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ARMED AND ARMORED CHINOOK SAFETY-RELEASE AND WEAPON-VERIFICATIO--ETC(U)
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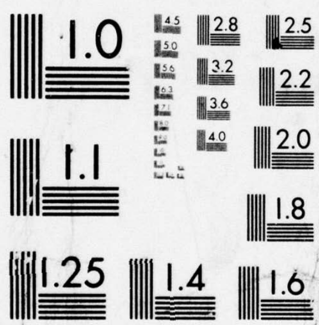

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NATIONAL BUREAU OF STANDARDS-1963-A

DEPARTMENT OF THE ARMY
UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama 36360

STEBG-TD

24 MAR 1966

SUBJECT: Letter Report, Armed and Armored Chinook Safety-Release and Weapon-Verification Testing, USATECOM Project No. 4-5-2010-07

(16) USATECOM-4-5-2010-07 (12) 21p.

TO: Commanding General
US Army Test and Evaluation Command
ATTN: AMSTE-BG
Aberdeen Proving Ground, Maryland 21005

(11) 24 Mar 66

1. References.

a. Message, STEBG-TD-M 12-51, President, US Army Aviation Test Board, 22 December 1965, subject: "Flight Testing of the Armed CH-47."

b. Training Test 1-5-1, US Army Combat Developments Command, December 1965, subject: "Armed CH-47 Helicopter Unit."

c. Message, ASZTB 32062, Aeronautical Systems Division, Wright-Patterson Air Force Base, 7 January 1966, subject: "Revised Interim Armed Chinook User Flight Release."

2. Background.

a. A contract was negotiated on 30 June 1965 to design and develop the necessary mounts and feed systems to accept armament subsystems and armor on the CH-47A Helicopter. The contractor conducted design tests at Aberdeen Proving Ground, Maryland, in November 1965.

b. Results of contractor-design tests indicated a need to modify some of the armament subsystems and aircraft structure. Further tests to resolve safety-of-flight problem areas were recommended (reference 1a). This test was directed in letter, AMSTE-BG, Headquarters, US Army Test and Evaluation Command, 7 January 1966, subject: "Armed and Armored Chinook Safety-Release and Weapons Verification Testing, USATECOM Project No. 4-5-2010-06/07."

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3. Objectives.

a. To verify the correction of unsatisfactory conditions experienced during contractor-design tests.

b. To determine the existence of safety hazards and problem areas.

4. Introduction to Tests.

a. Because of the short time available, the US Army Aviation Test Board (USAAVNTBD) participated in the engineer-type testing conducted by Development and Proof Services (D&PS) at Aberdeen Proving Ground, Maryland, in January and February 1966. The D&PS results are reported separately (USATECOM Project No. 4-5-2010-06).

b. The armament subsystems were provided by the US Army Weapons Command.

c. The US Army Aeromedical Research Unit (USAARU) conducted limited toxic gas level tests.

5. Summary of Results.

a. Unsatisfactory Conditions Previously Reported. The following are results of this test which are discussed in the same order as those discussed in the report of contractor testing (reference 1a):

(1) Safety of Flight.

(a) XM-159 Rocket Launcher. The XM-159, which has not been engineer or service tested, was found to be unsatisfactory.

1 No in-flight fires occurred during this test.

2 Rockets were fired accidentally because of faulty aircraft electrical circuitry. Specifically, when the reset button on the rocket launcher control panel was energized, a pair of rockets was fired unintentionally on two occasions.

3 After a few firings, the launchers developed a static electrical charge which could not be dissipated. This constituted a hazard.

4 Cracks developed in the launcher tubes after a few firings.

5 Torquing the warhead on the rocket motor had apparently overcome the tendency of the warhead to vibrate loose in the launcher when the 20mm cannons were fired.

(b) Emergency External Stores Release. No manual emergency external-stores-release system was provided. Aircraft capable of carrying external stores should incorporate a secondary or backup emergency release system. A manual release would be the most practicable for the armed Chinook.

(c) Gas Contamination. Toxic gas level measurements indicated that a level of 1000 parts per million of carbon monoxide gas persisted for 60 seconds after a 200-round burst from the 7.62mm ramp gun. A very strong ammonia-like odor was present and there was a definite reflex change in the breathing pattern of the gunner. The gunners complained of nausea after several firing runs. (See inclosure 1.) No measurements were made during rocket firing because of the launcher malfunctions.

(d) Noise Levels.

1 Noise level tests were not conducted because of the lack of a complete weapon system during testing. It was never possible to get the armed Chinook in an operational status to fire all weapons reliably at one time. However, results obtained during contractor-testing remain valid (see inclosure 2), and USAARU reports that the gunners will suffer ear injury (hearing loss) from the high noise levels of weapons firing. Use of earplugs and the standard APH-5 helmet will not attenuate this noise sufficiently. USAARU states that use of the US Navy SPH-3 (Gentex Model DH-76) helmet will provide the necessary attenuation when worn with efficient earplugs.

2 Present intercommunications capability is marginal. A possible method of improving this capability is discussed in inclosure 3.

(e) Structural Damage.

1 The manufacturer bonded metal blast shields to selected areas of the fuel pods to prevent damage to the honeycomb

structure from the .50-caliber machine gun blast. After limited firing, damage to the honeycomb structure to which the shields were attached was suspected.

2 The manufacturer installed a metal shielding in the overhead area of the ramp to protect the helicopter structures from gun blast damage. After limited firing, this shielding developed cracks near the retention rivets. Furthermore, the shielding seemed to have increased the blast effects of ramp gun firing on the gunner. The effectiveness of this modification from both a structural and human factors consideration is questionable.

(2) Weapon Condition. Many of the government-furnished-equipment weapon subsystems were received in an operationally-unserviceable condition and required extensive maintenance before they could be fired.

(3) Weapon Subsystems.

(a) The excessive malfunction rate of the pintle-mounted 7.62mm and .50-caliber machine guns was due to ammunition feeding failures. These were caused by ammunition siphoning in the boxes, chuting, and E-10 gun mount adapter problems (see D&PS report for details.)

(b) When the window guns were traversed to full-left or -right, sharp bends in the chuting bound the ammunition.

(4) Sight. The M-60 sight was unsuitable as installed. Several beam splitter glasses were broken and there was excessive "play" in the mount. In normal flight, the sight vibrated 17-20 mils, and, when a long burst was fired with the 20mm cannons, it vibrated 40 mils.

(5) Armament Control Panels. The pilot had to reach up to an overhead armament control panel to select either 20mm guns or rockets (both fired by depressing the same button on the cyclic stick). A simple wiring change to permit rocket firing by the cargo hook release switch on the cyclic stick would permit the pilot to fire the 20mm cannon or the rockets almost simultaneously without a hand movement from the controls and an eye movement from the gun sight and target. (Provisions for carrying external cargo have been removed from the armed Chinook.)

b. Findings Not Previously Reported.

(1) Installation Effects.

(a) The armament subsystems were compatible with the helicopter fire control system. (See 5a(5) above.)

(b) The helicopter electrical systems were adequate to activate all necessary systems.

(c) The weapons and the projectiles adequately cleared the fixed or movable helicopter components and other weapon subsystems except that the M-5 sight would not traverse to full-left or -right without removing the soundproofing padding from the bulkhead above and behind the copilot/gunner. Firing angles are tabulated on a weapon summary chart. (See inclosure 4.)

(d) The .50-caliber machine gun pintle mounts were unsatisfactory because of rotation of the gun in the E-10 adapter and lack of a counterbalance to reduce the gun weight during elevation. (See D&PS report for details.)

(e) The bomb racks functioned properly and a manual emergency release system was easily installed. However, it was difficult to check the launcher intervalometer setting when the 20mm cannon was installed.

(f) The boresight equipment assembly instructions were inadequate. Boresight technique instructions were not available for the M-5 during the test and the manufacturer's representative performed the boresight operation.

(g) Unique installation problems were as follows:

1 Ammunition boxes for the cabin guns were difficult to install because unfinished edges had to be ground down to fit. The boxes should be standardized to make them completely interchangeable.

2 After loaded ammunition boxes were installed in the trays, the boxes had to be opened and checked to see if the ammunition had retained its proper position. During normal handling, the ammunition often canted over on the projectile end because of the height and flexibility of the boxes.

3 The ammunition box latches popped open easily as a result of improper installation of the over-center devices.

4 The cover for the M-5 turret became detached in flight and caused a gun stoppage.

5 Electrical components of the 20mm cannon were uncovered and their reliability in a wet environment is doubtful.

6 The metal hoppers and canvas bags designed to catch and retain ejected cases and links did not always function as designed and s... of the links were dispersed on the cabin floor. Failure of the weld of the metal hoppers and torn bags indicates improvement is needed in these areas.

7 Warning decals are needed near work platforms to which armor has been added because of the added weight.

(2) Operational Characteristics. Because of the brief test period, chronic armament subsystem malfunctions, limited range space, and stringent safety restrictions at Aberdeen Proving Ground, virtually no testing was accomplished in the areas of range estimation, dispersion patterns, system accuracy, and combined weapons firing. However, the following results are considered pertinent:

(a) Firing the subsystems did not affect the flight control stability nor result in any unusual operational characteristics of the armed Chinook. The interim flight envelope as authorized by reference 1c seems conservative; the envelope authorized for a normal CH-47A appears to be feasible for the armed version.

(b) The gunners had difficulty maintaining target and sight alignment during turns with high angles of bank because of the elevation restriction (plus ten degrees) of the cabin guns. Although range restrictions prohibited thorough testing in this area, it was estimated that if the armed Chinook maintained an altitude of at least 1,000 feet and a slant range of approximately 1,000-1,500 meters, the gunners could keep a target under continuous fire.

(3) Tactical Effectiveness.

(a) The installation of the armament subsystems did not affect the ability of the helicopter to perform evasive maneuvers.

(b) Poor intercommunication during the weapon firing caused a problem in the control of gunners by the aircraft commander.

(4) Publications. The maintenance and installation instructions (draft technical manuals) provided were incomplete, inadequate, and were not in the Army format.

(5) Flight Crew.

(a) The use of the flight engineer as a gunner seems impractical (reference 1b). He should be permitted to roam the cabin area and be free to inspect for damage and malfunctions of the helicopter. He could also be used as a spare gunner in the event of injury to another gunner.

(b) The crew for the armed Chinook should consist of:

1 Aircraft commander-pilot.

2 Copilot/gunner.

3 Flight engineer (spare gunner).

4 Five gunners (one of whom is the crew chief manning the ramp gun).

6. Conclusions.

a. All of the unsatisfactory conditions experienced during contractor-design tests have not been corrected.

b. Problem areas and safety hazards still exist in the armed Chinook.

c. Further modifications and testing are required before Army determination of the tactical suitability of the armed Chinook can be made.

7. Recommendations. It is recommended that:

a. The armed Chinook as tested be considered unsuitable for Army use until the following have been accomplished:

(1) Correction of accidental firing, static electrical charge, and launcher-tube cracking problems of the XM-159 rocket launcher.

(2) Incorporation of an emergency external stores release.

(3) Thorough gas contamination testing.

(4) Thorough noise level testing.

(5) Investigation of the suspected structural damage resulting from firing the .50-caliber machine gun.

(6) Excessive malfunction rate of the pintle-mounted 7.62mm and .50-caliber machine guns.

(7) Correction of the vibration problems of the XM-60 sight.

(8) Relocation of the weapons selector switch to the cyclic stick grip.

(9) Standardization of ammunition boxes.

(10) Correction of the intercommunication problems which occurred during weapon firing.

(11) Provision of adequate manuals.

b. After the actions recommended above have been accomplished, the armed Chinook be further tested to assure its tactical suitability.

Raymond E. Johnson

4 Incl
as

RAYMOND E. JOHNSON
Colonel, Artillery
President

DEPARTMENT OF THE ARMY
U. S. ARMY AEROMEDICAL RESEARCH UNIT
FORT RUCKER, ALABAMA ~~36362~~ 36360

USAARU-AMR 11 February 1966

SUBJECT: Carbon Monoxide Measurements in the Armed Chinook

TO: President
United States Army Aviation Test Board
ATTN: Major William Scanlan, Armed Chinook Project Officer
Fort Rucker, Alabama

1. The addition of multiple rapid fire weapons to the CH-47 raises the question of the possibility of significant contamination of the cabin atmosphere. The mounting of machine guns, particularly gas operated types, within the cabin as well as the peculiar lack of ventilation near the tail ramp of the aircraft enhances the probability that such contamination occurs. Brisk ventilation in most of the cabin is assured by the open gun ports and favors rapid dissipation of weapons exhaust. Subjective complaints had been made by various crew members. The smell of cordite was reported by the pilot in the forward cabin during firing of the M-5 grenade launcher. In addition the tail gunner complained of nausea following firing runs. During this test particular care was taken to obtain adequate measurements in these two locations.

2. Analytical and toxicological problems arising from aircraft cabin atmosphere contamination due to the armament in helicopters are under intensive investigation at USAARU. The exhaust from the weapons may contain materials which cause immediate irritation of the eyes or breathing passages or later development of respiratory or gastrointestinal symptoms. Definite identification and the development of analytical techniques for these materials are in progress but pending completion of these studies only carbon monoxide concentration is being measured. The presence of carbon monoxide is a reliable indicater of weapons exhaust contamination and in World War II a study of the air contamination problems associated with artillery revealed that carbon monoxide was the most toxic material in the weapons exhaust.

Incl 1

3. Carbon monoxide was measured by means of a modified catalytic method and simultaneously by the use of National Bureau of Standards Colorimetric Tubes. Precision of the measurements was insured by calibration of the instruments with known gas mixtures both before and after the experiment. Calibrations were carried out at the same low temperatures that were encountered during testing. Representative breath analyses for carbon monoxide were made because these have been shown to reflect up-take of carbon monoxide by the blood stream. Measurements were obtained during the firing of the M-5 grenade launcher, the 20 mm cannon, 50 caliber machine guns and the 7.62 mm machine guns. No data were obtained on rocket firing and it was not possible to test all desired configurations because of malfunction of the weapons systems and firing range limitations.

4. During firing of the M-5 grenade launcher a faint cordite odor was perceptible in the cockpit but no carbon monoxide was detectable at any time. During firing of the 20 mm cannon and 50 caliber machine guns relatively low concentrations of carbon monoxide were noted for short periods of time. During firing of the 7.62 mm machine guns somewhat higher levels were noted throughout the aircraft with the exception of the cockpit in which no significant carbon monoxide concentration was recorded at any time. Highest carbon monoxide concentration was recorded near the tail gunner during a 200 round burst of fire from the 7.62 mm machine gun. During this test a level of 1,000 PPM was noted to persist for approximately 60 seconds. A very strong odor like that of ammonia was present and definite reflex changes in breathing pattern were noted by the observer. The results are summarized in Table 1. Breath measurements of carbon monoxide performed on the tail gunner and on USAARU personnel revealed no changes despite the fact that the sensitivity of the technique was sufficient for the reliable differentiation of smoking from non-smoking subjects. Unfortunately we were unable to get a breath measurement on the tail gunner after firing of the 7.62 mm machine gun due to other mission requirements.

5. In summary, no significant cabin atmosphere contamination was detectable during firing of the M-5 grenade launcher, 20 mm cannon or the 50 caliber machine gun. The 7.62 mm machine guns were associated with slightly higher carbon monoxide levels as would be expected. The location of the 7.62 mm gas operated machine gun on the tail ramp is particularly unfortunate because of the very poor ventilation existing in this area. The measured concentration of 1,000 PPM present for one minute permits a safety factor of approximately ten that is to say that the exposure could be repeated approximately 10 times in a period of time less than one hour before any measurable

performance decrement would be predicted.[1] Although we are unable to say definitely that this particular configuration is unsafe it does represent a significant decrease in the safety factor from that found in previous systems and the subjective irritation and respiratory difficulty noted is unquestionably undesirable. The above remarks apply only to the sustained firing of the 7.62 mm machine gun mounted on the tail ramp.

6. Reference 1: "Safe Human Tolerance for High Concentrations of Carbon Monoxide Over Short Periods of Time", Hall, L. A., Patterson, C. A., and Colehour, J. K. Project No. NM001 059.24.01, 26 Feb 1951, US Naval School of Aviation Medicine, NAS, Pensacola, Florida.

7. We would like to cite our continuing interest in making future measurements of this type in support of our toxicology research program.

1 Incl
Table 1

GEORGE L. HODY
Capt., MC
Chief, Toxicology Branch

cc: Col S. L. Marvin
Med R&D Cmd

TABLE 1

Weapon Tested	Sampling Location	Carbon Monoxide Concentration (PPM)	Approximate Duration of Contamination (seconds)
[illegible]	Cockpit and near ammo box	0	-
20 mm	cockpit right rear cabin left rear cabin	0 50-100 0-50	- 30-60 30-60
50 cal in pairs (except tail ramp)	cockpit right rear cabin left rear cabin right front cabin left front cabin	maximum 40	maximum 60
50 cal tail ramp alone	extreme rear cabin	40	60
7.62 mm in pairs (except tail ramp)	cockpit right rear cabin left rear cabin right front cabin left front cabin	maximum 140	40
7.62 mm tail ramp alone (200 rounds)	extreme rear cabin	1000	60

DEPARTMENT OF THE ARMY
U. S. ARMY AEROMEDICAL RESEARCH UNIT
FORT RUCKER, ALABAMA 36362

USAARU-CO

16 December 1965

SUBJECT: Impulse Noise Sound Pressure Levels in the Armored Version of the CH-47A Transport Helicopter

TO: President
United States Army Aviation Test Board
ATTN: Major Scanlan
Fort Rucker, Alabama 36362

Subject report is attached as requested.

FOR THE COMMANDER:

William [signature] for

1 Incl
as

E. P. MC LEAN
2/Lt., MSC
Adjutant

Incl 2

IMPULSE NOISE SOUND PRESSURE LEVELS IN THE ARMORED VERSION OF THE CH-47A TRANSPORT HELICOPTER

By

ROBERT T. CAMP, JR.

INTRODUCTION

An armored version of the CH-47A transport helicopter was made available to the U. S. Army Aeromedical Research Unit for measurement of peak impulse noise levels. The measurements were made at Aberdeen Proving Grounds during tests of the various guns by Boeing-Vertol personnel.

PROCEDURE

Peak sound pressure level measurements were made inside the aircraft during bursts of fire from the 20 mm cannon, the General Electric XM-18 7.62 mm machine gun measurements were made in the cockpit and the right door near the gun mount. Measurements were made in the cockpit and a position near the gunner during the firing of the 50 cal machine gun. Positions near the right door, the left port, and the cockpit were monitored during the tests of the 20 mm cannon.

INSTRUMENTATION

A Massa type M-141B ammonium dihydrogen phosphate microphone served as the transducer for the peak SPL measurements. A Brüel and Kjaer type 2203 precision sound level meter was used as a microphone preamplifier; the output of which was fed into a General Radio type 1556-B impact-noise analyzer for storage and measurement of the peak values of the gun fire.

RESULTS

Table I contains values of peak sound pressure levels measured in various positions inside the aircraft during the firing of three types of guns. The range of values were between 140 db SPL and 173 db (re 0.0002 dyne/cm^2). The greatest SPL was near the 50 cal gunner during the firing of the 50 cal machine gun. The gradient from that position to the cockpit was 31 db. The highest level measured in the cockpit was 152 db during the firing of the 20 mm cannon.

Incl 1 to Incl 2

TABLE I

Peak Impulse Noise Sound Pressure Levels in the Armored Version of the CH-47A Transport Helicopter

Positions inside the aircraft	7.62 mm	50 cal	20 mm
Cockpit	140 db	142 db	152 db
Right Door	167 db		169 db
Left Port			167 db
Near 50 cal gunner		173 db	

CONCLUSIONS

All measurements yielded values which are above the 140 db critical level for impulse noise provided by U. S. Army Technical Bulletin, TB MED 251, of 25 January 1965. All personnel who are subjected to these peak impulse levels are required to wear ear protection. It is therefore recommended that all operating personnel be required to wear helmets, earmuffs and/or earplugs with sufficient sound attenuation to reduce the effective levels at the ears below 140 db.

DEPARTMENT OF THE ARMY
UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama 36360

STEBG-TD-V 6 Jan 66

SUBJECT: Communication Problems in Armed UH-1B and UH-1D Helicopters

TO: Commanding General
Limited Warfare Laboratories
Aberdeen Proving Ground, Md 21005

1. Reference. Report of Test, USATECOM Project No. 4-4-1532-02, "Service Test of Combination 2.75" FFAR-M-6/UH-1B (XM-16) Helicopter Armament System," US Army Aviation Test Board, 23 Sept 1965.

2. Purpose. To furnish information concerning the communications problems experienced in armed helicopters while firing armament subsystems and concerning measures that may be taken to eliminate or reduce the associated noise to an acceptable level.

3. Discussion.

a. One of the deficiencies referenced in the cited report stated that communication was impossible among crewmembers and between the helicopter and other communications areas (aircraft and control tower) when the subsystem was fired.

b. Pilots returning from duty in Vietnam reported that communication with the door gunners was not possible because of wind, engine, and transmission noises.

c. Tests were conducted by USAAVNTBD personnel while firing the XM-23 machine gun installed on a UH-1D helicopter. The XM-23 noise was such that communication from other sources, as well as within the helicopter, could not be achieved using the standard Army APH-5 helmet. An APH-5 helmet was modified with ear protector muffs, Model ASP-184, manufactured by David Clark Co., Inc. and with a directional microphone, FSN 5965-680-9798. The loss of communication between the gunners and other crewmembers is caused partially from both gunners using a common signal distribution amplifier. As a result, when one gunner "keyed" to talk, the other gunner's microphone was also energized, thus picking up twice the ambient noise (wind, rotor, transmission, engine, etc.) and causing an impedance mismatch to the amplifier. To eliminate keying of both microphones by one gunner and to make communication possible, a miniature 28 v.d.c. relay, FSN 5945-837-5318 (Incl 1) was installed in series with each gunner's microphone and key line to permit individual keying by each gunner.

d. Tests of armament subsystems in CH-47A helicopter revealed the same communication problems; and although no extensive investigation was made, the UH-1B/1D fixes are equally applicable to the armed CH-47A helicopter.

5. Findings.

a. The modified helmet with the ear protector muffs was a significant improvement in attenuating ambient noise.

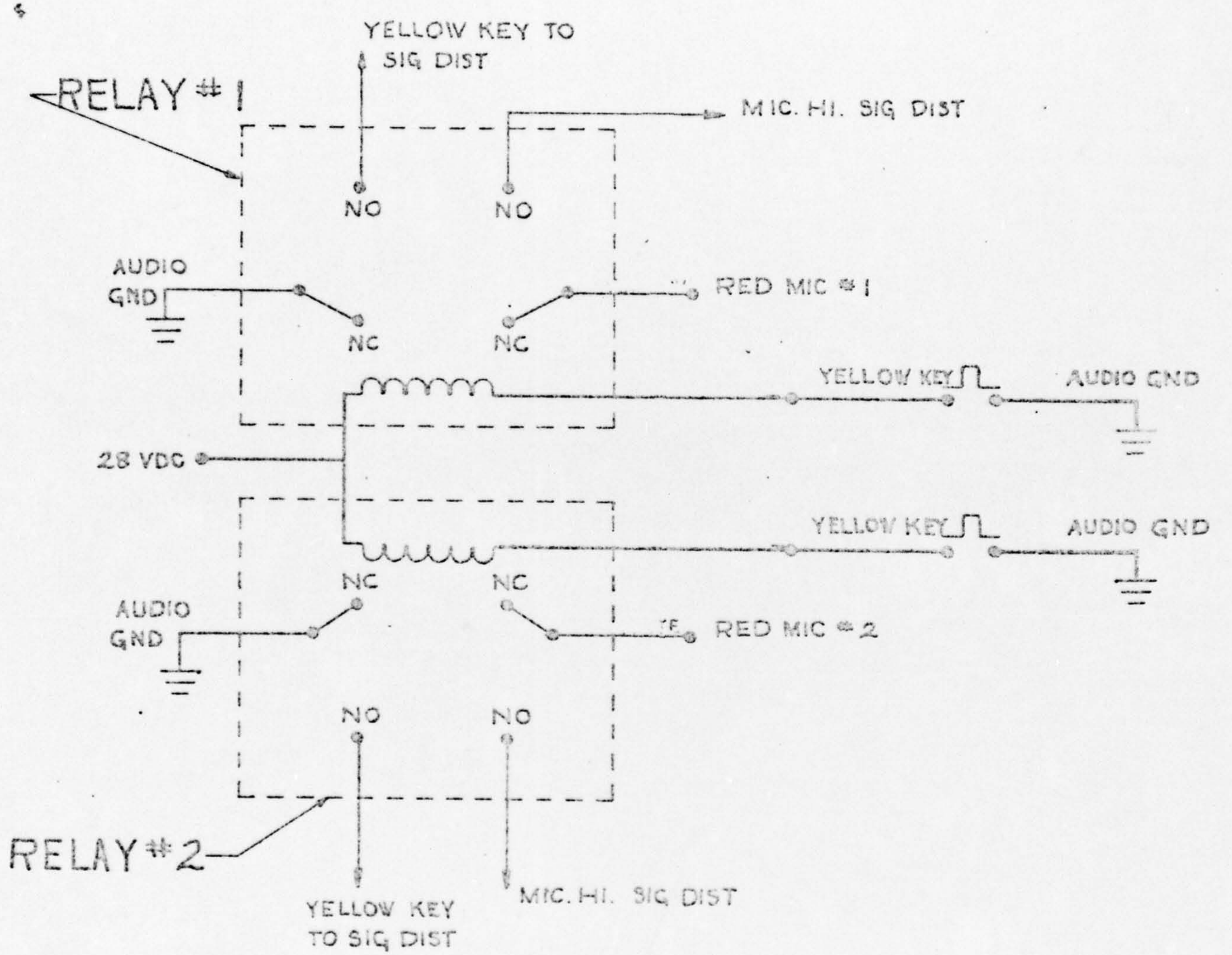
b. The directional microphone improved communication to an acceptable level.

c. The installation of the relays in series with each gunner's microphone line makes communication possible from the gunners to other crewmembers.

6. Conclusions. It is concluded that communication problems can be significantly reduced by the construction of a sound attenuating helmet with a highly directional microphone and installation of the miniature 28 v.d.c. relay.

/s/ Raymond E. Johnson
/t/ RAYMOND E. JOHNSON
Colonel, Artillery
President

1 Incl
as



INDIVIDUAL KEYING CIRCUIT
FOR GUNNER'S INTERCOM
IN UH-1B,D HELICOPTERS

WEAPON SUMMARY CHART - ARMED CHINOOK

Weapon	Total Rounds	Rate of Fire/Minute	Muz./Vel. (ft./sec.)	Firing Time (min.)	Firing Angles	Remarks
M-5 (40mm)	500	230-250	830	2	Elevation - $+5^\circ$ 49' Depression - -43° Azimuth - $\pm 60^\circ$	
M-24 (20mm)	800	800	2700	1	Fixed	
AN-M2 (50 cal.)	700	700	2800	1	Elevation Forward - -2° Aft - $+8^\circ$ Depression Forward - -32° Aft - -32° Azimuth - $\pm 45^\circ$	Forward cabin guns (side firing).
M-60D (7.62mm)	3000	600	2700	5		
AN-M2 (50 cal.)	700	700	2800	1	Elevation Forward - $+0^\circ$ Aft - $+10^\circ$ Depression Forward - -45° Aft - -45° Azimuth - $\pm 45^\circ$	Aft cabin guns (side firing).
M-60D (7.62mm)	3000	600	2700	5		

Incl 4

Weapon	Total Rounds	Rate of Fire/Minute	Muz./Vel. (ft./sec.)	Firing Time (min.)	Firing Angles	Remarks
AN-M2 (50 cal.)	700	700	2800	1	Elevation - +8° Depression - -45° Azimuth - $\pm$45°	Ramp gun (rear firing).
M-60D (7.62mm)	3000	600	2700	5	Elevation - +8° Depression - -45° Azimuth - $\pm$45°	Ramp gun (rear firing).
XM-159 Pod (2.75" rockets)	19	6/sec.	-----	--	Fixed	
XM-18 Pod (7.62mm)	1500	3000	2700	30 sec.	Fixed	