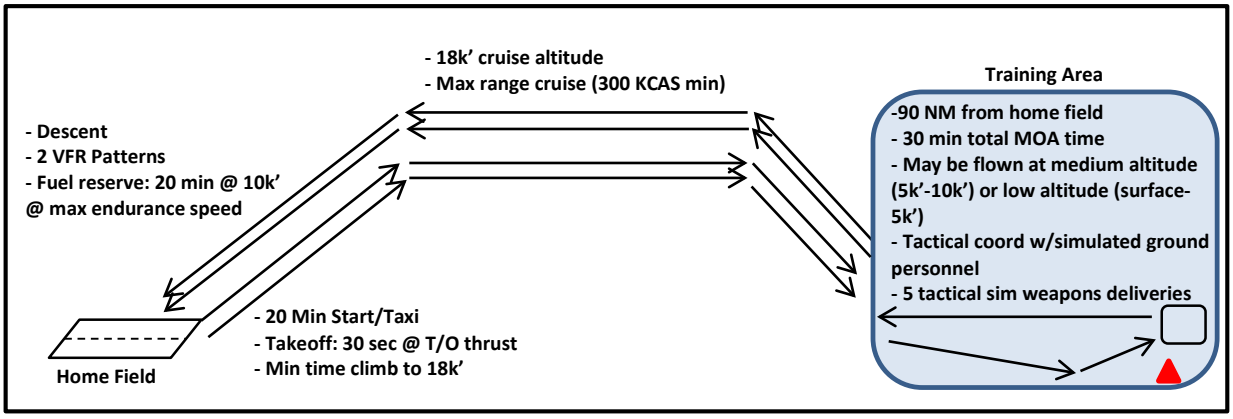
A.12 Introduction to Fighter Fundamentals (IFF) Profile 5, Surface Attack Tactics



	SEGMENT	FUEL	TIME	DISTANCE	SPEED	ALTITUDE	POWER
A	WARM-UP, TAKEOFF, AND ACCELERATE TO CLIMB SPEED	FUEL FOR 20 MIN @ GROUND IDLE + 30 SEC @ TAKEOFF/MAXIMUM POWER (A/B IF REQUIRED) + FUEL TO ACCELERATE FROM OBSTACLE CLEARANCE TO CLIMB SPEED @ MILITARY/INTERMEDIATE RATED THRUST. NO DISTANCE CREDIT.					
B	CLIMB			(2)	MINIMUM TIME CLIMB SCHEDULE	SL TO 18,000 FEET	INTERMEDIATE
C	CRUISE			90 NM (2)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
D	DESCENT			(2)		18,000 TO 5,000 FEET	
E	PENETRATION			50 NM	420 KCAS	SL TO 5,000 FEET BLOCK	
F	MANEUVER (3)	3 BOX PATTERNS, 15 NM EACH AT 420 KCAS					
G	WITHDRAWAL			50 NM	420 KCAS	SL TO 5,000 FEET BLOCK	
H	CLIMB			(2)	MINIMUM TIME CLIMB SCHEDULE	2,500 TO 18,000 FEET	INTERMEDIATE
I	CRUISE			90 NM (2)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
J	DESCENT			(2)		18,000 TO 1,000 FEET	
K	2 VFR PATTERNS	TWO PATTERNS CONSISTING OF FUEL FOR 13 NM @ 1,000 FEET PA @ PATTERN SPEED + FUEL TO ACCELERATE TO PATTERN SPEED AND CLIMB FROM SL TO 1,000 FEET @ MIL THRUST. ONE TOUCH & GO. TAKEOFF SEGMENT MAY BE ELIMINATED FOR PATTERN ENDING IN FULL STOP. NO DISTANCE CREDIT. (1)					
L	FULL STOP AND TAXI	NO FUEL USAGE PENALTY					
M	RESERVES		20 MIN	NO CREDIT	MAX ENDURANCE	10,000 FEET	

NOTES:
(1) PATTERN SPEED IS 300 KCAS
(2) 90 NM INCLUDES CLIMB/DESCENT DISTANCE
(3) 3 SIMULATED TACTICAL WEAPON DELIVERIES

5316 A.13 Introduction to Fighter Fundamentals (IFF) Profile 6, Close Air Support



	SEGMENT	FUEL	TIME	DISTANCE	SPEED	ALTITUDE	POWER
A	WARM-UP, TAKEOFF, AND ACCELERATE TO CLIMB SPEED	FUEL FOR 20 MIN @ GROUND IDLE + 30 SEC @ TAKEOFF/MAXIMUM POWER (A/B IF REQUIRED) + FUEL TO ACCELERATE FROM OBSTACLE CLEARANCE TO CLIMB SPEED @ MILITARY/INTERMEDIATE RATED THRUST. NO DISTANCE CREDIT.					
B	CLIMB			(2)	MINIMUM TIME CLIMB SCHEDULE	SL TO 18,000 FEET	INTERMEDIATE
C	CRUISE			90 NM (2)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
D	DESCENT			(2)		18,000 TO 5,000 FEET	
E	MANEUVER		30 MIN		350 KCAS	SL TO 10,000 FEET BLOCK	
F	CLIMB			(2)	MINIMUM TIME CLIMB SCHEDULE	2,500 TO 18,000 FEET	INTERMEDIATE
G	CRUISE			90 NM (2)	GREATER OF MAX RANGE OR 300 KCAS	18,000 FEET	
H	DESCENT			(2)		18,000 TO 1,000 FEET	
I	2 VFR PATTERNS	TWO PATTERNS CONSISTING OF FUEL FOR 13 NM @ 1,000 FEET PA @ PATTERN SPEED + FUEL TO ACCELERATE TO PATTERN SPEED AND CLIMB FROM SL TO 1,000 FEET @ MIL THRUST. ONE TOUCH & GO. TAKEOFF SEGMENT MAY BE ELIMINATED FOR PATTERN ENDING IN FULL STOP. NO DISTANCE CREDIT. (1)					
J	FULL STOP AND TAXI	NO FUEL USAGE PENALTY					
K	RESERVES		20 MIN	NO CREDIT	MAX ENDURANCE	10,000 FEET	

NOTES: (1) PATTERN SPEED IS 300 KCAS
(2) 90 NM INCLUDES CLIMB/DESCENT DISTANCE

A.14 Mission Usage Rates

Table A-1, Mission Usage Rates

	Flt Hrs/Sortie	Percent of Utilization	Lifetime Hours	Lifetime Sorties	Full-Stop Landings	Touch & Go Landings
SUPT 1 - Transition	1.1	11.9%	950.8	864	864	4320
SUPT 2 - Instrum/Nav	1.3	5.9%	468.2	360	360	1800
SUPT 3 - Low-Level Nav	1.2	1.8%	147.3	123	123	492
SUPT 4 - Formation	1.2	15.0%	1200.5	1000	1000	3000
SUPT 5 - Cross-Country	1.3	3.5%	280.9	216	216	648
IFF 1 - Formation	1.1	12.2%	976.4	888	888	2664
IFF 2 - BFM	0.9	30.6%	2449.0	2721	2721	2721
IFF 3 - ACM	0.9	6.5%	518.6	576	576	576
IFF 4 - BSA	0.9	5.6%	451.4	502	502	502
IFF 5 - SAT	1.1	3.2%	256.1	233	233	233
IFF 6 - CAS	1.1	3.8%	300.9	274	274	274
Totals per lifetime		100%	8000	7757	7757	17230

a. The *aircraft* begins each sortie with maximum fuel weight.
b. The *aircraft* is configured in the *Standard Configuration* for all mission profiles except the Cross-Country profile.
c. For the Cross-Country profile, the *aircraft* is configured with a loaded (140 lbs. worth of gear) Next Generation Cargo Pod as defined in Table 3-38, Loadout #2.
d. Engine operating time to include 20 minutes ground idle before takeoff and 10-minute taxi upon landing.
e. Mission Profiles A.3-A.13 and Table A-1 are to be used as the basis for Design Service Life as defined in section 3.1.3.1.
f. For *aircraft* configurations fully integrating aerial refueling capability (3.4.2.1), the usage shall be defined as follows: 2.5 % of IFF hours will include aerial refueling with 8 contacts/disconnects per hour.

APPENDIX B - ESCAPE SYSTEM CALCULATIONS

B.1 Dynamic Response Index (DRI)

The DRI is representative of the maximum dynamic compression of the vertebral column of the human body. In physical terms, the human body is described mathematically in terms of an analogous, lumped parameter mechanical model consisting of a mass, spring, and damper. DRI was originally developed for catapult phase only; given the acceleration vector is parallel to the spinal column; within 5^o of the z-axis. DRI terms have also been developed for the x-axis (DRI_x) and y-axis (DRI_y) which can be combined with the original z-axis term (essentially DRI_z) to describe acceleration effects on the human body from all axes after the ejection seat has separated from the *aircraft* (see MDRC below). The compression of the human body along an axis, i, is captured by the following second order differential equation:

$$\ddot{\delta}_i(t) + 2\zeta_i\omega_{n_i}\dot{\delta}_i(t) + \left(\omega_{n_i}\right)^2\delta_i(t) = A_i(t)$$

Where:

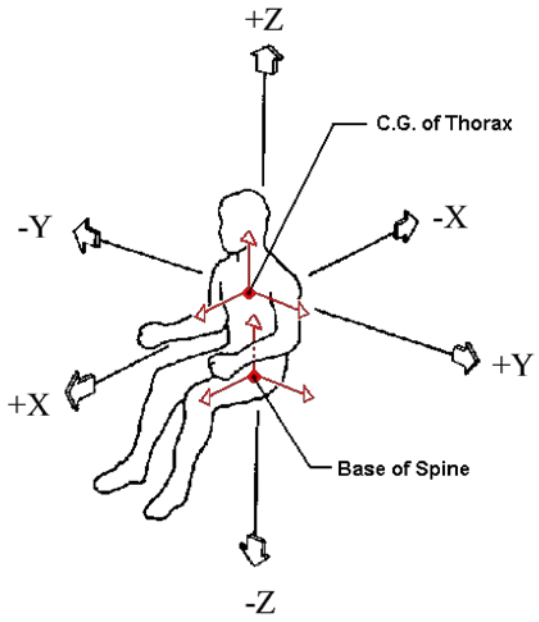
$\delta_i(t)$	Displacement of the occupant's body with respect to the critical point
$\dot{\delta}_i(t)$	Occupant's relative velocity with respect to the critical point
$\ddot{\delta}_i(t)$	Occupant's acceleration in an inertial frame
ζ_i	Damping coefficient ratio of the dynamic system
ω_{n_i}	Undamped natural frequency of the dynamic system
$A_i(t)$	Measured acceleration along the i-axis of the seat at the critical point

The estimated natural frequency and damping ratio for the USAF flying population along each axis direction is given in Table B-1 based on axis orientation as shown in Figure B-1.

5346 **Table B-1, Natural Frequency and Damping Ratio Coefficients**

Axis	Direction	ω_n (rad/s)	ζ
$-X$	Eyeballs Out	60.8	0.04
$+X$	Eyeballs In	62.8	0.2
$-Y$	Eyeballs Left	58.0	0.09
$+Y$	Eyeballs Right	58.0	0.09
$-Z$	Eyeballs Up	47.1	0.24
$+Z$	Eyeballs Down	52.9	0.224

5347 **Figure B-1, Seat and Human Axis Coordinate System**



5348 The dynamic response for each axis is calculated as follows; where g is the acceleration due to
5349 gravity:

5350 $$DR_i(t) = \frac{(\omega_{n_i})^2 \delta_i(t)}{g}$$

5351 At the maximum deflection, the DRI is defined as:

5352 $$DRI_i = \frac{(\omega_{n_i})^2 \delta_i^{max}}{g}$$

5353 **B.2 Multi-axis Dynamic Response Criterion (MDRC)**

5354 MDRC is defined as:

5355 $$MDRC(t) = \sqrt{\left(\frac{DR_x(t)}{DR_x^{lim}}\right)^2 + \left(\frac{DR_y(t)}{DR_y^{lim}}\right)^2 + \left(\frac{DR_z(t)}{DR_z^{lim}}\right)^2}$$

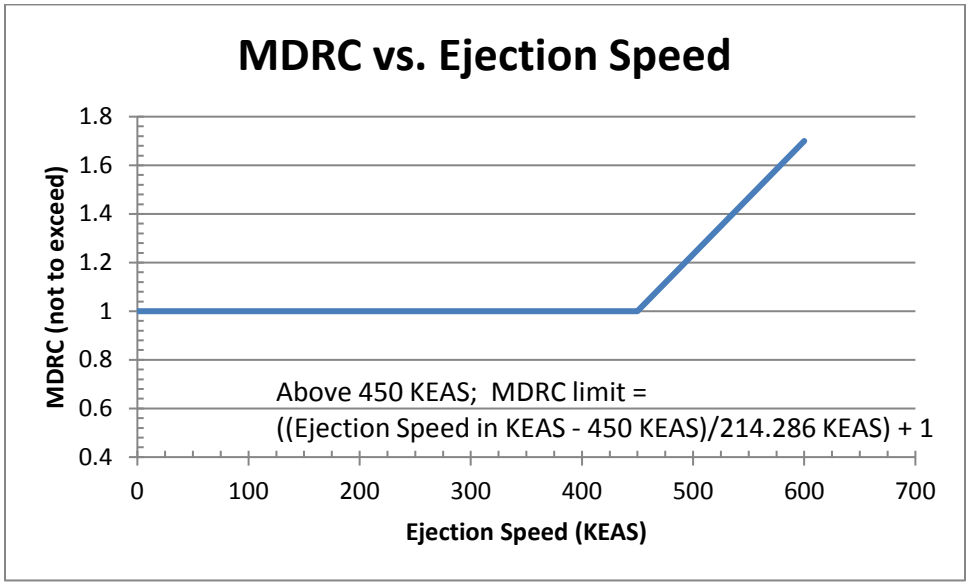
5356 Where:

$DR_{x,y,z}$	The dynamic response values computed for each x-, y-, and z-axis component of the acceleration time history (see paragraph a for calculation method).
$DR_{x,y,z}^{lim}$	The limit value of the dynamic response for each axis direction; as shown in Table B-2.

5357 **Table B-2, MDRC Dynamic Response Limits per Axis**

Axis Direction	Limits (5% Injury Risk)
- X Eyeballs Out +X Eyeballs In	$DR_x^{lim} = 35$ $DR_x^{lim} = 40$
- Y Eyeballs Left +Y Eyeballs right	$DR_y^{lim} = 17$ $DR_y^{lim} = 17$
- Z Eyeballs Up +Z Eyeballs Down	$DR_z^{\lim} = 16.5$ $DR_z^{lim} = 18$

5358 **Figure B-2, Maximum allowable MDRC value vs. Ejection Seat**



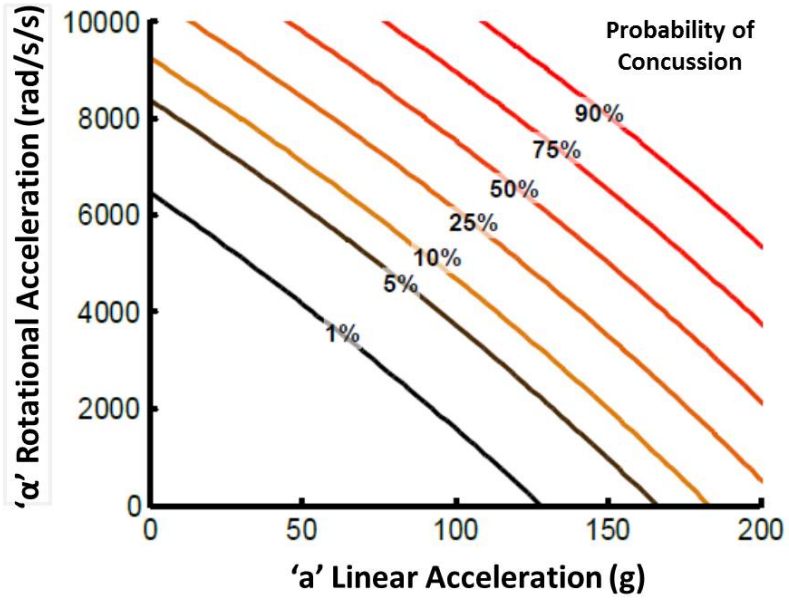
B.3 Head Injury

Head Injury calculations for catapult and free flight drogue phase are calculated using the resultant linear and rotational head accelerations, where ‘a’ is the observed peak linear acceleration and ‘α’ is the observed peak rotational acceleration, as a function of time.

Figure B-3 shows probability of concussion plotted against ‘a’ and ‘α’.

$$P_{concussion} = \frac{1}{1 + e^{-(-10.2+0.0433a+0.000873\alpha-0.00000092a\alpha)}}$$

Figure B-3, Probability of Concussion vs. Rotational and Linear Acceleration



B.4 Neck Injury

a. Multi-Axial Neck Injury Criteria (MANIC) (identified as MANIC(G_y) by Parr) is defined as:

$$MANIC = \sqrt{\left(\frac{F_X}{F_{Xcrit}}\right)^2 + \left(\frac{F_Y}{F_{Ycrit}}\right)^2 + \left(\frac{F_Z}{F_{Zcrit}}\right)^2 + \left(\frac{M_Y}{M_{Ycrit}}\right)^2 + \left(\frac{M_Z}{M_{Zcrit}}\right)^2}$$

b. Neck Moment Index about the x-axis (NMI_X) is defined as:

$$NMI_x = \frac{M_x}{M_{xcrit}}$$

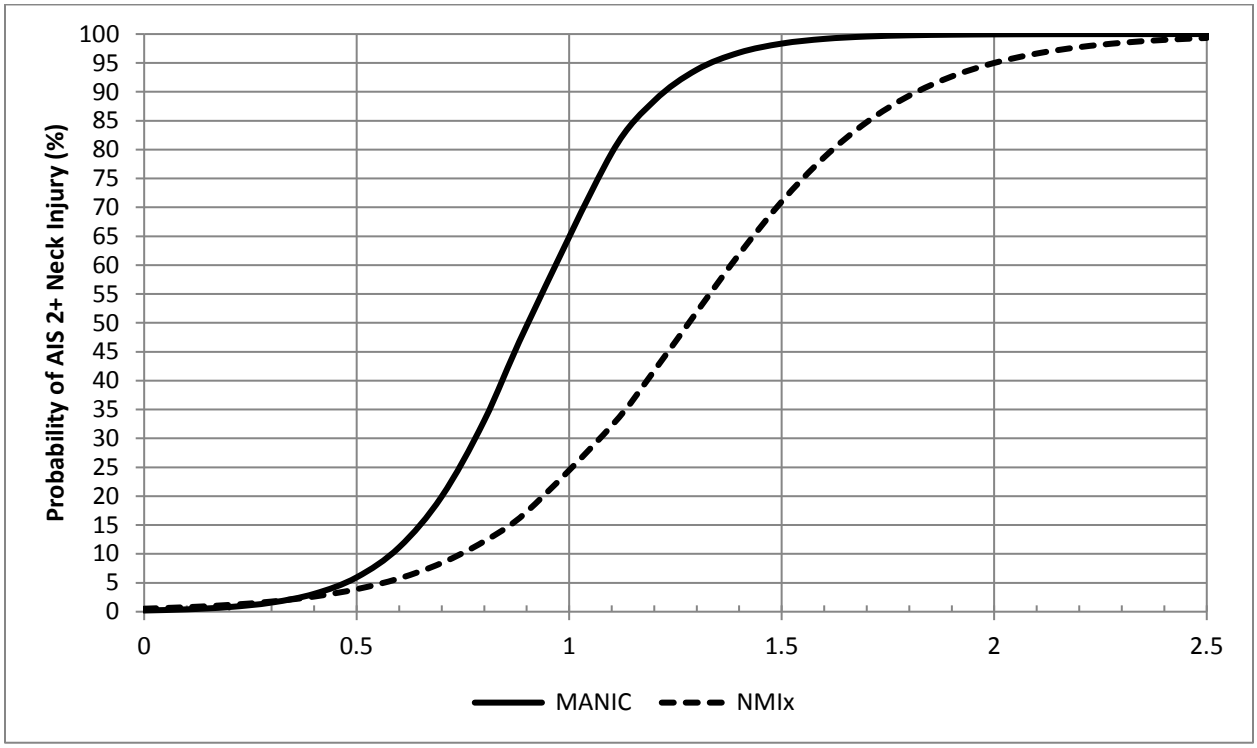
Where (for Appendix 8.4a. and 8.4b calculations):

F_x = observed x direction shear loading
F_{xcrit} = critical intercept value for x direction shear loading
F_y = observed y direction shear loading
F_{ycrit} = critical intercept value for y direction shear loading
F_z = observed axial loading ($+F_z$ = tension, $-F_z$ = compression)
F_{zcrit} = critical intercept value for axial loading (different for tension/compression)
M_x = observed moment about the anatomical x axis (side bending)
M_{xcrit} = critical intercept value for side bending
M_y = observed moment about the anatomical y axis (sagittal plane anterior/posterior bending, $+M_y$ = flexion, $-M_y$ = extension)
M_{ycrit} = critical intercept value for sagittal plane moments (different for flexion/extension)
M_z = observed moment about the anatomical z axis (neck twisting)
M_{zcrit} = critical intercept value for neck twisting

5383 **Table B-3, MANIC and NMIX Upper Neck Critical Values based on Body Mass**

Manikin Neck Size	Manikin Mass	Human Mass	Component	Force		Component	Moment	
	(lbs)	(lbs)		(lbs)	(N)		(in-lbs)	(N-m)
Small Female Hybrid III (for 103-135 pound manikin)	103	<114	F_{xcrit}	405	1802	M_{xcrit}	593	67
			F_{ycrit}			$-M_{ycrit}$ (extens)		
			$-F_{zcrit}$ (comp)	872	3880	M_{zcrit}		
			$+F_{zcrit}$ (tens)	964	4287	$+M_{ycrit}$ (flex)	1372	155
	125	114-130.5	F_{xcrit}	496	2206	M_{xcrit}	845	95
			F_{ycrit}			$-M_{ycrit}$ (extens)		
			$-F_{zcrit}$ (comp)	1099	4889	M_{zcrit}		
			$+F_{zcrit}$ (tens)	1214	5400	$+M_{ycrit}$ (flex)	1939	219
	136	130.5-143	F_{xcrit}	522	2322	M_{xcrit}	912	103
			F_{ycrit}			$-M_{ycrit}$ (extens)		
Mid Male Hybrid III (for 136-199 pound manikin)			$-F_{zcrit}$ (comp)	1157	5147	M_{zcrit}		
			$+F_{zcrit}$ (tens)	1278	5685	$+M_{ycrit}$ (flex)	2094	237
	150	143-161	F_{xcrit}	561	2495	M_{xcrit}	1016	115
			F_{ycrit}			$-M_{ycrit}$ (extens)		
			$-F_{zcrit}$ (comp)	1243	5529	M_{zcrit}		
			$+F_{zcrit}$ (tens)	1373	6107	$+M_{ycrit}$ (flex)	2333	264
	172	161-186	F_{xcrit}	625	2780	M_{xcrit}	1195	135
			F_{ycrit}			$-M_{ycrit}$ (extens)		
			$-F_{zcrit}$ (comp)	1385	6160	M_{zcrit}		
			$+F_{zcrit}$ (tens)	1530	6806	$+M_{ycrit}$ (flex)	2744	310
	200	186-210	F_{xcrit}	683	3038	M_{xcrit}	1364	154
			F_{ycrit}			$-M_{ycrit}$ (extens)		
Large Male Hybrid III (for 200 - 245 pound manikin)			$-F_{zcrit}$ (comp)	1513	6730	M_{zcrit}		
			$+F_{zcrit}$ (tens)	1671	7433	$+M_{ycrit}$ (flex)	3133	354
	220	210-232.5	F_{xcrit}	777	3456	M_{xcrit}	1584	179
			F_{ycrit}			$-M_{ycrit}$ (extens)		
			$-F_{zcrit}$ (comp)	1673	7440	M_{zcrit}		
			$+F_{zcrit}$ (tens)	1847	8216	$+M_{ycrit}$ (flex)	3673	415
	245	232.5+	F_{xcrit}	836	3719	M_{xcrit}	1850	209
			F_{ycrit}			$-M_{ycrit}$ (extens)		
			$-F_{zcrit}$ (comp)	1853	8243	M_{zcrit}		
			$+F_{zcrit}$ (tens)	2047	9106	$+M_{ycrit}$ (flex)	4248	480

Figure B-4, Probability of Neck Injury vs. MANIC and NMIX Values



c. Probability of *AIS* 2+ injury, as plotted in Figure B-4, based on the MANIC value is defined by:

$$P(AIS \geq 2) = \frac{1}{1 + e^{6.185 - 6.85 * MANIC}}$$

d. Probability of *AIS* 2+ injury, as plotted in Figure B-4, based on the Neck Moment Index about the x-axis (NMI_X) value is defined by:

$$P(AIS \geq 2) = \frac{1}{1 + e^{5.2545 - 4.1 * NMIx}}$$

APPENDIX C - STRUCTURES

C.1 Structures Tables

Table C-1only applies to development of the service loads spectra for airframe service life.

Table C-1, Turbulence Parameters

Altitude (K feet)	Mission Segment	Direction (NOTE)	P_1	b_1 (feet/sec)	P_2	b_2 (feet/sec)	L (feet)
0-1	CL, CR, D	Vert & Lat	1.00	2.51	.005	5.04	500
1-2.5	CL, CR, D	Vert & Lat	.42	3.02	.0033	5.94	1750
2.5-5	CL, CR, D	Vert & Lat	.30	3.42	.0020	8.17	2500
5-10	CL, CR, D	Vert & Lat	.15	3.59	.00095	9.22	2500
10-20	CL, CR, D	Vert & Lat	.062	3.27	.00028	10.52	2500
20-30	CL, CR, D	Vert & Lat	.025	3.15	.00011	11.88	2500
30-40	CL, CR, D	Vert & Lat	.011	2.93	.000095	9.84	2500
40-50	CL, CR, D	Vert & Lat	.0046	3.28	.000115	8.81	2500
50-60	CL, CR, D	Vert & Lat	.0020	3.82	.000078	7.04	2500
60-70	CL, CR, D	Vert & Lat	.00088	2.93	.000057	4.33	2500
70-80	CL, CR, D	Vert & Lat	.00038	2.80	.000044	1.80	2500

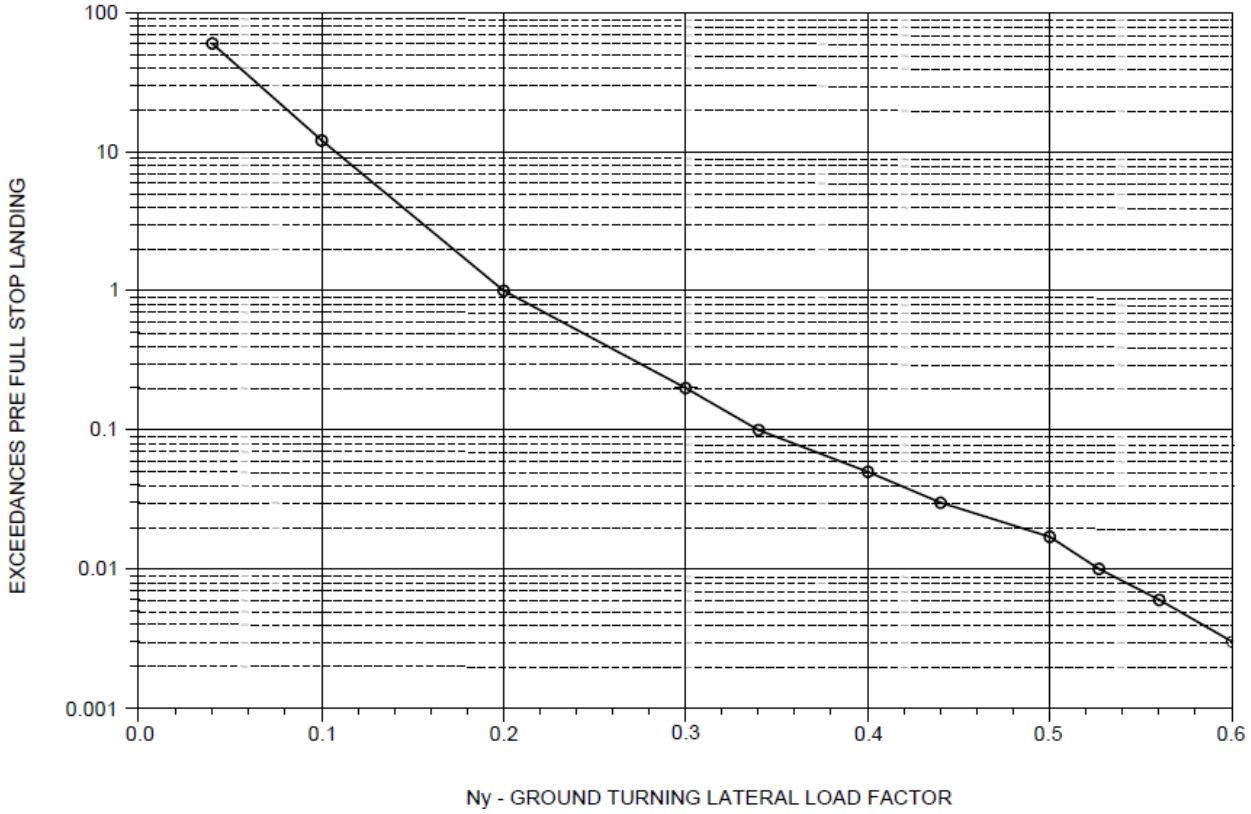
Abbreviations:	CL-climb segment	CR=cruise segment	D=descent segment

NOTE: Parameter values labeled Vert & Lat are to be used equally in both the vertical and lateral directions.

Table C-2, Cumulative Occurrences per Thousand Runway Landings that Load Factor N_z is Experienced at the Aircraft CG

N_z	Cumulative Occurrences
1 ± 0	494,000
1 ± 01	194,000
1 ± 02	29,000
1 ± 03	2,100
1 ± 04	94
1 ± 05	4
1 ± 06	0.155
1 ± 07	0.005
1 ± 08	0

Figure C-1, Ground Turning Lateral Load Factor Spectrum



C.2 Discrete Gust Loads Formulas

C.2.1 Vertical Gusts on Wing and Fuselage

Loads on the wing and fuselage shall be derived from the load factor established from the following formula:

$$n = n_0 \pm \frac{K_W V_e \cdot U_{d_e} \cdot a}{498 W/S}$$

n 1.0

V_e Equivalent airspeed in knots.

U_{d_e} Maximum equivalent gust velocity in feet per second of a single (1-cosine) gust of 25 wing mean aerodynamic chord lengths.

W/S Wing loading in pounds per square foot.

a Rate of change of normal force coefficient C_{N_A} with angle of attack (per radian), corrected for Mach number and aeroelastic effects.

K_W Dimensionless gust factor which accounts for the alleviated motion of the aircraft and the time lag of the build-up of aerodynamic lift. This parameter is based on mass ratio (μ) as

shown in Figure C-2. The subsonic curve shall be used for speeds below the critical Mach number. The mass ratio (μ) is expressed as the equation:

$$\mu = \frac{2W/S}{gca\rho}$$

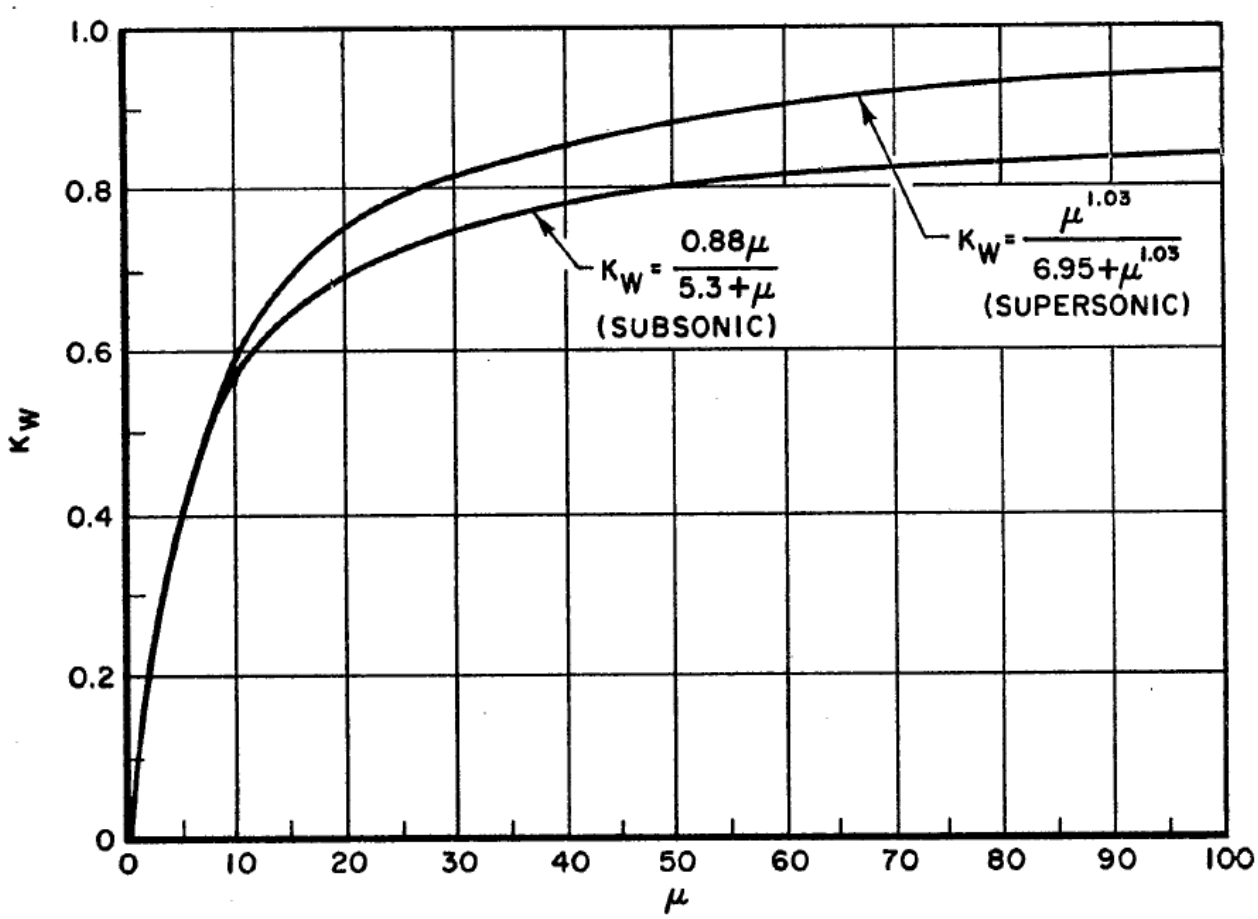
Where:

$g = 32.2\ FPS^2$.

$c =$ average chord, feet (area/span).

$\rho =$ air density, slugs per cubic feet.

Figure C-2, Gust Factor



C.2.2 Vertical Gusts on Fuselage and Horizontal Tail

The horizontal tail shall encounter a gust of design velocity. The incremental load on the tail shall be calculated as follows:

$$\Delta F_{ht} = \frac{K_{W_{ht}}}{498} \cdot U_{d_e} \cdot V_e \cdot S_{ht} \cdot a_{ht} \cdot \left(1 - \frac{d\epsilon}{d\alpha}\right)$$

where a_{ht} is the rate of change of the horizontal tail normal force coefficient with *angle of attack*. The gust factor $K_{W_{ht}}$ shall be equal to 1.1 K_W for the wing for the subcritical regime (K_W from Figure 9-1) and 1.0 K_W for the super-critical regime. No transient lift development shall be considered. The term $\left(1 - {d\epsilon}/{d\alpha}\right)$ represents the steady downwash effect at the tail.

C.2.3 Lateral Gusts on Fuselage and Vertical Tail

Fuselage and vertical tail gusts shall be calculated using the pertinent gust velocities of section 3.1.3.6.1.4 assumed acting horizontally. The tail plane is considered to have an initial sideslip of zero degrees. The incremental load shall be calculated without consideration of unsteady lift phenomena in accordance with the formula:

$$\Delta F_{vt} = \frac{K_{W_{vt}}}{498} \cdot U_{d_e} \cdot V_e \cdot S_{vt} \cdot a_{vt}$$

where $K_{W_{vt}}$ shall be equal to 1.0 and a_{vt} is the rate of change of the vertical tail normal force coefficient with angle of sideslip.

C.3 Power Spectral Technique for Developing Gust Loads

The gust loads shall be based on the gust environment while flying the specified mission profiles. Gust loads spectra shall be determined utilizing the continuous turbulence concept. This concept is based on a power spectral description for atmospheric turbulence and provides for inclusion of the significant rigid body and elastic modes to determine response parameters $\bar{A}$ and N_0. Values of $\bar{A}$ and N_0 shall be determined by dynamic analysis. $\bar{A}$ is defined as the ratio of root mean square load to root mean square gust velocity, expressed as:

$$\bar{A} = \frac{\sigma_\gamma}{\sigma_W} = \left[\frac{\int_0^{\Omega_c} \left|H_\gamma\right|^2 \Phi_W(\Omega) d\Omega}{\int_0^{\infty} \Phi_W(\Omega) d\Omega}\right]^{1/2} units/second$$

N_0 is defined as the characteristic frequency of response or equivalently as the radius of gyration of the load power spectral density function about zero frequency, expressed as:

$$N_0 = \frac{V}{2\pi}\left[\frac{\int_0^{\Omega_c} \Omega^2 \left|H_\gamma\right|^2 \Phi_W(\Omega) d\Omega}{\int_0^{\Omega_c} \left|H_\gamma\right|^2 \Phi_W(\Omega) d\Omega}\right]^{1/2} cycles/second$$

The power spectral density of the atmospheric turbulence is defined by the equation:

$$\Phi_W(\Omega) = \frac{\sigma_W^2 L}{\pi}\left[\frac{1 + \frac{8}{3}(1.339L\Omega)^2}{[1 + (1.339L\Omega)^2]^{11/6}}\right] \frac{ft/sec^2}{Rad/ft}$$

where:

$\Phi_W(\Omega)$ = power spectral density of atmospheric turbulence

σ_W^2 = root mean square gust velocity

Ω = reduced frequency (radians per foot)

L = length variable (feet). See Table C-1, column "L"

H_γ= Frequency response function and is defined over the frequency range of significance as the response (amplitude and phase angle) of the output variable y to a unit sinusoidal excitation.

The frequency of exceedance shall be determined as a function of load level by means of the following equation:

$$N_\gamma = \sum t\, N_0 \left[P_1 exp\left(\frac{-[y - y_{1G}]}{b_1 \bar{A}} \right) + P_2 exp\left(\frac{-[y - y_{1G}]}{b_2 \bar{A}} \right) \right] \; exceedance/second$$

where:

y = net value of load or stress

y_{1G}= value of the load or stress in one-g level flight

t = fraction of total flight time in the given segment

Turbulence field parameters (L, P, and b) are defined in Table C-1. A sufficient number of load and stress quantities shall be included in the dynamic analysis to ensure that stress distributions throughout the structure are realistically or conservatively defined. If a stability augmentation system is utilized to reduce the gust loads, a conservative estimate shall be made of the fraction of flight time that the system may be inoperative. The flight profiles shall include flight with the system inoperative for this fraction of the flight time. When a stability augmentation system is included in the analysis, the effect of system nonlinearities on loads at the limit load level shall be realistically or conservatively accounted for.

The expected utilization of the *aircraft* shall be represented by one or more flight profiles in which the payload and the variations with time of speed, altitude, gross weight, and center of gravity position are defined. The profiles shall be divided into mission segments, or blocks, for analysis. Average or effective values of pertinent parameters shall be defined for each segment.

APPENDIX D - TRADE SPACE

Advanced Pilot Training Program Aircraft System Specification

Requirements Selections and Certifications

Offerors shall select specification requirements in accordance with the instructions in *red italics* below and indicate their intent to have the requirements included in the APT Aircraft System Specification by signing the certification on the last page of this document.

***Trade Space**: Fill in the blank in the requirement statement below with the value representing the proposed solution's performance. Value must be at least 6.5 G. All values must be rounded down to the nearest 0.1 G.*

3.1.2.1 High G Maneuvering

The *aircraft* shall perform (without degradation to the *aircraft* structures, *components*, and systems) the high G maneuvering in accordance with (IAW) section A.1 with a load factor of at least ___ G using the additional performance ground rules defined in section A.1.

***Trade Space**: Fill in the blank in the requirement statement below with the value representing the proposed solution's performance. Value must be at least 20°. All values must be rounded down to the nearest 0.5°.*

3.1.2.6 High Angle-of-Attack (AOA) Maneuvering

The *aircraft* shall perform high *angle-of-attack (AOA)* maneuvering to include, but not limited to the following:

a. 1 G Deceleration with pitch (+2° to -2°) and roll (+30° to -30°) captures
b. 1 G Constant *AOA* Roll
c. Constant *AOA* Maneuver with Air-to-Air Tracking

The *aircraft* shall maintain an *AOA* of at least ___° during the maneuvers while maintaining Level 1 (*Satisfactory*) *flying qualities* and departure resistance using the following additional

performance ground rules: Fuel weight at 50% (relative to maximum fuel capacity), *PA* equal to 15,000 feet, Airspeed no greater than 0.9 Mach and Standard Day.

***Trade Space**: Check the box for one of the two requirements below, depending on whether the offer intends to meet the threshold or objective requirement, ordered respectively.*

☐ **Terrain Warning and Avoidance - Threshold**

3.2.3.5 Terrain Warning and Avoidance

The *aircraft* shall provide a Ground Proximity Warning System (GPWS) integrated with Radar Altimeter, and (for *aircraft* configurations with digital flight control system) include the necessary growth path (i.e., group A and other hardware *components*, excluding software) for installation and integration of an Auto-Ground Collision Avoidance System (Auto-GCAS).

4.2.3.5 Terrain Warning and Avoidance

The GPWS requirement shall be verified by flight test. The Auto-GCAS growth path requirement shall be verified by analysis. The flight test shall consist of verifying that the *aircraft* installed performance conforms to the TAWS Tailored Performance Matrix. The analysis shall verify the growth path for Auto-GCAS. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

☐ **Terrain Warning and Avoidance - Objective**

3.2.3.5 Terrain Warning and Avoidance

The *aircraft* shall integrate an Auto-Ground Collision Avoidance System (Auto-GCAS) that provides automatic recovery of the *aircraft* from any *aircraft* attitude (i.e., upright, banked, dive, inverted, etc.) at aircrew-selectable AGL altitude.

4.2.3.5 Terrain Warning and Avoidance

This Auto-GCAS requirement shall be verified by flight test. The requirement shall be successfully verified when the Government confirms the full content of the requirement is met to the extent that the verification method(s) can provide.

Trade Space: *Check the box to keep the requirement statements below, depending on whether the offer intends to meet the objective requirement. If offer does not intend to meet the objective requirement, then leave the box blank and sign your initials here:* _____

☐ **Ground Based Training Systems (GBTS) Connectivity Requirement**

3.2.4.5 Ground Based Training Systems (GBTS) Connectivity

Without any degradation to aircraft-to-aircraft network operations, the datalink shall provide data exchange between the *aircraft* and *Ground Based Training System* (*GBTS)* components (WST and OFT) with sufficient *data rate*, sufficient *link margin*, and no *objectionable latency* to support up to 12 *GBTS* components operating concurrently on the network and to enable the conduct of multi-ship missions involving *aircraft* and *GBTS* components (up to 8 participants in any combination of *aircraft*/*GBTS* components) within the Connectivity Region of the datalink. (Note: *GBTS* components and supporting ground datalink are collocated and within 100 NM line-of-sight from local flying area. *GBTS* components on the network are over and above the specified number of *aircraft* defined in section 3.2.4.3.)

3.2.4.5.1 GBTS Voice Communication

The *aircraft* shall provide two-way voice communication with *GBTS* components (WST and OFT) via either the datalink or a voice radio channel, using operator audio interface (headset and microphone), and without the need for operational multi-mode (VHF/UHF) radios in the *GBTS* components. (Note: Voice communication support for up to 12 *GBTS* components operating concurrently within 100 NM line-of-sight from local flying area.)

4.2.4.5 Ground Based Training Systems (GBTS) Connectivity

The requirement shall be verified by analysis and flight demonstration. The analysis shall consist of modeling and simulation to evaluate the data link throughput performance under different loading conditions. The flight demonstration shall consist of flying multi-ship test missions utilizing *aircraft* and GBTS components (WST and OFT). The test missions shall include *Embedded Training* system operations between the *aircraft* and *GBTS*. The verification shall be considered successful when the analysis and flight demonstration shows that the *aircraft* datalink provides the specified capability.

4.2.4.5.1 GBTS Voice Communication

The requirement shall be verified by flight demonstration. The flight demonstration shall consist of flying multi-ship test missions utilizing *aircraft* and GBTS components (WST and OFT). The test missions shall include *Embedded Training* system operations between the *aircraft* and *GBTS*. The verification shall be considered successful when the flight demonstration shows that the *aircraft* provides the specified capability.

Trade Space: *Check the box to keep the requirement statements below, depending on whether the offer intends to meet the objective requirement. If offer does not intend to meet the objective requirement, then leave the box blank and sign your initials here:* _____

☐ **Ground Support Station (GSS) Connectivity**

3.2.4.6 Ground Support Station (GSS) Connectivity

Without any degradation to aircraft-to-aircraft network operations, the datalink shall provide data exchange (including GSS-to-aircraft two-way text messaging) between the *aircraft* and GSS with sufficient *data rate*, sufficient *link margin*, and no *objectionable latency* to support up to 3 GSSs operating concurrently on the network and to enable the GSS live monitoring IAW section 3.2.4.6.2 and real-time mission scenario inputs IAW 3.6.7, within the Connectivity Region of the datalink. (Note: GSS and supporting ground datalink are collocated and within 100 NM line-of-sight from local flying area. GSS(s) on the network are over and above the specified number of *aircraft* defined in section 3.2.4.3)

3.2.4.6.1 GSS Voice Communication

The *aircraft* shall provide two-way voice communication with GSS via either the datalink or a voice (VHF/UHF) radio channel. (Note: Voice communication support for up to 3 GSSs operating concurrently within 100 NM line-of-sight from local flying area.)

3.2.4.6.2 GSS Live Monitoring

The GSS shall provide the live tactical picture of the training missions and display mission data IAW Table 3-3 to enable the GSS operator to effectively inject real-time mission scenario inputs into the independent missions.

Table 3-3, GSS Live Monitoring Functions and Display Presentation

a. *Aircraft* track with unique identifier, airspeed and altitude (*GBTS* is considered an *aircraft* for APT configurations if implementing *GBTS* Connectivity). b. Weapons event data. c. Threat/Target event data. d. Two-dimensional plan view of Local Flying Area (includes elevation contours, surface targets and range boundaries). e. Capability to zoom and pan. f. Capability to filter information by mission. g. Capability to compose and send text messages to a specific *aircraft*, to all participant *aircraft* in an individual mission, and to all *aircraft* in the local flying area.

4.2.4.6 Ground Support Station (GSS) Connectivity

The requirement shall be verified by analysis and flight demonstration. The analysis shall consist of modeling and simulation to evaluate the data link throughput performance under different loading conditions. The flight demonstration shall consist of flying single-ship and multi-ship test missions. The test missions shall include *Embedded Training* system operations between the *aircraft* and GSS. The verification shall be considered successful when the analysis and flight demonstration shows that the *aircraft system* provides the specified capability.

4.2.4.6.1 GSS Voice Communication

The requirement shall be verified by flight demonstration. The flight demonstration shall consist of flying single-ship and multi-ship test missions. The test missions shall include *Embedded Training* system operations between the *aircraft* and GSS. The verification shall be considered successful when the flight demonstration shows that the *aircraft system* provides the specified capability

4.2.4.6.2 GSS Live Monitoring

The requirement shall be verified by flight demonstration. The flight demonstration shall consist of flying single-ship and independent multi-ship test missions. The test missions shall include *Embedded Training* system operations between the *aircraft* and GSS. The verification shall be considered successful when the flight demonstration shows that the *aircraft system* provides the specified capability.

Trade Space: *Check the box to keep the requirement statements below, depending on whether the offer intends to meet the objective requirement. If offer does not intend to meet the objective requirement, then leave the box blank and sign your initials here:* _____

☐ Aerial Refueling Full Integration (Receiver)

3.4.2.1 Aerial Refueling Subsystem Full Integration (Receiver)

When the *aircraft* is configured with the fully integrated receptacle aerial refueling system, the following requirements shall also be met (over and above what is specified in section 3.4.2):

a. The *aircraft* shall be capable and compatible to aerial refuel as a receiver during day and night operations from the USAF KC-135 and KC-10 tanker boom systems using ATP 3.3.4.2 (Chapter 2) procedures and with KC-46 tanker boom system IAW KC-46 Interface Control Document for Receivers.
b. The *aircraft's* receptacle installation shall comply with NATO ATP 3.3.4.5, Section II interface requirements.

c. The receptacle installation and operation shall not degrade the performance of other subsystems such as: electrical system, hydraulic system, fuel system, fire protection, flight controls or aircrew egress.
d. The *aircraft* shall be capable of being aerial refueled from 15% fuel capacity to maximum fuel capacity or to its maximum in-flight gross weight (whichever is least) in less than 8 minutes.
e. Both aircrew positions shall have the required controls and indicators for each aircrew member to individually accomplish the rendezvous and aerial refueling tasks.
f. The *aircraft*, while engaged as a receiver, shall be able to maneuver (up to 30° bank) throughout the boom envelope of each tanker at all receiver permissible center of gravity (CG) ranges and gross weights up to *aircraft* maximum in-flight refuelable fuel capacity or maximum in-flight gross weight (whichever is least).
g. The *aircraft* shall provide an automated and manual (Receiver aircrew initiated) method to disconnect from the boom, while engaged as a receiver.
h. The *aircraft* shall provide a method to isolate the receptacle from the rest of the fuel system. The *aircraft* shall control fuel transfer sequencing and maintain CG throughout all *aircraft* on-loads without aircrew action.
i. The *aircraft* shall have external lighting IAW NATO ATP 3.3.4.5, Section II.
j. The *aircraft* shall provide independent control (on/off) of the upper rotating beacon light.
k. The *aircraft's* paint scheme shall have the applicable/appropriate markings for aerial refueling IAW NATO ATP 3.3.4.5, Section II.
l. The aerial refueling receptacle and surrounding area shall be free of obstructions and shall not need to be replaced for the *design service life* of the *aircraft* based on the usage defined in section A.14.

4.4.2.1 Aerial Refueling Subsystem Full Integration (Receiver)

The requirement shall be verified by analysis, inspection, ground test and flight test. The analysis shall include a detailed description of the subsystem and interfaces. The inspection shall include drawings and the *aircraft*. The ground test shall include the testing required to proceed to flight test (e.g., Iron bird testing or fuel system mock-up testing) as directed by the certification authority. The flight test shall be up to and including the contact position behind a KC-135, KC-46 and KC-10 tanker throughout the *aircraft's* refueling envelope with successful on-load of fuel at the required rate. The verification shall be satisfied with the issuance of a Category 3 Aerial Refueling Clearance per ATP 3.3.4.2 Annex BA to refuel as a receiver from the KC-135, KC-10 and KC-46 tankers during day and night ambient conditions.

Trade Space: *Check the box to keep the requirement statements below, depending on whether the offer intends to meet the objective requirement. If offer does not intend to meet the objective requirement, then leave the box blank and sign your initials here:* _____

☐ **Targeting Pod System Simulation**

3.6.6 Targeting Pod System Simulation

The *aircraft* shall provide unclassified targeting imagery, controls and switchology for aircrew to employ a simulated Targeting Pod system per Table 3-31. Targeting Pod system functionality shall be HOTAS-selectable via the *HOTAS controls*.

Table 3-31, Targeting Pod Functionality

a. Air-to-ground mode b. Forward looking infrared (FLIR) sensor c. Charge-coupled device (CCD) television sensor d. Laser range finder e. Long-range GPS geo-coordinates for weapons f. Variable field of view (super wide (24 degrees), wide (4 degrees) and narrow (1 degree)) g. Variable zoom levels h. Exchange of imagery between *aircraft* (*GBTS* is considered an *aircraft* for APT configurations if implementing *GBTS* Connectivity)

4.6.6 Targeting Pod System Simulation

The requirement shall be verified by ground demonstration and flight demonstration. The ground demonstration shall consist of demonstrating (off-aircraft) the specified Targeting Pod system capability. The flight demonstration shall consist of demonstrating the specified system capability including exchange of imagery between *aircraft* (*GBTS* is considered an *aircraft* for APT configurations if implementing *GBTS* Connectivity). The verification shall be considered successful when the ground demonstration and flight demonstration show that the specified system capability is provided.

***Trade Space**: Fill in the blank in the requirement statement below with the value representing the proposed solution's performance. Value must be no greater than 45 minutes. All values must be rounded up to the nearest 1 minute.*

3.8.8 Turn-Around Time

The *aircraft* Turn-Around Time shall not exceed ___ minutes. Servicing of *aircraft* systems/subsystems/*components* (i.e., fuel, oxygen, oil and electrical) shall be accomplished sequentially. Not more than two maintainers shall be required to perform the turn around. (Note: Turn-Around Time is defined as the clock time required to prepare a returned mission capable *aircraft* upon mission termination for issue to the next aircrew. The Turn-Around Time begins at engine shutdown of the previous mission and ends when the *aircraft* is reported ready for issue to the next aircrew.)

The aforementioned requirement statements in this document, identified by title and paragraph number, are intended to be incorporated into the APT System Specification and are hereby part of the offer made to the Government in response to RFP FA8617-16-R-6219.

_____

Company Name

Signed: _____

Name and Title (authorized to legally bind the company)

_____

Date