MIL-STD-1288

29 September 1972

MILITARY STANDARD

AIRCREW PROTECTION REQUIREMENTS

NONNUCLEAR WEAPONS THREAT

FSC 1500

DEPARTMENT OF DEFENSE

WASHINGTON, D.C.

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. Recommended corrections, additions, or deletions should be addressed to the U.S. Army Aviation Systems Command, ATTN: AMSAV-ES, PO Box 209, St. Louis, Missouri 63166.

FOREWORD

The need for realistic standards that reflect United States aircraft operational environments is urgent. Research and development in the past several years has produced effective new materials, devices and techniques to reduce the vulnerability of aircraft to enemy weapons threats. Although some specifications have been prepared, there has been little effort toward quality assurance of overall system effectiveness when these varied solutions are consolidated within the total airframe configurations. This standard presents a summary of requirements that should be followed when developing and designing aircrew stations that will operate in hostile environments. So that design criteria will provide efficient ballistic protection for the total aircrew, a systems approach is emphasized with guidelines included to regulate the quality of the entire protection system.

Since design guidance as outlined in this standard was so urgently needed for aircraft development procurements, a tri-service ad hoc committee, under the cognizance of the Aircrew Station Standardization Panel, was formed to draft a Military Design Standard for Aircrew Station Ballistic Protection. Aircraft survivability design data generated in past years in the areas of aircraft vulnerability reduction and aircrew protection were compiled and analyzed. Pertinent related design data were selected and developed into a design guide for use by engineers, designers, and other personnel responsible for vulnerability reduction and aircrew protection. This standard unites this design criteria associated with aircrew ballistic protection to provide guidance for overall survivability enhancement considerations. A comprehensive list of pertinent Military and Industry specifications, standards and reports is included.

The proposed standard was prepared and informally coordinated and approved by agencies of all three services through the efforts of the Aircrew Station Standardization Panel.

CONTENTS

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-I-5585	Installation of Low Pressure Oxygen Equipment 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

2.2 Other publications.

AFSC-DH-2-7	Design Handbook Series 2-0, Aeronautical Systems -- System Survivability (U), August 1969, Secret

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 697785
AFFDL TR 68-5	Design Techniques for Installing Parasitic Armor (U), February 1968, 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 pounds 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.

3.6 Parasitic armor. Applications of armor material that can be easily installed or removed from the basic airframe in kit form without adversely affecting aircraft structural integrity or operation.

3.7 Protection systems. Protective elements of the aircrew personal equipment or aircrew station which minimize aircrew vulnerability from direct enemy non-nuclear weapon threats.

3.8 Shielding. Protection of the aircrew by aircraft components located between the aircrew and any source of ballistic damage.

3.9 Spall. Delamination or fragmentation of armor material into irregular particles, chips or scales.

3.10 Survivability. Capability of a military aircraft to exist and perform its mission in a hostile environment.

3.11 Vulnerability. Susceptability of the aircrew to personal injury causing a loss of normal capability to perform the mission function as a result of having been subjected to ballistic damage.

3.12 Witness. Dummy or representation of crewmember used to identify projectile penetration, splash, and front or rear face spall condition hazardous to the crew.

4. GENERAL REQUIREMENTS

4.1 Primary threats. Primary threats to aircrews will vary as a function of aircraft type/performance/mission; and known or postulated enemy weapons. Threats to be considered in designing aircrew protection for a particular type of aircraft will be specified in the aircraft procurement document.

4.2 Secondary threats. Existence of secondary threats to aircrews will depend largely on detail design of the aircraft and its subsystems and equipment. Secondary threats to be considered in designing aircrew protection will be identified during the design phase of the aircraft and the aircrew vulnerability assessment (paragraph 5.2). These threats can include:

a. High velocity spall particles resulting from projectile or fragment impact with structure, windshields and canopy transparencies, crew station equipment and armor.

b. Fires resulting from projectile hits on such items as flammable fluid systems, liquid oxygen containers, and propellant actuated devices located in the crew station proximity.

c. Explosion from projectile hits on high pressure bottles and propellant actuated devices.

5. DETAIL REQUIREMENTS

5.1 Aircrew protection. During preliminary layout and design of the aircraft, aircrew members, structure and components shall be so located that maximum shielding is provided aircrew members in critical attack directions. Effective use of aircraft structure and components to shield crew members will reduce additional weight associated with armor type provisions. In new designs, aircrew protection systems weight, excluding body armor, will be included in the aircraft empty weight.

5.1.1 Design. The protection of aircrew station(s) and personnel against all nonnuclear threats which the aircraft will encounter in specified combat environments will be accomplished primarily through design. Use of armor to protect the area in question is allowable provided it is proven more efficient than any other means. Density of combat environment to be considered (low, medium, high) will be specified and defined in the aircraft procurement documents.

5.2 Vulnerability assessment. An analysis of the aircrew vulnerability shall be made as part of the overall design analysis of aircraft survivability. The analysis shall include evaluation of:

a. Range of threats specified for the aircraft.

b. Aircraft mission profile and performance, determining critical attack directions and projectile and fragment striking velocities.

c. Assessment of shielding provided by existing aircraft structure and components against the threat range.

d. Vulnerability reduction trade-off.

e. Casualty reduction analysis.

5.2.1 Assessment report. A report of this analysis shall be submitted to the procuring activity for approval.

a. The results of the analysis will identify: degree of aircrew vulnerability from various attack directions related to the threats; critical areas where additional protection is required; and optimum protection techniques, i.e., whether protection should be provided solely by aircraft armor or a combination of aircraft armor and shielding or individual protective devices such as a chest protector.

b. Benefits and penalties of incorporating the various protection design features shall be presented in terms of: increased mission completion; saved material; reduced casualties versus cost; weight; and performance penalties.

5.3 Primary threat protection. Non-critical aircraft components and structure shall be utilized to the maximum extent possible for shielding the aircrew. Multiple pilot stations shall be separated as much as practicable with consideration given to shielding between them. For additional protection, incorporation of armor and fragment suppression materials should be considered. The degree of protection to be installed will be determined by considering the following:

a. Allowable weight penalty determined by aircraft performance factors and trade-off of aircrew protection with other survivability enhancement provisions for critical systems such as fuel and flight controls.

b. Protection systems shall not restrict aircrew mobility and access to controls or vision such that it adversely affects combat mission accomplishment. Protection systems shall not interfere with normal or emergency ingress or egress of personnel or constitute a hazard to the aircrew in the event of a crash.

5.3.1 Armor protection design. Selection of armor protection to be incorporated at a particular crew position shall be based on the following factors:

a. Locating protective materials in closer proximity to a crewman reduces overall area of material and decreases weight penalties.

b. Armor protection shall not adversely affect normal or emergency crew operations nor affect crashworthiness characteristics of the aircraft.

c. Protection designs which shield more than one crewman or shield a critical aircraft component as well as the crewman can result in an overall weight savings.

d. Protection designs which provide shielding and serve as aircraft structure; i.e., integral armor, will be more efficient. Additional data on types of protection and factors to be considered in the selection are available in MIL-I-8675, AFSC-DH-2-7 and HEL TM 18-69.

5.3.2 Armor materials. A major factor in selecting armor materials is obtaining minimum areal density commensurate with protective requirements and design trade-offs. Another primary factor is front and rear face spall characteristics of the material. Materials which spall on the front face endangering protected or adjacent crewmen, shall incorporate a suitable spall shield. Materials which generate spall particles on the rear face when defeated shall not be used in crew stations unless suitable provisions are made to suppress the spall and prevent aircrew injury. Other factors to be considered are cost, availability, multi-hit capability, ease of fabrication, material thickness, durability and material response to combat aircraft environmental conditions. Another major factor in selecting armor material is its structural capacity to withstand crash or hard landing environments. Detailed data are available in AMMRC TR 71-21 and AFML TR 68-384.

5.3.3 Armor installations. Armor shall be incorporated either as an integral part of, or a parasitic addition to, the aircraft crew station or crew seat structure. The method used for a specific installation shall be selected considering such factors as: minimum weight penalty, operations required to remove and re-install armor in the field, aircraft status (design, production, in service) at the time decision is made to install armor, space limitations, access for maintenance and cost. Load bearing integral armor installations shall be designed to withstand design loads for the structural member involved (bulkhead, floor panel, seat back, etc.) as

well as ballistic impact loads resulting from the most severe design threat. Parasitic armor installations shall be designed to withstand in-flight and ballistic impact loads. When parasitic armor is located such that failure of the attachments will endanger any crew member, the installation shall be designed to withstand crash load factors. Detailed data on parasitic armor installation techniques, including a method for calculating design loads resulting from projectile impact are contained in AFFDL TR 68-5, AVLABS 66-54, AVLABS 67-78 and MIL-I-8675. Armor attachment methods and hardware will vary based on the particular installation problems. The following basic requirements shall be considered:

a. Attachments for composite and face hardened armor materials shall be designed so that the armor cannot be installed backwards (with soft face towards the incoming threat). Use of unsymmetrical fastener patterns is one method to accomplish this.

b. When armor must be removed and reinstalled for aircraft maintenance, the weight of a single armor panel shall not exceed 40 pounds or require special tools. Where practical, hinged or sliding armor panels shall be employed to facilitate maintenance access.

c. The bolt through method of armor attachment shall not be used where a projectile hit on the bolt will cause the bolt to become a secondary projectile endangering the aircrew.

d. Special attention shall be given to avoid attachment of armor to external surfaces of the aircraft in locations where failure of the attachments, separation of the armor panel, or pieces thereof, could damage engines, rotors, control surfaces, and other components critical to sustaining flight.

5.3.4 Basic types of armor protection. Starting at the crewman, where protective material is minimal, and progressing outward, the basic types are:

a. Body armor. Includes torso protectors, and other types of armor worn by the aircrew (See Appendix III).

b. Armored seats. Includes seats where the armor is an integral part of the seat and seats where armor is attached to an existing seat structure. When armor is added to existing ejection seat systems the affect of the added weight on ejection seat performance must be considered. Proposed armor installation for ejection seats shall be submitted to the procuring activity for a decision on whether the modified seat shall be retested in accordance with MIL-S-18471 and MIL-STD-846. When armor is added to existing seat systems, the effect of the added weight on seat crashworthiness (See MIL-S-58095(AV)) shall be considered and reported to the procuring activity.

c. Crew station armor. This includes armor mounted on (or integrated into) floors, sidewalks, bulkheads, instrument panels, and transparent armor used in areas for external vision.

d. External armor. Armor mounted on external surfaces of the aircraft in the vicinity of any aircrew station.

5.3.4.1 Body armor. Body armor is government furnished equipment and unless otherwise stated by the procuring activity, body armor, of a type indicated in Appendix III listing, shall be designated for each crewmember. Protection capability of the specified body armor shall be considered in the overall aircrew protection system design. For example, body armor designed to protect the front portion of the torso may be considered as a supplemental means, or the only means, to protect a pilot from threats from portions of the frontal attack direction. In addition to considering protection afforded by body armor, integration of body armor with the crew station and associatiated equipment shall be considered as follows:

a. Effect of the body armor weight and bulk on crew mobility, and consequently crew station arrangement, ensuring crewmembers are not prevented from performing assigned duties nor prevented from accomplishing normal or emergency egress/ingress.

b. Effect of the body armor weight and bulk on crew comfort, ensuring the crew station is designed to minimize fatigue.

c. Compatibility of body armor with the aircrew restraint system, parachute harness, survival gear, and other life support equipment.

d. Effect of body armor weight distribution on the seat plus man center of gravity relationship with ejection seat rocket thrust vector.

e. Effect of body armor weight on seat and restraint system crash loads.

5.3.4.2 Seat armor. Seat armor shall be used only where it does not compromise emergency escape or ejection requirements. Armored seats shall be designed to basic configuration, dimensional adjustment and strength requirements included in applicable seat specifications. On new armored seat designs, armor shall be integral with seat structure, serving as material to form seat bottom, back, and sides. Protection provided in terms of armor panel area and location shall be determined from results of the Vulnerability Analysis (paragraph 5.2) and crew station arrangement factors. For example, in a side-by-side pilot's seating arrangement, armor area coverage will be more extensive on outboard sides of the seats. Where required, seat side armor panels shall be hinged or retractable to provide maximum protection and still not restrict normal or emergency seat ingress/egress. Movable armor panels shall incorporate positive locks which are capable of withstanding seat crash loads. Special attention shall be given to design of seat adjustment mechanisms on armored seats to ensure proper counterbalancing for ease of adjustment and that adjustment position locks are designed to prevent inadvertent seat movement. Exposed armor edges shall be covered with cushioning material to prevent injury to crew members and damage to personal equipment. In addition to crash loads contained in applicable seat specifications, armored seats shall withstand ballistic impact loads associated with the design threat. Ballistic test requirements are contained in paragraph 6.0. Other features of armor protected seats shall include the following:

a. Installation and removal of armor system for maintenance, without the use of special tools.

b. Unrestricted operation of all controls, switches, and other equipment devices required during flight.

c. Normal seating and unimpaired movement for operation of aircraft and equipment.

d. Full operation of crew member seats in fore, aft, up, down, and recline positions.

e. Provisions to facilitate in-flight extraction of either pilot or copilot from his seat in the event of injury requiring removal.

f. Retain maximum visibility specified for each crew position.

g. Provide 100 percent protection of trunk/torso area of each crewman's body (excluding anterior chest/abdomen area), consistent with visibility and escape requirements.

h. Repairability is to be a major consideration in design of armor installations to avoid excessive repair time and loss of aircraft operational readiness in combat areas. Armor systems that are not easily replaced, or rapidly repaired in place, shall be avoided.

i. Multi-hit armor capability is desired to reduce the requirement for repair or replacement and corresponding logistic burdens.

5.3.4.3 Crew station armor. Location and types of armor installed within the crew station will be determined by the vulnerability analysis (paragraph 5.2) and materials selection considerations (paragraph 5.3.2). Wherever possible, armor shall serve a dual purpose to minimize weight penalties. For example, armor can be integral and serve as primary or secondary structural members (paragraph 5.3.3). Also, armor materials installed to suppress fragments could serve as temperature/sound insulation and/or interior trim. Where applicable, armor installed in the crew station for crew protection shall also be designed to protect other critical components, such as flight control components, increasing overall armor effectiveness.

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 useage.

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-I-5585.

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.

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; one inch from the edge of cantilever supported side panels; forward edge of the seat bottom in the vicinity of the seat occupant's legs; one inch from the edge of head protective armor panels; and one inch 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.

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

Review activities:

Army -- GL, TE
Navy -- MC
Air Force --

Preparing activity:

Army -- AV

Project No. 1500-0099

APPENDIX I

PERTINENT SPECIFICATIONS AND STANDARDS (FOR INFORMATION ONLY)

A. PROTECTIVE CLOTHING

1. MIL-A-12370 (GL), Body Armor, Fragmentation Protection

2. MIL-A-18628 (Aer), Armor, Body, Fragmentation Protection

3. MIL-A-43366 Armor, Body, Fragmentation Protection, Groin

4. MIL-C-43544 (GL), Carrier, Body Armor, Aircrewman, Small Arms Protective

5. MIL-H-43388 (GL), Helmet, Flying Protective, Ballistic and Crash

6. MIL-I-17368 (MC), Insert, Body Armor

7. 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-7168, Notice-1: Armor, Aircraft, Aluminum Alloy Plates; Deflector

5. MIL-A-7169, Notice-1: Armor, Aircraft, Aluminum Alloy Plates; Protector

6. MIL-A-13259, Armor, Steel, Strip

7. MIL-A-17856 (Aer)-2: Armor, Fragment, Non-Metallic

8. MIL-A-21648(Aer): Armor, Aircraft, Magnesium Lithium Alloy Plates

9. MIL-A-23556(Wep): Armor, Aircraft Titanium Alloy Plates

10. MIL-A-45225 (MR), Armor, Aluminum, Forged

11. MIL-A-46027 (MR), Armor, Aluminum, Plate, Weldable

12. MIL-A-46063, Armor, Aluminum, Plate, HT Weldable

13. MIL-A-46083 (MR), Armor, Aluminum, Extruded, Weldable

14. MIL-A-46103 (MR), Armor, Ceramic Faced Composite

15. MIL-S-46099, Armor, Steel, Dual Hardness

16. MIL-S-46100 (MR), Armor, Steel, Wrought, High Hardness

17. MIL-T-46077, Armor, Titanium, Plate, Weldable

18. MIL-T-46098, Armor, Ceramic Tile, Aluminum

19. MIL-C-7812, Cloth, Nylon Ballistic

20. MIL-C-12369 (QMC), Cloth, Ballistic Nylon

21. MIL-C-18491 (AS), Curtain, Flak Protective

22. MIL-F-43539, Felt, Ballistic Nylon

23. MIL-C-43635, Cloth Felt, Ballistic Nylon, Lightweight

24. MIL-G-54858, Glass, Laminated, Flat, Bullet-Resistant

25. MIL-P-25690, Plastic, Sheets, and Parts, Modified Acrylic Base, Monolithic, Crack Propagation Resistant

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-T-5029, (Notice 1,2) Test, Aircraft Armament Installations and Accessories, Standard Minimum Proof

6. MIL-S-9479, Seat, Upward Ejection, Aircraft

7. MIL-S-18471, Seats, Ejection, Airplane, Design and Installation of

8. MIL-STD-846, Escape System Testing, Ground, Track, and Flight Test

9. 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 0_2

3. MIL-C-19803 (Wep), Converter, Liquid 0_2, 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-I-5585, Installation of Low Pressure Oxygen Equipment in Aircraft, General Specification for

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 Fixed Wing, Rotary Wing, and V/STOL Aircraft

5. MS 33573, Dimensions, Clearance, Cockpit, Fixed Wing Aircraft

6. MS 33574, Dimensions, Basic, Cockpit, Stick-Controlled, Fixed Wing Aircraft

7. MS 33575, Dimensions, Basic, Cockpit, Helicopters

8. MS 33576, Dimensions, Basic, Cockpit, Wheel-Controlled, Fixed Wing Aircraft

9. MIL-H-46855, Human Performance Requirements

10. HEL-STD-S-5-65, An Evaluation Guide for Army Human Factors Engineering Requirements

11. AMRDL TR 71-41A, Survivability Guide for US Army Aircraft, Volume 1, Small-Arms Ballistic Protection, Nov 71, AD 891122L

12. AMRDL TR 71-41B, Survivability Guide for US Army Aircraft, Volume II, Small-Arms Ballistic Protection, Nov 71, AD 519060L

13. AMRDL TR 71-22 Crash Survival Design Guide, Oct 71, AD 733358

14. AMRDL TR 71-54 Design, Fabrication and Testing of an Integrally Armored Crashworthy Crew Seat, Jan 72

15. MIL-A-8860(ASG), Airplane Strength and Rigidity, General Specification for

16. MIL-A-8861(ASG), Airplane Strength and Rigidity, Flight Loads

17. MIL-A-8862(ASG), Airplane Strength and Rigidity, Landplane Landing and Ground Handling Loads

18. MIL-A-8863(ASG), Airplane Strength and Rigidity, Additional Loads for Carrier-Based Landplanes

19. MIL-A-8864(ASG), Airplane Strength and Rigidity, Water and Handling Loads for Seaplanes

20. MIL-A-8865(ASG), Airplane Strength and Rigidity, Miscellaneous Loads

21. MIL-A-8866(ASG), Airplane Strength and Rigidity, Reliability Requirements, Repeated Loads and Fatigue

22. MIL-A-8867(ASG), Airplane Strength and Rigidity, Ground Tests

23. MIL-A-8868(ASG), Airplane Strength and Rigidity Data and Report

24. MIL-A-8869(ASG), Airplane Strength and Rigidity, Special Weapons Effects

25. MIL-A-8870(ASG), Airplane Strength and Rigidity, Vibration, Flutter, and Divergence

APPENDIX II

PERTINENT OTHER PUBLICATIONS (For Information Only)

A. AIR FORCE

1. AFML TR 68-384 - Armor Materials Selection and Design Information (U), January 1969, AD 395777L, CONFIDENTIAL.

2. AFFDL TR 67-64 - Investigation of Passive Defense Provisions for Aircraft Crews and Passengers (U), March 1967, AD 384309, SECRET

3. AFFDL TR 68-5 - Design Techniques for Installing Parasitic Armor (U), February 1968, CONFIDENTIAL.

4. AFML TR 68-147 - Evaluation and Modification of Lightweight Armor Materials Systems and Date, (U) AD____, July 1968, SECRET.

5. AFSC-DH-2-7 - Design Handbook Series 2-0, Aeronautical Systems - System Survivability (U), August 1969, SECRET.

6. USAF ASD Project 68C035 Survivability/Vulnerability Study of the UH-1N Helicopter (U), November 1969, SECRET.

7. USAF ASD TR 69-14 - Survivability/Vulnerability Study of the UH-1F, CH/HH-3E, HH43B/F and the CH/HH-53B/C Helicopters, March 1969.

8. AFML-TR-70-81 - Optimization of Aircrew Body Armor for Specific Aircraft Missions, (U) AD____, April 1970, CONFIDENTIAL.

9. AFFDL-TR-70-58 - Passive Defense Protection of Aircraft Crews from Fragments and Spall (U), December 1970, SECRET.

10. AFML-TR-69-201 - Convertible Armor in Real Aircraft Geometric (U), December 1970, CONFIDENTIAL.

11. AFML-TR-69-105 - An Armor System to Defeat the 14.5MM API Projectile (U), December 1970, CONFIDENTIAL.

12. DC1C Report 69-1 - Ceramic Armor Technology (U), Symposium Proceeding Sponsored by AFML and DC1C, May 1969, CONFIDENTIAL.

B. ARMY

1. AMMRC AB1-39, The Lightweight Armor Program (U), 25 May 1966, DDC No. ____, CONFIDENTIAL.

2. AMMRC AB1-58, Armor Materials Assessments for Engineering System Development on Lightweight Helmet (U), 29 September 1966, CONFIDENTIAL.

3. AMMRC AB1-80, Heat Treatable Dual Hardness Steel Armor (U), 15 February 1967, SECRET.

4. AMMRC AB1-88, Transparent Armor Materials Technology (U), 14 June 1967, SECRET.

5. AMMRC AB1-108, Armor Materials R&D Review (U), 25 January 1968, SECRET.

6. AMMRC AB1-116, The Ballistic Performance of Potential Transparent Armor Materials (U), 20 May 1968, CONFIDENTIAL.

7. AMMRC AB1-125, Armor Materials R&D Review (U), September 1968, CONFIDENTIAL.

8. AMMRC AB1-150, Terminal Ballistic Tests with Soviet 7.62MM Ball and API Projectiles Impacting Various Lightweight Armor Materials (U), 21 March 1969, CONFIDENTIAL.

9. AMMRC TR 69-17, Summary of Terminal Ballistic Data on Lightweight Armor Materials (U), July 1969, AD 504360L, CONFIDENTIAL.

10. AMSAA TM 46. Analysis of Combat Damage on U.S. Army UH-1 Helicopter in Vietnam (1965 and 1966) (U) August 1969, AD 505430, CONFIDENTIAL.

11. AVLABS 64-57, Environmental Ballistic Evaluation of HFC Armor for CH-34 Helicopter (U), CONFIDENTIAL, March 1965, AD 362956.

12. AVLABS 66-5, Feasibility of Armor Material as Basic Aircraft Structure, March 1966, AD 631467.

13. AVLABS 66-14, Optimization of Armor Protection for Army Aircraft Aircrews (U), CONFIDENTIAL, March 1966, AD 371961.

14. AMMRC MS 69-02, Proceedings of Symposium on Lightweight Armor Materials (U), AD 504302L, April 1969, CONFIDENTIAL.

15. AVLABS 66-92, Ballistic Resistant Aircraft Components (U), February 1967, AD 380550L, CONFIDENTIAL.

16. 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.

17. AVLABS 66-91, Aircrew Survival Capsules for Future Army Aircraft (U), April 1967, AD 381318L, CONFIDENTIAL.

18. AVLABS 67-2, Study and Design of Armored Aircrew Crash Survival Seat (FOUO), March 1967, AD 812994L.

19. AVLABS 67-49, Reduction of Hazard from Secondary Fragments Created by Ballistic Pentration of Aircraft, October 1967, AD 665656.

20. AVLABS 67-78, Dynamic Effects of Caliber 0.50 Projectile Impact on Armor and Support Structures, March 1968, AD 39130IL.

21. AVLABS 68-51, An Evaluation of Armored Aircrew Crash Survival Seats, July 1968, AD 841794L.

22. AVLABS 69-15, Manufacturing Technology - Dual Property Steel Armor for Aircraft Components, April 1968, AD 854769.

23. AVLABS 69-52, Ballistic Test and Evaluation of Formed Sections of Heat Treatable Dual-Property Steel Armor (U), June 1969, AD 503387L, CONFIDENTIAL.

24. AVSCOM 66-4, Aircraft Armor Design Data (U), December 1966, Chapter 2, Armor Material Evaluation, (U) AD384769, SECRET. Chapter 3, Critical Component Analysis, (U) AD384770, CONFIDENTIAL. Chapter 4, Encounter Vulnerability, (U) AD384771, CONFIDENTIAL. Chapter 5, Armor Kit Evaluation, (U) AD384772, CONFIDENTIAL. Chapter 6, Lightweight Armor Objectives, AD 384773.

25. BAL TR-65 (Ballistic Analysis Laboratory), The Characteristics of Particle Formed During the Perforation of Aluminum Alloy by Steel Fragments (U), August 1967, AD384694, CONFIDENTIAL.

26. BAL TR-66, The Resistance of Steel Targets to Perforation by Small Caliber Armor-Piercing Projectiles, (U) April 1968, AD 389744, CONFIDENTIAL.

27. BAL TR-70, The Resistance of Aluminum Alloy Targets to Perforation by Small-Caliber, Armor-Piercing Projectiles, (U) January 1969, AD 395838, CONFIDENTIAL.

28. BRL TR 733, Passive Defense of Aircraft (U), August 1960, AD 376935, CONFIDENTIAL.

29. BRL TR 1151, Passive Protection of Aircraft (U), October 1961, AD 327015, CONFIDENTIAL.

30. BRL TM 1496, Reduction of Army Aircraft Vulnerability (U), August 1963, AD 345047, CONFIDENTIAL.

31. Frankford Arsenal 67-7-1, High Strength Aluminum Armor Composites, August 1966.

32. HEL TM 18-69, Armor Systems Development/Evaluation Guidelines,September 1969,

33. NATICK 67-44-CM, Development of Transparent Armor System for Aircraft (U), December 1966, AD____, CONFIDENTIAL.

C. NAVY

1. NAVAIR 00-25-524, Guide to the Reduction of Aircraft Vulnerability (U), March 1962, CONFIDENTIAL.

2. NWL Confidential Rpt AR-116, Military Specification Program Plan for Ceramic Armor to Defeat 14.5mm API Projectiles (U) October 1971.

3. NWL Confidential Rpt TR-2394, Armor Ballistic Data Handbook (U) March 1970.

4. NWL Confidential Rpt TR-2533, Program Plan for Development of an Aircraft Armor System to Defeat 14.5mm API Projectiles (U) February 1971.

5. NWL Confidential Rpt TR-2534, Aircraft Armor for Protection Against 14.5mm Anti-Aircraft Projectiles: First Interim Report (U) January 1971.

6. NWL Unclassified Rpt TR-2574, Personnel Armor Handbook June 1971.

7. NWL Confidential Rpt TR-2633, Aircraft Armor for Protection Against 14.5mm Anti-Aircraft Projectiles: Second Interim Report (U) October 1971.

8. NWL Confidential Rpt TR-2673, Projection of Navy Armor RDT&E Program for Protecting Against the Conventional Weapon Threat (U) February 1972.

9. NADC-AW-6607, Methodology for Determining Efficient Armor for Military Aircraft, 15 August 1966, AD 809030L.

D. OTHER

1. Bell Helicopter No. 209-099-085, Analysis of Increase of Obliquity Angle from Normal, Due to Airframe Structure for the Design of Seats (U), June 1966, CONFIDENTIAL.

2. Ballistic Splash Analysis of Dual Property Steel Armor, Philco Aeroneutronic No. S-3442.

3. Design Study of Lightweight Armored Helicopter Seats Incorporating Crash Attenuation Supports, (U) of 29 January 1970, The Budd Company, Systems Technology Div., Fort Washington, PA.

APPENDIX III

TABLE I - BODY ARMOR INFORMATION

ITEM OF EQUIPMENT NOMENCLATURE & SPECIFICATION	IDENTIFICATION STOCK NUMBERS	LEVEL OF PROTECTION	PRIMARY MATERIALS	APPROXIMATE WEIGHT (Lbs)
Armor, Body, Aircrewman, Small Arms Protective, Front Plate with Carrier LP/P. DES. 5-71	8470-935-3183 - Short 8470-935-3184 - Regular 8470-935-3185 - Long	.30 Cal AP at 100 yds range and 0° obliquity	Ceramic Composite Armor (alumina oxide) Class 1	Small - 13 lbs Regular - 14 lbs 3 oz. Long - 16 lbs 8 oz.
Armor, Body, Aircrewman, Small Arms Protective, Front & Back Plate with Carrier LP/P. DES. 5-71	8470-935-3192 - Short 8470-935-3193 - Regular 8470-935-3194 - Long	Same as above	Same as above	Small - 24 lbs 9 oz. Regular - 28 lbs 8 oz. Long - 34 lbs 2 oz.
Armor, Body, Fragmentation Protective, Vest with 3/4 Collar MIL-B-12370(GL)	Without Plastic Stiffeners 8470-823-7370 - Small 8470-823-7371 - Medium 8470-823-7372 - Large	.22 Cal. 17 grain fragment simulator V50-1250 ft/sec.	Cloth, Ballistic Nylon - Spec. MIL-C-12369	Small - 7 lbs 13 oz Medium - 8 lbs 11 oz Large - 9 lbs 5 oz X-Large - 10 lbs 3 oz
	With Plastic Stiffeners 8470-122-1299 - Small 8470-122-1300 - Medium 8470-122-1301 - Large 8470-122-1302 - X-Large	.22 Cal. 17 grain fragment simulator V50 1250 ft/sec.		Small - 8 lbs 5 oz Medium - 9 lbs 2 oz Large - 9 lbs 13 oz X-Large - 10 lbs 11 oz
Armor, Body, Fragmentation Protective, Titanium/Nylon Vest - MIL-A-43197(GL)	8470-965-4772 - Small 8470-965-4773 - Medium 8470-965-4774 - Large		Cloth, Ballistic Nylon - Spec. MIL-C-12369 & MIL-T-9046C	Small - 8 lbs 1 oz Medium - 9 lbs 11 oz Large - 9 lbs 4 oz

APPENDIX III
TABLE I - BODY ARMOR (cont'd)

ITEM OF EQUIPMENT NOMENCLATURE & SPECIFICATION	IDENTIFICATION STOCK NUMBERS	LEVEL OF PROTECTION	PRIMARY MATERIALS	APPROXIMATE WEIGHT (Lbs)
Armor, Body, Fragmentation Protective (For the Groin)	8470-753-6110 - Size 28 8470-753-6111 - Size 30 8470-753-6112 - Size 32 8470-753-6113 - Size 34 8470-753-6114 - Size 36 8470-753-6115 - Size 38 8470-753-6116 - Size 40 8470-753-6117 - Size 42	.22 Cal. 17 grain fragment simulator V50 - 1250 ft/sec.	Cloth, Ballistic Nylon - Spec. MIL-C-12369	Average weight - 4 lbs.
Helemt Flyer: Crash Type Glass Outer Shell 06-106 (SPH-4) LP/DES. 53-70	8415-144-4981 - Regular 8415-144-4985 - X-Large	None (Crash protection only)	Fibreglass & Resin Polystyrene	3 lbs.
Body Armor, Aircrewman, Fragmentation - Small Arms Protective for Crew Chief & Gunner, Front & Back Protection LP/P. DES. 5-71	8470-450-3698 - Short 8470-450-3699 - Regular 8470-450-3700 - Long	.30 Cal. AP at 100 yds range & 0° obliquity for ceramic plate & .22 cal. 17 grain fragment simulator V50-1250 ft/sec. for Vest	Class 1 Ceramic Composite Armor - Alumina Oxide with Cloth, Ballistic Nylon(Nylon 128)	Short - 30 lbs 3 oz. Regular - 34 lbs 3 oz. Long - 39 lbs 8 oz.
Gunner - Crew Chief As Above	8470-450-3704 8470-450-3705 8470-450-3706	Same as above	Utilizing Boron Carbide Ceramic Material, Class 3	Short - 25 lbs 4 oz. Regular - 27 lbs 9 oz. Long - 31 lbs 1 oz.

APPENDIX III
TABLE I - BODY ARMOR (cont'd)

ITEM OF EQUIPMENT NOMENCLATURE & SPECIFICATION	IDENTIFICATION STOCK NUMBERS	LEVEL OF PROTECTION	PRIMARY MATERIALS	APPROXIMATE WEIGHT (Lbs)
Body Armor, Aircrewman, Fragmentation - Small Arms Protective for Pilot-Copilot, Front Protection Only LP/P. DES. 5-71	8470-450-3713 - Short 8470-450-3714 - Regular 8470-450-3715 - Long	.30 Cal. AP at 100 yrs range & 0° obliquity for ceramic plate and .22 cal. 17 grain fragment simulator V50-1250 ft/sec. for Vest	Class I Ceramic Composite Armor - Alumina Oxide with Cloth, Ballistic Nylon (Nylon 128)	Short - 14 lbs 5 oz. Reg. - 15 lbs 12 oz. Long - 18 lbs 8 oz.
Pilot - Copilot As Above	8470-450-3719 8470-450-3720 8470-450-3721	Same as above	Utilizing Boron Carbide Ceramic Material, Class 3	Short - 11 lbs 8 oz. Reg. - 12 lbs 3 oz. Long - 14 lbs

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity.

SPECIFICATION

ORGANIZATION	CITY AND STATE

CONTRACT NO	QUANTITY OF ITEMS PROCURED	DOLLAR AMOUNT
		$

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO IF "YES", IN WHAT WAY?

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

SUBMITTED BY *(Printed or typed name and activity)*	DATE

DD FORM 1 OCT 64 1426