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AUTHORITY

OACSFOR D/A ltr, 13 Sep 1973

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ARMY CONCEPT TEAM IN VIETNAM
APO SAN FRANCISCO 96384

DEPARTMENT OF THE ARMY
ARMY CONCEPT TEAM IN VIETNAM
APO San Francisco 96384

AIRCREW
PROTECTIVE ARMOR

DEPARTMENT OF THE ARMY
ARMY CONCEPT TEAM IN VIETNAM
APO San Francisco 96384

AVIB-CO

SUBJECT: Final Report - Aircrew Protective Armor

TO: Commanding General
United States Army Vietnam
ATTN: AVHGC-DST
APO 96375

1. Reference: Letter, AVHGC-DH, Headquarters, US Army Vietnam, 23 February 1967, subject: Letter of Instruction.

2. In accordance with the provisions of the foregoing reference, the attached final report is forwarded for review and transmittal to Department of the Army.

3. Request a copy of the USARV and CINCUSARPAC forwarding indorsements be furnished the Commanding Officer, Army Concept Team in Vietnam (ACTIV).

FOR THE COMMANDER:

1 Incl
as

F. A. KLEIN
CPT, AGC
Adjutant

AVHGC-DST (1 Feb 68)
SUBJECT: Final Report - Aircrew Protective Armor

HEADQUARTERS, UNITED STATES ARMY VIETNAM, APO San Francisco 96375 13 FEB 1968

TO: Commander in Chief, United States Army, Pacific, ATTN: GPOP-OT, APO 96558
✓Commanding Officer, Army Concept Team in Vietnam, APO 96384

Headquarters USARV concurs with the findings, conclusions, and recommendations contained in the attached report except to clarify in para 10 a(3) that crewchief and gunner seats are not equipped with armor back rest; therefore, the fire retardant mesh back (figure 3) is not appropriate for gunner and crewchief use. The vest with back and front plates (figure 2 and 3) is required for these crewmember's protection.

FOR THE COMMANDER:

Philip J. Lombardi 1st Lt

1 Incl
nc

JOHN V. GETCHELL
Captain, AGC
Assistant Adjutant General

DEPARTMENT OF THE ARMY
ARMY CONCEPT TEAM IN VIETNAM
APO San Francisco 96384

AVIB-AAD/SS

SUBJECT: Letter Report of Evaluation - Aircrew Protective Armor (ACA 55/67I)

TO: Commanding General
United States Army Vietnam
ATTN: AVHGC-DST
APO 96375

1. References:

a. Letter, ACTIV, subject: Aircrew Protective Armor, 1 March 1967, with 3 Incl.

b. USARV message, (U) AVHGC, 35350 JTTCO-ARCC, subject: Request for Assistance, dated 24 May 1967.

c. U. S. Army Natick Laboratory message, (U) 1322, subject: Request for Assistance of Natick Laboratory, dated 23 August 1967.

d. Letter, DA, OCRD, CRDCM, subject: Plan For Evaluation of Variable-Type Body Armor (U), dated 6 Nov 67.

2. Authority:

Letter, ACTIV, subject: Aircrew Protective Armor, 1 March 1967, w/3rd Ind, HQ USARV, AVHGC-DST, 14 May 1967.

3. Purpose:

The purpose of the evaluation was to determine if a new prototype aircrew protective armor is comfortable, does not interfere in the performance of required duties, and if struck by small arms fire provides adequate protection against ceramic spall.

4. Background:

a. The present aircrew protective armor consists of ceramic, fiberglass front, and back plates with carrier. This system provides protection against small arms fire, but will not contain ceramic spall when struck by high velocity projectiles.

b. Reference 1a requested US Army Natick Laboratories comments concerning the wearing of the body armor fragmentation vest over the ceramic plates and recommendations on how to reduce the distribution of spall.

c. The ACTIV request of reference 1a was a result of an ACTIV UH-1 aircraft being hit by ground fire. A projectile struck near the edge of the ceramic chest protector of the aircraft commander, shattered, and caused pieces of the projectile to ricochet from the armor and strike the aircraft commander (right seat) on the arm and the pilot (left seat) in the eye. Several fairly large pieces of spall also penetrated the plexiglass in the left door of the cockpit. Sharp cornered ceramic fragments from the shattered edge of the armor also caused minor injuries to the crew.

d. By 1st Indorsement to reference 1a, US Army Natick Laboratories advised ACTIV that for immediate relief to reduce or eliminate bullet splash and ceramic spall the body armor fragmentation protective vest should be worn over the aircrewman small arms protective armor. This procedure is now USARV policy.

e. Natick Laboratories further advised that the most satisfactory system would be one that eliminated all projectile splash and spall regardless of where the hit occurred on the armor and also provide bullet splash, ceramic spall, and aircraft structure spall protection to those areas of the torso not covered by the present items. Natick Laboratories stated that prototypes based on this approach were being fabricated and offered to make available a representative to hand carry twenty (20) of these prototypes to ACTIV for evaluation. ACTIV and USARV concurred in Natick Laboratories proposal by 2nd and 3rd Indorsements to reference 1a.

5. Description of Materiel:

a. The evaluation item consisted of a lightweight nylon felt-filled vest with collar which covers the lower neck, upper front and back of the torso to the waist line. Incorporated in the front and back of the vest are pockets containing the present aircrew armor ceramic/fiberglass plates. The pockets are made of four plies of ballistic nylon which cover the front and extend around the edges of the plate.

b. The vest weighs 8 lbs 9oz for a size regular, exclusive of the armor plates. The vest also incorporates a six ply ballistic nylon collar covered with NOMEX cloth. A shoulder adjustment and quick release snap fastener is incorporated on the right shoulder for emergency removal of the vest. The front flap closures are the same as those used on the current aircrew armor carrier.

c. US Army Natick Laboratories has stated that:

(1) The new aircrew protective armor will provide spall and fragment protection (V50-1100 FPS, 17GR FRAG SIMULATION) to the upper torso not covered by the small arms fire protective ceramic/fiberglass composite plate.

(2) The plates provide protection against 30 cal AP ammunition (100 yd range up to 0° obliquity).

(3) The ballistic nylon pockets containing the plates will substantially reduce projectile splash and ceramic spall from 0° to 60° hits on the armor in the central areas of the torso and from 0° to approximately 45° hits 1½ inches from the edge of the armor.

(4) Photographs of the vest with ceramic fiberglass plates being worn are attached (Figure 1).

6. Data Collection:

Data were collected by interviews and user comments.

7. Discussion:

a. Twenty sets of the evaluation items were delivered to ACTIV on 27 Sep 67. In accordance with the evaluation plan eight sets were delivered to the 114th Aviation Company, Vinh Long on 29 Sep 67, and 12 sets were delivered to the 334th Assault Helicopter Company, Binh Hoa, on 3 Oct 67.

b. Evaluating units were informed that the new aircrew protective armor was to be evaluated against the alternate current system of wearing the standard flak vest over the ceramic protective plates with standard carrier. Units were also informed that test items were to be worn by as many crews as practical within each unit.

c. As a result of discussions and user comments and observations during the evaluation the following information was obtained:

(1) The new aircrew protective armor is superior to the alternate current system of wearing the standard flak vest over the ceramic protective plates with carrier.

(2) The new aircrew protective armor is easier and quicker to put on and to take off than the alternate current system.

(3) It is also more comfortable, allows more freedom of movement, is lighter by approximately 2 lbs, and is not as bulky as the old system.

(4) The collar of the new aircrew protective armor, however, hinders head movement and has a tendancy to chafe the neck.

(5) The new aircrew protective armor is somewhat restrictive to aviators due primarily to the unnecessary flak protection provided the back and sides while seated in an armor protective seat.

(6) The quick release on the right shoulder of the new system makes it more difficult for the pilot (right seat) to remove the vest than would a quick release on the left shoulder. To remedy this condition, a quick release could be provided on both the right and left shoulder. This release would not only increase the ease of removal of the vest in an emergency, but also would provide the aviator the option of wearing only the front portion of the vest, if desired, in flight. To permit the aviator the flexibility of wearing only the front portion of the vest, a fire-retardant mesh back portion could be provided. The mesh back could be designed to fasten to the front portion utilizing the same quick release principle now incorporated in the vest. The mesh back could incorporate the same front flap closures as the vest (Figure 1).

(7) Further reduction of projectile splash and ceramic spall could possibly be obtained by incorporating a layer of ballistic felt in the pockets containing the ceramic fiberglass plates.

8. Findings:

a. Comfort

(1) The aircrewman can perform required duties without undue discomfort or interference from the new aircrew protective armor.

(2) The collar of the new aircrew protective armor hinders head movement, has a tendency to chafe the neck, and therefore should be removed.

(3) The new aircrew protective armor is somewhat restrictive to aviators due mainly to the unnecessary flak protection provided on the back and sides while seated in an armor protective seat.

(4) The quick release on the right shoulder of the new aircrew protective armor makes it more difficult for the pilot (right seat) to remove the vest than would a quick release on the left shoulder.

(5) The new aircrew protective armor is lighter, more comfortable, and allows more freedom of movement than the alternate current system.

(6) The new aircrew protective armor is not as bulky and is easier to put on and take off than the alternate current system.

b. Protection

There was no incident during this evaluation which permitted a determination as to whether the new aircrew protective armor gives added protection to the wearer by retaining spall and preventing injuries from flying spall.

9. Conclusion:

The new aircrew protective armor developed by US Army Natick Laboratories satisfies the requirements for an aircrew armor system for use in RVN and is superior to the alternate current system of wearing the standard flak vest over the ceramic protective plates with carrier.

10. Recommendations:

a. The new aircrew protective armor, modified as follows, should replace the alternate current system.

(1) Remove collar of vest

(2) Add a quick release device on the left shoulder of vest.

(3) Incorporate a fire retardant mesh back of the variable-armor design, for wear by aviators in flight (Figure 3).

b. If there are no significant, associated problems, incorporate a layer of ballistic felt in the new aircrew protective armor pockets which contain the ceramic/fiberglass plates.

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J Elmore Swenson

J ELMORE SWENSON
Colonel, Artillery
Acting Commander

FIGURE 1 - FRONT VIEW

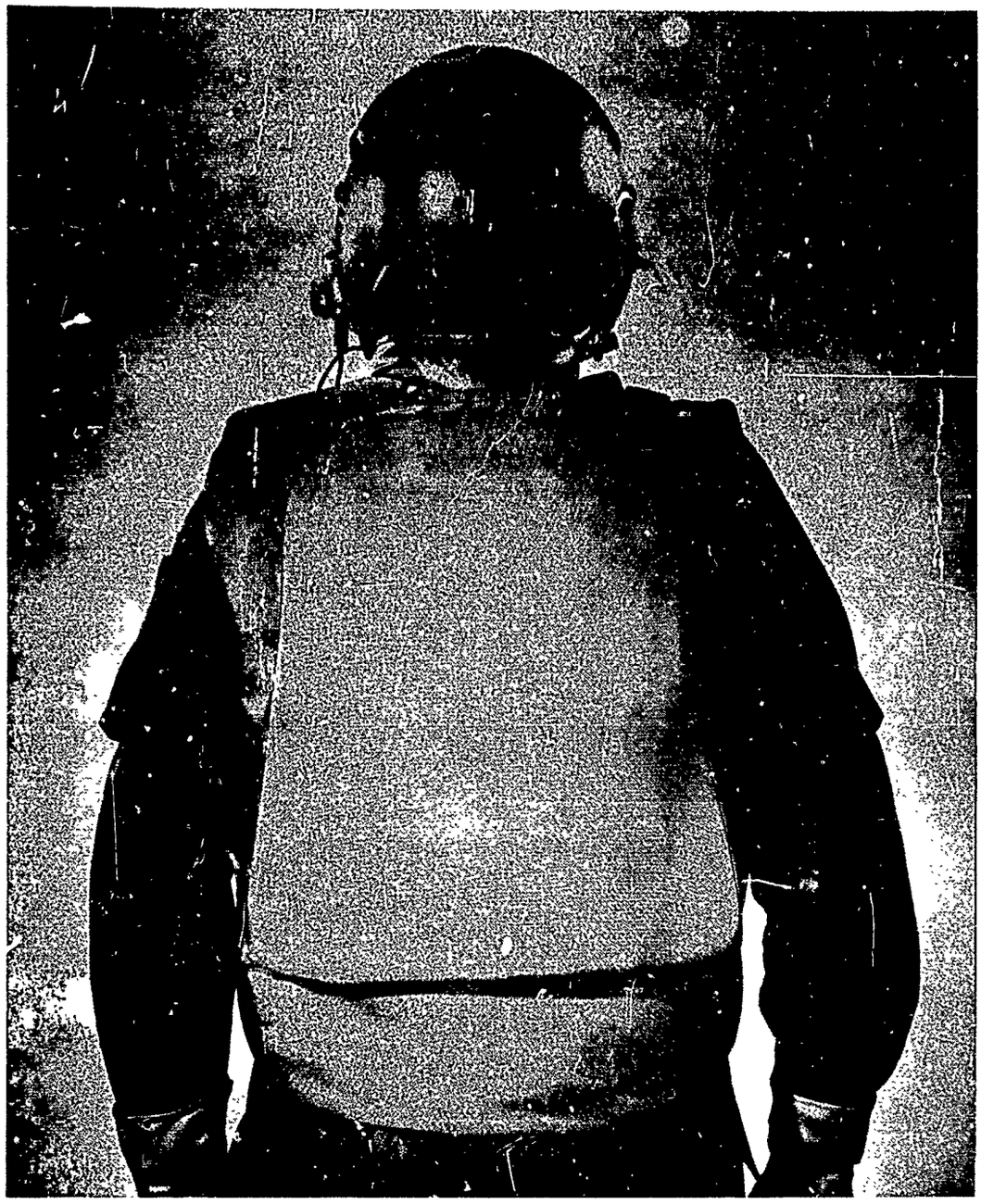

FIGURE 2 - REAR VIEW

FIGURE 3 - FIRE RETARDENT MESH BACK (PROPOSED)

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY United States Army Natick Laboratory Natick, Massachusetts

13. ABSTRACT

The present aircrew armor will not contain the bullet splash nor the spall when struck by a projectile. Natick Laboratory designed and fabricated a nylon felt filled vest to carry the ceramic, fiber glass plates. Natick Laboratory tests confirmed the credibility of design. The Army Concept Team in Vietnam (ACTIV) evaluated the items to determine if the equipment was comfortable and would not interfere with performance of crew duties. The item was found to be satisfactory with a few minor modifications.

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