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TECHNICAL REPORT
70-19-AD

EMERGENCY RESCUE PARACHUTES IN HELICOPTERS

by
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Project Reference:
1F162203-D195

July 1969

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FOREWORD

This report is the result of the study requested by the U. S. Army Materiel Command to determine problems with standard Army emergency rescue parachutes when used by aviators of rotary wing aircraft and to establish a suitable course of action to alleviate any problems. Results of an evaluation of aircrew protective armor compatibility with emergency rescue parachutes and overwater survival kit have been included as being pertinent to the findings of the study.

This work was conducted under Project No. 1F162203-D195, Exploratory Development of Airdrop Systems.

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ABSTRACT

The study performed was an evaluation of present emergency rescue parachutes in Army helicopters, to determine problems and establish a suitable course of action to alleviate problems. An Army helicopter investigation was conducted with each emergency rescue parachute to determine compatibility with cockpit geometry and seat design. The study revealed that present emergency rescue parachutes are not compatible with all Army helicopters and will not be with future aircraft unless significant changes are made in cockpit geometry, seat configuration and parachute design. The use of aircrew protective armor with emergency rescue parachutes and overwater survival kit is compatible and does not result in compromise to personnel safety during parachute opening, descent and landing. However, donning of the protective armor with present emergency rescue parachutes would only magnify the incompatibility of these parachutes with present Army helicopters.

EMERGENCY RESCUE PARACHUTES IN HELICOPTERS

1. INTRODUCTION

This report is a study done in response to a message from U. S. Army Materiel Command, dated 8 February 1968 which requested Natick Laboratories to determine problems with current standard US Army emergency type parachutes when used by aviators in rotary wing aircraft, establish a suitable course of action to alleviate such problems and establish criteria for procurement and stockage of a parachute that is acceptable to the aviators.

2. DISCUSSION

Within the Army, for some time, there has been considerable discussion and controversy on use of emergency rescue parachutes in helicopters.

At request of the Quartermaster General, May 1962, a study was conducted to determine feasibility of use of parachutes in helicopters. The study concluded that the use of a parachute for emergency bailout was feasible under autorotational conditions.⁽²⁾ A parachute was even more feasible during catastrophic type accidents as it provided the only possible means of survival. It was also concluded that helicopters should be equipped with parachutes for all flights above 500 feet rather than the present 1500 feet altitude. Information obtained from the US Army Board for Aviation Accident Research for a fourteen month period (15 Jun 66 - 15 Aug 67), indicates that eight catastrophic failures (19 fatalities) and five mid-air collisions (16 fatalities) of helicopters took place at altitudes where parachutes could have been used in the helicopter.

A number of case histories of successful bailouts from helicopters have been recorded.⁽³⁾

The present policy of use of parachutes in Army helicopters is covered by AR 95-1 "Army Aviation - General Provisions," 6 March 1964.

With the exception of observation-type helicopters, occupants of Army aircraft will be equipped with parachutes on all flights; however, major commanders are authorized to waive this requirement for:

"1. Multiengine aircraft used in personnel carrier operations when the aircraft has reliable single engine performance at all stages of the mission profile.

"2. All aircraft during normal transport operations when carrying patients, children, and other persons who cannot be fitted by parachutes.

"3. All utility and transport helicopter flights other than test flights or extended flights above 1500 feet altitude over terrain not suitable for autorotational landing.

"4. Troop lift operations in Army aircraft when combat equipment or flight conditions would render emergency escape from the aircraft by parachute impracticable."

An Equipment Improvement Recommendation (EIR) submitted by the U.S. Army Aviation Test Board (USAAVNTBD), Ft. Rucker, Alabama focused attention on the problem involved with use of standard Army back type emergency rescue parachute when worn on mission profiles in the UH-1D and CH-47 helicopters. Test pilots reported discomfort during flights while wearing this parachute. Discomfort was attributed to the size (primarily thickness) and weight of the parachute and the restricted movements of pilots while wearing the parachute. USAAVNTBD found that the pilots' comfort was increased when the standard Army back type emergency parachute was replaced with the Navy NB-6 thinpack parachute. An Equipment Improvement Recommendation suggested that an evaluation be conducted to determine the feasibility of replacing standard Army back with thinpack parachute on all rotary wing aircraft flights which require use of parachute. As a result of evaluation of the above EIR's and a request from U. S. Army Aviation Systems Command for type classification and procurement data packages on the Navy NB-6 and NB-8 parachutes, the US Army Natick Laboratories (NLABS) recommended that Army requirements for emergency rescue parachutes be reviewed in light of current standard parachutes and user problems related to their use with present and future Army aircraft. It was also recommended that any decision to adopt Navy parachutes, re-classify existing standard Army parachutes or develop new parachute designs be based upon such a review.

Based on these recommendations, a study was conducted to determine problems with current standard Army emergency rescue parachute when used by rotary wing aviators and establish a suitable course of action to alleviate such problems.

A meeting was held in March 1968 between representatives of the U. S. Army Board for Aviation Accident Research, U. S. Army Aviation Systems Command, U. S. Army Airborne Electronics & Special Warfare Board, U. S. Army Aeromedical Research Unit, U. S. Army Aviation Center, U. S. Army Aviation School, U. S. Army Combat Developments Command Aviation Agency and the U. S. Army Natick Laboratories to discuss the problems on use of emergency rescue parachutes in helicopters. As a result of this meeting the following actions were taken:

1. NLABS prepared and coordinated with interested agencies proposed change to AR 95-1, intended to clarify what flights require the use of a parachute.

2. NLABS initiated a letter to the U. S. Army Combat Developments Command requesting appropriate action be taken to review the present and/or planned use of parachutes in helicopters, determine whether or not a valid requirement exists and, if so, the exact nature of the requirement. The reply from CDC stated that no requirement exists for use of parachutes in Army helicopters other than a limited requirement for test activities.⁽⁴⁾

3. NLABS conducted an aircraft compatibility investigation to determine degree of compatibility of the Navy NB-6 and NB-8 modified with the standard Army adjustable harness with canopy releases, and the standard Army emergency rescue back and chest parachutes with cockpit geometry and seat configuration.

a. Aircraft Included in Investigation

<u>Popular Name</u>	<u>Designation</u>
Iroquois	UH-1A, UH-1B, UH-1D
Cobra	AH-1B
Cayuse	OH-6A
Sioux	OH-13E, OH-13T
Chickasaw	UH-19D
Shawnee	CH-21C
Raven	OH-23D, OH-23G
Chocktaw	CH-34C
Mojave	CH-37B
Chinook	CH-47A, CH-47B
Tarhe	Ch-54A

b. Aircraft Compatibility with Emergency Rescue Parachutes:

(1) A check-out of the Navy NB-6 and NB-8 parachutes and the Army emergency rescue back and chest parachutes was conducted at the Naval Air Station, Lakehurst, New Jersey and Fort Rucker, Alabama with the present Army helicopters, as well as any helicopters considered to be sufficiently developed to be of immediate concern. This check-out was conducted to determine any interface problems concerning seat configuration and cockpit geometry.

(2) The parachutes were worn (with exception of chest type for which only the harness was worn*) in each helicopter: (a) with the back cushion out, if removable, and (b) with the seat in its extreme rearward movement.

*NOTE: (Chest parachute, can by means of snaps, be readily attached to the harness, permitting only the harness to be worn until use of parachute is required).

(3) An individual of the 90% percentile wore the parachutes and was strapped into the pilot's seat to determine if the cyclic stick could be brought to a full stop and whether or not overhead circuit breakers and instrument panel could be reached without difficulty. All observations were made while helicopter was on the ground. No mission profiles were flown.

c. Results of Investigation:

Iroquois (UH-1A, UH-1B, UH-1D)

The seats and pedals are adjustable on each model. On the UH-1A and UH-1B back cushions are removeable; however the UH-1D has a contoured seat without removeable back cushion.

NB-6: Individual was able to bring cyclic stick to full stop and reach overhead circuit breakers and instrument panel of the UH-1A and UH-1B. Individual had some difficulty when in contour seat of UH-1D.

NB-8: Individual was unable to bring cyclic stick to full stop or reach overhead circuit breakers on all models.

Standard Army Back: Individual was unable to bring cyclic stick to full stop or reach overhead circuit breakers on all models.

Standard Army Chest: Harness can be worn separately and chest parachute stored where it is readily accessible when needed under seat.

Cobra (AH-1B)

The seats are not adjustable. Pedals are adjustable. Back cushions are removeable.

NB-6, NB-8 and Standard Army Back cannot be worn due to extremely limited space within the cockpit. There is no space to store the chest parachute even though the harness may be worn.

Cayuse (OH-6A)

The seats are not adjustable. Pedals are adjustable. Back cushions are not removeable.

NB-6, NB-8 and Standard Army Back cannot be worn due to extremely limited space within the cockpit. There is no space to store the chest parachute in the forward compartment, even though harness may be worn.

Sioux (OH-13E, OH-13Y)

The seats are not adjustable. Pedals are adjustable. Back cushions are removeable.

NB-6 and NB-8: Individual was able to bring cyclic stick to full stop and reach the instrument panel.

Standard Army Back: Individual was unable to bring cyclic stick to full stop.

Standard Army Chest may be stored in front of seat, however, may obstruct pedal movement during flight.

Chickasaw (UH-19D)

The seats are adjustable up and down. Pedals are adjustable. Back cushions are removeable.

NB-6, NB-8 and Standard Army Back: Individual was able to bring cyclic stick to full stop and reach the overhead circuit breakers and instrument panel.

Standard Army Chest may be stored where it is readily accessible when needed.

Shawnee (CH-21C)

The seats are adjustable up and down. Pedals are adjustable. Back cushions are removeable.

NB-6, NB-8 and Standard Army Back: Individual can bring cyclic stick to full stop and reach overhead circuit breakers and instrument panel.

Standard Army Chest may be stored where it is readily accessible when needed.

Raven (OH-23D, OH-23G)

The seats are not adjustable. Pedals are adjustable. Back cushions are not removeable.

NB-6: Individual was able to bring cyclic stick to full stop and reach instrument panel in OH-23G. Individual was unable to bring cyclic stick to full stop in OH-23D.

NB-8 and Standard Army Back: Individual was unable to bring cyclic stick to full stop.

Standard Army Chest cannot be stored due to limited space in cockpit.

Choctaw (CH-34C)

The seats are adjustable up and down. Pedals are adjustable. Back cushions are removeable.

NB-6, NB-8 and Standard Army Back: Individual was able to bring cyclic stick to full stop and reach overhead circuit breakers and instrument panel.

Standard Army Chest can be stored where it is readily accessible when needed.

Mojave (CH-37B)

The seats are adjustable up and down. Pedals are adjustable. Back cushions are removeable.

NB-6 and NB-8: Individual was able to bring cyclic stick to full stop and reach instrument panel. Individual had some difficulty reaching overhead circuit breakers.

Standard Army Back: Individual was unable to reach overhead circuit breakers.

Standard Army Chest can be stored where it is readily accessible when needed.

Chinook (CH-47A, CH-47B)

The seats are adjustable. Pedals are adjustable. Back cushions are removeable.

NB-6 and NB-8: Individual was able to bring cyclic stick to full stop and reach overhead circuit breakers and instrument panel.

Standard Army Back: Individual was unable to bring cyclic stick to full stop or reach overhead circuit breakers.

Standard Army Chest can be stored where it is readily accessible when needed.

Tarhe (CH-54A)

The seats are adjustable. Pedals are adjustable. Back cushions are removeable.

NB-6, NB-8 and Standard Army Back: Individual was able to bring cyclic stick to full stop and reach overhead circuit breakers and instrument panel.

Standard Army Chest can be stored where it is readily accessible when needed.

c. SUMMARY OF HELICOPTER/PARACHUTE COMPATIBILITY INVESTIGATION

HELICOPTER MODEL	PARACHUTES			
	ARMY STD BACK	ARMY STD CHEST	NAVY NB-6	NAVY NB-8
Iroquois...				
UH-1A	NO	YES	YES	YES
UH-1B	NO	YES	YES	YES
UH-1D	NO	YES	NO	NO
Cobra...				
AH-1B	NO	NO	NO	NO
Cayuse...				
OH-6A	NO	NO	NO	NO
Sioux...				
OH-13E	NO	NO	YES	NO
OH-13T	NO	NO	YES	NO
Chickasaw...				
UH-19D	YES	YES	YES	YES
Shawnee...				
CH-21C	YES	YES	YES	YES
Raven...				
OH-23D	NO	NO	NO	NO
OH-23G	NO	NO	YES	NO
Choctaw...				
CH-34C	YES	YES	YES	YES
Mojave...				
CH-37B	NO	YES	YES	YES
Chinook...				
CH-47A	NO	YES	YES	YES
CH-47B	NO	YES	YES	YES
Tarhe...				
CH-54A	YES	YES	YES	YES

YES = Parachute Compatible

NO = Parachute Incompatible

Compatibility of Aircrew Protective Armor and Emergency Rescue Personnel Parachutes (Appendix II) A compatibility evaluation of aircrew protective armor with emergency rescue personnel parachutes requested by NLABS was conducted by the Naval Aerospace Recovery Facility 20 August - 20 November 1968. A program of 98 tests was conducted successfully. Conclusions were that the protective armor is compatible with the US Army parachute harness, back-type and chest-type assembly. It also concluded that wearing of the protective armor does not compromise personnel safety during exit from C-47 aircraft, parachute opening, descent or landing. However, even though aircrew protective armor and emergency rescue parachutes are compatible, donning of this equipment and trying to get into or out of Army helicopters would only magnify the equipments incompatibility with present cockpit geometry and seat design of Army helicopters.

3. CONCLUSIONS

Use of an emergency rescue parachute has been found in actual field use to be feasible for emergency bailout from a helicopter under autorotational conditions and during catastrophic-type accidents as a means of survival.

The present standard Army back and chest emergency rescue parachute as well as the proposed replacements, the Navy NB-6 and NB-8 are not compatible with all Army helicopters. A number of Army helicopters such as the Cobra, Cayuse, and the Cheyenne have no capability whatsoever to support the use of any of the present emergency rescue parachutes.

Aircrew protective armor is compatible with the US Army parachute harness, back-type and chest-type assemblies, and overwater survival kit. Wearing the aircrew protective armor does not compromise personnel safety during parachute opening, descent and landing. However, wearing of protective armor and an emergency rescue parachute in Army helicopters would only magnify the incompatibilities with cockpit geometry, and seat and parachute design which have been found to exist in Army helicopters.

The problem of use of emergency rescue parachutes in helicopters will not be resolved until necessary attention is given to in-flight emergency escape requirements in the aircraft design, so that, if an emergency rescue parachute system is feasible, a cockpit geometry and seat design will be provided that is compatible to the system.

4. RECOMMENDATIONS

AR 95-1 should be changed to reflect that, with exception of observation-type helicopters, occupants of Army aircraft will be equipped with parachutes on all flights; however, major commanders are authorized to waive this requirement for--

All utility and transport helicopter flights, with exception of:

- a. Test flights
- b. Extended flights above 500 feet altitude over terrain not suitable for autorotational landings, or if instrument flight condition is anticipated.

As an interim improvement to the problem the most compatible available parachute is the NB-6 modified which should be used until significant aircraft and parachute compatibility can be attained through modification of cockpit geometry, and seat and parachute design; and/or development of a new parachute emergency escape system for helicopters.

Action should be taken to define the requirements for helicopter escape systems for future generations of this type of aircraft to provide a basis for exploratory research and development into such systems based upon the current and anticipated immediate future emergency escape system technology.

REFERENCES

1. AR 95-1, Army Aviation - General Provisions, 6 March 1964.
2. "Parachutes in Helicopters", Air Delivery Equipment Division, US Army Natick Laboratories, December 1963.
3. "A Chance to Live", Army Aviation Digest, October 1967.
4. CDCMR-O, US Army Combat Developments Command, 31 July 1968, Subject: "Use of Parachutes in Army Helicopters."

APPENDIX I

C O P Y

U. S. NAVAL AEROSPACE RECOVERY FACILITY
El Centro, California 92243

In Reply Refer To: 1
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Ser 185
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From: Commanding Officer, Naval Aerospace Recovery Facility
To: Commanding General, U. S. Army Natick Laboratories (Code
AMXRE-APE), Natick, Massachusetts 01760

Subj: Compatibility Evaluation of Air Crew Protective Armor;
preliminary report on

Ref: (a) U.S. Army Natick Laboratories ltr AMXRE-APE of
10 April 1968, Engineering Evaluation of Compatibility
of Air Crew Armor and Emergency Rescue Personnel
Parachutes

1. The Naval Aerospace Recovery Facility conducted Test Program No. 34-68 for determination of the compatibility of the subject protective armor with personnel parachute and survival systems in accordance with the reference (a) request. The program consisted of 98 tests in six phases and was accomplished during the period 20 August 1968 to 20 November 1968.

2. Tests were conducted utilizing U.S. Army equipment provided by U.S. Army Natick Laboratories. The test conditions and results of each phase are described as follows:

a. Phase I. Thirty-two tests were conducted from heights necessary to obtain 10 and 20g shock loads using a 40-foot high drop tower. The torso and articulated dummies were rigged with the U.S. Army parachute harness, and loads were measured by use of strain link transducers. Shock loads were sustained without damage and movement of the protective armor was negligible.

b. Phase II. Twenty-four tests, each test consisting of two front, two side and two back falls, were conducted by test parachutists from a 4-foot high training platform. The test parachutists were of various heights and weights and were equipped with the U.S. Army parachute harness and protective armor vests. No armor shift or discomfort due to wearing the armor vest was noted. No injuries were incurred and all test parachutists reported the protective armor vest acceptable for parachute landings.

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c. Phase III. Sixteen airdrop tests were conducted from a C-47 aircraft flying at 110 KIAS (knots indicated airspeed) and 1,000-ft. pressure altitude. The articulated dummies used were equipped with standard back-type or chest-type parachute assemblies and the protective armor vest. All tests were satisfactory with no detectable shift of the protective vest and the configuration was determined safe for use in live jump tests.

d. Phase IV. Sixteen live jump tests were conducted from a C-47 aircraft flying at 110 KIAS and 5,000 feet pressure altitude. During the first eight tests of this phase, the test parachutists were equipped with the standard U.S. Army back-type personnel parachute assembly and protective armor vests. The first two of the second group of eight tests were conducted using the standard U.S. Army chest-type personnel parachute assembly and protective armor vests. The remaining six tests were made with the U.S. Navy NC-3 chest-type parachute assembly and protective armor vests. The NC-3 assembly was substituted for the U.S. Army assembly to afford a greater degree of parachute canopy control during preparation for landing and its use is not considered to have compromised protective armor vest evaluation. The protective armor vest was reported to be comfortable to wear, did not interfere with parachuting procedures and had negligible movement throughout conduct of all tests. In several instances the parachute harness chest strap slipped up and over the front armor plate but did not cause discomfort or result in injury.

e. Phase V. Four flotation tests were conducted to determine effect of the additional weight of protective armor vest on flotation capability and characteristics of the LPU-2P underarm life preserver. Two test subjects weighing 150 and 210 pounds, respectively, were equipped with parachute harness assemblies, protective armor vests, U.S. Army overwater survival kits, and LPU-2P life preservers. Parachutists entered the water in various body attitudes from a 3-foot high dock with the LPU-2P life preservers inflated. Flotation was considered to be satisfactory in all instances. The survival kit created additional buoyancy, but it tended to raise the hips and it was determined imperative that the LPU-2P bladders be secured to each other after inflation to insure that the wearer's face remain above the water surface.

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f. Phase VI. Six live jump tests were conducted with water landings in the Salton Sea. Test parachutists equipped with standard U.S. Army back-type personnel parachute assemblies, overwater survival kits, LPU-2P life preservers and protective armor vests exited from a C-47 aircraft flying at 110 KIAS and 5,000 feet pressure altitude. The survival kit life raft was deployed during parachute descent. No discomfort or armor shift was reported during parachute descent and water entry; the LPU-2P life preservers provided adequate flotation. Boarding the raft was reported to be difficult in four instances and was not accomplished in the other two. Difficulty in boarding was attributed to lack of raft rigidity and entanglement with the parachute suspension lines, coupled with some reduction in personal mobility because of inflated LPU-2P preservers and the armor vest. It was not possible for the larger men to board their rafts when contending with waves approximately 2-feet high.

3. It is concluded that:

a. The protective armor vest is compatible with the U. S. Army parachute harness, back-type and chest-type parachute assemblies, and overwater survival kit utilized during conduct of this test program.

b. Wearing the protective armor vest does not result in compromise to personnel safety during aircraft exit, parachute descent and landing on land or in water.

c. The LPU-2P provides adequate flotation when both bladders are inflated fully and secured together.

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UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D		
(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)		
1. ORIGINATING ACTIVITY (Corporate author) Airdrop Engineering Laboratory US Army Natick Laboratories Natick, Massachusetts 01760		2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED
		2b. GROUP
3. REPORT TITLE Emergency Rescue Parachutes in Helicopters		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)		
5. AUTHOR(S) (First name, middle initial, last name) Major James W. Wolff		
6. REPORT DATE July 1969	7a. TOTAL NO. OF PAGES 14	7b. NO. OF REFS 4
8a. CONTRACT OR GRANT NO.	8b. ORIGINATOR'S REPORT NUMBER(S) 70-19-AD	
b. PROJECT NO. 1F162203-D195		
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
d.		
10. DISTRIBUTION STATEMENT This document has been approved for public release and sale; its distribution is unlimited.		
11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY US Army Natick Laboratories Natick, Massachusetts 01760	
13. ABSTRACT The study performed was an evaluation of present emergency rescue parachutes in Army helicopters to determine problems and establish a suitable course of action to alleviate problems. An Army helicopter investigation was conducted with each emergency rescue parachute to determine compatibility with cockpit geometry and seat design. The study revealed that present emergency rescue parachutes are not compatible with all Army helicopters and will not be with future aircraft unless significant changes are made in cockpit geometry, seat configuration and parachute design. The use of aircrew protective armor with emergency rescue parachutes and overwater survival kit is compatible and does not result in compromise to personnel safety during parachute opening, descent and landing. However, donning of the protective armor with present emergency rescue parachutes would only magnify the incompatibility of these parachutes with present Army helicopters.		

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