MIL-STD-1288
Notice-2
30 August 1974

MILITARY STANDARD

AIRCREW PROTECTION REQUIREMENTS

NONNUCLEAR WEAPONS THREAT

TO ALL HOLDERS OF MIL-STD-1288.

1. THE FOLLOWING PAGES OF MIL-STD-1288 HAVE BEEN REVISED AND SUPERSEDE THE PAGES LISTED:

NEW PAGE	DATE	SUPERSEDED PAGE	DATE
3	29 September 1972	Reprinted without change	
4	30 August 1974	4	29 September 1972
5	29 September 1972	Reprinted without change	
6	30 August 1974	6	29 September 1972
7	30 August 1974	7	29 September 1972
8	30 August 1974	8	29 September 1972
9	29 September 1972	Reprinted without change	
10	30 August 1974	10	29 September 1972

2. RETAIN THIS NOTICE PAGE AND INSERT BEFORE THE TABLE OF CONTENTS.

3. Holders of MIL-STD-1288 will verify that page changes indicated above have been entered. The notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the Military Standard is completely revised or cancelled.

Custodians:
Army -- AV
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Preparing activity:
Army -- AV
(Project 15GP-0006)

Review Activities
Army -- GL-TE
Navy -- MC
Air Force --

FSC 15 GP

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.

.37 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. Susceptibility 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 Design. The protection of aircrews against nonnuclear threats will be accomplished primarily through design. During preliminary layout and design of the aircraft, the aircrew members, structure, and components shall be so located that maximum shielding is provided the aircrew in the critical attack directions. Effective use of aircraft structure and components to shield the aircrew will reduce the added weight associated with armor system provisions. In new designs, aircrew protection system weight, excluding body armor, will be included in the aircraft empty weight.

5.1.1 (Deleted).

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

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

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, sidewalls, 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 associated 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 agress/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 specification, 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. (Deleted).

i. (Deleted).

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 5.3.2). 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.

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