

MIL-STD-1288
 NOTICE 3
 24 August 1981

MILITARY STANDARD
 AIRCREW PROTECTION REQUIREMENTS
 NONNUCLEAR WEAPONS THREAT

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NEW PAGE	DATE	SUPERSEDED PAGE	DATE
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Custodians:
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Project 15GP-0036

FSC 15GP

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MILITARY STANDARD

AIRCREW PROTECTION REQUIREMENTS
NONNUCLEAR WEAPONS THREAT



FSC 1500

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24 August 1981

DEPARTMENT OF DEFENSE
WASHINGTON, DC 20301

Aircrew Protection Requirements Nonnuclear Weapons Threat

MIL-STD-1288

1. This Military Standard is approved for use by all Departments and Agencies of the Department of Defense.
2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to:

Commander
US Army Aviation Research and
Development Command
ATTN: DRDAV-ERS
4300 Goodfellow Boulevard
St. Louis, MO 63120

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1. SCOPE

1.1 Scope. The purpose of this document is to establish the design of protection systems, as defined herein, to protect aircrews from the threats posed by enemy nonnuclear weapons.

1.2 Application. The requirements contained herein apply to aircraft procured by military departments for combat operations wherein the aircraft will be subjected to hostile air-to-air and ground-to-air nonnuclear weapons. This encompasses all types of aircraft with the exception of those designated for research and training.

2. REFERENCED DOCUMENTS

2.1 Specifications and standards. The issues of the following documents in effect on date of invitation for bids form a part of this standard to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-C-7905	Cylinders, Compressed Air, Nonshatterable
MIL-D-19326	Design and Installation of Liquid Oxygen Systems in Aircraft, General Specification for
MIL-D-8683	Design and Installation of Gaseous Oxygen Systems in Aircraft, General Specification for
MIL-I-8675	Installation, Aircraft Armor
MIL-S-18471(AS)	System, Aircrew Automated Escape, Ejection Seat Type; General Specification for
MIL-S-58095(AV)	Seat System; Crashworthy, Nonejection, Aircrew, General Specification for

STANDARDS

MILITARY

MIL-STD-846	Escape System Testing, Ground, Track, and Flight Test
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2.2 Other publications.

AFSC-DH-2-7	Design Handbook Series 2-0, Aeronautical Systems, System Survivability (U), August 1969, Secret
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AFML TR 68-384	Armor Materials Selection and Design Information (U), January 1969, AD 395777L, Confidential.
AMMRC TR 71-21	Ballistic Technology of Lightweight Armor (U), July 1971, Confidential.
AVLABS 66-54	Study of Dynamic Effects of Caliber 0.30 and 0.50 Projectile Impacts on Ceramic Plastic Armor and Supporting Bracketry (U), August 1966, AD 376883L, Confidential.
AVLABS 67-68	Dynamic Effects of Caliber 0.50 Projectile Impact on Armor and Support Structures (U), March 1968, AD 391301L, Confidential.
HEL TM 18-69	Armor Systems Development/Evaluation Guidelines, September 1969, AD 697885
AFFDL TR 68-5	Design Techniques for Installing Parasitic Armor (U), February 1968, Confidential.
NAVAIR 00-25-524A	Guide to Reduction of Aircraft Vulnerability (U), 1 August 1970, Confidential.

(Copies of specifications, standards and other publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer).

3. DEFINITIONS. The definitions listed herein are solely for the purpose of this document.

3.1 Aircrew. Complement of personnel required by the aircraft design to perform specific tasks in support of designated missions; i.e., pilot, copilot, navigator, crew chief, systems operator, gunner, etc., but excluding passengers.

3.2 Areal density. Weight of a particular material per unit of surface area, expressed as pound per square foot.

3.3 Casualty. Individual injured to the extent that he is partially or fully incapacitated and thus prevented from normal performance of assigned duties.

3.4 Defeated. Armor material damaged to the point of spallation or penetration.

3.5 Integral armor. Applications of armor material that are a part of the airframe and are not intended to be removed unless damaged. The armor application may or may not be a load bearing part of the aircraft.

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5.3.4.4 External armor. When aircraft and crew station configurations and other factors make it necessary to install crew protective armor on external surfaces of the aircraft, consideration shall be given to integrating armor and external structure. Attachment of parasitic armor to external surfaces of the aircraft shall be avoided where possible due to adverse aerodynamic effects involved. Thickness, contour, and installation will become major factors in selecting armor material for external applications since increases in drag must be minimized. Where possible, external armor installation shall be designed to protect other critical components for increased efficiency. For example, an integral armored nose wheel well door could protect critical flight control components and escape system components, as well as the crew.

5.4 Secondary threat protection. Paragraph 4.2 identifies types of secondary threats to which crew members can be exposed. Design requirements to protect crew members from these hazards are as follows:

a. High pressure containers used in oxygen systems, emergency escape capsule pressurization systems, and other applications shall be non-shatterable types conforming to MIL-C-7905. Wherever possible, these containers shall be separated from the crew by structure and other components.

b. Propellant actuated devices used in crew escape systems shall be located so they receive maximum shielding from aircraft structures and other inert components to minimize the possibility of damage and ignition by projectile and fragment hits. Special attention shall be given to the shielding of large propellant devices, such as escape capsule or offensive missile rocket motors, since their ignition or detonation could cause loss of aircrew and aircraft.

c. Selection of materials for use in aircraft crew station transparencies and interiors shall include consideration of spallation and spall suppression properties of the material. Metals, glass, and plastics which spall, shatter, or otherwise generate flying debris when hit by projectile or fragments shall be avoided. Fabrics, reinforced plastics, and other materials which suppress spall and projectile fragments shall be installed where vision requirements do not prohibit usage.

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d. The oxygen distribution system shall be designed to minimize its vulnerability. Design requirements reducing vulnerability of oxygen systems and minimizing secondary hazards are contained in MIL-D-19326 and MIL-D-8683.

e. Flammable materials should be avoided in the cockpit to avoid effects of smoke, fire, or explosion. Items (lines, bottles, etc.) containing flammable or toxic materials shall not be located in the aircrew stations.

5.5 Drawings and mockups.

5.5.1 Drawings. Drawings of aircrew protection provisions proposed in accordance with this standard shall be prepared and submitted to the procuring activity in accordance with the Contractor Data Requirements List of the Contract (DD Form 1423). Drawings shall include three views and inboard profiles which show the relationship of the protection provisions to the aircrew and other items of equipment in the aircraft. Assembly, sub-assembly, and detail drawings shall be provided which completely describe the protection provisions, including materials and attachment provisions.

5.5.2 Mockups.

5.5.2.1 New aircraft developments. Aircrew station protection provisions proposed in accordance with this standard shall be included in the mockup constructed by the contractor for new aircraft development programs. Suitable materials may be used to simulate aircrew protection provisions but physical dimensions shall be identical to those proposed for the production aircraft. When protection provisions, such as armor, are buried within the aircraft structure; means shall be provided on the mockup to inspect armor clearances and attachments.

5.5.2.2 Operational aircraft modifications. Aircrew station protection provisions designed for incorporation by retrofit of operational aircraft shall be mocked up in an actual aircraft. Prototype protection provisions shall be used in the mockup. When retrofit is to be accomplished by supplying a kit for installation by the operational organization, the contractor shall demonstrate installation procedures during the Mockup Inspection Meeting.

6.0 Test Requirements.

6.1 General. Test requirements to verify the ballistic limit capability of armor materials are contained in the Quality Assurance Provisions Sections of armor material specifications. The test requirements and analytical procedures to verify the structural integrity of armored seats and armor installations under in-flight and crash load conditions are contained in applicable aircraft seat and structures specifications. Tests prescribed in this standard apply to verification of crew protection installations under projectile and fragment impact conditions and will be performed when specifically required by the procuring activity.

6.2 Test equipment.

6.2.1 Projectile. Test projectiles shall conform to the maximum design threat specified by the procuring activity for the protection system being tested. Projectile velocity at impact with the protection system shall conform to the maximum design threat with the exception of those tests where the protection system is purposely defeated to evaluate backface spall hazard (reference para 6.4.1).

6.2.2 Firing mechanisms. Firing mechanisms shall be capable of propelling the projectile at velocities above normal muzzle velocities to simulate those cases where vector sum of the aircraft and projectile velocities exceed muzzle velocities.

6.2.3 Measurement system. The measurement system shall provide velocity of the projectile in feet per second to an accuracy of plus or minus two percent at a point as close as possible to the protection installation being tested. On all tests, maximum percentile anthropomorphic witness specified by the procuring activity, fabricated from wall board, styrofoam or gelation and clothed in the required aircrew clothing and equipment for the mission, shall be installed in the area normally occupied by the crew member. This witness will be used to quantify projectile residual velocity, given a penetration, and identify any front and rear face spall conditions which exist at time of projectile hit.

6.3 Test plan. Detailed test procedures will vary as a function of design threat, type of protection, and configuration of aircraft and crew station. Before initiating tests under this standard, the contractor shall prepare a complete test plan describing proposed test procedures and schedule.

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The test plan shall include test objectives, description of each test, equipment and facilities to be used, and data to be recorded. The contractor shall not proceed with the test program until written approval of the test plan is received from the procuring activity. When required, the test plan shall be specified on the Contractor Data Requirements List of the contract (DD Form 1423).

6.4 Test procedures.

6.4.1 Armored seats. The complete armored seat, with cushions where applicable, shall be mounted to a simulated aircraft floor or bulkhead structure using actual seat mounting points and hardware. The witness package shall be installed in the seat. When the seat is to be used in a multi-occupant crew station, witness packages shall also be located at positions of other crew members to record any spall from the armored seat which could endanger other crew members. Projectiles conforming to design threat will be shot at critical hit points on the armored seats. Typical critical hit points are: joints in armor panels between seat back, bottom, and sides; two inches from the edge of cantilever supported side panels; forward edge of the seat bottom in the vicinity of the seat occupant's legs; two inches from the edge of head protective armor panels, and two inches from attachment points of seat framework to seat buckets. The contractor shall identify in the test plan a minimum of twelve critical hit points for testing the armored seat. At least one of the critical hit points shall be designated for a test where the armor is purposely defeated to evaluate back-face spall suppression. When the armored seat consists of two or more different armor materials, additional tests for back-face spall suppression evaluation will be required.

a. In developing the test plan, the contractor shall consider spreading hit points over the entire armored seat such that one seat will be adequate for all tests, provided extensive failure is not encountered. Failure of armor to meet its specification criteria limits for ballistic protection, failure of armor attachments, excessive deflection of armor attachments which endangers occupants, and generation of spall which impacts the witness packages, constitute test failures.

b. In addition, the armor system will be tested for retention during the crash environment as specified by the procuring activity.

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6.4.2 Internal and external crew station armor. Test specimens shall consist of armor (integral or parasitic) and adjacent structure effected by armor installation. The test step shall include witness packages located at the aircrew positions effected by the armor installation. Projectiles conforming to design threat will be shot at critical hit points on crew station armor. Typical critical hit points are: joints between armor panels, areas where armor is attached to supporting brackets or directly to the structure, high stress areas of integral armor, and at the unsupported edge of cantilever supported armor panel. In the test plan, the contractor shall identify critical hit points for testing of each armor panel. Where identical armor installations are used at different points in the aircraft, testing of one typical installation is adequate, e.g., identical armor installations on both sides of the cockpit. Failure of armor to meet its specification criteria limits for ballistic protection, failure of armor attachments, excessive deflection of armor attachments which damage or adversely effect critical components or endanger the crew, and generation of spall which impacts the witness packages constitute test failures.

6.5 Test report. Results of the tests shall be documented in a report as specified on the Contractor Data Requirements List of the contract (DD Form 1423).

Custodians:

Army - AV
Navy - AS
Air Force - 11

Preparing activity:

Army - AV

Review activities:

Army - GL, TE
Navy - MC
Air Force -

Project No. 1500-0099

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APPENDIX I

PERTINENT SPECIFICATIONS AND STANDARDS (FOR INFORMATION ONLY)

A. PROTECTIVE CLOTHING

1. MIL-A-12370 (GL), Body Armor, Fragmentation Protection
2. MIL-A-43366 Armor, Body, Fragmentation Protection, Groin
3. MIL-C-43544 (GL), Carrier, Body Armor, Aircrewman, Small Arms Protective
4. MIL-H-87140 Helmet, Flyers HGU-36/P
5. MIL-I-17368 (MC), Insert, Body Armor
6. LP/5-71 Body Armor, Small Arms Protective, Aircrewman, 22 Mar 71

B. MATERIALS

1. JAN-A-256, Notice-1: Armor, Homogeneous, Rolled Steel; Aircraft Type
2. JAN-A-434: Armor, Steel Rolled Plate Non-magnetic (5/32 to 1 1/16 in. incl.) Aircraft Type
3. MIL-A-00784 (OS) (Jan-A-784-1): Armor, Steel, Plate Rolled; Face Hardened, 1/4 to 1 1/8 inches
4. MIL-A-13259, Armor, Steel, Strip

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5. MIL-A-45225 (MR), Armor, Aluminum, Forged
6. MIL-A-46027 (MR), Armor, Aluminum, Plate, Weldable
7. MIL-A-46063, Armor, Aluminum, Plate, HT Weldable
8. MIL-A-46083 (MR), Armor, Aluminum, Extruded, Weldable
9. MIL-A-46103 (MR), Armor, Ceramic Faced Composite
10. MIL-S-46099, Armor, Steel, Dual Hardness
11. MIL-S-46100 (MR), Armor, Steel, Wrought, High Hardness
12. MIL-T-46077, Armor, Titanium, Plate, Weldable
13. MIL-C-12369 (QMC), Cloth, Ballistic Nylon
14. MIL-C-18491 (AS), Curtain, Flak Protective
15. MIL-F-43539, Felt, Ballistic Nylon
16. MIL-C-43635, Cloth Felt, Ballistic Nylon, Lightweight
17. MIL-P-25690, Plastic, Sheets, and Parts, Modified Acrylic Base, Monolithic, Crack Propagation Resistant

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C. TESTING

1. MIL-STD-662, Ballistic Acceptance Test for Personal Armor Material
2. MIL-P-46593, Fragment Simulating Projectiles
3. MIL-I-8675 (Aer), Installations, Aircraft Armor
4. MIL-I-8675 (Aer), Installations, Aircraft Armor (Proposed)
5. MIL-S-9479, Seat, Upward Ejection, Aircraft
6. MIL-S-18471, Seats, Ejection, Airplane, Design and Installation of
7. MIL-STD-846, Escape System Testing, Ground, Track, and Flight Test
8. MIL-S-81771(AS), Seats, Aircrew, Adjustable, Aircraft, General Specification for

D. SECONDARY HAZARDS

1. MIL-C-7905, Cylinders, Compressed Gas, Non-Shatterable
2. MIL-C-25666, Converter, Liquid O₂
3. MIL-C-19803 (Wep), Converter, Liquid O₂, 10 Liter
4. MIL-C-22284 (Wep), Container, A/C Fire Extinguishing System, Bromotrifluoromethane
5. MIL-R-8573 (ASG), Reservoirs, Air, Non-Shatterable Steel
6. MIL-D-19326, Design and Installation of Liquid Oxygen Systems in Aircraft, General Specification for
7. MIL-D-8683, Design and Installation of Gaseous Oxygen Systems in Aircraft, General Specification for.

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E. OTHER

1. MIL-STD-203, Aircrew Station Controls and Displays for Fixed Wing Aircraft
2. MIL-STD-250, Aircrew Station Controls and Displays for Rotary Wing Aircraft
3. MIL-STD-850, Aircrew Station Vision Requirements for Military Aircraft
4. MIL-STD-1333, Aircrew Station Geometry for Military Aircraft.
5. MS33574, Dimensions, Basic, Cockpit, Stick-Controlled, Fixed Wing Aircraft
6. MIL-H-46855, Human Performance Requirements
7. HEL-STD-S-5-65, An Evaluation Guide for Army Human Factors Engineering Requirements
8. AMRDL TR 71-41A, Survivability Guide for US Army Aircraft, Volume I, Small-Arms Ballistic Protection, Nov 71, AD 891122L
9. AMRDL TR 71-41B, Survivability Guide for US Army Aircraft, Volume II, Small-Arms Ballistic Protection, Nov 71, AD 519060L
10. AMRDL TR 71-22 Crash Survival Design Guide, Oct 71, AD 733358
11. AMRDL TR 71-54 Design, Fabrication and Testing of an Integrally Armored Crashworthy Crew Seat, Jan 72

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12. MIL-A-8860(ASG), Airplane Strength and Rigidity, General Specification for
13. MIL-A-8861(ASG), Airplane Strength and Rigidity, Flight Loads
14. MIL-A-8862(ASG), Airplane Strength and Rigidity, Landplane Landing and Ground Handling Loads
15. MIL-A-8863(ASG), Airplane Strength and Rigidity, Additional Loads for Carrier-Based Landplanes.
16. MIL-A-8864(ASG), Airplane Strength and Rigidity, Water and Handling Loads for Seaplanes
17. MIL-A-8865(ASG), Airplane Strength and Rigidity, Miscellaneous Loads
18. MIL-A-8866(ASG), Airplane Strength and Rigidity, Reliability Requirements, Repeated Loads and Fatigue
19. MIL-A-8867(ASG), Airplane Strength and Rigidity, Ground Tests
20. MIL-A-8868(ASG), Airplane Strength and Rigidity Data and Report
21. MIL-A-8869(ASG), Airplane Strength and Rigidity, Special Weapons Effects
22. MIL-A-8870(ASG), Airplane Strength and Rigidity, Vibration, Flutter, and Divergence