




DEPARTMENT OF DEFENSE  
**UNITED STATES AIR FORCE**

**MIL-HDBK-516C CHANGE NOTICE No. 516CN-5**

<p align="center"><b>AIRWORTHINESS BOARD DETERMINATION          MIL-HDBK-516C CHANGE NOTICE</b></p>	<p>1. DATE (YYYYMMDD)          09 November 2016</p>
<p>2. ALFCMC/EZ POINT OF CONTACT          Andrew Kididis</p>	<p>3. PHONE (DSN)          986-9683</p>
<p>4. BOARD SECRETARIAT          SSgt Alicia Hall, AFLCMC/EZSC</p>	<p>5. PHONE (DSN)          656-9576</p>
<p>6. SUMMARY OF AIRWORTHINESS BOARD DETERMINATION / MIL-HDBK-516C CHANGE          (See attached Airworthiness Board charts for more information.)</p> <p>MIL-HDBK-516C Section (9.1.1) Escape system safety compatibility</p> <p>Change impacts:</p> <ul style="list-style-type: none"> <li>• Modified Criterion: Administrative change only; see attached charts</li> <li>• Modified Standard: Complete re-write of Standard. See attached charts</li> <li>• Modified Method of Compliance: Administrative change only; see attached charts</li> </ul>	
<p>7. TAA SIGNATURE</p> <p><b>X</b> </p> <hr/> <p>Jorge F. Gonzalez          Technical Airworthiness Authority</p>	<p>8. ORGANIZATION</p> <p>AFLCMC/EN-EZ</p>



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# USAF Airworthiness Change Notice Board



## Ejection Injury Criteria

8 Nov 16

Andrew Kididis  
AFLCMC/EZFC  
DSN: 986-9683  
Andrew.Kididis@us.af.mil



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# Change Notice (CN) Overview



- **Title**: Ejection Injury Criteria
- **Date Proposed**: 12 May 2016
- **POC**: Andrew Kididis, AFLCMC/EZFC, DSN 986-9683
- **Revision To**: CN Proposal Revises MIL-HDBK-516C

Paragraph(s) Impacted	Impact to C/S/MOC			
	Title	New	Modified	No Change
9.1.1 Escape system safety compatibility.	Criterion		X	
	Standard		X	
	Method of Compliance		X	

C = Criteria

S = Standard

MOC = Method of Compliance



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# Rationale for Change



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- **Rationale:**

- Changes to Criterion and Method of Compliance are administrative only.
- Current Standard is out of date, too generic.
- Congressional and DoD IG recommendations to maintain 5% injury probability in all phases of ejection.
- Multiple criteria exist for measuring ejection performance/injury potential (particularly for neck injury) but not all can be related to probability of injury.
- Modified standard consolidates criteria that can relate directly to injury probability, driving to 5% probability (or better) where possible while keeping within capability of current technology.
  - Ties injury risk to defined injury standard of Abbreviated Injury Scale (AIS) level 2.



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# Proposed Criterion

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- **Proposed Criterion:**

**Criterion (Army, Navy and Air Force):** Verify that any escape system is compatible with the air system, and that all occupants can safely egress from the aircraft and/or control station.



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# Proposed Standard

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- **Proposed Standard:**

**Standard (Army and Navy):** An escape system or means of emergency escape is incorporated within...[no other changes to current text in this paragraph]

**Standard (Air Force):** [New standard for Air Force only, incorporating part of the current paragraph and adding additional criteria as follows]

**Markup Key:** Current Text [~~Proposed Deletion~~] [Proposed Addition]



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# Proposed Standard

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- **Dynamic Response Index (DRI) changed from requirement of 18 to 16.**
  - Demonstrated capability that will help reduce overall injury risk for later phases of ejection
- **Also reduces DRI by 2 for different temp conditions**
- **Clarified DRI basis of seat geometry & harness type**



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# Proposed Standard

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- **Limits Multi-axis Dynamic Response Criterion (MDRC) to 1.0 (5% AIS 2 injury risk) up to 450 KEAS.**
  - DRz limits for the MDRC calculation (similar to DRI limit) is not changed (from 18 to 16) due to interrelationship with MDRC terms.
  - MDRC applied all the way through parachute full open; transitioning from seat to manikin lumbar accelerations at seat/aircrew separation





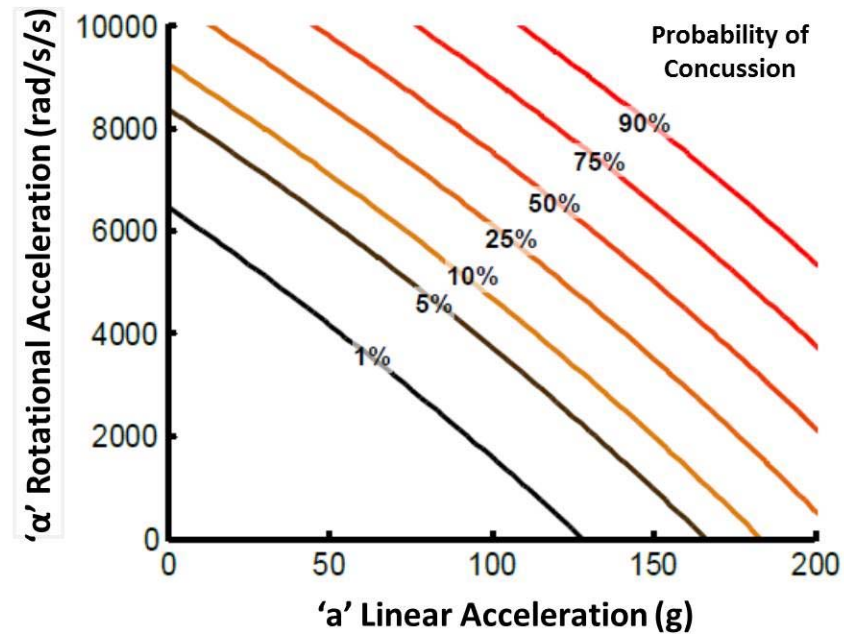
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# Proposed Standard

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- **Added specific criteria for head accelerations based on concussion risk**
  - Includes both linear and rotational accelerations





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# Proposed Standard

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- **Simplified parachute opening shock accelerations for parachute applications where fully instrumented manikin not utilized.**
  - **15 G limit at any altitude for random body position**
  - **25 G limit at any altitude for controlled/optimum body position**
- **Added vertical descent rate criteria**
  - **Not to exceed 23 ft/sec for max applicable aircrew suspended weight.**



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# Proposed Standard

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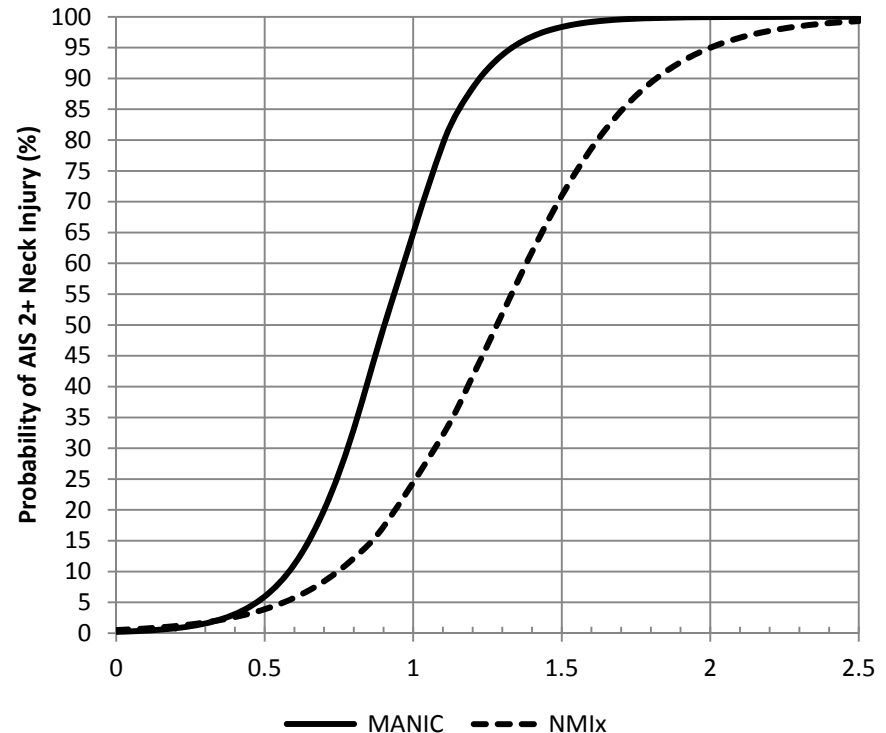
- **Added stability criteria for seat pitch & yaw**
  - **+/- 20° pitch and positively damped at all speeds through rocket burn out for systems with head supported mass greater than shown in EZFC-CSB-16-001**
  - **+/- 20° yaw and positively damped above 250 KEAS (current state-of-art does not include low speed yaw control capability)**
- **Added requirement for limb restraints on systems faster than 300 kts**
  - **Legacy data showed increase injury rate with airspeed and 5% risk at about 300 kts.**



# Proposed Standard



- **Added specific neck injury criteria**
  - **Multi-Axial Neck Injury Criteria (MANIC) combined with Neck Moment Index for x moment ( $NMI_x$ )**
  - **limits set at 5% up to 450 KEAS and linear increase to 15% at 600 KEAS**





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# Proposed Standard

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- **Added criteria to define minimum escape system capability**
  - **Altitude: 0 ft to absolute ceiling of aircraft**
  - **Velocity: 0 airspeed to 600 KEAS or max aircraft speed (which ever is less)**



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# Proposed Standard

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- **Included legacy criteria and data acquisition, reduction & reporting in Crew Systems Bulletin as a reference**
  - **Comments/concerns about levying new criteria on minor mods to legacy systems**
  - **EZFC-CSB-16-001**



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# Proposed Method of Compliance



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- Proposed Method of Compliance:

**Method of Compliance (Army, Navy and Air Force):** Inspection of engineering drawings verifies the escape system has all components necessary to allow aircrew escape. System level performance as integrated... [no other changes]



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# Specific Comments-1



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- **1. Organization:** Boeing, Laurette Lahey & Lockheed, Don Roberts
- **Comment:** The probability of concussion requirements will drive neck/head restraints beyond current accepted methodology.
- **Date Comment Received:** 21 & 10 Mar 16
- **Response:** Based on data review and lack of any concerns raised by seat manufacturers, this should not be an issue.
  
- **2. Organization:** Boeing, Laurette Lahey & F-35 JPO/USN, Jeff Nichols
- **Comment:** Parachute descent rate is given with a max of 337 lbs (which is F-35 max weight); the max weight requirement will vary depending on program; suggest removing defined max weight requirement.
- **Date Comment Received:** 21 & 2 Mar 16
- **Response:** The F-35 weight was initially carried forward since it was used on testing in recent programs. To be more generic this was changed to the max applicable aircrew suspended weight.





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# Specific Comments- 2



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- **3. Organization:** Boeing, Laurette Lahey
- **Comment:** Escape capability section should include low altitude terrain clearance table.
- **Date Comment Received:** 21 Mar 16
- **Response:** Data review indicates seat technologies used to meet the criteria do not have a significant impact on terrain clearance.
  
- **4. Organization:** Lockheed, Don Roberts
- **Comment:** The 2 % catapult injury rate seems to overreach the 5% congressional mandate.
- **Date Comment Received:** 10 Mar 16
- **Response:** The 2% rate has been historically achieved on the ACES II system for nearly 40 years. The USAF does not want to lose capability in this area on future systems.



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# Specific Comments- 3



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- **5. Organization:** Lockheed, Don Roberts
- **Comment:** Define “new” programs. Programs under contract before this change comes into effect should not be required to meet the new guidelines. Also, there should be some recognition for minor mods to legacy seats that do not have to meet the new guidelines.
- **Date Comment Received:** 10 Mar 16
- **Response:** Added “programs... on contract” to verbiage about applicability. Also, we have stated that only major mods or new/replacement programs will need to meet new criteria.
  
- **6. Organization:** Lockheed, Don Roberts
- **Comment:** Insufficient detail, definition of when each phase begins and ends.
- **Date Comment Received:** 10 Mar 16
- **Response:** There are descriptions of each phase based on events, such as “free-flight and drogue phase, from seat/aircraft separation to seat/aircrew separation” which provides sufficient detail without being too restrictive.



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# Specific Comments- 4



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- **7. Organization:** Lockheed, Don Roberts
- **Comment:** Appendix A is unnecessary and is overreach as contained in a standard. It is too detailed and locks down methodology without vision of future improvements or superior technology.
- **Date Comment Received:** 10 Mar 16
- **Response:** The appendix will be included in a Crew Systems Bulletin and provided as minimum capability requirements.
  
- **8. Organization:** EZSA, Mark Mueller
- **Comment:** Change is too long to put in MIL-HDBK-516, details should be put in a spec or standard and just summarized in -516.
- **Date Comment Received:** 7 Mar 16
- **Response:** Many details are integral to the criteria. Update is needed now and incorporating into other standard or spec revision will take much longer. Looking for guidance on the best approach.
  
- **9. Organization:** EZSA, Mark Mueller
- **Comment:** Do not include the appendix in MIL-HDBK-516; include in another document.
- **Date Comment Received:** 7 Mar 16
- **Response:** The appendix will be included in a Crew Systems Bulletin.



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# Specific Comments- 5



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- **10. Organization:** AFLCMC/HGBEA (U-2), Naumann Sheikh
- **Comment:** The revision adds a lot of detail about ejection seats to a section that covers overall escape systems.
- **Date Comment Received:** 7 Mar 16
- **Response:** Have added wording to clarify what part applies to ejection seats.
  
- **11. Organization:** AFLCMC/HGBEA (U-2), Naumann Sheikh
- **Comment:** All the details do not fit in with typical format of MIL-HDBK-516
- **Date Comment Received:** 7 Mar 16
- **Response:** See response to comment # 8.
  
- **12. Organization:** AFLCMC/HGBEA (U-2), Naumann Sheikh
- **Comment:** All the new changes may eclipse other types of escape systems since they concentrate only on ejection seats and may set a bad precedent of adding a lot of unnecessary requirements to MIL-HDBK-516.
- **Date Comment Received:** 7 Mar 16
- **Response:** We do not consider these requirements unnecessary. Ejection seats are the most complex of escape systems that we currently use and require more attention.



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# Specific Comments- 6



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- **13. Organization:** AFLCMC/HGBEA (U-2), Naumann Sheikh
- **Comment:** Recommend change current wording to best separate various types of escape systems.
- **Date Comment Received:** 7 Mar 16
- **Response:** We have added wording to clarify that these updates are for ejection seats and other systems as applicable.
  
- **14. Organization:** AFLCMC/HGBEA (U-2), Naumann Sheikh
- **Comment:** Remove obsolete quantities from current standard.
- **Date Comment Received:** 7 Mar 16
- **Response:** Limits/quantities have all been updated in the revision.
  
- **15. Organization:** AFLCMC/HGBEA (U-2), Naumann Sheikh
- **Comment:** Add or update references in new content.
- **Date Comment Received:** 7 Mar 16
- **Response:** Completed.



# Specific Comments- 7



- **16. Organization:** AFLCMC/HGBEA (U-2), Naumann Sheikh
- **Comment:** If new content can't be referred to directly from other references, create a new reference document that can be cited in MIL-HDBK-516.
- **Date Comment Received:** 7 Mar 16
- **Response:** See response to comment #8.
  
- **17. Organization:** F-35 JPO/USN, Jeff Nichols
- **Comment:** Concerned that 2% catapult injury rate requirement will result in catapult energy being too low and that while reducing back injuries it, would result in more fatalities due to hitting ground before getting a chute.
- **Date Comment Received:** 2 Mar 16
- **Response:** Data review indicates these changes have no significant effect on terrain clearance and would not have helped in historic USAF mishaps. If catapult energy is used efficiently, less energy is needed. Also, see answer #4.
  
- **18. Organization:** F-35 JPO/USN, Jeff Nichols
- **Comment:** What reference contains the legacy requirements that are mentioned?
- **Date Comment Received:** 2 Mar 16
- **Response:** We have updated to reflect that legacy requirements are those put on contract at time of original legacy program.



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# Specific Comments- 8



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- **19. Organization:** F-35 JPO/USN, Jeff Nichols
- **Comment:** Where does seat geometry/harness type requirement come from? This would force Navy DRI limit down to 14 and could be in danger of losing 0/0 capability.
- **Date Comment Received:** 2 Mar 16
- **Response:** Original DRI method was developed with a specific set of seat geometry and harness type. This has been lost over the years but the update brings the method back to how it was intended to be applied.
  
- **20. Organization:** F-35 JPO/USN, Jeff Nichols
- **Comment:** DRz limit associated with MDRC is still 18 but has been changed to 16 for the catapult stroke; why are these different.
- **Date Comment Received:** 2 Mar 16
- **Response:** DRz limit is used independently for the catapult stroke but is incorporated into equation with other limits for MDRC. We did not want to adversely impact the MDRC calculations by changing DRz within the MDRC method.



# Specific Comments- 9



- **21. Organization:** F-35 JPO/USN, Jeff Nichols
- **Comment:** Why is 25 g chute limit across the board; we have historically allowed up to 35 g when aircrew is supported by the seat?
- **Date Comment Received:** 2 Mar 16
- **Response:** This is mostly OBE since we are using MDRC for primary criteria for an ejection seat case. For applications where MDRC data is not available, this limit is for chute deployment/inflation when occupant is not in a seat or being pulled out of the seat and not supported by the seat; USAF has historically limited this to 25g.
  
- **22. Organization:** F-35 JPO/USN, Jeff Nichols
- **Comment:** What is meaning of “over entire rise time portion of force time curve?”
- **Date Comment Received:** 2 Mar 16
- **Response:** Comment is OBE since this applies to g-onset requirement which has been deleted.
  
- **23. Organization:** F-35 JPO/USN, Jeff Nichols
- **Comment:** Why 23 ft/sec descent rate, we have historically used 24 ft/sec?
- **Date Comment Received:** 2 Mar 16
- **Response:** Descent rate has been based on available technology. For years it was actually 25 ft/sec, then 24 ft/sec; currently chutes have been tested and in use that can achieve an average of 23 ft/sec with the heaviest suspended weight.





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# Specific Comments- 10



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- **24. Organization:** F-35 JPO/USN, Jeff Nichols
- **Comment:** Stability criteria (20 deg limit) needs work; I don't see an issue with a seat pitching back 60 deg in a 0/0 ejection.
- **Date Comment Received:** 2 Mar 16
- **Response:** We have seen in F-35 many pitfalls from having an unstable seat. The stability requirement is an old USAF requirement that we have brought back to improve performance on new seats and avoid issues associated with instability.
  
- **25. Organization:** F-35 JPO/USN, Jeff Nichols
- **Comment:** Is head neck criteria (para 8.1) inferring that tests should be done with head out of optimal position?
- **Date Comment Received:** 2 Mar 16
- **Response:** Yes; any head/neck restraint device must be robust enough to work when the head is not in the optimal position.



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# Specific Comments- 11

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- **26. Organization:** F-35 JPO/USN, Jeff Nichols
- **Comment:** Navy prefers to have single metric and use full MANIC with Mx term.
- **Date Comment Received:** 2 Mar 16
- **Response:** That would be our preference too but developer of MANIC method indicated there was not enough data available at this time for Mx term to support use of full MANIC.
  
- **27. Organization:** F-35 JPO/USN, Jeff Nichols
- **Comment:** What does it mean to have +/- 2 inch tolerance about each individual CG for full range of population?
- **Date Comment Received:** 2 Mar 16
- **Response:** Clarified that for each CG position, add a 2 inch sphere around it to create the full CG range.



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# Recommendation



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Role	Organization	Coordination	Approve	Disapprove	Date	Comment
TA	AFLCMC/EZFC	Marty Andries	X		8/17/16	
TD	AFLCMC/EZA	Mike Knisely	X		8/24/16	
TD	AFLCMC/EZF	Larry Rogers	X		8/17/16	
TD	AFLCMC/EZS	William Mejias	X w/comments		8/31/16	<p>1. Proposed language that discusses applicability to new a/c acquisition, upgrade/modification programs, legacy systems, etc. are not proper for the MIL-HDBK. A new AA is a more proper vehicle to expand applicability assertions, etc.</p> <p>2. Supporting documentation, equations/calculations (such as DRI), should be included on separate AW bulletin or AA document.</p>

• **Recommendation:**

Approve

Disapprove

• **Potential safety/design impact to currently fielded fleet:**

Significant

Insignificant

Checking 'Significant' above will help TAA determine need to inform program offices of urgent safety/design issue

### 9.1.1 Escape system safety compatibility.

**Criterion (Army, Navy and Air Force):** No change to current text.

**Standard (Army and Navy):** No change to current text.

**Standard (Air Force):** [all new below]

An escape system or means of emergency escape is incorporated within the air vehicle for both ground and ditching conditions, and in-flight conditions if specified. (An escape system may include ejection seats, escape capsules, escape path clearance systems, emergency exits, and ground egress aids used to perform the functions of escape, survival, and recovery of air vehicle occupants.) Automated ejection seats, escape capsules or modules function to separate the aircrew from the aircraft and recover them to the earth. Escape system functionality, including operation of escape path clearance systems, does not induce more than a 5% probability of Abbreviated Injury Scale (AIS) 2 or greater injury severity level as defined below throughout the required performance envelope. Means of emergency egress (e.g., use of explosive components for egress, sharp edges, hot metal percussion) does not cause Abbreviated Injury Scale (AIS) 2 or greater injury severity or hinder required procedures for escape, evasion and evacuation. For systems that allow for one or a portion of the aircrew to eject independently, the ability to sustain flight and for remaining aircrew to subsequently eject is not precluded.

Canopies and hatches do not present a risk of collision with any ejectee of the aircraft during the escape and recovery sequence from straight and level flight conditions.

Applied free-flight inertial forces during escape do not exceed a 5% probability of AIS 2 injury, with correspondingly low catapult forces to facilitate this probability level, as defined below for speeds up to at least 450 Knots Equivalent Air Speed (KEAS). For speeds above 450 KEAS up to the aircraft maximum speed or 600 KEAS, whichever is less (for open ejection seats) the probability of AIS 2 injury does not exceed the levels defined by the injury criteria below.

Note that Control Stations may not have powered or automated egress systems(s).

Specific injury criteria for in-flight escape shown below are met. Unless otherwise noted, the criteria is effective at date of publication and applicable to all new aircraft acquisition programs and ejection seat/escape system acquisition or upgrade/modification programs to include the addition of Helmet Mounted Display (HMD) systems to existing aircraft, on contract after date of publication. In addition the criteria applies to the full range of required aircrew anthropometry and aircrew weight range from 103-245 pounds nude weight. For ejection seats the criteria also applies to the full escape envelope up to the aircraft maximum speed or 600 KEAS, whichever is less. For legacy systems that are not receiving a major seat upgrade or replacement, legacy requirements, as well as specific criteria reference data, and guidance on ejection testing data acquisition,

reduction and reporting, are provided in AFLCMC Crew Systems Bulletin EZFC-CSB-16-001.

- a. Accelerations, catapult phase: The acceleration imposed on the seat occupant in the +G<sub>z</sub> direction (parallel to the spinal column) by the ejection catapult should be limited in terms of Dynamic Response Index (DRI) values for the z-axis, DRI<sub>z</sub>, calculated according to the method described below. The following DRI<sub>z</sub> limits are for specific catapult pre-ignition temperature and ejected weight representing the ejection seat, personal equipment, and human body weight representative of the crew member population anthropometric range. In addition the following limits are based on a configuration which includes the head rest not more than one inch in front of the seat back tangent line, the seat back tangent line no more than 5° offset from the catapult thrust vector, and standard USAF torso harness with a chest strap and lap belt restraint (or equivalent restraint as determined by 711<sup>th</sup> HPW).

Ensure 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<sub>z</sub> value in excess of 16.

Ensure 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<sub>z</sub> value in excess of 16.0 with an allowable standard deviation of 1.0.

Ensure 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<sub>z</sub> value in excess of 20.0 with an allowable standard deviation of 1.0.

For systems that are inconsistent with the above configuration i.e. head rest more than one inch forward of back tangent line, seat back tangent line more than 5° offset from catapult thrust vector and other harness systems, the DRI<sub>z</sub> values for all pre-ignition temperatures are reduced by 2.0 in order to compensate for the differences. DRI calculation method shall be per EZFC-CSB-16-001.

- b. Accelerations, free-flight, drogue and recovery parachute opening phase (seat/aircraft separation to recovery parachute full open): All accelerations shall be limited to meet a Multi-axis Dynamic Response Criterion (MDRC) value not to exceed 1.0 (5% risk of AIS 2 injury) up to 450 KEAS. This shall be based on seat acceleration data (seat back x, y and seat pan z) up to seat/aircrew separation and manikin acceleration data (chest x, y and lumbar z) after seat/aircrew separation. MDRC calculation and dynamic response limit values shall be per EZFC-CSB-16-001.
- c. Accelerations, head Injury, all phases: The probability of a concussion ( $P_{\text{concussion}}$ ) does not exceed 5% using the resultant linear and rotational head accelerations as given in EZFC-CSB-16-001.

- d. Accelerations, recovery parachute deployment/inflation phase: For applications using torso manikins or test vehicles where a fully instrumented manikin is not used and no data exists to determine the MDRC, the maximum resultant deceleration/stabilization recovery parachute deployment and inflation loads experienced by the aircrew during escape do not exceed the following maximum resultant chest accelerations.

No more than 15 G (vector sum) if the direction of force applied to the body is random and unpredictable as in a typical manual bailout or crew mounted parachute system.

No more than 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.”).

- e. Descent rate, recovery parachute descent/steady state phase: Recovery parachute average descent rates do not exceed vertical velocity of 23 ft/sec at sea level (SL) on a standard day for the maximum applicable aircrew suspended weight.
- f. Stability, free-flight and drogue phase (seat/aircraft separation to seat/aircrew separation): Seat stability will be maintained to align the neutral axis direction of the aerodynamic deceleration parallel to the main rocket thrust line at low speeds (where rocket thrust is the predominant force and drogues may not be deployed long enough to be effective) or the eyeballs-out (eyeballs-in for backward facing seats) direction at higher speeds (where free-stream velocity is the predominant force). Excursions about the neutral axis shall be limited to +/- 20° in the yaw plane and positively damped at speeds above 250 KEAS. For systems where head supported mass exceeds the weight and center of gravity limitations per EZFC-CSB-16-001, excursions about the neutral axis shall also be limited to +/- 20° in the pitch plane and be positively damped at all ejection speeds through rocket burn out.
- g. Limb flail, windblast, free-flight and drogue phases (seat immersion into airflow to seat/aircrew separation): Aircraft capable of speeds above 300 KEAS must incorporate limb restraints (arm & leg) to prevent limb flail. Legacy data indicates probability of flail injuries increases with airspeed and is approximately 5% probability at 300 KEAS. Leg restraints should prevent movement of the legs laterally beyond the sides of the seat. Arm restraints should prevent movement of arms rearward beyond the seat back tangent line.

- h. Neck injury criteria, all phases: The neck injury criteria detailed below apply through all phases of the ejection with and without helmet mounted displays such as night vision goggles or joint helmet mounted cueing system. This includes cases where deployable head and neck protection devices are used and applies when the devices are deployed in contact with the pilots head/helmet and if the head is out of nominal position when deployed.

Upper neck forces and moments will be limited to meet a Multi-Axial Neck Injury Criteria (MANIC) not to exceed 0.47 and a Neck Moment Index about the x-axis (NMI<sub>x</sub>) not to exceed 0.56 at the occipital condyles (C0-C1) for speeds up to and including 450 KEAS. For speeds greater than 450 KEAS the MANIC and NMI<sub>x</sub> limit may increase linearly as a function of speed up to a MANIC of 0.65 and NMI<sub>x</sub> of 0.86 at 600 KEAS. MANIC and NMI<sub>x</sub> calculations and component limit values shall be per EZFC-CSB-16-001.

- i. Escape Capability: Ejection seat systems will have the capability for zero altitude (in level flight) up to the absolute ceiling of the aircraft and from zero airspeed to maximum velocity of the aircraft or 600 KEAS whichever is less (for an open ejection seat).

**Method of Compliance (Army Navy and Air Force):** No change to current text.

**Add to references:**

Parr, Jeffrey, "A Method to Develop Neck Injury Criteria to Aid Design and Test of Escape Systems Incorporating Helmet Mounted Displays", AFIT/DS/ENV/14-01.

Rowson, Steven and Duma, Stefan, "Brain Injury Prediction: Assessing the Combined Probability of Concussion Using Linear and Rotational Head Acceleration", Annals of Biomedical Engineering, Vol. 41, No.5, May 2013.

Gennarelli, Thomas & Wodzin, Elaine, editors, "Abbreviated Injury Scale 2005, Updated 2008", Association for the Advancement of Automotive Medicine, Oct 2008.

Joint Service Specification Guide, 2010-11, Crew Systems Emergency Egress Handbook, 30 Oct 1998.

Joint Service Specification Guide, 2010-12, Deployable Aerodynamic Decelerator Handbook, 30 Oct 1998.