SYSTEM REQUIREMENTS DOCUMENT (SRD)

NEXT GENERATION EJECTION SEAT (NGES)
FOR THE A-10, F-15, F-16, F-22, AND B-1B

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1. SCOPE

1.1 Scope. This System Requirements Document establishes the requirements for the Next Generation Ejection Seat (NGES), which will replace the legacy Advanced Concept Ejection Seat (ACES) II ejection seat and integrate with the existing crew ejection seat escape systems on the A-10, F-15, F-16, F-22, and B-1B aircraft.

1.2 System objective. The objective of the NGES is to provide seating accommodation during normal flight operations, a means of safe escape for the entire USAF anthropometric flying population, and a modular structure that does not require removal of the A-10, F-15, F-16, F-22, or B-1B escape hatches/canopies for any maintenance task requiring seat removal.

1.3 Basis. This SRD is based upon the individual specifications for the A-10, F-15, F-16, F-22, and B-1B platforms, amended with updated Air Combat Command (ACC) and Air Force Global Strike Command (AFGSC) requirements to improve the safety and sustainability of the system.

2. APPLICABLE DOCUMENTS

2.1 Government documents. The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

2.1.1 Military specifications.

MIL-C-25918 Amendment 2 6 Oct 1965	Cartridge Actuated Devices, Aircraft Crew Emergency Escape, General Specification for
MIL-C-83124 30 Oct 1969	Cartridge Actuated Devices / Propellant Actuated Devices, General Design Specification for
MIL-C-83125 10 Mar 1969	Cartridge for Cartridge Actuated / Propellant Actuated Devices, General Design Specification for
MIL-D-81980 24 Sep 1974	Design and Evaluation of Signal Transmission Subsystems: General Specification for
MIL-D-81980 Amendment 1 14 Aug 1975	Design and Evaluation of Signal Transmission Subsystems: General Specification for
MIL-DTL-23659F 10 Jun 2010	Initiators, Electric, General Design Specification for
MIL-DTL-25579H 3 Oct 2014	Hose Assembly, Polytetrafluoroethylene, High Temperature, Medium Pressure, General Specification for
MIL-P-83126A 8 Feb 1980	Propulsion Systems, Aircrew Escape, Design Specification for
MIL-R-8236F Amendment 1 03 Nov 1995	Reel, Shoulder Harness, Inertia Lock

2.1.2 Standards.

2.1.2.1 Federal.

49 CFR 173.124	Department of Transporation Flammable Solid Definitions
SAE-AMS-STD-595A Change Notice 1 01 Feb 2017	Colors Used in Government Procurement

FAR 25.853	Federal Avaiation Regulation Compartment Interiors
NASM33540	Safety Wiring and Cotter Pinning, General Practices for
NASM33588	Nut, Self-Locking, Aircraft, Reliability and Maintainability Usage Requirements for

2.1.2.2 Military.

MIL-STD-1247D Notice l 14 Jul 2014	Markings, Functions and Hazards Designations of Hose, Pipe, and Tube Lines for Aircraft Missile, and Space Systems
MIL-STD-130N Change 1 16 Nov 2012	Identification Marking of U.S. Military Property
MIL-STD-1472G 11 Jan 2012	Human Engineering
MIL-STD-461G 11 Dec 2015	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-464C 1 Dec 2010	Electromagnetic Environmental Effects Requirements for Systems
MIL-STD-470B 30 May 1989	Maintainability Program for Systems and Equipment
MIL-STD-704F Change 1 5 Dec 2016	Aircraft Electric Power Characteristics
MIL-STD-7080 31 May 1994	Selection and Installation of Aircraft Electric Equipment
MIL-STD-721C Notice 2 12 Jun 1981	Definitions of Terms for Reliability and Maintainability
MIL-STD-810G Change 1 15 April 2014	Environmental Engineering Considerations and Laboratory Tests
MIL-STD-882E 11 May 2012	System Safety

2.1.3 Publications.

AF Drawing 52C1543	Streamer Assembly - Warning, Flight Status
JSSG-2010-11 30 Oct 1998	Crew Systems Emergency Egress Handbook
AFSC DH 2-2 Revision 2 5 Apr 1991	Crew Stations and Passenger Accommodations Handbook
MIL-HDBK-454B 15 Apr 2007	General Guidelines for Electronic Equipment
MIL-HDBK-838 3 Dec 1997	Lubrication of Military Equipment
MIL-HDBK-5400 30 Nov 1995	Electronic Equipment, Airborne, General Guidelines for
MIL-HDBK-516C 12 Dec 2014	Airworthiness Certification Criteria
MIL-HDBK-516C Change Notice 5 9 Nov 2016	Change Notice: Section 9.1.1, Escape System Safety Compatibility
TO 14S1-11-3 31 Dec 1998	ACES II Survival Kits
AFRL-HE-WP-TR- 2002-0118 Jan 2002	Body Size Accommodation in USAF Aircraft

2.2 Non-government documents. Documents pertaining to "legacy" or "existing" aircraft specifications will be provided by the prime airframe manufacturer of the respective aircraft through Associated Contractor Agreements (ACA).

2.2.1 Publications

ASTM D2261-96 2002	Standard Test Method for Tearing Strength of Fabrics by the Tongue (Single Rip) Procedure (Constant-Rate-of-Extension Tensile Testing Machine)

ASTM D3511-16 2016	Standard Test Method for Pilling Resistance and Other Related Surface Changes of Textile Fabics: Brush Pilling Tester
ASTM D4157-13 2013	Standard Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)
ASTM D6413-15 2015	Standard Test Method for Flame Resistance of Textiles (Vertical Test)

3. SYSTEM REQUIREMENTS

3.1 General.

3.1.1 Requirements. The NGES system requirements specified herein shall be separated into the following categories: general, compatibility, characteristics, design and construction, major subsystems, and logistics. Objective requirements are the desired level of performance and are denoted by (O). Threshold requirements are the minimum acceptable level of performance that must be met and are denoted by (T). If neither (O) nor (T) is designated, the requirement is the minimum acceptable level of performance. The term "seat system" shall refer to the NGES seat system that satisfies the requirements herein. The term "legacy" shall refer to the A-10, F-15, F-16, F-22, and B-1B configurations of the ACES II ejection seat.

3.1.2 Item definition. For this specification, the term "seat system" shall refer to the following major subsystems and their components:

a. *Seat assembly (or Seat System)*– A complete ejection seat consisting of all seat components including the seat structural assembly, energetics, adjustment actuators, and installed components.

b. *Seat Structural Assembly* – The primary structural components of the seat including linkages, controls, and mechanical mechanisms minus energetics and installed equipment.

c. *Energetic components* – Any components that produce power through propellant/explosive devices, or chemical/electrical energy including but not limited to: ejection initiators, gas generators, catapult, rocket motors, mortars, severance cutters, thrusters, thermal batteries and various detonation or explosive energy transmission lines.

d. *Seat adjustment actuator* – An electromechanical device that can adjust the seat or crew sitting position to accomodate anthropmentric crew variations.

e. *Installed equipment* – any non-energetic components that can be removed without disassembling the seat structural assembly, including but not limited to: recovery sequencers, inertia reels, airspeed/altitude sensors, drogue parachute, recovery parachute assembly, and routine maintenance items such as the seat cushion, back pad, emergency oxygen, lap belt, and survival kit.

3.1.3 Design commonality. The individual left, right, fore, or aft seat systems shall be identical to each other in all respects, except where configuration differences are essential for unique left, right, fore or aft crew station applications. Likewise, the NGES system shall maximize commonality of parts amongst all five aircraft platform configurations.

3.2 Compatibility.

3.2.1 Aircraft compatibility. Ejection seat variations, mandatory to accommodate aircraft platform interface inconsistencies, shall be permitted. The seat system and variations shall not require modifications to the aircraft interfaces in accordance with (IAW) applicable aircraft Interface Control Documents (ICD). The ejection seat shall be compatible with the existing ejection seat guide rails, emergency oxygen interfaces (including floor attachment as required), electrical power and connection, SAFE/ARM status indicator wiring, Helmet Mounted Device

(HMD) seat position sensors, crew station ejection clearance envelope, transparency, and all crew station controls. All aircraft modifications must be performed at the operational level and be completed in less than eight clock hours or 25 man hours.

3.2.1.1 Structral compatibility. With respect to both normal flight operations and ejection loads, the ejection seat shall not require any aircraft structural modifications with the exception of minor secondary structural modifications to accommodate the limb restraint stowage and attachment points as approved by the procurement agency. The seat system operational loads shall not damage the aircraft structure in a way that prohibits safe ejection IAW this specification.

3.2.1.2 Aircaft escape path clearance and sequencing system compatibility. An ejection seat variant for each aircraft shall be fully compatible with the existing aircraft sequencing systems including the ejection initiation interface and catapult/rocket motor initiation interface with energetic transmission line variations specific to each platform. The seat system shall maintain compatibility with the relevant canopy/hatch removal and interseat sequencing timing and delays. The seat system shall not further encroach on the existing cockpit ejection clearance envelope unless demonstrated to provide no increased injury risk.

3.2.1.3 Aircraft maintenance and inspection compatibility. The ejection seat shall be compatible with platform unique legacy seat maintenance position capability requirements. Seat installation and maintenance position capability shall permit all current aircraft maintence and inspection tasks currently defined in aircraft platform Technical Orders that do not require seat removals.

3.2.2 Personal services and equipment compatibility. The ejection seat shall be fully compatible with the connections, disconnects, and functional capabilities for legacy crew member personal services, including communication cables, oxygen supply lines, HMD cables/connectors, and pressure garment (g-suit) supply lines. The seat restraint system, inertial reel connections, survival kit connections, and recovery parachute connections shall incorporate the legacy torso-harnesses specified below. The torso harness shall be retained by the crew member during normal ingress/egress. The seat system shall comply with the functional capabilities and requirements specified herein for crew members wearing any combination of required clothing and equipment as specified in TABLE 1.

TABLE 1. Aircrew Flight Equipment (AFE)

Descriptive Nomenclature	**A-10**	**F-15**	**F-16**	**F-22**	**B-1B**
Aircrew Ensembles					
Integrated Aircrew Ensemble (IAE)	X	X	X	X	X
Next Generation Aircrew Protective Ensemble (NGAPE)	X	X	X	X	
Aircrew Flight Clothing					
CWU-27/P Flyer’s Coverall (Summer)	X	X	X	X	X
CWU-27/P Flyer’s Coverall (Tan)	X	X	X	X	X
CWU-64/P Flyer’s Coverall (Winter)	X	X	X	X	X
CWU-45/P Jacket (Winter)	X	X	X	X	X
CWU-36/P Jacket (Summer)	X	X	X	X	X
Flyer’s Winter Hood	X	X	X	X	X

Descriptive Nomenclature	A-10	F-15	F-16	F-22	B-1B
Flyer's Gloves (GS/FRP-2)	X	X	X	X	X
Flyer's Gloves Inserts (Cold Weather)	X	X	X	X	X
IAE Integrated Flight Layer (IFL) Coverall	X	X	X	X	X
IAE Underlayers	X	X	X	X	X
<u>Multi-Climate Protective System</u>					
CWU-88/P Shirt, Men's Silkweight	X	X	X	X	X
CWU-89/P Shirt, Women's Silkweight	X	X	X	X	X
CWU-90/P Drawers, Men's Silkweight	X	X	X	X	X
CWU-91/P Drawers, Women's Silkweight	X	X	X	X	X
CWU-92/P Shirt, Men's Midweight	X	X	X	X	X
CWU-93/P Shirt, Women's Midweight	X	X	X	X	X
CWU-94/P Drawers, Men's Midweight	X	X	X	X	X
CWU-95/P Drawers, Women's Midweight	X	X	X	X	X
CWU-96/P Shirt, Men's Heavyweight	X	X	X	X	X
CWU-97/P Shirt, Women's Heavyweight	X	X	X	X	X
CWU-98/P Drawers, Men's Heavyweight	X	X	X	X	X
CWU-99/P Drawers, Women's Heavyweight	X	X	X	X	X
CWU-100/P Jacket, Men's Fleece	X	X	X	X	X
CWU-101/P Jacket, Women's Fleece	X	X	X	X	X
CWU-102/P Vest, Men's Fleece	X	X	X	X	X
CWU-103/P Vest, Women's Fleece	X	X	X	X	X
CWU-104/P Overalls, Men's, Cold Weather Fleece	X	X	X	X	X
CWU-105/P Overalls, Women's, Cold Weather, Fleece	X	X	X	X	X
CWU-106/P Jacket, Men's Waterproof Outershell	X	X	X	X	X
CWU-107/P Jacket, Women's Waterproof Outershell	X	X	X	X	X
CWU-108/P Trousers, Men's Waterproof Outershell	X	X	X	X	X
CWU-109/P Trousers, Women's Waterproof Outershell	X	X	X	X	X
IAE Thermal Underlayers	X	X	X	X	X
Cold Weather Aviation System (CWAS)	X	X	X	X	
<u>Bladder Relief Device</u>					
Advanced Mission Extender Device (AMXD) Max	X	X	X	X	X
<u>Aircrew Laser Eye Protection (ALEP)</u>					
ALEP Block II Day[1,2]	X	X	X	X	X
ALEP Block II Night[2]	X	X	X	X	X
JHMCS Compatible ALEP Spectacle (JCAS)[3]		X	X		
<u>Mask Equipment</u>					
MBU-12/P Oxygen Mask	X	X	X		X
MBU-20/P Combat Edge Mask	X	X	X	X	
MBU-20A/P Oxygen Mask (Non-PBG)	X	X	X	X	X

Descriptive Nomenclature	A-10	F-15	F-16	F-22	B-1B
CRU-60/P Oxygen Connector	X	X	X		
CRU-94/P Oxygen Connector		X	X	X	
CRU-120/A Connector (OBOG Systems Only)			X		
CRU-122/A Connector (OBOG Variant Systems Only)				X	
CRU-60/P Oxygen Connectors (G002-4240-01)	X	X			X
Gentex Mask Light	X	X	X	X	
JSAM Tactical				X	
Helmets					
HGU-55/P	X	X	X		X
HGU-55/P, High-Speed	X	X	X	X	X
HGU-55/P L/W, Light-Weight	X	X	X	X	X
HGU-55A/P, JHMCS		X	X		
Helmet-Mounted Equipment					
PLZT					X
PLZT Top Latch Mount					X
Helmet Mounted Cueing System (HMCS)	X				
HMIT / Scorpion HMD	X		X		
HoBIT (HMD)	X		X		
Attenuating Custom Communication Earpiece System (ACCES)	X	X	X	X	X
Joint Helmet Mounted Cueing System (JHMCS)		X	X		
Anti-Exposure Suits					
CWU-22/P Batted Underwear	X	X	X	X	X
CWU-23/P Liner	X	X	X	X	X
CWU-43/P Aramid Underwear	X	X	X	X	X
CWU-44/P Aramid Underwear	X	X	X	X	X
CWU-62A/P Coverall	X	X	X	X	X
CWU-62B/P Coverall	X	X	X		X
CWU-74/P Coverall	X	X	X	X	X
CWU-86/P Coverall	X	X	X	X	X
OTS-600 Dry Suit (601GBR005B)	X	X	X	X	X
IAE Environmental Protection Layer (EPL)	X	X	X	X	X
Anti-G Garments					
CSU-13B/P Anti-G Trouser	X	X	X		
CSU-17/P Anti-G Vest		X	X	X	
CSU-22/P Anti-G Trouser		X	X		
CSU-23/P Anti-G Trouser				X	
Torso Harness Assembly					
PCU-15 Series Harness	X	X	X	X	X
PCU-16 Series Harness	X	X	X	X	X
MXU-22/P Lumbar Pad	X	X	X		X
PCU-22/P Lumbar Pad					X
Koch Gen I Canopy Release	X	X			
Koch Modified Gen II Canopy Release	X	X	X		X

Descriptive Nomenclature	A-10	F-15	F-16	F-22	B-1B
Frost Canopy Release			X	X	X
PCU-63(V)/P Universal Water Activated Release System	X	X	X	X	X
Personnel Lowering Device (PLD)					
PCU-10/P	X	X	X	X	X
PCU-21/P					X
Survival Vests					
SRU-21/P	X	X	X	X	X
IAE Survival Vest	X	X	X	X	X
Airsave Survival Vest	X	X	X	X	
Air Ace Survival Vest	X	X	X	X	X
Chemical Defense Equipment					
Cotton Undershirt	X	X	X		X
Cotton Drawers	X	X	X		X
CWU-66/P Coverall	X	X	X	X	X
Chemical Protective Gloves (Butyl)	X	X	X	X	X
Chemical Protective Glove Inserts	X	X	X	X	X
MBU-13/P Mask	X	X	X		
HGU-41/P Hood	X	X	X		
MBU-19/P Mask-Hood	X	X	X		X
CQU-7/P	X	X	X		X
MXU-835/P Communication Unit	X	X	X		X
Night Vision Systems					
AN/AVS-9 (4949 G Series)	X	X	X	X	X
AN/AVS-10 (PNVG)	X	X	X		
Life Preservers					
LPU-9/P	X	X	X		X
LPU-10/P					X
LPU-38/P	X	X	X	X	X
IAE LPU	X	X	X	X	

[1] Block II Day is qualified on F-16 (Block 30), F-15 (D and E)

[2] F-16 (Block 40 and 50), F-15 (C and E) are the platforms that fly with JHMCS

[3] JCAS is qualified on the following platforms: F-16 (Block 40 and 50), F-15 (C and E) which are the platforms that fly with JHMCS

3.2.3 Electrical power compatibility.

3.2.3.1 Electrical power supply. The seat system shall be compatible with the power characteristics and limits as supplied to the legacy ejection seat on specified aircraft platforms. The seat system shall perform IAW the requirements herein when supplied with electrical power having the characteristics and limits defined in MIL-STD-704.

3.2.3.2 Electrical power usage. The seat system maximum steady-state electrical power shall not exceed the aircraft platform's technical specifications.

3.2.3.3 Momentary power interruptions. The seat system shall automatically recover after a momentary power interruption (as defined in MIL-STD-704) upon resumption of normal power within the time periods of TABLE 2.

TABLE 2. Electrical Power Interruption

Power Interruption Time	Performance Requirements
0 to 0.050 seconds	IAW MIL-STD-704, Section 4.2.2
0.050 or greater	IAW this specification

3.3 Characteristics.

3.3.1 *Performance*

3.3.1.1 Ejection position. The seat system shall eject IAW this specification from any position within its vertical/horizontal adjustment range.

3.3.1.2 Ejectable occupant weight. The seat system shall perform IAW this specification for any appropriate combination of aircrew nude weight (103 – 245 lbs), aircrew flight equipment weight (TABLE 1), and survival kit contents weight (15-40 lbs, TABLE 8, ref TO 14S1-11-3) for a total ejectable occupant weight range from a minimum of 138 lbs to a maximum of 337 lbs.

3.3.1.3 Escape envelope. The seat system shall perform IAW this specification for all level flight conditions from 0 to 600 KEAS and altitudes of 0 to 60,000 feet.

3.3.1.4 Terrain clearance. The seat system shall perform IAW this specification at the low altitude, adverse attitude conditions specified in TABLE 3.

TABLE 3. Low Level Escape Performances

A-10 / F-15 [1]

Attitude [°]		Velocity [knots]	Altitude Required [ft] for percentile noted		
Fore & Aft	Roll Angle		5th	50th	95th
Level	60	120	0 [2]	0 [2]	0 [2]
Level	180	150	152	147	143
Level	0	150	107 [3]	115 [3]	124 [3]
60 down	0	200	332	335	338
30 down	0	450	484	503	524
60 down	60	200	357	360	364
45 down	180	250	464	465	465

1. Unless otherwise specified, the cited conditions are at the initiation of the rocket catapult. Altitudes shown are nominal for parachute first fill.
2. Impact occurs at instant of seat-aircraft separation.
3. 10,000 ft/min sink rate.

F-16 [1]

Attitude [°]		Velocity [knots]	Altitude Required [ft] [2] for percentile noted		
Fore & Aft	**Roll Angle**		**5th**	**50th**	**95th**
Level	60	120	0 [3]	0 [3]	0 [3]
Level	180	150	157 / 152	157 / 149	156 / 145
Level	0	150	93 / 106 [4]	105 / 111 [4]	118 / 119 [4]
60 down	0	200	276 / 304	293 / 305	309
30 down	0	450	443 / 453	479 / 473	511 / 496
60 down	60	200	315 / 338	330 / 339	344 / 340
45 down	180	250	387 / 439	405 / 439	418 / 439

1. Unless otherwise specified, the cited conditions are at the initiation of the rocket catapult. Altitudes shown are nominal for parachute first fill.
2. Values are listed in A Version / B Version format. If one number is shown, it applies to both F-16 variants.
3. Impact occurs at instant of seat-aircraft separation.
4. 10,000 ft/min sink rate.

F-22 [1]

Attitude [°]		Velocity [knots]	Altitude Required [ft] for percentile noted		
Fore & Aft	**Roll Angle**		**5th**	**50th**	**95th**
Level	60	120	0 [2]	0 [2]	0 [2]
Level	180	150	152	147	143
Level	0	150	118 [3]	121 [3]	128 [3]
60 down	0	200	336	337	340
30 down	0	450	487	505	524
60 down	60	200	369	368	370
45 down	180	250	464	465	465

1. Unless otherwise specified, the cited conditions are at the initiation of the rocket catapult. Altitudes shown are nominal for parachute first fill.
2. Impact occurs at instant of seat-aircraft separation.
3. 10,000 ft/min sink rate.

B-1B [1]

Attitude [°]		Velocity [knots]	Altitude Required [ft]	
Fore & Aft	Roll Angle		Ejection Seat [4]	Total Altitude [5]
Level	60	120	0 [2]	0 [2]
Level	180	150	200	200
Level	0	150	300 [3]	490 [3]
60 down	0	200	500	980
30 down	0	450	700	1350
60 down	60	200	550	560
45 down	180	250	780	1090

1. Unless otherwise specified, the cited conditions are at the initiation of the rocket catapult. Altitudes shown are nominal for parachute first fill.
2. Impact occurs at instant of seat-aircraft separation.
3. 10,000 ft/min sink rate.
4. Applies to seat number 4 when ejected.
5. Applies to the intiation of the escape sequence for the automatic ejection sequencing of four crewmembers.

3.3.1.5 Collision avoidance, damage, and trajectory divergence. During an ejection, the ejection seat and parachute subsystems shall not contact or collide with external aircraft structures and jettisoned canopies/hatches. For multi-seat aircraft, an individual ejection shall not introduce aircraft damage that will prohibit a continued safe flight capability and subsequent crewmember ejection. For multi-seat aircraft, the seat system shall provide lateral escape divergence ensuring that there are no collisions between ejection seats, jettisoned canopies/hatches, parachutes, or crewmembers.

3.3.1.6 Major injury probability. The ejection seat system shall function to separate the aircrew from the aircraft and deliver the crewman, with necessary survival equipment, to the earth's surface in such a physical condition that they can perform the actions required to survive, evade capture, and establish signals to aid in rescue operation. The ejection seat system shall meet the performance requirements specified in this document without exceeding a five percent risk of an Abbreviated Injury Scale (AIS) 2 injury, unless otherwise specified.

3.3.1.7 Catapult/Rocket acceleration. The seat back tangent line shall be no more than 5 degrees offset from the acceleration thrust vector prior to seat-aircraft separation. The acceleration imposed on the seat occupant in the $+G_Z$ direction (parallel to the spinal column) by the ejection catapult/rocket shall be limited in terms of Dynamic Response Index (DRI) values for the z-axis, DRI_Z, calculated according to the method described in APPENDIX A. The following DRI_z limits are for specific catapult/rocket pre-ignition temperature and ejected weight representing the ejection seat, personal equipment, and human body weight representative of the crew member population anthropometric range. The limits for specific catapult/rocket motor pre-ignition temperature and ejected weight representing the ejection seat, personal equipment, and a human body nude weight range of 103 lbs to 245 lbs shall be as follows:

a. The mean seat pan acceleration time history generated in system level ejection sled or in-flight tests at test ambient conditions does not yield a DRI_Z value in excess of 16.0 (approximately 1% risk of AIS 2 spinal injury).

b. The mean seat pan acceleration time history generated in controlled component testing at a pre-ignition temperature of 70 °F does not yield a DRI_Z value in excess of 16.0 (approximately 1% risk of AIS 2 spinal injury) with an allowable standard deviation of 1.0.

c. The mean seat pan acceleration time history generated in controlled component testing at a pre-ignition temperature of 165 °F does not yield a DRI_Z value in excess of 20.0 with an allowable standard deviation of 1.0.

3.3.1.8 Multi-axial acceleration. All accelerations, from seat/aircraft separation through parachute full inflation, shall not exceed a Multi-axis Dynamic Response Criterion (MDRC) value of 1.0 up to 450 KEAS or a linear increase above 450 KEAS of 1.7 at 600 KEAS, as shown in FIGURE 1. MDRC accelerations shall be measured and calculated using the method in APPENDIX A.3.

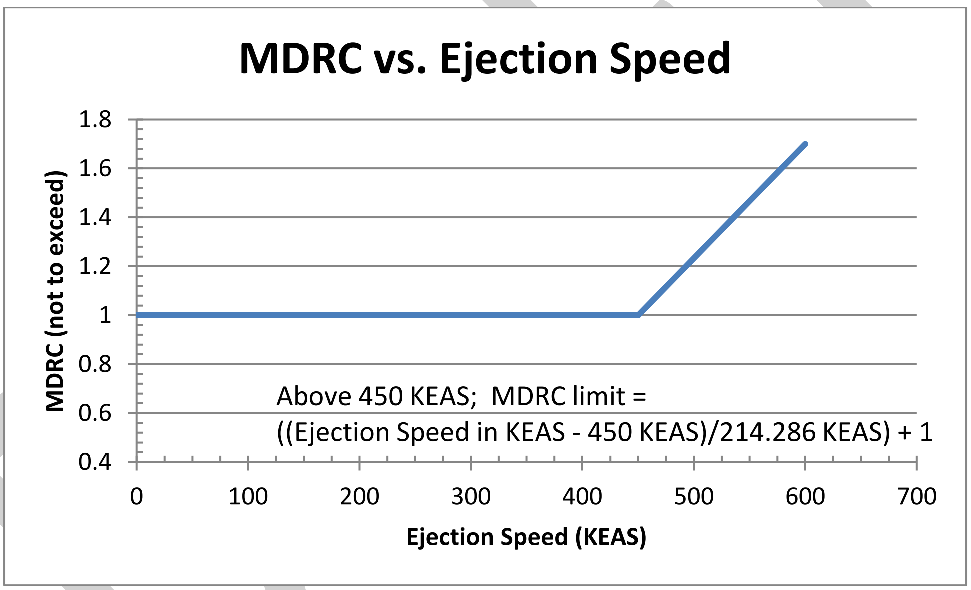

FIGURE 1 - Maximum Allowable MDRC vs. Ejection Speed

3.3.1.9 Chest acceleration. The maximum resultant deceleration/stabilization recovery parachute deployment and inflation loads experienced by the aircrew during escape do not exceed 25 G (vector sum) 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.")

3.3.1.10 Neck injury criteria.

3.3.1.10.1 $MANIC_Z$. Throughout the entire ejection sequence (up to 600 KEAS), the $MANIC_Z$ shall not exceed a five percent risk of AIS 2 injury at the occipital condyles (C0-C1), which corresponds to the values in TABLE 4. Probability curves and calculations are included in APPENDIX A.4.

TABLE 4. $MANIC_Z$ Limits

Limit	Unit	Small (103 lbs - 136 lbs)	Mid-Size (137 lbs - 199 lbs)	Large Male (200 lbs - 245 lbs)
Tension	lbs (**N**)	186 (**828**)	295 (**1313**)	357 (**1589**)

3.3.1.10.2 $\underline{MANIC_X}$. Throughout the entire ejection sequence, the $MANIC_X$ shall not exceed a five percent risk of AIS 2 injury up to 450 KEAS, linearly increasing to a 15% risk of AIS 2 injury at 600 KEAS (T) or remain below five percent risk of AIS 2 injury up to 600 KEAS (O) at the occipital condyles (C0-C1). Probability curves and calculations are included in APPENDIX A.5.

$$MANIC_X(v) = \begin{cases} 0.56, & 0 \leq v \leq 450 \\ \frac{1}{50}\left(\frac{1}{10}v - 17\right), & v > 450 \end{cases}$$

3.3.1.10.3 $\underline{MANIC_Y}$. Throughout the entire ejection sequence, the $MANIC_Y$ shall not exceed a five percent risk of AIS 2 injury up to 450 KEAS, linearly increasing to a 15% risk of AIS 2 injury at 600 KEAS (T) or remain below five percent risk of AIS 2 injury up to 600 KEAS (O) at the occipital condyles (C0-C1). Probability curves and calculations are included in APPENDIX A.6.

$$MANIC_Y(v) = \begin{cases} 0.48, & 0 \leq v \leq 450 \\ \frac{1}{100}\left(\frac{17}{150}v - 3\right), & v > 450 \end{cases}$$

3.3.1.10.4 $\underline{NMI_X}$. Throughout the entire ejection sequence, the Neck Moment Index (NMI_X) shall not exceed 0.5 at the occipital condyles (C0-C1). Calculations are included in APPENDIX A.7.

3.3.1.11 Head acceleration. Throughout the entire ejection sequence, head acceleration, as indicated in the probability of a concussion ($P_{concussion}$), shall not exceed a five percent risk as defined in APPENDIX A.4.

3.3.1.12 Automated performance. The dynamic performance of the seat system shall not require any manual pre-flight or inflight controls or actions, unless otherwise specified in this document.

3.3.2 *Physical*

3.3.2.1 Weight. The installed seat system weight, including survival kit container, adjustment actuators, and rocket/catapult systems but less survival kit equipment, shall be no greater than 185 lbs.

3.3.2.2 Color.

3.3.2.2.1 Seat color. The seat system color for all platforms shall be Black, #37038, IAW SAE-AMS-STD-595.

3.3.2.2.2 Ejection control color. The seat system ejection control color for all platforms shall be orange-yellow (#13538) with one quarter-inch-wide stripes black (#37038) both IAW SAE-AMS-STD-595.

3.3.2.3 Drain holes. The seat system shall incorporate drain holes into the seat bucket and any enclosures where water could accumulate or moisture might become entrapped.

3.3.2.4 Strength.

3.3.2.4.1 Proof loads. The seat system shall withstand the proof loads specified in TABLE 5 without permanent deformation.

TABLE 5. Proof Loads [Pounds]

Test	Location	Load	Direction	Distribution of Force
Seat pan	Center of the front edge	368	Downward, perpendicular	Distributed over a laterally centered 3 inch x 3 inch area
Armrest (if applicable)	4 Inch aft of forward edge	184	Downward, perpendicular	Over a length simulating the form of the aircrew's forearm
Ejection Controls	Center of handgrip	276	Perpendicular to control in the pull direction	Over a length simulating the width of an aircrew's hand
Headrest	Center of the headrest	460	Aftward, perpendicular	Over an area simulating the form of the aircrew's flight helmet
Seatback	Seatback	1381	Aftward, perpendicular to seatback tangent line	Uniformly distributed over the seatback (below the headrest)

3.3.2.4.2 Ultimate loads. The seat system shall withstand the ultimate loads specified in TABLE 6 without fracture of materials or failure of attachments.

TABLE 6. Ultimate Loads [Pounds]

Test	Location	Load	Direction	Distribution of Force
Seat pan	Center of the front edge	553	Downward, perpendicular	Distributed over a laterally centered 3 inch x 3 inch area

Armrest (if appl.)	4 Inch aft of forward edge	276	Downward, perpendicular	Over a length simulating the form of the aircrew's forearm
Ejection controls	Center of handgrip	414	Perpendicular to control in the pull direction	Over a length simulating the width of an aircrew's hand
Headrest	Headrest	691	Aftward, perpendicular	Over an area simulating the form of the aircrew's flight helmet
Headrest	Headrest cg	[1]	Forward, perpendicular	Point load
Seatback	Seatback	2072	Aftward, perpendicular to seatback tangent line	Uniformly distributed over the seatback (below the headrest)
Restraint subsystem	Occupant cg	11880; 2417	Forward & 20° of forward; downward	Point load
Seat system	Seat-occupant cg	[2]	Forward & 20° of forward; downward	Point load
Ejection air load[3]	Exposed seat-occupant cp	[4]	Perpendicular to seatback tangent line	Over area of seatback exposed to airstream
Ejection load	1.5 times the maximum loads imposed by all ejection subsystems during an ejection sequence such as rockets, catapults, thrusters, parachutes, lanyards, or mortars			
Crash Loads	The seat structure and restraint system shall withstand a 40G dynamic crash load with 245 lb occupant. (dynamic crash acceleration profile per SAE AS8049)			

[1]*40 times the headrest/parachute container assembly weight*
[2]*11880 plus 40 times seat system weight; 5940 plus 25 times seat system weight*
[3]*when seat is in the most structurally critical position in the guide rails.*
[4]*free-stream dynamic pressure for a 600-KEAS (Knots Equivalent Airspeed) ejection*

3.3.3 *Environmental*.

3.3.3.1 Operating temperature. The seat system, excluding Cartridge Actuated Devices/Propellant Actuated Devices (CAD/PAD) devices, shall perform IAW the requirements of this document within an operational temperature range of -65°F to +165°F. CAD/PAD shall perform IAW MIL-C-83124, MIL-C-83125, and MIL-P-83126 with the exception that the components must withstand an exposure temperature range of -65°F to +200°F.

3.3.3.2 Temperature shock. The seat system, excluding CAD/PAD devices, shall perform IAW the requirements of this document after exposure to a change in thermal environment between -65°F to +165°F with maximum transfer rates of one minute. CAD/PAD shall perform IAW MIL-C-83124, MIL-C-83125, and MIL-P-83126 after exposure to changes in the thermal environment between -65°F and +200°F with maximum transfer rates of one minute.

3.3.3.3 Humidity. The seat system shall perform IAW the requirements of this specification after exposure to 95% relative humidity and a temperature profile varying between 86°F and 140°F.

3.3.3.4 Explosive decompression. The seat system shall perform IAW the requirements of this specification after experiencing an explosive decompression of 9.0 psi in 0.1 seconds.

3.3.3.5 Salt-fog. The seat system shall perform IAW the requirements of this specification during and after exposure to 5% salt-fog solution for 2 cycles of 48 hours.

3.3.3.6 Rain. The seat system shall perform IAW the requirements of this specification during and after exposure to rain rates of 4.0 in/hr and 40 mph winds for a period of 30 minutes.

3.3.3.7 Dust. The seat system shall perform IAW the requirements of this specification during and after exposure to a dust concentration of 0.3 g/ft^3 at a velocity of 1750 ft/min.

3.3.3.8 Sand. The seat system shall perform IAW the requirements of this specification during and after exposure to a sand concentration of 0.18 g/m^3 at a velocity of 40 mi/hr.

3.3.3.9 Fungus. The seat system nonmetallic materials shall not deteriorate after exposure to the following fungi: aspergillus flavus, aspergillus versicolor, penicillium funiculosum, chaetomium globosum, and aspergillus brasiliensis.

3.3.3.10 Vibration. The seat system shall perform IAW the requirements of this specification during and after exposure to the platform-specific vibration spectrum.

3.3.3.11 Mechanical shock. The seat system shall perform IAW the requirements of this specification after experiencing a functional mechanical shock. (Sawtooth shock pulse shape of 20G peak magnitude for a duration of 11 (±1) milliseconds)

3.3.3.12 Crash hazard shock. The seat system and its mounting points shall withstand the following shock magnitudes and respective directions for a duration of 11 (±1) milliseconds. The mounting provisions shall not fail, and the equipment shall remain in place and shall not create a hazard. Operation of the equipment is not required during or after the shock.

3.3.3.12.1 Vertical. The seat system and its mounting points shall perform IAW 3.3.3.12 when subjected to a 10G upward load and a 25G downward load.

3.3.3.12.2 Longitudinal. The seat system and its mounting points shall perform IAW 3.3.3.12 when subjected to a 40G forward load, a 40G load 20 degrees to each side of forward, and a 20G aftward load.

3.3.3.13 Flame resistance. The seat system upholstery and cover materials shall be flame resistant and self-extinguishing in accordance with the Twelve Second Burn Test procedures specified in Federal Aviation Regulation (FAR) 25.853, Appendix F, Part I.

3.3.3.14 Nuclear hardness.

3.3.3.14.1 Nuclear Electromagnetic Pulse (EMP). The crew ejection seat escape system shall be classified as a mission hardness critical item for inadvertent ejection and shall meet the requirements of MIL-STD-464. Failure of components within the seat ejection system as a result of EMP shall not cause inadvertent seat ejection or performance degradation of interfacing mission-essential aircraft systems.

3.3.3.14.2 Transient Radiation Effects on Electronics (TREE). The crew ejection seat escape system shall meet the requirements of MIL-STD-461 upon exposure to the TREE environments. The crew ejection seat shall not inadvertently fire upon exposure to the TREE environments.

3.3.3.14.3 Thermal. The crew ejection seat escape system shall be IAW 3.3.3.1.

3.3.3.14.4 Solar Radiation. Textile materials including the seat cushions and upholstery shall be resistant to exposed solar radiation. The minimum service life for seat cushions and upholstery shall be 3 years without physical or functional degradation, with the exception of minor color fading.

3.3.4 *Maintainability.*

3.3.4.1 Seat removal and installation. The seat system shall not require removal of the aircraft escape hatches or canopies in order for the entire seat assembly to be completely removed from and installed into the aircraft. Seat installation and removal shall be accomplished using existing platform crew access spaces. A modular seat structure shall permit partial removal of the seat assembly to facilitate maintence actions (T) and permit time change components installation/removal on-aircraft (O).

3.3.4.2 Hand-packed parachutes. All seat system recovery and drogue parachutes shall be hand-packed, requiring only hand tool aids and no unique mechanical pressure fixtures or vacuum assistance.

3.3.4.3 Parachute packing containers. All seat system recovery and drogue parachutes shall be packed in removable containers as a modular component, or as part of a seat modular component to facilitate routine inspection and repacking.

3.3.4.4 Ground servicing. The seat assembly shall be designed to allow removal and installation of the ground servicing items to include the recovery parachute and container, lap belt, and survival kit using a single unlock mechanism that does not require any tooling.

3.3.4.5 Survival Kit Packing. The survival kit shall allow packing as a field service organizational maintenance task and shall not require unique support equipment or tools.

3.3.4.6 Inspection cycle. The seat system shall meet the requirements of this specification while using a complete inspection cycle of 36 months for the A-10, F-15, F-16, and F-22. The seat system shall meet the requirements of this specification while using a complete inspection cycle of 60 months for the B-1B.

3.3.4.7 Mean Time Between Failure (MTBF). The seat system shall have a minimum MTBF of no less than 1200 flight hours when operated in the environments of 3.3.3.

3.3.4.8 Maintenance Man Hour per Flight Hour (MMH/FH). The seat system shall require not more than 0.00142 MMH/FH at a maturity of 100,000 flying hours, as defined by MIL-STD-721.

3.3.4.9 Mean Time To Repair (MTTR). The seat system shall have a total MTTR for both on- and off- aircraft maintenance not to exceed 1.30 hours as defined by MIL-STD-470. For all platforms, the on- and off- aircraft maintenance shall utilize a mean maintenance crew size not to exceed two.

3.3.4.10 Useful life. The seat system in combination with required time change item replacements shall have a useful life of not less than 30 years under any natural combination of aircraft operating and storage life without exceeding the operational service life.

3.3.4.11 Service life. The seat structural assembly, electrical, and mechanical systems shall have an operational service life of not less than 11,000 flight hours under any natural combination of environmental conditions specified in 3.3.3. Fabric and textile items shall not be service life limited, unless approved by the procurement agency, and replaceable at the discretion of the USAF during periodic inspection.

3.3.4.12 Storage life. The seat system fully configured for aircraft installation shall have a storage life of not less than 5 years.

3.3.4.13 Reliability. The minimum probability of success for the ejection seat system shall be 98% at the 90% Lower Confidence Limit (LCL).

3.3.4.14 Demonstrated reliability. The minimum demonstrated reliability of the ejection seat shall be 90% at the 90% LCL. The minimum demonstrated reliability for escape system integration with the aircraft shall be 75% at the 90% LCL.

3.4 Design and construction.

3.4.1 *Marking*

3.4.1.1 Product identification. The seat system major structural assemblies shall be permanently and legibly marked IAW MIL-STD-130 with a nameplate (FIGURE 2) securely attached in a location where it can be read without the removal of either the entire seat assembly or a modular sub-assembly from the aircraft, and containing the following information, at a minimum:

Part No. ______________________	Part Name _____________________
Specification No. _______________	Serial No. ______________________
Mfr Code _____________________	Mfr Name ______________________
Stock No. ________*____________	Prime Contract No. ______**_______
US	

**Federal stock class and federal item identification (when assigned)*
***As specified in the Purchase Order*

FIGURE 2. Product Identification Label

3.4.1.2 Equipment identification. The seat system equipment shall be marked for identification IAW the IUID and marking requirements of MIL-STD-130.

3.4.1.3 Transmission line identification. The seat system ballistic transmission lines shall be marked for identification IAW JSSG 2010; the fluid lines IAW MIL-STD-1247.

3.4.2 *Materials, processes, and parts*

3.4.2.1 Workmanship. The seat system materials shall be of the highest quality, lightest weight practicable, and suitable for the purpose intended. The seat system shall be developed and finished with craftsmanship, cleanliness and neatness; be free from defects, burrs, and sharp edges; have accurate dimensions, radii, fillets, and marking of parts and assemblies; have thoroughness of welding, brazing, painting, riveting, and machine finishing; have alignment of parts and tightness of assembly screws and bolts; be free of any projections or sharp edges which could snag, jam, or damage clothing and equipment, injure the seat occupant or maintenance personnel, foul personal equipment, jeopardize operation of seat components, or interfere with recovery parachute operation.

3.4.2.2 Fumes. The seat system materials shall not emit gasses prior to ejection initiation that can combine with the atmosphere to form acids or corrosive alkali, nor toxic or corrosive fumes.

3.4.2.3 Fluid exposure. The seat system materials exposed to fluids normally used in aircraft shall be resistant to damage by such fluids.

3.4.2.4 Lubrication. The seat system lubricants and lubrication shall use MIL-HDBK-838 as guidance and function within the temperature range of -65 to +200 degrees F. The seat system and its components shall only require the application of lubrication as needed, but no more than one lubrication application per 90 day period.

3.4.2.5 Captive hardware. The seat system shall use captive hardware for maintenance actions accomplished while the seat is installed in the aircraft.

3.4.2.6 Safetying. The seat system shall use self-locking fasteners IAW NASM33588 for mounting or assembly in preference to safety wiring or cotter pinning IAW NASM 33540. No safety wire or cotter pins shall be required for on-aircraft seat maintenance tasks. Any uses of safety wire or cotter pins used in the design of the seat shall be approved by the procuring agency.

3.4.2.7 Interchangeability. The seat system parts having the same part number shall be functionally and dimensionally interchangeable with each other across all platforms with respect to installation and performance.

3.4.2.8 Component misinstallation. The design of the seat system shall preclude improper installation of replaceable components.

3.4.3 Electrical design

3.4.3.1 Wiring. The seat system wiring shall meet the requirements of MIL-HDBK-454, Guideline 20, and shall be installed IAW MIL-HDBK-454, Guideline 69.

3.4.3.2 Insulation resistance. The seat system electrical components shall have insulation resistance of not less than 100 megaohms when subjected to 500 ± 50 volts direct current (vdc) applied between all mutually insulated circuits.

3.4.3.3 Voltage withstand. The seat system adjustment actuator operating on aircraft power shall withstand, without damage or insulation breakdown, 1500 volts root mean square (vrms) (standard conditions) and 700 vrms (60,000-ft altitude) at 60 Hz frequency, for one minute between mutually insulated parts.

3.4.3.4 Electrical protection

3.4.3.4.1 Under-voltage protection. The seat system adjustment actuator shall not be damaged by voltages below the minimum specified in MIL-STD-704 and shall automatically resume normal operations when the voltage returns within limits.

3.4.3.4.2 Overload protection. The seat system adjustment actuator shall meet the electrical overload protection requirements of MIL-HDBK-5400; parts and circuits likely to carry an overload due to failures, open circuits, or grounding of wiring external to the actuator shall withstand the overload for any duration without permanent damage, and the actuator shall automatically return to normal operation when the cause of the overload is removed.

3.4.3.5 Electromagnetic Interference and Compatibility (EMIC). The seat system shall be designed and tested for EMIC requirements contained in MIL-STD-461. The seat system shall be designed to prevent spurious functioning or degradation of any electro-explosive device, and to prevent the out-of-sequence activation of or interference with electrical/electronic control circuits, when installed in the aircraft.

3.4.4 *Safety*

3.4.4.1 Inadvertent actuation. The seat system ejection control handgrip(s) shall be protected with a mechanical safety lock system to guard against inadvertent actuation of the controls or ejection functions when the safety system control is in the safe position. The safety control and position shall be readily visible to a seated occupant, and able to be rapidly moved to an armed position with a single motion. An indicator capability shall be incorporated as a discrete input compatible with aircraft platform warning systems.

3.4.4.2 Safety devices. The seat system design and development shall incorporate the safety principles prescribed in MIL-STD-882. All identified hazards shall be mitigated to either a medium, low, or an eliminated risk. Safety devices, that cannot be inadvertently left in a safe configuration during flight, shall be incorporated to render the seat or modules safe for routine maintenance and ground operations. Removable devices shall be minimized, but if incorporated shall be interconnected when practical and shall use streamers having the inscription “Remove Before Flight” IAW Air Force Drawing 52C1543.

3.4.4.3 Installation keying. The seat system shall prevent installation of seats designated for left, right, fore, or aft crew station application in the incorrect location.

3.4.4.4 Public display of aircraft. The ejection seat system and its corresponding safety devices of 3.4.4.2 shall allow for safe public display of the aircraft without requiring removal of either the entire ejection seat or any part of the egress system.

3.4.5 *Anthropometric accommodation*

3.4.5.1 Human factors. The seat system shall be commensurate with human engineering principles IAW MIL-STD-1472.

3.4.5.2 Ejection seat accomodation. Ejection seat performance shall be IAW this specification for any occupant represented by the multivariate anthropometric cases in TABLE 7.

3.4.5.3 Aircraft Accommodation Compatibility. The ejection seat installation and positioning adjustments shall fully accommodate the existing platform crew station anthropometric accomodation requirements without introducing any reduction to current anthropometric accomodations for respective aircraft pilots, as reported in AFRL-HE-WP-TR-2002-0118. The specified crew population shall be able to adjust the seat sitting position to reach the platform design eye location without any reduction in internal and external visibility from legacy seat installations. The ejection seat, as installed in specified target aircraft, shall allow all legacy crew mission tasks to be safely conducted without altering external visibility, or control reach and function. The seat accommodation shall not interfere with or reduce the crew member’s reach and control actuation capability in comparison to the legacy seat installation.

TABLE 7. Multivariate Anthropometric Cases (in)*

Dimension	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Functional (thumbtip) 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, erect	32.8	35.5	34.9	38.5	40.0	38.0	31.0
Eye height sitting, erect	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 (bideltoid) 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
Upper 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 range	103–245 lbs						

**Anthropometric dimensions are defined in MIL-STD-1472G, Appendix B*

3.5 <u>Major subsystems.</u>

3.5.1 *Seat assembly*

3.5.1.1 <u>Structure subsystem.</u>

3.5.1.1.1 <u>Limb retention.</u> The seat shall incorporate limb restraints on all aircraft platforms to restrain the arms and legs and prevent flail injuries during the ejection sequence, including windblast, free-flight, and drogue phases, up to 600 KEAS. Limb restraints shall be passive in that no additional pilot strap-in actions will be required. 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 be compatible with the aircraft platform's current personal flight equipment listed in TABLE 1 and shall neither require equipment modification nor hinder aircrew ground egress procedures and timing. The arm restraint system shall not preclude the crew from reaching and actuating the manual parachute deployment handle, or an independent system shall be provided to release the arms to allow the crew to reach and actuate the parachute deployment handle.

3.5.1.1.2 <u>Lap belt retention.</u> The seat assembly shall be designed to prevent lap belt buckles from being trapped between the seat assembly and aircraft consoles when the lap belt is unbuckled, or from jamming any aircraft controls during seat position adjustment.

3.5.1.1.3 Armrests. Armrests shall be incorporated into the B-1B seat variant and shall mount on the seat sides and pivot from a using position to a stowed position and have the same vertical adjustment range of the legacy B-1B ejection seat. The using position shall be in the current location relative to the cockpit internal configuration as defined by the ICD. Stowed position shall not interfere with crew mission tasks.

3.5.1.1.4 Canopy Breakers. Canopy breakers shall be installed on F-15 and A-10 ejection seats to fracture the transparency and allow ejection should the canopy fail to jettison during the automatic ejection sequence. All F-15 seat system configurations shall be fitted with canopy breakers that are capable of penetrating the 0.43 inch thick stretched acrylic F-15 canopy. All A-10 seat system configurations shall be fitted with canopy breakers that are capable of penetrating the 0.31 inch thick stretched acrylic A-10 canopy. Canopy breakers shall be absent on all F-16, F-22, and B-1B seat system configurations.

3.5.1.2 Personnel restraint subsystem. The personnel restraint subsystem shall incorporate a lap belt, an inertia reel, and an inertia reel lock control. Personnel restraint shall be compatible with the PCU-15/P and PCU-16/P harnesses (TABLE 1) and attachment fittings in order to provide full torso restraint and control. The lap belt shall be repairable in the field.

3.5.1.2.1 Ingress and egress. The personnel restraint subsystem shall require a maximum disconnect of five fastening devices for normal aircrew ingress and egress (e.g. lap belt, canopy releases (TABLE 1), and survival kit attachment). The seat system shall permit emergency egress within the aircraft platform emergency egress timing requirements IAW MIL-HDBK-516.

3.5.1.2.2 Lower torso restraint. The fastened lap belt shall be located on a plane which is 45 ± 2° with respect to the seat cushion tangent line and that passes through a point along the seat cushion tangent line within a maximum of 2 inches forward from the seat reference point (SRP) IAW FIGURE 3.

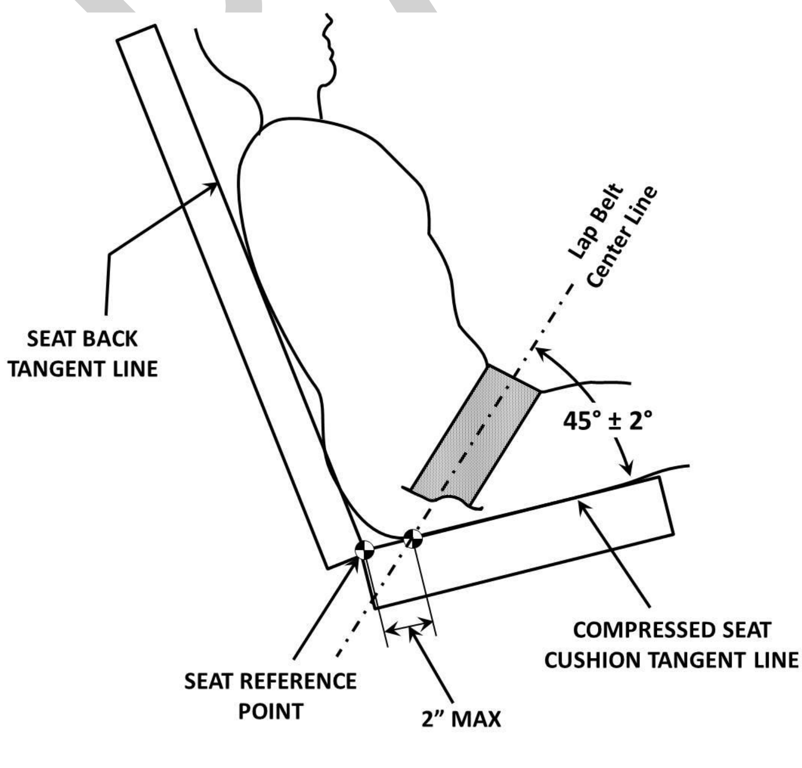

FIGURE 3. Lower Torso Restraint Attachment Detail

3.5.1.2.3 Inertia reel lock. The inertia reel lock mechanism shall be IAW MIL-R-8236 apart from any exceptions outlined by the requirements of this specification.

3.5.1.2.4 Inertia reel lock lever. The inertia reel lock lever shall be usable by the aircrew while fully retracted.

3.5.1.2.5 Inertia reel strap bearing point. The inertia reel strap bearing point shall be located with respect to the aircrew so that no compression loads are transferred to the aircrew's spinal column when the reel is in the fully retracted position.

3.5.1.2.6 Powered retraction. An automatic positioning/retraction system shall retract the crewmember's upper torso into an ejection ready position, while taking up a load of 300 lbs, within 0.3 sec at 70° F and 0.4 sec at -65° F, without exceeding a retraction velocity of 9 ft/s.

3.5.1.2.7 Torso load. The retraction shall not exceed an applied, cumulative load to the aircrew upper torso or harness of 100 lbs once fully retracted and locked.

3.5.1.2.8 Restraint release. The personnel restraint subsystem shall automatically release the crewmember restraints for seat-man separation.

3.5.1.3 Emergency release subsystem. The emergency release subsystem shall provide a manually actuated, ballistically powered backup control which effects emergency seat-man separation and recovery parachute deployment after ejection.

3.5.1.3.1 Release control. The emergency release operation shall be initiated by actuation of a control and located in an easy-to-reach position for a crewmember in the fully retracted position.

3.5.1.3.2 Release functionality. The emergency restraint release subsystem shall deploy the recovery parachute and release the crewmember, along with their attached survival kit, from the seat.

3.5.1.3.3 Release non-operation. The emergency restraint release subsystem shall not be able to be actuated prior to ejection or seat aircraft separation.

3.5.1.4 Headrest subsystem.

3.5.1.4.1 Forward Position. The headrest shall be within one inch (T) or zero inches (O) forward of the seat back tangent line.

3.5.1.4.2 Head motion. The headrest and head/neck protection mechanisms shall not interfere with any of the aircrew's operational mission tasks.

3.5.1.4.3 Lateral restraint. The headrest and head/neck protection mechanisms shall facilitate lateral head centering prior to seat-aircraft separation and maintain the laterally centered head position until initial recovery parachute deployment.

3.5.1.4.4 Seat-man interference. The headrest and head/neck protection mechanisms shall neither interfere with seat-man separation nor induce pilot injury upon actuation.

3.5.1.5 Initiation subsystem.

3.5.1.5.1 Automatic-manual mode. For multi-seat aircraft, ejection initiation shall be compatible with the aircraft sequencing system and allow for automatic initiation when the appropriate signal is received, regardless if ejection controls have been manually actuated. Dual seat fighter aircraft shall also have the capability to configure the aft seat for solo flight. Pre-cocked initiators shall not be used.

3.5.1.5.2 Control handles. Ejection seat initiation controls shall not intrude into the space occupied by the aircrew or hinder routine ingress, egress, or flight operations. A-10, F-15, and B-1B ejection seat variants shall have ejection initiation control handles located within reach on the sides of the seat. When activated, both handles shall move in unison and fire initiators compatible with the aircraft sequencing system. F-16 and F-22 ejection seat variants shall have an ejection initiation control handle located at the front of the seat bucket within the plane of the seat centerline and be manually initiated by a single motion that fires initiators compatible with the aircraft sequencing system.

3.5.1.5.3 Control force. Whether exerted by a one- or two-handed pull, the seat assembly ejection control handles shall actuate at 45 ± 5 pounds.

3.5.1.6 Sequencing subsystem. A recovery sequencer shall be incorporated to automatically govern the initiation and timing of all ejection operational events. The sequencer shall be capable of being tested to confirm full redundancy and operational performance while installed on a seat that is removed from the aircraft. On-seat testing shall verify electro-explosive device (EED) connections via bridgewire continuity. Any test set used for system verification shall, at a minimum, provide fault codes for diagnostics and shall not require calibration.

3.5.1.6.1 Mode selection. The recovery sequencing device shall incorporate fully redundant capability with no single point of failure to prevent successful operation. Comparative logic shall be incorporated to select default operational timing in the event of independent system branch conflicts.

3.5.1.6.2 Sequence subsystem. In the event of an ejection sequence, the ejection seat shall be capable of recording the event times of seat functions, selected operating modes, any sensed air pressure and/or airspeed velocity sensing data, the linear accelerations along three orthogonal axes, and angular accelerations about three orthogonal axes.

3.5.1.6.3 Sequencer initiation: Sensors shall power on and become stabilized such that recording begins a minimum of 40 msec prior to sequencer timing start. The sequencer shall record 300 sec of data minimum.

3.5.1.6.4 Recording rates: Shall be a minimum of 333 Hz from sequencer power up through five seconds after seat man separation. Data beyond this time shall be recorded at a minimum of 1 Hz.

3.5.1.6.5 Data limits: X,Y, and Z linear accelerations shall be recorded in 0.01g increments within a range of +/- 60g. X,Y, and Z angular positions and angular rates at 180 deg/sec minimum shall also be recorded.

3.5.1.6.6 Recovery of mishap information. The sequencer system shall provide the non-proprietary means for Government personnel to download and decode the data into interpretable engineering units for onsite, mishap investigation.

3.5.2 *Energetic components*

3.5.2.1 Propellant devices. Propellant devices incorporated in the seat system shall conform to the applicable requirements of MIL-C-83124 and MIL-C-83125.

3.5.2.2 Propulsion subsystem. The design of rockets, catapults, and other means of initial propulsion shall conform to MIL-P-83126, as applicable.

3.5.2.3 Energetics transmission lines. The seat shall interface with the respective aircraft interseat sequencing systems and provide the correct input signals to the system in order to initiate the ejection sequence.

3.5.2.4 Cartridge Actuated Devices/Propellant Actuated Devices. No less than ninety percent (90%) of the CAD/PAD items shall be currently in the USG inventory and have a minimum installed life of 6 years with a minimum shelf/storage life of 10 years as assigned by the Joint CAD/PAD program office (T), or the seat design shall incorporate ACES II legacy CAD/PAD (O). Components with a limited life requiring changeouts, refurbishment, or periodic testing shall, to the maximum extent possible, have replacement and/or testing cycles compatible with the aircraft overhaul or inspection schedule (3.3.4.6). The seat system shall not introduce any Hazard Class 4 devices with respect to shipping/transport, as per 49 CFR 173.124.

3.5.2.5 CAD/PAD commonality. All CAD/PAD components shall be common across every configuration of the ejection seat, unless a part is approved by the procuring agency.

3.5.3 *Seat adjustment actuator*

3.5.3.1 Adjustment control. The seat system shall incorporate an actuator as a means to adjust the seat to accommodate the specified aircrew population in accordance with 3.4.5.3. The actuator shall be compatible with an aircraft-mounted, three-position ON/OFF/Momentary-ON type switch.

3.5.3.2 Variable adjustment. The actuator shall provide infinitely variable adjustment of the seat system along the guide rails.

3.5.3.3 Adjustment Position. The seat adjustment actuator shall have an adjustment range sufficient to allow aircrew to reach the aircraft design eye position.

3.5.3.4 Operating loads. The actuator shall operate during the application of a static compressive load of at least 450 pounds.

3.5.3.5 Electrical compliance. The actuator shall comply with the requirements of MIL-STD-7080 and not exceed the maximum power draw limits specified by each aircraft platform for legacy seat installations

3.5.4 *Installed equipment*

3.5.4.1 Stabilization subsystem. The stabilization subsystem shall control seat-man stability during free flight from seat-aircraft separation through recovery parachute deployment (seat-man separation) by counteracting rotations caused by the eccentricity between the dynamic center of gravity (cg), the rocket thrust line, and the aerodynamic forces.

3.5.4.1.1 Deceleration forces. The stabilization subsystem shall align the neutral axis direction of the aerodynamic deceleration parallel to the main rocket thrust line for low speed ejections where the rocket thrust is the predominant force and drogues may not be deployed long enough to be effective. The stabilization subsystem shall align the neutral axis direction of the aerodynamic deceleration in the eyeballs-out direction for higher speed ejections where the free-stream velocity is the predominant force. The stabilization subsystem shall also limit excursions and damped oscillations about the neutral axis to ±20° in the pitch plane at all ejection speeds and ±20° in the yaw plane at speeds above 250 KEAS.

3.5.4.1.2 Recovery attitude. The stabilization subsystem shall maintain the seat's pitch attitude during recovery parachute deployment between 0 degrees and 90 degrees aft such that the forces from the recovery parachute are colinear with the spinal column through first full parachute opening.

3.5.4.1.3 Trim attitude. The seat system shall limit the stabilized trim attitude of the seat-man combination in free fall to 75° between the seat positive Z axis direction (FIGURE A.2) and the drogue attachment load axis.

3.5.4.1.4 CG envelope. The stabilization subsystem shall accommodate the static cg locations of the combined seat/occupant for the specified pilot anthropometric population range. The cg envelope shall encompass a 4 inch wide ellipse with 2 inch radius circular ends with the foci located at the forward uppermost cg location and the lowest aft cg location, commensurate with seat adjustments in a full up and full down position respectively.

3.5.4.2 Recovery parachute subsystem.

3.5.4.2.1 Interface. The recovery parachute subsystem shall be seat-mounted and compatible with legacy torso harness canopy releases.

3.5.4.2.2 Container. The parachute, with the exception of the lower portions of the riser, shall be fully enclosed in a protective container.

3.5.4.2.2.1 Water intrusion. The recovery parachute container shall protect the parachute from water intrusion.

3.5.4.2.2.2 Flash fire. The recovery parachute container shall protect the parachute from flash fire.

3.5.4.2.3 High Altitude. For high altitude ejections, the recovery parachute subsystem shall automatically deploy at a minimum altitude of 15,000 feet Mean Sea Level (MSL), consistent with the emergency oxygen system supply and acceleration/injury requirements in this specification.

3.5.4.2.4 Seat-man separation. The recovery parachute shall allow positive seat-man separation by deployment and inflation without seat-man-parachute interference.

3.5.4.2.5 Dynamic performance. The recovery parachute subsystem performance shall be deployed in the minimum time consistent with the requirements of this specification.

3.5.4.2.6 Wake recontact. The recovery parachute subsystem shall minimize wake recontact effects to prevent partial collapse after first full-open.

3.5.4.2.7 Descent rate. The recovery parachute vertical descent velocity shall not exceed 23 ft/sec with a 337-lb suspended weight, where suspended weight is the weight of everything suspended by the canopy releases.

3.5.4.2.8 Oscillation. The recovery parachute subsystem shall not exceed steady-state descent oscillation of ±15 degrees from the vertical.

3.5.4.2.9 Horizontal drive. The recovery parachute shall have a nominal horizontal drive of 10 ± 5 ft/sec during steady state descent.

3.5.4.2.10 Steering. The recovery parachute subsystem shall have a selectable steering capability with occupant accessible controls and a minimum turn rate of 20 deg/s during steady-state descent when actuated by the aircrew.

3.5.4.2.11 Parachute color. The recovery parachute canopy shall have a pattern approximating 1/3 White (#37875), 1/3 OSHA Safety Orange (#12246), 1/6 Foliage Green (#24165), and 1/6 Beige (#30450) IAW SAE-AMS-STD-595.

3.5.4.3 Life support subsystem. The ejection seat shall integrate with the following personal life support services; breathing oxygen, counter pressure garment oxygen, and positive pressure for chemical/biological (CB) protection as applicable to legacy capability, seat integration, and personal equipment listed in TABLE 1.

3.5.4.3.1 Emergency oxygen. The seat system shall incorporate a legacy emergency oxygen bottle that provides a supply of emergency breathing oxygen to be used for inflight emergencies and ejection descent from the maximum escape envelope altitude of the aircraft (3.3.1.3). The emergency oxygen system shall be fully compatible with the aircraft and cremember oxygen supply system and equipment, including platform unique supply line sizes, hose routing/locations, connectors, regulators, and seat mounted components. Emergency oxygen supply lines routed to CRU connectors shall be automatically capped at disconnect.

3.5.4.3.2 Oxygen bottle compatibility. The seat system shall incorporate legacy 22 cubic inch or 50 cubic inch capacity emergency oxygen bottles consistent with current aircraft oxygen system configurations and requirements.

3.5.4.3.3 Oxygen regulation. The seat shall accommodate seat mounted oxygen regulators consistent with legacy platform configurations.

3.5.4.3.4 Oxygen actuation. The emergency oxygen supply shall be actuated automatically during the seat ejection process and shall be capable of manual actuation by the crewmember during flight or while the crewmember is seated and fully retracted.

3.5.4.3.5 Oxygen serviceability. An emergency oxygen bottle quantity indicator shall be readily visible while the seat is installed in the aircraft, and the bottle shall be serviceable or replaceable while the seat is installed in the aircraft.

3.5.4.4 Survival equipment subsystem.

3.5.4.4.1 Bucket volume. The seat bucket shall accommodate a 1500 cubic inch volume survival kit.

3.5.4.4.2 Lateral restraint. The survival kit shall be restrained from lateral movement and from rising above the seat lip during negative-g maneuvers.

3.5.4.4.3 Deployment. The survival kit, which consists of a container and components, shall attach to the torso harness (TABLE 1). The survival kit shall automatically deploy during seat-man separation.

3.5.4.4.4 Survival equipment. The survival kit shall be capable of accommodating any combination of equipment listed in TABLE 8 within the 1500 cubic inch volume. The survival kit container shall be stowed in the seat bucket without specific restriction on packing order of contents. The survival kit shall be hand packed (without specialized equipment), inspected, and maintained by AFE personnel.

3.5.4.4.5 Survival kit construction. The survival kit shall consist of a non-rigid container.

TABLE 8. Survival Kit Equipment

National Stock Number	Descriptive Nomenclature	Part Number
0000-00-0000	Bag, Sleeping 3 in. x 7.25 in. x 16 in.	
8465-00-265-4925	Box, Match Waterproof	
6605-00-151-5337	YS Compass	
5110-00-234-6532	File, Flat Smooth 6 In	
8415-00-543-7130	LM Hood, Winter	
4220-00-763-3766	Plugs, Repair Life Raft	
6230-00-067-5209	Light Marker, Distress	SDU-5/E
6350-00-105-1252	Mirror, Emergency	MK-1
5820-00-782-5308	Transceiver, Radio	PRC-90
6135-00-838-0706	LS Battery- Instl Plus Snare	BA-1568/U
4220-01-003-6763	LS Raft	LRU-16/P
8970-00-082-5665	Ration	
5110-00-570-6896	Saw, Survival	MF-15, F-16, F-22, AND B-1B
6850-00-270-9986	Dye, Marker	
4240-00-065-6713	Survival Tool Kit	SRU-18/P
8960-01-124-4543	Water, Drinking	
8440-00-153-6717	Socks, Wool Pair	
8415-00-265-6748	Mitten Insert Pair	M-38
5110-00-162-2005	Knife, Pocket	
0000-00-000-0000	Wire, Brass (Snare) 20 Feet/Coil	
4 720-00-141-9080	Tubing, Latex 6 Feet	
8465-00-254-8803	Whistle	
8510-00-162-5658	Ointment, Sun MIL-S-11262	
1370-00-115-3432	L275 Signal, Distress	MK-13
6445-00-139-3671	Medical Kit	2D-1
5826-01-099-6404	LS Beacon, Locator	AN-URT-44
5826-00-414-0393	LS Antenna, Beacon	AN-URT-44
6135-01-050-3193	LS Battery-Instl	A3-03-0052
8415-00-270-0229	Hat, Sun	
6850-00-161-6202	COM Repellant Insect	6-12
1005-01-042-9820	Modified Rifle	GUU-5P

3.5.4.5 Personnel locator subsystem. The seat system shall incorporate a selectable control that prohibits or allows automatic actuation of the emergency beacon. Upon ejection, the seat system shall only actuate the emergency locator beacon when the automatic mode has been selected.

3.5.4.6 Seat cushion subsystem. The seat cushion shall provide crewman support and comfort for extended missions up to 22 hrs and shall be comprised of a seat bottom cushion assembly and a seatback cushion assembly.

3.5.4.6.1 Compression load. The seat bottom cushion shall (O) isolate the crewman from the hardness of the seat by limiting compression across the entire cushion to 50% of the original uncompressed height, or (T) have equivalent compression performance as the legacy cushion

3.5.4.6.2 Pressure distribution. The seat bottom cushion shall (O) contour to the crewman and provide a natural pressure distribution with no local peak pressures exceeding 2.5 psi, or (T) have equivalent pressure distribution performance as the legacy cushion.

3.5.4.6.3 Durability. The seat cushions shall be resistant to tearing, abrasion, and pilling.

3.6 Logistics.

3.6.1 Ground support. The seat system and removable modules shall include physical provisions for ground safety devices, installation, removal, servicing, and handling.

3.6.2 Support equipment. The seat system and removable modules shall be installed, tested, serviced, maintained, and removed using only common Air Force support equipment, legacy seat support equipment, or new equipment that may be locally manufactured in the field by using drawings incorporated into the seat maintenance technical order (TO).

3.6.3 Personnel. Seat system maintenance shall not require additional personnel beyond the Air Force Specialty Codes (AFSC) and skill levels that currently perform maintenance on the legacy seat.

3.6.4 Supply. The seat system design shall maximize cost-effective use of standard (common usage) parts, components, subsystems, and support accessories; minimize introduction of new items into the supply system; not require new supply methods, systems, or reporting procedures; maximize economical overall cost for packaging supply and resupply.

3.6.5 Facilities. The design of the seat system shall not require construction of new maintenance facilities.

3.6.6 Transportability. The seat system (absent of removable CAD/PAD components and pressurized oxygen bottle) shall be transportable by all modes of commercial transportation to permit employment, deployment, and logistics support.

4. QUALIFICATION PROVISIONS

4.1 <u>General.</u> Section 4 contains the methodology for verifying the system's design, operation, and performance to meet all the requirements established in SYSTEM REQUIREMENTS.

4.1.1 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, not analysis). 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.

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

4.1.3 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.

4.1.4 Verification Cross Reference Matrix (VCRM). The VCRM (TABLE 9) provides the cross reference between each Section 3 requirement, the associated minimum required verification methods defined in 4.1.5 , and the associated verification paragraph numbers.

4.1.5 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.

Inspection	This verification method consists of actual component, system, function, or installation examination by visual examination, simple physical manipulation, or simple measurement without the use of special laboratory appliances or procedures, and includes review of authenticated documentation.
Analysis	This verification method consists of an evaluation of components or systems interacting with their intended environment using technical calculations, mathematical models or simulations based on physical laws and empirical data, algorithms, charts, graphs, or other scientific principles and procedures. Analysis associated with refining test data is not a part of this method. If there is insignificant or no change between legacy system and new system, then verification can be made by similarity.

Demonstration	This verification method consists of non-instrumented operation, adjustment, or reconfiguration of the actual component or system under specified controlled conditions on the air vehicle or in an equivalent environment, where functional success is determined on a qualitative or pass-fail basis.
Test	This verification method consists of quantitative measuring and analysis of the resulting data of the characteristics or performance of actual components or systems in controlled real or representative conditions, with instrumentation and data analysis accomplished IAW a set of applicable test procedures.

TABLE 9 is provided for reference.

TABLE 9. Verification Cross Reference Matrix

Section	Requirement	Verification Method	Verification Section
3.2	**Compatibility**	**---**	**4.2**
3.2.1	Aircraft compatibility	Demonstration/Test	4.2.1
3.2.1.1	Structural compatibility	Demonstration/Analysis	4.2.1.1
3.2.1.2	Aircraft escape path clearance and sequencing system compatibility	Demonstration/Test	4.2.1.2
3.2.1.3	Aircraft maintenance and inspection compatibility	Demonstration	4.2.1.3
3.2.2	Personal services and equipment compatibility	Demonstration	4.2.2
3.2.3	Electrical power compatibility	---	4.2.3
3.2.3.1	Electrical power supply	Test	4.2.3.1
3.2.3.2	Electrical power usage	Test	4.2.3.2
3.2.3.3	Momentary power interruptions	Test	4.2.3.3
3.3	**Characteristics**	**---**	**4.3**

3.3.1	*Performance*	---	*4.3.1*
3.3.1.1	Ejection position	Analysis/Test	4.3.1.1
3.3.1.2	Ejectable weight	Test	4.3.1.2
3.3.1.3	Escape envelope	Test	4.3.1.3
3.3.1.4	Terrain clearance	Analysis	4.3.1.4
3.3.1.5	Collision avoidance, damage, and trajectory divergence	Test	4.3.1.5
3.3.1.6	Major injury probability	Test	4.3.1.6
3.3.1.7	Catapult/Rocket acceleration	Test	4.3.1.7
3.3.1.8	Multi-axial acceleration	Test	4.3.1.8
3.3.1.9	Chest acceleration	Test	4.3.1.9
3.3.1.10	Neck injury criteria	---	4.3.1.10
3.3.1.10.1	$MANIC_Z$	Test	4.3.1.10.1
3.3.1.10.2	$MANIC_X$	Test	4.3.1.10.2
3.3.1.10.3	$MANIC_Y$	Test	4.3.1.10.3
3.3.1.10.4	NMI_X	Test	4.3.1.10.4
3.3.1.11	Head acceleration	Test	4.3.1.11
3.3.1.12	Automated performance	Demonstration/Test	4.3.1.12
3.3.2	*Physical*	---	*4.3.2*
3.3.2.1	Weight	Inspection	4.3.2.1
3.3.2.2	Color	---	4.3.2.2
3.3.2.2.1	Seat color	Inspection	4.3.2.2.1
3.3.2.2.2	Ejection control color	Inspection	4.3.2.2.2
3.3.2.3	Drain holes	Inspection/Demonstration	4.3.2.3
3.3.2.4	Strength	---	4.3.2.4

3.3.2.4.1	Proof loads	Test	4.3.2.4.1
3.3.2.4.2	Ultimate loads	Test	4.3.2.4.2
3.3.3	*Environmental*	---	*4.3.3*
3.3.3.1	Operating temperature	Test	4.3.3.1
3.3.3.2	Temperature shock	Test	4.3.3.2
3.3.3.3	Humidity	Test	4.3.3.3
3.3.3.4	Explosive decompression	Test	4.3.3.4
3.3.3.5	Salt-fog	Test	4.3.3.5
3.3.3.6	Rain	Test	4.3.3.6
3.3.3.7	Dust	Test	4.3.3.7
3.3.3.8	Sand	Test	4.3.3.8
3.3.3.9	Fungus	Test	4.3.3.9
3.3.3.10	Vibration	Test	4.3.3.10
3.3.3.11	Mechanical shock	Test	4.3.3.11
3.3.3.12	Crash hazard shock	Test	4.3.3.12
3.3.3.12.1	Vertical	Test	4.3.3.12.1
3.3.3.12.2	Longitudinal	Test	4.3.3.12.2
3.3.3.13	Flame resistance	Test	4.3.3.13
3.3.3.14	Nuclear hardness	---	4.3.3.14
3.3.3.14.1	Nuclear EMP	Analysis	4.3.3.14.1
3.3.3.14.2	TREE	Analysis	4.3.3.14.2
3.3.3.14.3	Thermal	Analysis	4.3.3.14.3
3.3.3.14.4	Solar radiation	Test	4.3.3.14.4
3.3.4	*Maintainability*	---	*4.3.4*

3.3.4.1	Seat removal and installation	Demonstration	4.3.4.1
3.3.4.2	Hand-packed parachutes	Demonstration	4.3.4.2
3.3.4.3	Parachute packing containers	Demonstration	4.3.4.3
3.3.4.4	Ground servicing	Demonstration	4.3.4.4
3.3.4.5	Survival kit packing	Demonstration	4.3.4.5
3.3.4.6	Inspection cycle	Analysis	4.3.4.6
3.3.4.7	MTBF	Analysis	4.3.4.7
3.3.4.8	MMH/FH	Analysis	4.3.4.8
3.3.4.9	MTTR	Analysis	4.3.4.9
3.3.4.10	Useful life	Analysis	4.3.4.10
3.3.4.11	Service life	Analysis	4.3.4.11
3.3.4.12	Storage life	Analysis	4.3.4.12
3.3.4.13	Reliability	Analysis	4.3.4.13
3.3.4.14	Demonstrated reliability	Test	4.3.4.14
3.4	**Design and construction**	**---**	**4.4**
3.4.1	*Marking*	---	*4.4.1*
3.4.1.1	Product identification	Inspection	4.4.1.1
3.4.1.2	Equipment identification	Inspection	4.4.1.2
3.4.1.3	Transmission line identification	Inspection	4.4.1.3
3.4.2	*Materials, processes, and parts*	---	*4.4.2*
3.4.2.1	Workmanship	Inspection	4.4.2.1
3.4.2.2	Fumes	Analysis	4.4.2.2
3.4.2.3	Fluid exposure	Analysis	4.4.2.3
3.4.2.4	Lubrication	Analysis	4.4.2.4

3.4.2.5	Captive hardware	Inspection/Demonstration	4.4.2.5
3.4.2.6	Safetying	Inspection	4.4.2.6
3.4.2.7	Interchangeability	Demonstration/Analysis	4.4.2.7
3.4.2.8	Component misinstallation	Inspection/Demonstration	4.4.2.8
3.4.3	*Electrical design*	---	*4.4.3*
3.4.3.1	Wiring	Analysis	4.4.3.1
3.4.3.2	Insulation resistance	Test	4.4.3.2
3.4.3.3	Voltage withstand	Demonstration/Test	4.4.3.3
3.4.3.4	Electrical protection	---	4.4.3.4
3.4.3.4.1	Under-voltage protection	Demonstration	4.4.3.4.1
3.4.3.4.2	Overload protection	Demonstration	4.4.3.4.2
3.4.3.5	EMIC	Test	4.4.3.5
3.4.4	*Safety*	---	*4.4.4*
3.4.4.1	Inadvertent actuation	Inspection/Demonstration	4.4.4.1
3.4.4.2	Safety devices	Inspection/Analysis	4.4.4.2
3.4.4.3	Installation keying	Inspection	4.4.4.3
3.4.4.4	Public display of aircraft	Demonstration/Analysis	4.4.4.4
3.4.5	*Anthropometric accommodation*	---	*4.4.5*
3.4.5.1	Human factors	Analysis	4.4.5.1
3.4.5.2	Ejection seat accommodation	Test	4.4.5.2
3.4.5.3	Aircraft accommodation compatibility	Demonstration	4.4.5.3
3.5	**Major subsystems**	---	**4.5**
3.5.1	*Seat assembly*	---	*4.5.1*
3.5.1.1	Structure subsystem	---	4.5.1.1

3.5.1.1.1	Limb retention	Analysis/Test	4.5.1.1.1
3.5.1.1.2	Lap belt retention	Inspection	4.5.1.1.2
3.5.1.1.3	Armrests	Inspection/Demonstration	4.5.1.1.3
3.5.1.1.4	Canopy breakers	Inspection/Test	4.5.1.1.4
3.5.1.2	Personnel restraint subsystem	Inspection/Demonstration	4.5.1.2
3.5.1.2.1	Ingress and egress	Inspection/Demonstration	4.5.1.2.1
3.5.1.2.2	Lower torso restraint	Demonstration/Analysis	4.5.1.2.2
3.5.1.2.3	Inertia reel lock	Analysis/Test	4.5.1.2.3
3.5.1.2.4	Inertia reel lock lever	Demonstration	4.5.1.2.4
3.5.1.2.5	Inertia reel strap bearing point	Demonstration	4.5.1.2.5
3.5.1.2.6	Powered retraction	Test	4.5.1.2.6
3.5.1.2.7	Torso load	Test	4.5.1.2.7
3.5.1.2.8	Restraint release	Demonstration	4.5.1.2.8
3.5.1.3	Emergency release subsystem	Analysis	4.5.1.3
3.5.1.3.1	Release control	Inspection/Demonstration	4.5.1.3.1
3.5.1.3.2	Release functionality	Demonstration	4.5.1.3.2
3.5.1.3.3	Release non-operation	Demonstration	4.5.1.3.3
3.5.1.4	Headrest subsystem	---	4.5.1.4
3.5.1.4.1	Forward Position	Analysis	4.5.1.4.1
3.5.1.4.2	Head motion	Demonstration	4.5.1.4.2
3.5.1.4.3	Lateral restraint	Demonstration	4.5.1.4.3
3.5.1.4.4	Seat-man interference	Demonstration/Test	4.5.1.4.4
3.5.1.5	Initiation subsystem	---	4.5.1.5
3.5.1.5.1	Automatic-manual mode	Demonstration/Analysis	4.5.1.5.1

3.5.1.5.2	Control handles	Inspection/Demonstration	4.5.1.5.2
3.5.1.5.3	Control force	Test	4.5.1.5.3
3.5.1.6	Sequencing subsystem	Analysis/Test	4.5.1.6
3.5.1.6.1	Mode selection	Analysis/Test	4.5.1.6.1
3.5.1.6.2	Sequence subsystem	Demonstration/Test	4.5.1.6.2
3.5.1.6.3	Sequencer initiation	Test	4.5.1.6.3
3.5.1.6.4	Recording rates	Test	4.5.1.6.4
3.5.1.6.5	Data limits	Test	4.5.1.6.5
3.5.1.6.6	Recovery of mishap information	Inspection/Demonstration	4.5.1.6.6
3.5.2	*Energetic components*	---	*4.5.2*
3.5.2.1	Propellant devices	Analysis/Test	4.5.2.1
3.5.2.2	Propulsion subsystem	Analysis/Test	4.5.2.2
3.5.2.3	Energetic transmission lines	Demonstration/Analysis	4.5.2.3
3.5.2.4	CAD/PAD	Analysis/Test	4.5.2.4
3.5.2.5	CAD/PAD commonality	Analysis	4.5.2.5
3.5.3	*Seat adjustment actuator*	---	*4.5.3*
3.5.3.1	Adjustment control	Demonstration	4.5.3.1
3.5.3.2	Variable adjustment	Demonstration	4.5.3.2
3.5.3.3	Adjustment position	Demonstration	4.5.3.3
3.5.3.4	Operating loads	Test	4.5.3.4
3.5.3.5	Electrical compliance	Analysis/Test	4.5.3.5
3.5.4	*Installed equipment*	---	*4.5.4*
3.5.4.1	Stabilization subsystem	Test	4.5.4.1
3.5.4.1.1	Deceleration forces	Test	4.5.4.1.1

3.5.4.1.2	Recovery attitude	Inspection/Analysis	4.5.4.1.2
3.5.4.1.3	Trim attitude	Test	4.5.4.1.3
3.5.4.1.4	CG envelope	Analysis/Test	4.5.4.1.4
3.5.4.2	Recovery parachute subsystem	---	4.5.4.2
3.5.4.2.1	Interface	Inspection	4.5.4.2.1
3.5.4.2.2	Container	Inspection	4.5.4.2.2
3.5.4.2.2.1	Water intrusion	Demonstration	4.5.4.2.2.1
3.5.4.2.2.2	Flash fire	Demonstration	4.5.4.2.2.2
3.5.4.2.3	High altitude	Test	4.5.4.2.3
3.5.4.2.4	Seat-man separation	Demonstration	4.5.4.2.4
3.5.4.2.5	Dynamic performance	Test	4.5.4.2.5
3.5.4.2.6	Wake recontact	Demonstration	4.5.4.2.6
3.5.4.2.7	Descent rate	Test	4.5.4.2.7
3.5.4.2.8	Oscillation	Test	4.5.4.2.8
3.5.4.2.9	Horizontal drive	Test	4.5.4.2.9
3.5.4.2.10	Steering	Test	4.5.4.2.10
3.5.4.2.11	Parachute color	Inspection	4.5.4.2.11
3.5.4.3	Life support subsystem	Demonstration/Test	4.5.4.3
3.5.4.3.1	Emergency oxygen	Inspection/Test	4.5.4.3.1
3.5.4.3.2	Oxygen bottle compatibility	Demonstration	4.5.4.3.2
3.5.4.3.3	Oxygen regulation	Demonstration/Test	4.5.4.3.3
3.5.4.3.4	Oxygen actuation	Demonstration/Test	4.5.4.3.4
3.5.4.3.5	Oxygen serviceability	Inspection/Demonstration	4.5.4.3.5
3.5.4.4	Survival equipment subsystem	---	4.5.4.4

3.5.4.4.1	Bucket volume	Analysis	4.5.4.4.1
3.5.4.4.2	Lateral restraint	Analysis	4.5.4.4.2
3.5.4.4.3	Deployment	Demonstration/Test	4.5.4.4.3
3.5.4.4.4	Survival equipment	Demonstration	4.5.4.4.4
3.5.4.4.5	Survival kit construction	Analysis	4.5.4.4.5
3.5.4.5	Personnel locator subsystem	Analysis/Test	4.5.4.5
3.5.4.6	Seat cushion subsystem	Demonstration	4.5.4.6
3.5.4.6.1	Compression load	Test	4.5.4.6.1
3.5.4.6.2	Pressure distribution	Test	4.5.4.6.2
3.5.4.6.3	Durability	Test	4.5.4.6.3
3.6	**Logistics**	**---**	**4.6**
3.6.1	Ground support	Demonstration	4.6.1
3.6.2	Support equipment	Demonstration/Analysis	4.6.2
3.6.3	Personnel	Analysis	4.6.3
3.6.4	Supply	Analysis	4.6.4
3.6.5	Facilities	Analysis	4.6.5
3.6.6	Transportability	Analysis	4.6.6

4.2 Compatibility

4.2.1 Aircraft compatibility. Demonstration and test shall verify that the seat system meets the requirement for aircraft compatibility in 3.2.1. The procedure shall be as follows: The seat shall be installed along the existing guide rails in the F-15, F-16, F-22, B-1B, and A-10 cockpits. The seat-aircraft interface connections shall be made and verified. The external seat components designed to move, whether manually or automatically, during flight operation or prior to full seat departure from the aircraft during an ejection shall be adjusted through their full range of motion to verify adequate clearance. All interface connections and external component motions shall be verified through the full fore-aft cradle adjustment range, the fully up-down seat actuator adjustment range, and the full escape path through the F-15, F-16, F-22, B-1B and A-10 canopies/hatches. Ejection sled tests verify functional compatibility and installation requirements.

4.2.1.1 Structural compatibility. Demonstration and analysis shall verify that the seat system meets the requirement for structural compatibility in 3.2.1.1. The procedure shall be as follows: The seat shall be fully installed in the F-15, F-16, F-22, B-1B, and A-10 cockpit without requiring any major structural modification. Footwell attachments for the limb restraints shall be installed, if approved by the procurement agency. Structural compatibility with respect to ejection (and catapult) loads shall be verified by structural analysis.

4.2.1.2 Aircraft escape path clearance and sequencing system compatibility. Demonstration and test shall verify that the seat system meets the requirement for aircraft escape path clearance and sequencing system compatibility in 3.2.1.2. The procedure shall be as follows: Dual seat sled tests shall be conducted for the F-15 and F-16 aircraft using the existing interseat sequencing timing to ensure seat system coordination with the respective canopy removal system. Single seat sled tests shall be conducted for the F-15, F-16, A-10, and F-22 aircraft to ensure that the seat system is compatible with the existing initiation systems. Multi-seat sled tests shall be conducted for the B-1B aircraft using the existing interseat sequencing timing to ensure seat system coordination with the hatch removal system. Demonstration shall ensure that the seat system does not encroach on the existing cockpit ejection clearance envelope. If the seat system does encroach on the cockpit, sled testing shall verify that the seat system does not provide an increased injury risk.

4.2.1.3 Aircraft maintenance and inspection compatibility. Demonstration shall verify that the seat system meets the requirement for aircraft maintenance and inspection compatibility in 3.2.1.3. The procedure shall be as follows: The seat system shall be installed in all aircraft platforms and adjusted to a maintenance position, if applicable on the aircraft platform. While in the maintenance position, routine maintenance tasks shall be simulated to ensure the procedures can be completed. Validation of any affected aircraft TO's shall be demonstrated.

4.2.2 Personal services and equipment compatibility. Demonstration shall verify that the seat system meets the requirement for personal services and equipment compatibility in 3.2.2. The seat system shall demonstrate compatibility with all connections, disconnects, and functional capabilities including communication cables, oxygen supply lines, HMD cables/connectors, and pressure garment supply lines.

4.2.3 Electrical power compatibility.

4.2.3.1 Electrical power supply. Test shall verify that the seat system meets the requirement for electrical power supply in 3.2.3.1. The procedure shall be as follows: Seat system functional tests shall be conducted incorporating power characteristics as specified by aircraft platform legacy interface requirements.

4.2.3.2 Electrical power usage. Test shall verify that the seat system meets the requirement for electrical power usage in 3.2.3.2. The procedure shall be as follows: The seat shall be installed in the F-15, F-16, F-22, B-1B, and A-10 cockpits or in a lab environment under simulated loads. The current draw shall be measured as the seat is cycled through maximum required power draw consistent with operational use.

4.2.3.3 Momentary power interruptions. Test shall verify that the seat system meets the requirement for momentary power interruptions in 3.2.3.3. The procedure shall be as follows:

The seat shall be subject to the power interruption times of TABLE 2 and then functioned as normal.

4.3 Characteristics.

4.3.1 Performance.

4.3.1.1 Ejection position. Analysis and test shall verify that the seat system meets the requirement for ejection position in 3.3.1.1. The procedure shall be as follows: Ejection sled tests shall verify capability of ejection from the full up to full down seat adjustment range, in addition to the B-1B fully aft and fully forward seat cradle positions.

4.3.1.2 Ejectable occupant weight. Test shall verify that the seat system meets the requirement for ejectable weight in 3.3.1.2. The procedure shall be as follows: The seat shall be sled tested with test manikins, equipment, and survival kit configurations representing the weight ranges specified in 3.3.1.2.

4.3.1.3 Escape Envelope. Test shall verify that the seat system meets the requirement for Escape Envelope in 3.3.1.3. The procedure shall be as follows: Sled testing shall be conducted with fully dressed manikins from 0 KEAS to 600 KEAS to ensure full operation of the seat system at ground level. Manikins, AFE, and velocities shall be selected in order to fully encompass the operational missions of the individual aircraft platforms. High altitude ejection shall be verified by bomb drop, laboratory, or in-flight ejection test.

4.3.1.4 Terrain Clearance. Analysis shall verify that the seat system meets the requirement for Terrain Clearance in 3.3.1.4. The procedure shall be as follows: Contractor modeling, validated by system test, shall simulate ejections at terrain clearance limits to ensure operation of seat is capable of sufficiently recovering crewmembers.

4.3.1.5 Collision avoidance, damage, and trajectory divergence. Test shall verify that the seat system meets the requirement for collision avoidance, damage, and trajectory divergence in 3.3.1.5. The procedure shall be as follows: Single seat, dual seat, and quad seat sled tests shall be conducted to ensure each individual seat system is capable of safely ejecting without colliding with aircraft, jettisoned canopies/hatches, other ejection seats, parachutes, or crewmembers.

4.3.1.6 Major injury probability. Test shall verify that the seat system meets the requirement for major injury probability in 3.3.1.6.

4.3.1.7 Catapult/Rocket acceleration. Test shall verify that the seat system meets the requirement for catapult/rocket acceleration in 3.3.1.7. The procedure shall be two-fold: 1) The design and the engineering drawings of the seat shall be reviewed to ensure that the resultant catapult/rocket acceleration prior to seat-aircraft separation is within 5° of the seatback tangent line, and 2) a triaxial accelerometer and three orthogonal seat rate sensors shall be mounted (consistent with the coordinate system of FIGURE A.2) on the seat pan just under the base of the manikin's spine during each sled test. The acceleration data of the Z-axis accelerometer from ejection initiation to seat-aircraft separation shall be used to calculate a maximum DRI_Z value IAW APPENDIX A.1.

4.3.1.8 Multi-axial acceleration. Test shall verify that the seat system meets the requirement for multi-axial acceleration in 3.3.1.8. The procedure shall be as follows: A triaxial accelerometer and three orthogonal seat rate sensors shall be mounted during each sled test (consistent with the coordinate system of FIGURE A.2 on the seat pan just under the base of the manikin's spine with the Z-axis parallel to the seatback tangent plane. An additional triaxial accelerometer shall be mounted (consistent with the coordinate system of FIGURE A.2 on the seatback centerline 18.19 inches from the seat reference point IAW FIGURE A.2. The acceleration output from the Z-axis accelerometer at the seat pan shall be used to calculate the $DR_z(t)$. The X- and Y-axes acceleration outputs from the seatback accelerometer shall be used to calculate the $DR_x(t)$ and $DR_y(t)$. These three dynamic response traces in conjuction with the appropriate limits in TABLE 12 shall be used to compute the MDRC value from seat-aircraft separation through seat-man separation. The output data from both sets of triaxial accelerometers and seat rate sensors shall also be used to calculate the MDRC at the critical point using the methods in APPENDIX A.

4.3.1.9 <u>Chest acceleration.</u> Test shall verify that the seat system meets the requirement for chest acceleration in 3.3.1.9. The procedure shall be as follows: sled testing will be conducted.

4.3.1.10 <u>Neck injury criteria</u>.

4.3.1.10.1 <u>MANIC$_Z$.</u> Test shall verify that the seat system meets the requirement for MANIC$_Z$ in 3.3.1.10.1. The procedure shall be as follows: sled testing will be conducted.

4.3.1.10.2 <u>MANIC$_X$.</u> Test shall verify that the seat system meets the requirement for MANIC$_X$ in 3.3.1.10.2. The procedure shall be as follows: sled testing will be conducted.

4.3.1.10.3 <u>MANIC$_Y$.</u> Test shall verify that the seat system meets the requirement for MANIC$_Y$ in 3.3.1.10.3. The procedure shall be as follows: sled testing will be conducted.

4.3.1.10.4 <u>NMI$_X$.</u> Test shall verify that the seat system meets the requirement for NMI$_X$ in 3.3.1.10.4. The procedure shall be as follows: sled testing will be conducted.

4.3.1.11 <u>Head acceleration.</u> Test shall verify that the seat system meets the requirement for head injury probability in 3.3.1.11. The procedure shall be as follows: Accelerometers shall be mounted within the cg of the head of the manikin during each sled test consistent with the coordinate system of FIGURE A.1. Acceleration data shall be used to calculate probability of concussion, as per APPENDIX A.

4.3.1.12 <u>Automated performance.</u> Demonstration and test shall verify that the seat system meets the requirement for automated performance in 3.3.1.12.

4.3.2 *Physical*

4.3.2.1 <u>Weight.</u> Inspection shall verify that the seat system meets the requirement for weight in 3.3.2.1. The procedure shall be as follows: The seat system shall be fully built up, with all subsystems installed, except the contents of the survival kit, and weighed.

4.3.2.2 <u>Color.</u>

4.3.2.2.1 <u>Seat color.</u> Inspection shall verify that the seat system meets the requirement for seat color in 3.3.2.2.1.

4.3.2.2.2 <u>Ejection control color.</u> Inspection shall verify that the seat system meets the requirement for ejection control color in 3.3.2.2.2.

4.3.2.3 <u>Drain holes.</u> Inspection and demonstration shall verify that the seat system meets the requirement for drain holes in 3.3.2.3. The procedure shall be as follows: The seat system shall be inspected for accumulated water following the environmental rain test of 3.3.3.6.

4.3.2.4 Strength.

4.3.2.4.1 Proof loads. Test shall verify that the seat system meets the requirement for proof loads in 3.3.2.4.1. The procedure shall be as follows: A test fixture shall be designed to replicate the aircraft guide rail interface, the catapult attachment, and the seat height actuator mount. The fixture shall be adequately strong to limit fixture deflection during strength tests. For the seat pan, armrests, and ejection controls, a plate shall be used to distribute the proof loads; for the headrest, a block representative of the HGU-55/P shall be used; and for the seatback, a body block shall be used to simulate an occupant. Forces shall be applied gradually or incrementally through the center of gravity of the distribution blocks to simulate static loading. Displacement gauges shall be used to measure seat deflection. The seat pan, armrest, ejection controls, and headrest shall be checked for functionality following the proof load.

4.3.2.4.2 Ultimate loads. Test shall verify that the seat system meets the requirement for ultimate loads in 3.3.2.4.2. The procedure shall be as follows: A test fixture shall be designed to replicate the aircraft guide rail interface, the catapult attachment, and the seat height actuator mount. The fixture shall be adequately strong to limit fixture deflection during strength tests. For the seat pan, armrests, and ejection controls, a plate shall be used to distribute the proof loads; for the headrest, a block representative of the HGU-55/P shall be used; and for the seatback, restrain subsystem, and seat system, a body block shall be used to simulate an occupant. The resultant force shall be applied gradually or incrementally at the center of gravity of the distribution blocks to simulate static loading. Displacement gauges shall be used to measure seat deflection. The ejection air load test shall be conducted with the seat raised up the guide rails to the most structurally critical position, where the seatback is exposed to the airstream, but the seat bucket is still fixed to the guide rails. The seat pan, armrest, ejection controls, and headrest shall be checked for functionality following the proof load.

4.3.3 *Environmental*

4.3.3.1 Operating temperature. Test shall verify that the seat system meets the requirement for operating temperature in 3.3.3.1. The procedure shall be IAW MIL-STD-810, Method 501.6, Procedure II, Operation and Method 502.6, Procedure II, Operation. The seat system shall be cycled three times with system performance measured at the peak temperature response time.

4.3.3.2 Temperature shock. Test shall verify that the seat system meets the requirement for temperature shock in 3.3.3.2. The procedure shall be IAW MIL-STD-810, Method 503.6, Procedure I-C, Multi-Cycle Shocks from Constant Extreme Temperature. The seat system shall be cycled three times with system performance measured at the peak temperature response time.

4.3.3.3 Humidity. Test shall verify that the seat system meets the requirement for humidity in 3.3.3.3. The procedure shall be IAW MIL-STD-810, Method 507.6, Procedure II, Aggravated Cycle.

4.3.3.4 Explosive decompression. Test shall verify that the seat system meets the requirement for explosive decompression in 3.3.3.4. The procedure shall be IAW MIL-STD-810, Method 500.6, Procedure IV, Explosive Decompression.

4.3.3.5 Salt-fog. Test shall verify that the seat system meets the requirement for salt-fog in 3.3.3.5. The procedure shall be IAW MIL-STD-810, Method 509.6 with two sets of alternating 48-hour cycles of salt fog and drying.

4.3.3.6 Rain. Test shall verify that the seat system meets the requirement for rain in 3.3.3.6. The procedure shall be IAW MIL-STD-810, Method 506.6, Procedure I, Rain and Blowing Rain.

4.3.3.7 Dust. Test shall verify that the seat system meets the requirement for dust in 3.3.3.7. The procedure shall be IAW MIL-STD-810, Method 510.6, Procedure I, Blowing Dust.

4.3.3.8 Sand. Test shall verify that the seat system meets the requirement for sand in 3.3.3.8. The procedure shall be IAW MIL-STD-810, Method 510.6, Procedure II, Blowing Sand.

4.3.3.9 Fungus. Test shall verify that the seat system meets the requirement for fungus in 3.3.3.9. The procedure shall be IAW MIL-STD-910, Method 508.7

4.3.3.10 Vibration. Test shall verify that the seat system meets the requirement for vibration in 3.3.3.10. The procedure shall be IAW MIL-STD-810, Method 514.7, Procedure I, General Vibration.

4.3.3.11 Mechanical shock. Test shall verify that the seat system meets the requirement for mechanical shock in 3.3.3.11. The procedure shall be IAW MIL-STD-810, Method 516.7, Procedure I, Functional.

4.3.3.12 Crash hazard shock. Test shall verify that the seat system meets the requirement for crash hazard shock in 3.3.3.12. The procedure shall be IAW MIL-STD-810, Method 516.7, Procedure II, Crash Hazard.

4.3.3.12.1 Vertical. See 4.3.3.12.

4.3.3.12.2 Longitudinal. See 4.3.3.12.

4.3.3.13 Flame resistance. Test shall verify that the seat system meets the requirement for flame resistance in 3.3.3.13. The procedure shall be IAW ASTM D6413. (IAW FAR 25.853, Appendix F, Part II)

4.3.3.14 Nuclear hardness.

4.3.3.14.1 Nuclear EMP. Analysis shall verify that the seat system meets the requirement for EMP in 3.3.3.14.1. The procedure shall be as follows: Analysis shall be performed and shall be supported by developmental testing when existing hardness data is insufficient to give confidence in the hardened design.

4.3.3.14.2 TREE. Analysis shall verify that the seat system meets the requirement for TREE in 3.3.3.14.2. The procedure shall be as follows: Analysis shall be performed IAW MIL-STD-461 to verify the hardness and it shall be supported by component (piecepart or circuit) test data. Maximum use shall be made of existing test data. The analysis shall categorize hardness levels and design margins for each mission critical subsystem, Line Replaceable Unit (LRU), circuit, or piecepart.

4.3.3.14.3 Thermal. Analysis shall verify that the seat system meets the requirement for thermal in 3.3.3.14.3. The procedure shall be as follows: Analysis shall verify the hardness of all material used in the construction of the seat system exterior surfaces.

4.3.3.14.4 Solar Radiation. Test shall verify that the seat system meets the requirement for solar radiation resistance in 3.3.3.14.4. The seat cushion upholstery material shall be tested

IAW MIL-STD-810, Method 505.4 Procedure II. Pass criteria for this test shall be the successful completion of the tests in Paragraph 4.10.1.5.4 through Paragraph 4.10.1.5.6.

4.3.4 *Maintainability*

4.3.4.1 Seat removal and installation. Demonstration shall verify that the seat system meets the requirement for seat removal and installation in 3.3.4.1. The procedure shall be as follows: The seat system shall be installed on the ejection guide rails in the F-15, F-16, F-22, and A-10 aircraft without removing the canopies. The seat system shall be installed through the crew entry door of the B-1B aircraft and onto the ejection guide rails. The seat shall be subsequently removed from the rails and out the crew entry door. Demonstrations shall verify that the seat system permits time change component installation and removal while on-aircraft.

4.3.4.2 Hand-packed parachutes. Demonstration shall verify that the seat system meets the requirement for hand-packed parachutes in 3.3.4.2. The procedure shall be as follows: Both the drogue parachute and recovery parachute shall be hand packed by AF personnel.

4.3.4.3 Parachute packing containers. Demonstration shall verify that the seat system meets the requirement for parachute packing containers in 3.3.4.3. The procedure shall be as follows: Both the drogue parachute container and recovery parachute container shall be removed from the seat as separate modules.

4.3.4.4 Ground servicing. Demonstration shall verify that the seat system meets the requirement for ground servicing in 3.3.4.4. The procedure shall be as follows: Ground servicing mechanism shall be unlocked without the use of tools and the survival kit, lap belts, and recovery parachute assembly shall be removed from the seat. Demonstrations shall include reinstallation of the survival kit, lap belts, and recovery parachute assembly as well as resetting the ground servicing mechanism.

4.3.4.5 Survival Kit Packing. Demonstration shall verify the seat system meets the requirement for survival kit packing in 3.3.4.5. The procedure shall be as follows: The survival kit shall be packed without unique support equipment or tools.

4.3.4.6 Inspection cycle. Analysis shall verify that the seat system meets the requirement for inspection cycle in 3.3.4.6.

4.3.4.7 MTBF. Analysis shall verify that the seat system meets the requirement for MTBF in 3.3.4.7.

4.3.4.8 MMH/FH. Analysis shall verify that the seat system meets the requirement for MMH/FH in 3.3.4.8.

4.3.4.9 MTTR. Analysis shall verify that the seat system meets the requirement for MTTR in 3.3.4.9.

4.3.4.10 Useful life. Analysis shall verify that the seat system meets the requirement for useful life in 3.3.4.10.

4.3.4.11 Service life. Analysis shall verify that the seat system meets the requirement for service life in 3.3.4.11.

4.3.4.12 Storage life. Analysis shall verify that the seat system meets the requirement for storage life in 3.3.4.12. .

4.3.4.13 Reliability. Analysis shall verify that the seat system meets the requirement for reliability in 3.3.4.13.

4.3.4.14 Demonstrated reliability. Test shall verify that the seat system meets the requirement for demonstrated reliability in 3.3.4.14. The procedure shall be as follows: For seat qualification, 22 sled tests will be performed that encompass the velocity and pilot size population envelope. For seat integration, 8 sled tests will be performed to ensure that the new systems are compatible with the existing aircraft IAW MIL-HDBK-516.

4.4 Design and construction.

4.4.1 *Marking*

4.4.1.1 Product identification. Inspection shall verify that the seat system meets the requirement for product identification in 3.4.1.1. The procedure shall be as follows: Each of the major seat structural assemblies shall be inspected while installed in the aircraft for the nameplate. All of the nameplate information shall be verified for completeness and readability.

4.4.1.2 Equipment identification. Inspection shall verify that the seat system meets the requirement for equipment identification in 3.4.1.2.

4.4.1.3 Transmission line identification. Inspection shall verify that the seat system meets the requirement for transmission line identification in 3.4.1.3.

4.4.2 *Materials, processes, and parts*

4.4.2.1 Workmanship. Inspection shall verify that the seat system meets the requirement for workmanship in 3.4.2.1. The procedure shall be as follows: A quality assurance inspection list shall be developed for all workmanship items listed in 3.4.2.1 applied to the specific seat components. The seat system shall be inspected for defects and hazards to equipment, seat occupants, or maintenance personnel.

4.4.2.2 Fumes. Analysis shall verify that the seat system meets the requirement for fumes in 3.4.2.2.

4.4.2.3 Fluid exposure. Analysis shall verify that the seat system meets the requirement for fluid exposure in 3.4.2.3.

4.4.2.4 Lubrication. Analysis shall verify that the seat system meets the requirement for lubrication in 3.4.2.4.

4.4.2.5 Captive hardware. Inspection and demonstration shall verify that the seat system meets the requirement for captive hardware in 3.4.2.5. The procedure shall be as follows: Captive hardware use shall be verified by inspection of engineering drawings. On-aircraft maintenance of the seat system shall be performed while the seat system is installed in the aircraft. No hardware shall come loose from the seat.

4.4.2.6 Safetying. Inspection shall verify that the seat system meets the requirement for safetying in 3.4.2.6. The procedure shall be as follows: Inspection of engineering drawings shall verify use of safety wiring or cotter pinning, and that all safetying is IAW 3.4.2.6.

4.4.2.7 Interchangeability. Demonstration and Analysis shall verify that the seat system meets the requirement for interchangeability in 3.4.2.7. The procedure shall be as follows:

Analysis of respective components and engineering drawings shall verify the critical dimensions for interchangeability. Interchangeable parts shall be installed to ensure the part fits as intended.

4.4.2.8 Component misinstallation. Inspection and demonstration shall verify that the seat system meets the requirement for component misinstallation in 3.4.2.8. The procedure shall be as follows: Replaceable seat system components shall be inspected to verify they cannot be improperly installed. Fit check will verify that components cannot physically be installed improperly.

4.4.3 Electrical design.

4.4.3.1 Wiring. Analysis shall verify that the seat system meets the requirement for wiring in 3.4.3.1.

4.4.3.2 Insulation resistance. Test shall verify that the seat system meets the requirement for insulation resistance in 3.4.3.2. The procedure shall be as follows: The test voltage shall be applied until the resistance value stabilizes or for one minute, whichever occurs first.

4.4.3.3 Voltage withstand. Demonstration and test shall verify that the seat system meets the requirement for voltage withstand in 3.4.3.3. The procedure shall be as follows: Testing shall be conducted to verify that the seat system is able to withstand the requirements of 3.4.3.3. Additionally, the manufacturer of the seat system adjustment actuator motor shall perform acceptance tests at 1000 vrms.

4.4.3.4 Electrical protection

4.4.3.4.1 Under-voltage protection. Demonstration shall verify that the seat system meets the requirement for under-voltage protection in 3.4.3.4.1.

4.4.3.4.2 Overload protection. Demonstration shall verify that the seat system meets the requirement for overload protection in 3.4.3.4.2.

4.4.3.5 EMIC. Test shall verify that the seat system meets the requirement for EMIC in 3.4.3.5.

4.4.4 *Safety*

4.4.4.1 Inadvertent actuation. Inspection and demonstration shall verify that the seat system meets the requirement for inadvertent actuation in 3.4.4.1. The procedure shall be as follows: The design and engineering drawings shall be reviewed for compliance. The seat system shall be set to its safe setting. While in its safe setting, the handle shall be pulled.

4.4.4.2 Safety devices. Inspection and analysis shall verify that the seat system meets the requirement for safety devices in 3.4.4.2.

4.4.4.3 Installation keying. Inspection shall verify that the seat system meets the requirement for installation keying in 3.4.4.3. The procedure shall be as follows: The design and engineering drawings shall be reviewed for compliance.

4.4.4.4 Public display of aircraft. Demonstration and analysis shall verify that the seat systems meets the requirements for public display of aircraft in 3.4.4.4. The procedure shall be as follows: The seat system shall be put in a public display safety mode. Analysis from the safety device sections will verify that the seat is unable to actuate.

4.4.5 *Anthropometric accommodation*

4.4.5.1 Human factors. Analysis shall verify that the seat system meets the requirement for human factors in 3.4.5.1. The procedure shall be as follows: A human factors evaluation shall be conducted to verify MIL-STD-1472 compliance.

4.4.5.2 Ejection seat accommodation. Test shall verify that the seat system meets the requirement for ejection seat accommodation in 3.4.5.2. The procedure shall be as follows: The seat system shall be sled tested with manikins representing the, anthropometric cases and dimensions in TABLE 7.

4.4.5.3 Aircraft Accommodation Compatibility. Demonstration shall verify that the seat system meets the requirement for aircraft accommodation compatibility and human systems integration in 3.4.5.3. The procedure shall be as follows: A human factors evaluation assessment shall be conducted using subject personnel, representative of the anthropometric population, wearing representative AFE (TABLE 1) to validate that the seat system does not interfere with routine operational tasks, allows each subject to reach the design eye point, does not hinder a crewmember's reach, allows sufficent Over the Nose Vision (ONV), rudder reach, overhead clearance, shin clearance, escape path clearance checks, and control actuation capability when compared to the legacy seat. The 711th Human Performance Wing (HPW) will provide anthropometric subjects to be used in demonstrations. The percentage of USAF males and females accommodated shall be compared with the F-15, F-16, F-22, B-1B, and A-10 accommodation levels IAW AFRL-HE-WP-TR-2002-0118.

4.5 Major subsystems.

4.5.1 *Seat assembly*

4.5.1.1 Structure subsystem.

4.5.1.1.1 Limb retention. Analysis and test shall verify that the seat system meets the requirement for limb retention in 3.5.1.1.1. The procedure shall be as follows: Analysis of the limb retention shall verify that crewmember legs will be incapable of moving laterally, beyond the sides of the seat. Analysis of the limb retention shall verify that crewmember arms will be incapable of moving rearward beyond the seat back tangent line. Sled testing shall verify that the limb retention mechanisms work in conjunction with normal seat system operation to prevent limb flail.

4.5.1.1.2 Lap belt retention. Inspection shall verify that the seat system meets the requirement for lap belt retention in 3.5.1.1.2. The procedure shall be as follows: The seat system shall be installed in the aircraft. The male and female lap belt ends shall be inserted between the seat and aircraft consoles to the extent possible and subsequently pulled back out. Demonstration shall verify that the lap belt ends cannot jam aircraft controls during seat adjustment.

4.5.1.1.3 Armrests. Inspection and demonstration shall verify that the seat system meets the requirement for armrests in 3.5.1.1.3. The procedure shall be as follows: The engineering drawings shall be reviewed for compliance, and both arm rests shall be rotated through their full range of motion. Demonstrations shall verify that the stowed, armrest position does not interfere with crew mission tasks.

4.5.1.1.4 Canopy breakers. Inspection and test shall verify that the seat system meets the requirement for canopy breakers in 3.5.1.1.4. The procedure shall be as follows: Inspection shall verify that only the seat configurations that require canopy breakers have them installed. The ejection seat, manikin, and representative canopy shall be installed into a test sled. While the canopy remains in place, the ejection seat will be fired. Testing will be conducted at zero-altitude, zero-airspeed as well as during zero-altitude, high-speed sled testing to ensure canopy fragments do not interfere with the ejection seat function throughout the escape envelope.

4.5.1.2 Personnel restraint subsystem. Inspection and demonstration shall verify that the seat system meets the requirement for personnel restraint subsystem in 3.5.1.2. The procedure shall be as follows: The personnel restraint subsystem shall be inspected to verify the incorporation of a lap belt, an inertia reel, and an inertia reel lock control. The personnel restraint subsystem shall be connected to a PCU-15/P and PCU-16/P harness to verify the compatibility of the attachment points.

4.5.1.2.1 Ingress and egress. Inspection and demonstration shall verify that the seat system meets the requirement for ingress and egress in 3.5.1.2.1. The procedure shall be as follows: The seat system engineering drawings shall be reviewed for personnel restraint design verification. An emergency egress demonstration shall verify platform emergency egress timing compliance.

4.5.1.2.2 Lower torso restraint. Demonstration and analysis shall verify that the seat system meets the requirement for lower torso restraint in 3.5.1.2.2. The procedure shall be as follows: A sample size population representing TABLE 7 shall don the equipment of TABLE 1, sit in the seat, and fasten the lap belt. The angle between the lap belt and bottom plane of the seat bucket shall be measured.

4.5.1.2.3 Inertia reel lock. Analysis and test shall verify that the seat system meets the requirement for inertia reel lock in 3.5.1.2.3. The procedure shall be as follows: The inertia reel lock mechanism engineering drawings shall be reviewed for compliance with MIL-R-8236.

4.5.1.2.4 Inertia reel lock lever. Demonstration shall verify that the seat system meets the requirement for inertia reel lock lever in 3.5.1.2.4. The procedure shall be as follows: A sample size population representing TABLE 7 shall fasten the seat restraint system and operate the inertia reel lock lever.

4.5.1.2.5 Inertia reel strap bearing point. Demonstration shall verify that the seat system meets the requirement for inertia reel strap bearing point in 3.5.1.2.5. The procedure shall be as follows: Case 1 and Case 6 manikins shall be installed in the seat with the restraint system retracted. Load cells mounted along the spinal column of the manikins shall record the presence of spinal compression.

4.5.1.2.6 Powered retraction. Test shall verify that the seat system meets the requirement for powered retraction in 3.5.1.2.6.

4.5.1.2.7 Torso load. Test shall verify that the seat system meets the requirement for torso load in 3.5.1.2.7. The procedure shall be as follows: Case 1 and Case 6 manikins shall be installed in the seat with the restraint system fastened. The powered reatraction system shall be activated, and the tension in the shoulder straps shall be measured to confirm tension loads do not exceed 100 lbs.

4.5.1.2.8 Restraint release. Demonstration shall verify that the seat system meets the requirement for restraint release in 3.5.1.2.8. The procedure shall be as follows: Sled testing with manikins shall be conducted. Sled test video shall be reviewed and post-test inspection of the seat system shall verify that the lap belt and parachute risers separated from the seat.

4.5.1.3 Emergency release subsystem. Analysis shall verify that the seat system meets the requirement for emergency release subsystem in 3.5.1.3. The procedure shall be as follows: Engineering drawings shall be reviewed.

4.5.1.3.1 Release control. Inspection and demonstration shall verify that the seat system meets the requirement for release control in 3.5.1.3.1. The procedure shall be two-fold: 1) The emergency release control drawing shall be reviewed, and 2) a sample size population representing TABLE 7 shall fasten the seat restraint system, fully retract and lock the inertia reel, and actuate the emergency release control.

4.5.1.3.2 Release functionality. Demonstration shall verify that the seat system meets the requirement for release functionality in 3.5.1.3.2. The procedure shall be as follows: The emergency restraint release subsystem shall be actuated to ensure the recovery parachute is deployed, the crewmember is released, and the survival kit is retained.

4.5.1.3.3 Release non-operation. Demonstration shall verify that the seat system meets the requirement for release non-operation in 3.5.1.3.3. The procedure shall be as follows: The seat system shall be installed in the ejection guide rails and the emergency release handle shall be remotely actuated.

4.5.1.4 Headrest subsystem.

4.5.1.4.1 Forward position. Analysis shall verify that the seat system meets the requirement for forward position in 3.5.1.4.1. The procedure shall be as follows: The seat system engineering drawings shall be reviewed.

4.5.1.4.2 Head motion. Demonstration shall verify that the seat system meets the requirement for head motion in 3.5.1.4.2. The procedure shall be as follows: The seat system shall be installed in the aircraft. A sample size aircrew population shall perform operational mission tasks.

4.5.1.4.3 Lateral restraint. Demonstration shall verify that the seat system meets the requirement for lateral restraint in 3.5.1.4.3. The procedure shall be as follows: The seat system shall be sled tested. The manikin neck shall be instrumented and video cameras shall be used to capture head motion. Video, neck instrumentation data, and/or witness marks shall be used to identify head movement.

4.5.1.4.4 Seat-man interference. Demonstration and test shall verify that the seat system meets the requirement for seat-man interference in 3.5.1.4.4. The procedure shall be as follows: The Case 1 and Case 6 manikins shall be installed in the seat, and the seat-manikin combination shall be suspended above the ground by the parachute risers. The seat shall be set to its configuration just prior to seat-man separation and then released, thereby effecting seat-man separation. Seat-man interference shall also be verified during sled tests.

4.5.1.5 Initiation subsystem.

4.5.1.5.1 Automatic-manual mode. Demonstration and analysis shall verify that the seat system meets the requirement for automatic-manual mode in 3.5.1.5.1. The procedure shall be as follows: A represenative signal consistent with the aircraft interface shall be introduced to the initiation system to demonstrate seat ejection will occur.

4.5.1.5.2 Control handles. Inspection and demonstration shall verify that the seat system meets the requirement for control handles in 3.5.1.5.2. The procedure shall be as follows: The seat system engineering drawings shall be reviewed for compliance, and ejection control handles shall be separately pulled to verify actuation of all initiators.

4.5.1.5.3 Control force. Test shall verify that the seat system meets the requirement for control force in 3.5.1.5.3. The procedure shall be as follows: A cable with a load cell shall be attached to the ejection control. For side handle seats, the cable shall be pulled in a direction parallel to that of the control handle travel. For center handle ejection seats the cable shall be pulled at angles within a 60 degree cone of the axis of motion.

4.5.1.6 Sequencing subsystem. Analysis and test shall verify that the seat system meets the requirement for sequencing subsystem in 3.5.1.6. The procedure shall be as follows: Engineering drawings shall be analyzed for system redundancy, and test shall verify that the sequencer is capable of being tested while installed in a seat removed from the aircraft. Test shall verify all EED connections are functioning properly.

4.5.1.6.1 Mode selection. Analysis and test shall verify that the seat system meets the requirement for mode selection in 3.5.1.6.1. The procedure shall be as follows: The recovery sequencer design and engineering drawings shall be reviewed for compliance. Proper mode selection shall be verified by laboratory functional tests and sled testing.

4.5.1.6.2 Sequence subsystem. Demonstration and test shall verify that the seat system meets the requirement for sequence subsystem in 3.5.1.6.2. The procedure shall be as follows: The recovery sequencer shall be tested to ensure specified data is recorded. Demonstration shall verify that the sequencer is capable of being tested while installed.

4.5.1.6.3 Sequencer initiation. Test shall verify 3.5.1.6.3.

4.5.1.6.4 Recording rates. Test shall verify 3.5.1.6.4.

4.5.1.6.5 Data limits. Test shall verify 3.5.1.6.5.

4.5.1.6.6 Recovery of mishap information. Inspection and demonstration shall verify that the seat system meets the requirement for recovery of mishap information in 3.5.1.6.6. The procedure shall be as follows: The locations of the data transfer points on the seat shall be located, the means of downloading and decoding required information shall be demonstrated, and any necessary software programs to be used in conjunction with data recovery shall be documented.

4.5.2 *Energetics components*

4.5.2.1 Propellant devices. Analysis and test shall verify that the seat system meets the requirement for propellant devices in 3.5.2.1. The procedure shall be as follows: Analysis and test data shall verify that all propellant devices are IAW 3.5.2.1.

4.5.2.2 Propulsion subsystem. Analysis and test shall verify that the seat system meets the requirement for propulsion subsystem in 3.5.2.2. The procedure shall be as follows: Analysis and test data shall verify that all propulsion components are IAW 3.5.2.2.

4.5.2.3 Energetics transmission lines. Demonstration and analysis shall verify that the seat system meets the requirement for ballistic transmission lines in 3.5.2.3. The procedure shall be as follows: Analysis of vendor data shall verify that the ballistic lines are IAW 3.5.2.3. The vendor shall submit component data analysis to be reviewed by the government verifying that the ballistic lines are IAW 3.5.2.3. The aircraft side of the intersequencing connection shall be included to verify the compatibility with the seat system.

4.5.2.4 CAD/PAD. Analysis and test shall verify that the CAD/PAD items meet the requirement for CAD/PAD in 3.5.2.4.

4.5.2.5 CAD/PAD commonality. Analysis shall verify that the CAD/PAD items meet the requirement for CAD/PAD commonality in 3.5.2.5.

4.5.3 *Seat adjustment actuator*

4.5.3.1 Adjustment control. Demonstration shall verify that the seat system meets the requirement for adjustment control in 3.5.3.1. The procedure shall be as follows: The seat shall be installed in the aircraft and shall be connected to the aircraft actuator switch. The actuator switch shall be set to the ON position to verify that the seat will travel through its full adjustment range, The switch shall then be set to the OFF position, as well as the Momentary-ON postion for short intervals to verify compatibility.

4.5.3.2 Variable adjustment. Demonstration shall verify that the seat system meets the requirement for variable adjustment in 3.5.3.2. The procedure shall be as follows: The seat shall be installed in the aircraftand adjusted to the minimum sitting height. The seat height shall then be set to 1/8 inch increments along the full adjustment postions of the seat.

4.5.3.3 Adjustment position. Demonstration shall verify that the seat system meets the requirement for adjustment in 3.5.3.3. The procedure shall be as follows: The seat shall be installed in the aircraft. Seat adjustment actuation and an anthropometric analysis shall confirm a seated occupant can be positioned at the design eye location..

4.5.3.4 Operating loads. Test shall verify that the seat system meets the requirement for operating loads in 3.5.3.4. The procedure shall be as follows: The seat shall be installed in the ejection guide rails and shall be connected to the aircraft actuator switch. A manikin shall be outfitted with appropriate equipment from TABLE 1 and installed in the seat. Additional weight shall be added to the seat pan until the total weight resting on the actuator is 450 pounds. The actuator shall be cycled 2138 complete strokes.

4.5.3.5 Electrical compliance. Analysis and test shall verify that the seat system meets the requirement for electrical compliance in 3.5.3.5. The procedure shall be as follows: Analysis of vendor data shall verify that the actuator is IAW MIL-STD-7080. The current draw shall be measured as the seat is cycled through its full range of travel (fully-down position to fully-up position to fully-down position) under the static load of the combined max weight of the seat, occupant, equipment, and safety factor.

4.5.4 *Installed equipment*

4.5.4.1 Stabilization subsystem. Test shall verify that the seat system meets the requirement for stabilization subsystem in 3.5.4.1. The procedure shall be as follows: Sled testing shall be conducted. Triaxial accelerometer data will be analyzed to verify that the stabilization subsystem is sufficiently counteracting aerodynamic rotations.

4.5.4.1.1 Deceleration forces. Test shall verify that the seat system meets the requirement for deceleration forces in 3.5.4.1.1. The procedure shall be as follows: Sled testing shall be conducted. Seat instrumentation shall record a time trace of seat pitch and yaw accelerations.

4.5.4.1.2 Recovery attitude. Inspection and analysis shall verify that the seat system meets the requirement for recovery attitude in 3.5.4.1.2. The procedure shall be as follows: The sled test videos shall be analyzed to ensure proper seat-man orientation up to recovery parachute first full open.

4.5.4.1.3 Trim attitude. Test shall verify that the seat system meets the requirement for trim attitude in 3.5.4.1.3. The procedure shall be as follows: Case 1 and Case 6 manikins shall be restrained in the seat and drop tested from altitude and the trim angle shall be measured.

4.5.4.1.4 CG envelope. Analysis and test shall verify that the seat system meets the requirement for CG envelope in 3.5.4.1.4. The procedure shall be as follows: Analysis will verify calculations to ensure the seat system accommodates the allowable CG envelope. Sled testing shall verify the stabilization subsystem performance for the allowable cg envelope.

4.5.4.2 Recovery parachute subsystem.

4.5.4.2.1 Interface. Inspection shall verify that the seat system meets the requirement for interface in 3.5.4.2.1. The procedure shall be as follows: The engineering drawings shall be reviewed for compliance.

4.5.4.2.2 Container. Inspection shall verify the seat system meets the requirement for a parachute container as specified in 3.5.4.2.2.

4.5.4.2.2.1 Water intrusion. Demonstration shall verify that the seat system meets the requirement for water intrusion in 3.5.4.2.2.1. The procedure shall be as follows: The recovery parachute shall be inspected for moisture intrusion into the parachute pack following the rain test of MIL-STD-810, Method 506.6 Rain Test, Section 5.2 Water Penetration, Subsection (a).

4.5.4.2.2.2 Flash fire. Demonstration shall verify that the seat system meets the requirement for flash fire in 3.5.4.2.2.2.

4.5.4.2.3 High Altitude. Test shall verify that the seat system meets the requirement for high altitude in 3.5.4.2.3. The procedure shall be as follows: Deployment of the recovery parachute shall be demonstrated in functional or laboratory testing by testing the functionality of the system and/or key components when placed in the specified altitude environment.

4.5.4.2.4 Seat-man separation. Demonstration shall verify that the seat system meets the requirement for seat-man separation in 3.5.4.2.4. The procedure shall be as follows: Sled testing and seat drop tests shall verify that the deployment of the recovery parachute extracts the aircrew from the ejection seat without any interference.

4.5.4.2.5 Dynamic performance. Test shall verify that the seat system meets the requirement for dynamic performance in 3.5.4.2.5. The procedure shall be as follows: Sled testing shall be conducted.

4.5.4.2.6 Wake recontact. Demonstration shall verify that the seat system meets the requirement for wake recontact in 3.5.4.2.6. The procedure shall be as follows: The parachute performance shall be documented during sled and seat drop tests. Video shall be reviewed to assess the extent and duration of any parachute collapses.

4.5.4.2.7 Descent rate. Test shall verify that the seat system meets the requirement for descent rate in 3.5.4.2.7. The procedure shall be as follows: The parachute shall be drop tested at the maximum suspended weight. The manikin shall be instrumented to collect Global

Positioning System (GPS) position data or barometric pressure data. The average rate of descent shall be calculated over the entire steady state drop distance and converted to standard day sea level.

4.5.4.2.8 Oscillation. Test shall verify that the seat system meets the requirement for oscillation in 3.5.4.2.8. The procedure shall be as follows: The parachute shall be drop-tested at the maximum and minimum suspended weights. The angle from vertical shall be estimated from video data.

4.5.4.2.9 Horizontal drive. Test shall verify that the seat system meets the requirement for horizontal drive in 3.5.4.2.9. The procedure shall be as follows: The parachute shall be drop tested with live jumpers at the maximum suspended weight. The horizontal drive shall be calculated from the total path velocity and the rate of descent data.

4.5.4.2.10 Steering. Test shall verify that the seat system meets the requirement for steering in 3.5.4.2.10. The procedure shall be as follows: The parachute shall be drop tested by live jumpers at the maximum suspended weight. The live jumpers shall execute the max turn maneuvers during descent. The turn rate shall be verified by test data.

4.5.4.2.11 Parachute color. Inspection shall verify that the seat system meets the requirement for parachute color in 3.5.4.2.11. The procedure shall be as follows: The parachute color pattern and engineering drawings shall be inspected. The orange, green, white, and beige colors shall be visually color matched with a precise color matching chips available through and IAW SAE-AMS-STD-595.

4.5.4.3 Life support subsystem. Demonstration and test shall verify that the seat system meets the requirement for life support subsystem in 3.5.4.3.

4.5.4.3.1 Emergency oxygen. Inspection and test shall verify that the seat system meets the requirement for an emergency oxygen bottle supply per 3.5.4.3.1.

4.5.4.3.2 Oxygen bottle compatibility. Demonstration shall verify that the seat system meets the requirement for the oxygen bottle capacity in 3.5.4.3.2.

4.5.4.3.3 Oxygen regulation. Demonstration and test shall verify that the seat system meets the requirement for oxygen regulation in 3.5.4.3.3.

4.5.4.3.4 Oxygen actuation. Demonstration and test shall verify that the seat system meets the requirement for automatic oxygen system actuation IAW 3.5.4.3.4.

4.5.4.3.5 Oxygen serviceability. Inspection and demonstration shall verify that the seat system meets the requirement for oxygen serviceability IAW 3.5.4.3.5.

4.5.4.4 Survival equipment subsystem.

4.5.4.4.1 Bucket Volume. Analysis shall verify that the seat system meets the requirement for bucket volume in 3.5.4.4.1. The procedure shall be as follows: The engineering drawings shall be analyzed to calculate the dimensions of the seat bucket.

4.5.4.4.2 Lateral restraint. Analysis shall verify that the seat system meets the requirement for lateral restraint in 3.5.4.4.2. The procedure shall be as follows: The survival kit shall be packed with combinations of equipment from TABLE 8 and installed into the seat system. The seat shall be installed into a centrifuge and subjected to negative g aircraft maneuvers.

4.5.4.4.3 Deployment. Demonstration and test shall verify that the seat system meets the requirement for deployment in 3.5.4.4.3. The procedure shall be as follows: Survival kit attachment to the torso harness shall be verified by demonstration. The survival kit automatic deployment system shall be verified by sled testing. Full kit deployment shall be demonstrated by hanging harness or laboratory demonstrations.

4.5.4.4.4 Survival equipment. Demonstration shall verify that the seat system meets the requirement for survival equipment in 3.5.4.4.4. The procedure shall be as follows: The survival kit shall be packed with combinations of the equipment listed in TABLE 8, equivalent to the volume specified in 3.5.4.4.4, and subsequently installed in the seat pan.

4.5.4.4.5 Survival kit construction. Analysis shall verify that the seat system meets the requirement for survival kit construction in 3.5.4.4.5.

4.5.4.5 Personnel locator subsystem. Analysis and test shall verify that the seat system meets the requirement for personnel locator in 3.5.4.5.

4.5.4.6 Seat cushion subsystem. Demonstration shall verify that the seat system meets the requirement for seat cushion in 3.5.4.6.

4.5.4.6.1 Compression load. Test shall verify that the seat system meets the requirement for compression load in 3.5.4.6.1. The procedure shall be as follows: The seat bottom cushion shall be subjected to a 1-hr compression load by a government-approved, 245-lb Anthropometric Test Device (ATD) donned in the flight-representative equipment configuration with the maximum weight, or by an ATD representative of maximum total aircrew and equipment weight. While still under the load, the cushion shall be examined after one hour to determine how much it has compressed. The compressed height at any given point across the entire cushion shall be compared with its original uncompressed height.

4.5.4.6.2 Pressure distribution. Test shall verify that the seat system meets the requirement for pressure distribution in 3.5.4.6.2. The procedure shall be as follows: A government-approved, 245-lb ATD donned in the flight-representative equipment configuration with the maximum weight, or an ATD representative of maximum total aircrew and equipment weight shall be seated on the seat bottom cushion. Standard pressure data collection methods shall be used to measure the pressure distribution over the seat cushion, especially around the contact points.

4.5.4.6.3 Durability. Test shall verify that the seat system meets the requirement for durability in 3.5.4.6.3. The seat cushion assembly upholstery tear strength shall be tested IAW ASTM D 2261-96. The seat cushion upholstery material abrasion resistance shall be tested IAW ASTM D 4157-13. The seat cushion upholstery material pilling resistance shall be tested IAW ASTM D 3511.

4.6 Logistics.

4.6.1 Ground support. Demonstration shall verify that the seat system meets the requirement for ground support in 3.6.1.

4.6.2 Support equipment. Demonstration and analysis shall verify that the seat system meets the requirement for support equipment in 3.6.2.

4.6.3 Personnel. Analysis shall verify that the seat system meets the requirement for personnel in 3.6.3.

4.6.4 <u>Supply.</u> Analysis shall verify that the seat system meets the requirement for supply in 3.6.4.

4.6.5 <u>Facilities.</u> Analysis shall verify that the seat system meets the requirement for facilities and facility equipment in 3.6.5.

4.6.6 <u>Transportability.</u> Analysis shall verify that the seat system meets the requirement for transportability in 3.6.6.

APPENDIX A – Techniques

A.1 Manikin Representation. The coordinate system of the head and neck shall be consistent with FIGURE A.1, and the three manikins with their respective head and necks listed in TABLE 10 shall represent the corresponding populations.

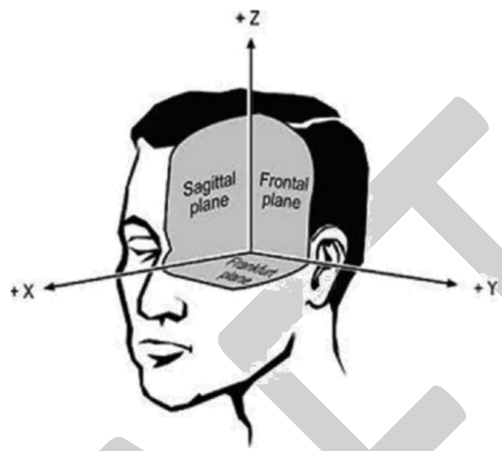

FIGURE A.1 Head Coordinate System

TABLE 10. Manikin Sizes

Manikin Type	Manikin Head	Manikin Neck	Manikin Nude Mass	Population
Small Female (Case 1)	SF-81	Small Female Hybrid III	103 ± 3 lb	96–135 lbs
Mid Male	ADAM-L	Mid Male Hybrid III	172 ± 5 lb	136–199 lbs
Large Male (Case 6)	LM-110	Large Male Hybrid III	245 ± 5 lb	200–245 lbs

A.2. Dynamic Response Index (DRI). The DRI is representative of the maximum dynamic compression of the vertebral column of the human body along a given axis. 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 along each orthogonal body axis. For simplicity, the motion of the body in each orthogonal axis is assumed to be independent so that each orthogonal axis can be modeled with a different dynamic system. The motion of the body is with respect to a critical point, which is the point in the seat coordinate system at which the dynamic response (DR) and the associated risk of injury are computed. The critical point is defined in the seat coordinate system in FIGURE A.2.

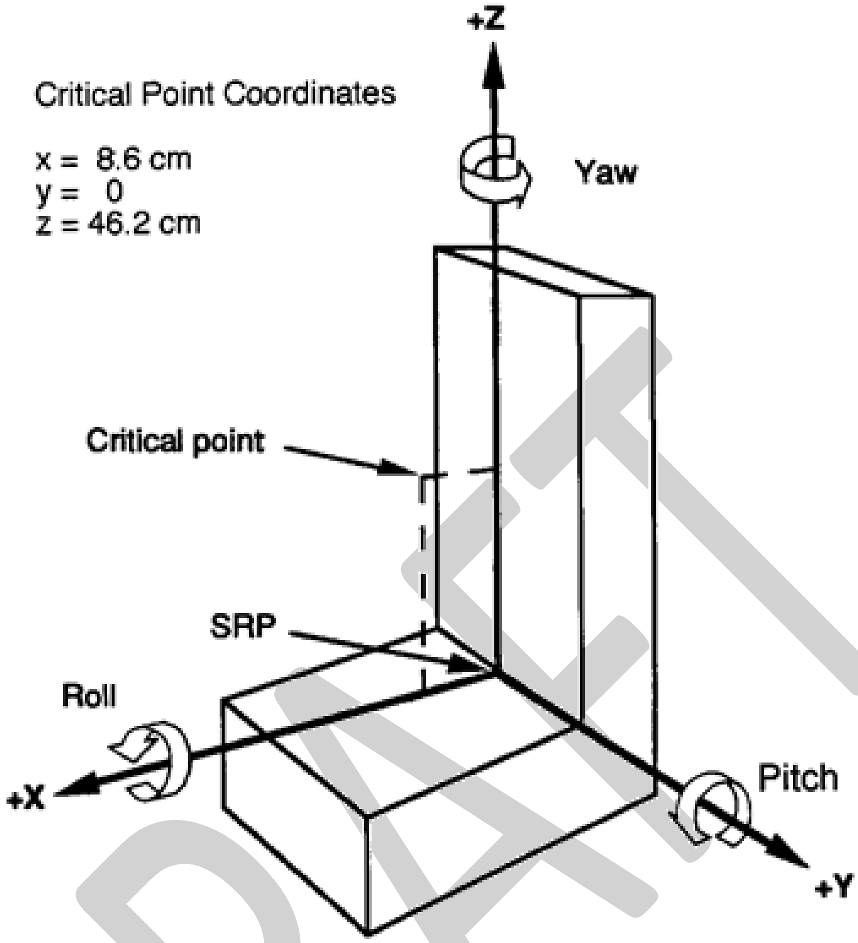

FIGURE A.2 Seat Acceleration Coordinate System

Since placement of an accelerometer at the critical point is not practical, the linear acceleration at any point in the seat coordinate system and the angular velocity of the seat can be used to calculate the linear acceleration at the critical point. The acceleration at some Point A can be calculated with the acceleration at some Point B as follows:

$$\boldsymbol{a}_A = \boldsymbol{a}_B + \dot{\boldsymbol{\omega}} \times \boldsymbol{r}_{A/B} + \boldsymbol{\omega} \times (\boldsymbol{\omega} \times \boldsymbol{r}_{A/B})$$

where

$\boldsymbol{r}_{A/B}$	The position vector from point B to point A
$\boldsymbol{\omega}$	Instantaneous angular velocity vector of the seat
$\dot{\boldsymbol{\omega}}$	Instantaneous angular acceleration vector of the seat
$\boldsymbol{a}_A$	The total acceleration at Point A
$\boldsymbol{a}_B$	The total acceleration at Point B

The acceleration at the critical point can then be computed as

$$\boldsymbol{A} = A_x\boldsymbol{i} + A_y\boldsymbol{j} + A_z\boldsymbol{k}$$

where

$\boldsymbol{A}$	Total acceleration at the critical point
A_x, A_y, A_z	Components of acceleration at the critical point along the x-, y-, and z-axes respectively
$\boldsymbol{i}, \boldsymbol{j}, \boldsymbol{k}$	Unit vectors along the x-, y-, and z-axes respectively

The response 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 relative acceleration with respect to the critical point
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 Air Force flying population along each axis direction is given in TABLE 11.

TABLE 11. 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

The dynamic response is calculated as follows:

$$DR_i(t) = \frac{\left(\omega_{n_i}\right)^2 \delta_i(t)}{g}$$

where g is the acceleration due to gravity, and the DRI is

$$DRI_i = \frac{\left(\omega_{n_i}\right)^2 \delta_i^{max}}{g}$$

A.3 Multi-Dynamic Response Criteria (MDRC). Seat accelerations shall be measured in accordance with MIL-HDBK-516 criteria and guidance. To determine the risk of injury, use the following steps:

1. Determine the transient acceleration $A_i(t)$ at the critical point of the seated occupant in each axis (X, Y, and Z).
2. Solve the second order differential equation for the displacement $\delta_i(t)$ of the occupant in each axis (X, Y, and Z) using APPENDIX A.1.
3. Calculate the dynamic response $DR_i(t)$ for each axis using the low probability of major injury limits.
4. Find the maximum MDRC (3.3.1.8). This is the Injury Risk Criterion (IRC).
5. If the IRC is > 1.0, repeat Steps 1–4, replacing Step 3 with the next highest DR limits.
6. If IRC is < 1.0, this is the risk level for the applied acceleration.

For velocities greater than 450 KEAS, the MDRC of all accelerations shall not exceed the values obtained by the equation:

$$MDRC = \begin{cases} 1.0, & 0 < v < 450 \\ \frac{(v-450)}{214.286} + 1, & v \geq 450 \end{cases}$$, where v is ejection speed measured in KEAS

Dynamic Response (DR) limits corresponding to a medium risk as defined in TABLE 12, where MDRC is defined as follows:

$$MDRC(t) = \sqrt{\left(\frac{DR_x(t)}{DR_x^{lim}}\right)^2 + \left(\frac{DR_y(t)}{DR_y^{lim}}\right)^2 + \left(\frac{DR_z(t)}{DR_z^{lim}}\right)^2}$$

where

$DR_{x,y,z}(t)$ The dynamic response values computed for each x-, y-, and z-axis component of the acceleration time history (see APPENDIX A.2 for calculation method).

$DR_{x,y,z}^{lim}(t)$ The limit value of the dynamic response for each axis direction.

TABLE 12. MDRC Dynamic Response Limits Per Axis

Axis Direction		**Limits (5% Injury Risk)**
$-X$	Eyeballs Out	$DR_x^{lim} = 35$
$+X$	Eyeballs In	$DR_x^{lim} = 40$
$-Y$	Eyeballs Left	$DR_y^{lim} = 17$
$+Y$	Eyeballs Right	$DR_y^{lim} = 17$
$-Z$	Eyeballs Up	$DR_z^{lim} = 16.5$
$+Z$	Eyeballs Down	$DR_z^{lim} = 18$

A.4 $\underline{MANIC_Z}$ is defined as:

$$MANIC_Z(F_Z) = +F_Z$$

Where:

Fz = observed axial loading (+Fz = tension, -Fz = compression)

$MANIC_Z$ probability curves are as follows:

Small Weight Probability

$$P5(AIS \geq 2) = \frac{1}{1 + e^{7.259 - 0.0232735 * MANIC_Z(pounds)}}$$

Mid-Weight Probability

$$P50(AIS\geq 2)= \frac{1}{1+ e^{7.254-0.014596*MANIC_Z(pounds)}}$$

Large Weight Probability

$$P95(AIS\geq 2)= \frac{1}{1+ e^{7.258-0.0120595*MANIC_Z(pounds)}}$$

A.5 <u>$MANIC_X$</u> is defined as:

$$MANIC_X(F_Z, M_Y) = \left|\frac{F_Z}{F_{Zcrit}}\right| + \left|\frac{M_Y}{M_Y crit}\right|$$

Where:

F_z = the measured axial tension (+Fz) or compression load (–Fz)
F_{zcrit} = critical limit value for axial tension or compression load
M_y = the measured flexion (+My) or extension bending moment (–My)
M_{ycrit} = critical limit value for flexion or extension moment

The absolute value is incorporated because +Fz is tension and –Fz is compression and each has a different critical value. The same is true for My, where +My is flexion and –My is extension and each has a different critical value. This criteria is also referred to as $MANIC_{XZ}$ and is equivalent to the previously designated N_{ij} criteria.

$MANIC_X$ probability curve is as follows:

$$P(AIS\geq 2)= \frac{1}{1+ e^{5.2545-4.1*MANIC_X}}$$

A.6 <u>$MANIC_Y$</u> is defined as:

$$MANIC_Y = \sqrt{\left(\frac{F_X}{F_{Xcrit}}\right)^2 + \left(\frac{F_Y}{F_{Ycrit}}\right)^2 + \left(\frac{F_Z}{F_{Zcrit}}\right)^2 + \left(\frac{M_Y}{M_{Ycrit}}\right)^2 + \left(\frac{M_Z}{M_{Zcrit}}\right)^2}$$

Where:

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 (+Fz = tension, -Fz = compression)

F_{Zcrit} = critical intercept value for axial loading (different for tension and compression)
M_Y = observed moment about the anatomical y axis (sagittal plane anterior and posterior bending, +My = flexion, -My-extension)
M_{Ycrit} = critical intercept value for flexion-extension bending moments (different for flexion and extension)
M_Z = observed moment about the anatomical z axis (neck twisting)
M_{Zcrit} = critical intercept value for neck twisting

$MANIC_Y$ probability curve is as follows:

$$P(AIS \geq 2) = \frac{1}{1 + e^{6.185-6.85*MANIC_Y}}$$

The probability of AIS 2 or greater injury corresponding to the $MANIC_Y$ value is shown in FIGURE A.3.

A.7 <u>NMI_X</u> is defined as:

$$NMI_x = \frac{M_x}{M_{xcrit}}$$

Where:

M_X = observed moment about the anatomical x axis (lateral bending)
M_{Xcrit} = critical intercept value for lateral bending

The upper neck critical values for MANIC and NMI_X calculations are listed in TABLE 13.

TABLE 13. MANIC and NMI$_X$ Upper Neck Critical Values

Manikin Neck Size	Manikin Mass (lbs)	Human Mass (lbs)	Component	Force (lbs)		Component	Moment (in-lbs)	
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

Plotted in FIGURE A.3, the probability of AIS 2+ injury based on the Neck Moment Index about the x-axis (NMI_X) value is defined by:

$$P(AIS \geq 2) = \frac{1}{1 + e^{5.2545 - 4.1 * NMIx}}$$

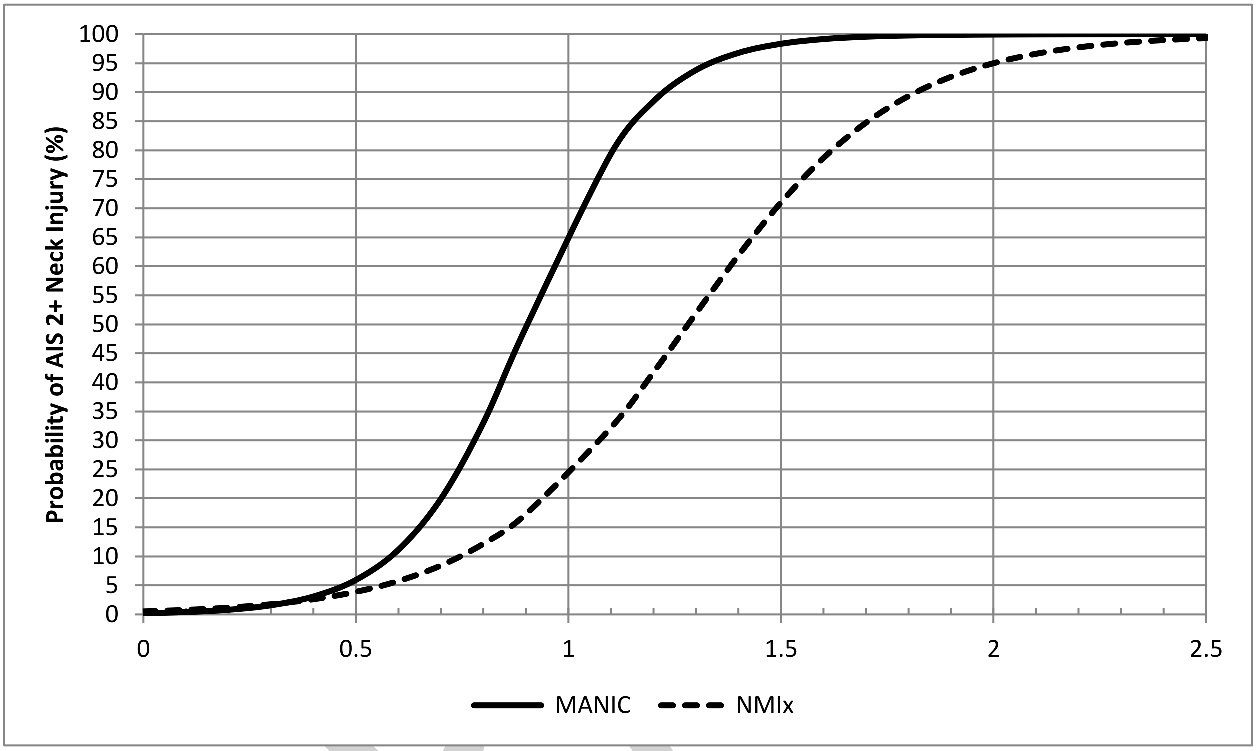

FIGURE A.3. Probability of Neck Injury vs. MANIC and NMI_X Values.

A.8 Probability of concussion. FIGURE A.4 shows the probability of concussion ($P_{concussion}$) plotted against ‘a’ and ‘α’ where ‘a’ is the observed linear acceleration at a given time and ‘α’ is the observed rotational acceleration at that same time. The value of $P_{concussion}$ is defined by:

$$P_{concussion} = \frac{1}{1 + e^{-(-10.2 + 0.0433a + 0.000873\alpha - 0.00000092a\alpha)}}$$

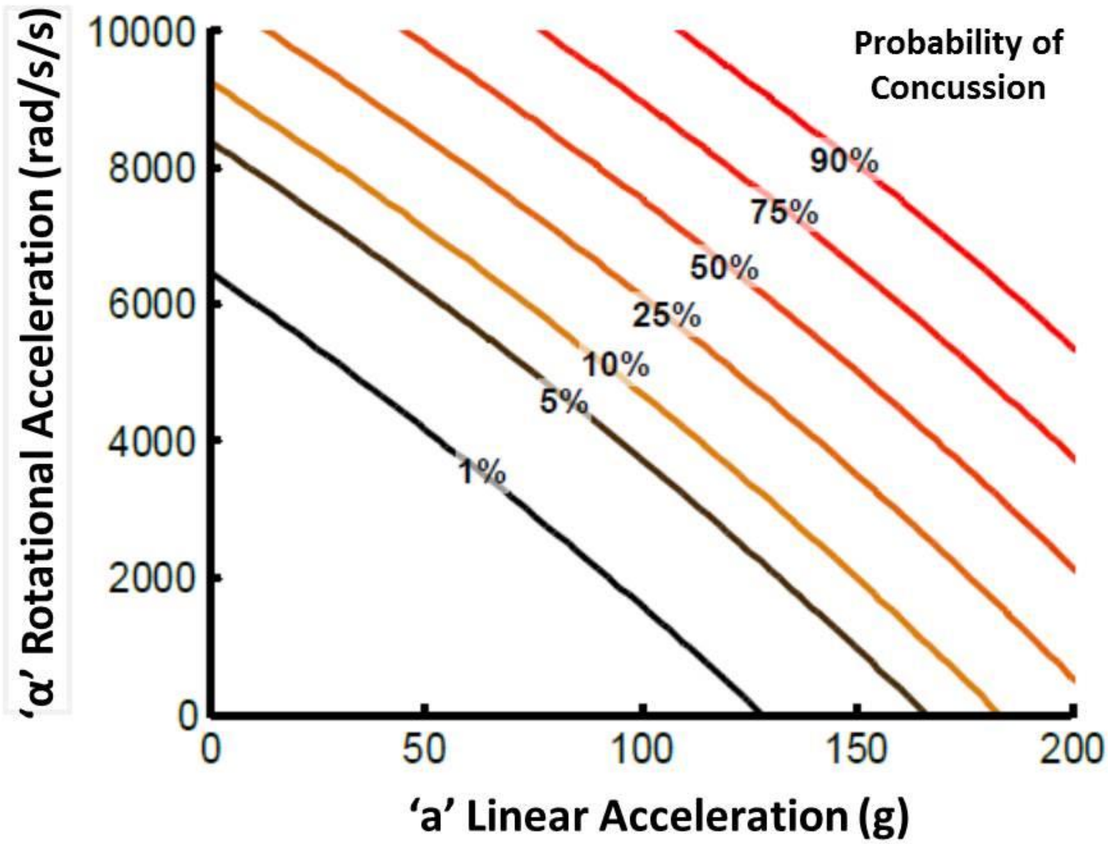

FIGURE A.4. Probability of Concussion vs. Rotational and Linear Acceleration

APPENDIX B – Acronyms/Abbreviations

Acronyms and abbreviations pertinent to this specification are as follows:

ACA	Associated Contractor Agreements
ACC	Air Combat Command
ACCES	Attenuating Custom Communication Earpiece System
ACES	Advanced Concept Ejection Seat
ADAM	Advanced Dynamic Anthropomorphic Manikin
AFE	Aircrew Flight Equipment
AFGSC	Air Force Global Strike Command
AFSC	Air Force Specialty Code
AIS	Abbreviated Injury Scale
ALEP	Aircrew Laser Eye Protection
AMXD	Advanced Mission Extender Device
ATD	Anthropometric Test Device
CAD/PAD	Cartridge Actuated Devices/Propllant Actuated Devices
CB	Chemical/Biological
cg	Center of Gravity
cp	Center of Pressure
CWAS	Cold Weather Aviation System
DR	Dynamic Response
DRI	Dynamic Response Index
EMIC	Electromagnetic Interference and Compatibility
EMP	Electromagnetic Pulse
EPL	Environmental Protection Layer
F	Fahrenheit
FAR	Federal Aviation Regulation
g	Gravity Units
GPS	Global Positioning System
HIC	Head Injury Criterion
HMCS	Helmet Mounted Cueing System
HMD	Helmet Mounted Device
HMIT	Helmet Mounted Integrated Targeting
HPW	Human Performance Wing
Hz	Hertz
IAE	Integrated Aircrew Ensemble
IAW	In Accordance With
ICD	Interface Control Document
IFL	Integrated Flight Layer
IRC	Injury Risk Criterion
JCAS	Joint Close Air Support

JHMCS	Joint Helmet Mounted Cueing System
KEAS	Knots Equivalent Air Speed
lb	Pound
LCL	Lowest Confidence Limit
LPU	Life Preserver Unit
LRU	Line Replaceable Unit
MANIC	Multi-axial Neck Injury Criteria
MDRC	Multi-axis Dynamic Response Criterion
MMH/FH	Maintenance Man-Hour Per Flight Hour
mph	Miles Per Hour
msec	Milliseconds
MSL	Mean Sea Level
MTBF	Mean Time Between Failure
MTTR	Mean Time to Repair
NGAPE	Next Generation Aircrew Protective Ensemble
NGES	Next Generation Ejection Seat
NMI	Neck Moment Index
OBOG	Onboard Oxygen Generating
ONV	Over-the-Nose Vision
PBG	Pressure Breathing (g)
PCONCUSSION	Probability of Concussion
PLD	Personnel Lowering Device
PNVG	Panoramic Night Vision Goggles
psi	Pounds per Square Inch
psig	Pounds per Square Inch Gage
SRD	System Requirements Document
SRP	Seat Reference Point
TO	Technical Order
TREE	Transient Radiation Effects on Electronics
VAC	Voltage Alternating Current
VCRM	Verification Cross Reference Matrix
VDC	Volts Direct Current
VRMS	Volts Root Mean Square