JULY 1972

AD_____

ANNUAL PROGRESS REPORT

1 July 1971 - 30 June 1972

Reported by:
Robert W. Bailey, COL, MSC
Commanding Officer

U. S. ARMY AEROMEDICAL RESEARCH LABORATORY
Fort Rucker, Alabama 36360

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Disclaimer

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R & D

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US Army Aeromedical Research Laboratory
Fort Rucker, Alabama 36360

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Washington, D. C. 20314

13. ABSTRACT
The mission of the US Army Aeromedical Research Laboratory is to conduct studies on current and anticipated medical research problems of fundamental or immediate nature relevant to Army aviation and airborne operations. To provide consultative service to other elements of the Army as apporpriate. Maintains liaison with Army, Navy, Air Force, Federal Aviation Administration and other federal and civilian institutions, both domestic and foreign, which are concerned with, or have an interest in aviation.

1

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ANNUAL PROGRESS REPORT

Fiscal Year 1972

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Reported by:
Robert W. Bailey, COL, MSC
Commanding Officer

30 June 1972

U. S. ARMY AEROMEDICAL RESEARCH LABORATORY
Fort Rucker, Alabama 36360

U. S. ARMY AEROMEDICAL RESEARCH LABORATORY

MISSION

To conduct studies on current and anticipated medical research problems of fundamental or immediate nature relevant to Army aviation and airborne operations. To provide consultative service to other elements of the Army as appropriate. Maintains liaison with Army, Navy, Air Force, Federal Aviation Administration and other Federal and civilian institutions, both domestic and foreign, which are concerned with or have an interest in aviation.

FOREWORD

The U. S. Army Aeromedical Research Laboratory (USAARL), a Class II activity of the US Army Medical Research and Development Command, Office of The Surgeon General, was established in 1962 to perform medical research in Army aviation and airborne operations.

USAARL, along with several other research organizations, is a tenant activity at the Army Aviation Center, Fort Rucker, Alabama. The concentration of men and equipment at the Center provides assigned research personnel an ideal opportunity to maintain a current knowledge of the developments in Army aviation which affect mission accomplishments. A further opportunity is afforded by the cooperative research being accomplished by this activity and other laboratory groups such as the United States Army Aviation Test Board, US Army Combat Developments Command Aviation Agency, US Army Agency for Aviation Safety (USAAAVS), Human Research Organizations and our counterparts in the Navy, Air Force, and Federal Aviation Agency.

The identification and investigation of problems in aviation medicine that are both soluble and important are this activity's goals. Problems presently being considered range from long-term fundamental research in the areas of vision, hearing loss, communications, and crash protection to the more immediate problems of the environmental characteristics of particular aircraft.

Considering the future, it is impossible to determine the problem areas which will be of most importance, but by maintaining a close relationship with the aviator and the active work of other research organizations this Laboratory will continue to work upon the problems it can identify and provide the service that aviation has requested.

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RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY

1. AGENCY ACCESSION	2. DATE OF SUMMARY	REPORT CONTROL SYMBOL
DA OD 6737	72 06 30	DD-DR&E(AR)636

3. DATE PREV SUM'RY	4. KIND OF SUMMARY	5. SUMMARY SCTY	6. WORK SECURITY	7. REGRADING	8a. DISP'N INSTR'N	8b. SPECIFIC DATA CONTRACTOR ACCESS	9. LEVEL OF SUM
71 06 21	D. Change	U	U	NA	NL	☒ YES ☐ NO	A. WORK UNIT

10. NO./CODES	PROGRAM ELEMENT	PROJECT NUMBER	TASK AREA NUMBER	WORK UNIT NUMBER
a. PRIMARY	62110A	3AO62110A 819	00	111
b. CONTRIBUTING				
c. CONTRIBUTING	CDOG 114(f)			

11. TITLE (Precede with Security Classification Code)

(U) Technical and Administrative Support to Army Aeromedical Research (01)

12. SCIENTIFIC AND TECHNOLOGICAL AREAS 000400 Administration and Management; 004600 Cost Effectiveness; 005100 Documentation and Information Technology

13. START DATE	14. ESTIMATED COMPLETION DATE	15. FUNDING AGENCY	16. PERFORMANCE METHOD
62 09	Cont	DA	C. In-House

17. CONTRACT/GRANT

a. DATE/EFFECTIVE: EXPIRATION:

b. NUMBER: Not Applicable

c. TYPE: d. AMOUNT:

e. KIND OF AWARD: f. CUM. AMT.

18. RESOURCES ESTIMATE

FISCAL YEAR	a. PROFESSIONAL MAN YRS	b. FUNDS (In thousands)
PRECEDING 72	16	773
CURRENT 73	17	878

19. RESPONSIBLE DOD ORGANIZATION

NAME: US Army Aeromedical Research Laboratory

ADDRESS: Fort Rucker, Alabama 36360

RESPONSIBLE INDIVIDUAL

NAME: Bailey, Robert W., COL, CO

TELEPHONE: (205) 255-5107

20. PERFORMING ORGANIZATION

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PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)

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TELEPHONE: (205) 255-5107

SOCIAL SECURITY ACCOUNT NUMBER:

ASSOCIATE INVESTIGATORS

NAME: Price, A. D., LTC

NAME: DA

21. GENERAL USE

22. KEYWORDS (Precede EACH with Security Classification Code) (U) Administration; (U) Management; (U) Cost Effectiveness; (U) Documentation; (U) Information Technology

23. TECHNICAL OBJECTIVE, 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)

23. (U) To provide technical, logistical and administrative support to those involved in Army aeromedical research at the US Army Aeromedical Research Laboratory.

24. (U) To evaluate and then supply, insofar as possible, that technical, logistical and administrative support required by research members of the laboratory in order that the laboratory can fulfill its mission. Among other things, this includes provision for scientific guidance and advice, technical support in development, construction, distribution and maintenance of research equipment and associated items, the attainment, distribution and cataloging of scientific literature, and accounting, bookkeeping and clerical support. It also provides that these areas will be administered under an administration utilizing sound and accepted managerial practices. The funding required includes all fixed cost items such as rent, civilian salaries, etc.

25. (U) 71 07 - 72 06 An additional 4,338 square feet of floor space was acquired, and is utilized as a safety design laboratory. With the additional space, the laboratory has a total working area of 43,163 square feet.

1

*Available to contractors upon originator's approval

DD FORM 1498 MAR 68

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY

1. AGENCY ACCESSION	2. DATE OF SUMMARY	REPORT CONTROL SYMBOL
DA OD 6734	72 06 30	DD-DR&E(AR)636

3. DATE PREV SUM'RY	4. KIND OF SUMMARY	5. SUMMARY SCTY	6. WORK SECURITY	7. REGRADING	8a. DISP'N INSTR'N	8b. SPECIFIC DATA-CONTRACTOR ACCESS	9. LEVEL OF SUM
71 06 21	D. Change	U	U	NA	NL	☒ YES ☐ NO	A. WORK UNIT

10. NO./CODES:	PROGRAM ELEMENT	PROJECT NUMBER	TASK AREA NUMBER	WORK UNIT NUMBER
a. PRIMARY	62110A	3AO62110A 819	00	055
b. CONTRIBUTING				
c. CONTRIBUTING	CDOG 114(f)			

11. TITLE (Precede with Security Classification Code)

(U) Direct Field Research Support to Immediate Army Aeromedical Problems (02)

12. SCIENTIFIC AND TECHNOLOGICAL AREAS

001300 Aircraft; 006000 Escape Rescue and Survival; 013300 Protective Equipment

13. START DATE	14. ESTIMATED COMPLETION DATE	15. FUNDING AGENCY	16. PERFORMANCE METHOD
64 06	Cont	DA	C. In-House

17. CONTRACT/GRANT

a. DATES/EFFECTIVE: EXPIRATION:

b. NUMBER: Not Applicable

c. TYPE: d. AMOUNT:

e. KIND OF AWARD: f. CUM. AMT.

18. RESOURCES ESTIMATE		a. PROFESSIONAL MAN YRS	b. FUNDS (In thousands)
FISCAL YEAR	PRECEDING 72	4	7
	CURRENT 73	3	37

19. RESPONSIBLE DOD ORGANIZATION

NAME: US Army Aeromedical Research Laboratory

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ASSOCIATE INVESTIGATORS

NAME: Albright, J., LTC

NAME: Kaplan, B., LTC DA

21. GENERAL USE

Foreign Intelligence Considered

22. KEYWORDS (Precede EACH with Security Classification Code) (U) Aircraft; (U) Protective Equipment; (U) Human Factors Engineering; (U) Stress Physiology; (U) Man-Machine Relations; (U) Telemetry; (U) Parachuting

23. TECHNICAL OBJECTIVE, 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)

(U) Personnel Selection and Maintenance (Medical)

23. (U) To provide valid, meaningful and medically pertinent information, new designs and equipment developments based on research with respect to immediate field aeromedical problem areas found in US Army aviation.

24. (U) The approach will always be based on sound and accepted experimental methodology, though particular techniques of application will vary as a function of the problem under investigation.

25. (U) Progress in this area is reflected by reports on the following topics: Medical aspects of engineering and service test of standard air delivery equipment (personnel) at high drop zone elevations; problems of adaptation to long range large scale aerial troop deployment; crash injury economics: aircrewman injury and death costs occurring in UH-1 Army aircraft accidents; environmental effects on attack helicopter crew task performance in the NATO theater; dynamic and crashworthy evaluation of the UH-1B, C, D, H medical attendant's seat; evaluation of the improved Martin Baker (MK-J5) ejection seat in respect to spinal alignment; crash injury economics: a cost of crewmember head trauma in Army UH-1 accidents in FY 69. Work has begun on the crashworthy troop seat for UTTAS. Change 3 to AR 95-5 implemented the Army Life Support Retrieval Program. Work continues on acquired left bundle branch block, long range troop deployments, crash injury economics and the Cheyenne helicopter.

*Available to contractors upon originator's approval

GENERAL DETAIL SHEET

TITLE: Direct Field Research Support to Immediate Army Aeromedical Problems

OBJECTIVE:

To provide valid, meaningful and medically pertinent information based on research with respect to immediate field aeromedical problem areas found in US Army aviation.

BACKGROUND, METHODOLOGY, STATUS:

Statements concerning the above for this area of research can be found on the following pages numbered 4 through 18.

RECOMMENDATIONS:

It is recommended that research in this area be funded on a continuing basis.

CRASH INJURY ECONOMICS

OBJECTIVE

This study is an economic and manpower analysis of Army aircrew injuries and/or deaths to determine what fraction of the aircraft accident cost these injuries represent.

BACKGROUND

In the cost assessment of a helicopter accident, only the aircraft is considered. The tremendous cost of emergency medical care, medical follow up, long term disability benefits and/or death benefits to the next of kin are never considered. Monetary factors are common denominators influencing managerial and policy decisions that will ultimately dictate crashworthy design.

METHODOLOGY

Using USAAAVS accident files, a list of those individuals, either killed or injured, has been compiled for FY 69. For those injured (approximately 175), medical records are being requested from the various treatment facilities. For those killed (approximately 240), the survivors' benefits are being compiled from the Army Finance Center, The Veterans Administration and the Social Security Administration.

STATUS

Definitive economic analyses have been accomplished for multiple cost parameters. Statistical computer programs have been written and debugged to facilitate continuing studies in this area. It has been demonstrated that the Human Economic loss of Army helicopter accidents often exceeds the hardware cost. The data from this study have been used by AVSCOM to justify continuation of the Crash Resistant Fuel System Retrofit Program into most all helicopters.

Reports published:

Crash Injury Economics: The Costs of Training and Maintaining an Army Aviator, Report No. 71-17, April 1971

Crash Injury Economics: Injury and Death Costs in Army UH-1 Accidents in Fiscal Year 1969, Report No. 71-18, December 1971

Crash Injury Economics: The Costs of Crewmember Head Trauma in Army UH-1 Accidents in Fiscal Year 1969, Report No. 72-16, June 1972

LIFE SUPPORT EQUIPMENT RETRIEVAL AND ANALYSIS PROGRAM AND LIFE SUPPORT EQUIPMENT EXHIBIT

OBJECTIVE

To perform a bioengineering analysis, evaluation, injury correlation and storage of life support equipment that has been subjected to the aircraft crash environment. To integrate hardware and material with the biological requirements of man and insert technical and scientific data into the developmental cycle that will result in product improvement and new design criteria.

BACKGROUND

Life support equipment involved in aircraft accidents is subjected to its ultimate test with human subjects. Until recently, (25 November 1971) this equipment was not formally being evaluated after aircraft accidents. Improvements in life support equipment has therefore been made on an empirical, haphazard basis. Change 3, AR 95-5, March 1972 requires the president of an aircraft accident investigation board to send all pieces of life support equipment involved in either injury causation or prevention to USAARL for biomedical and engineering evaluation. The data obtained could never be safely duplicated with human subjects. From these exposures, and the uniquely valuable data resulting from their analysis, recommendations for product improvement or design criteria will be established on a sound basis.

METHODOLOGY

Change 3 to AR 95-5 requires the flight surgeon assigned to the accident investigation board to examine the life support equipment involved in aircraft accidents to send items implicated in injury causation or prevention to USAARL. A biomedical and engineering evaluation and injury correlation will be performed on the equipment, data coded, and added to additional information stored at USAAAVS. Pathology data from AFIP (JCAP) will be integrated as appropriate. Periodic statistical analysis of all data will be performed by USAAAVS.

STATUS

This is a coordinated USAARL-USAAAVS project. An exhibit of particularly interesting material is being used to demonstrate the life support equipment role in accident prevention as an

educational function to student flight surgeons, aviators, and officers.

A systems analysis approach has been devised, methods of collecting, interpreting, and integrating data in useful formats are being continuously explored. Attempts to identify trends are resulting in a thorough investigation of the present system and its related equipment. A continuing record of damage to life support equipment will be kept to ascertain possible trends in equipment failure. This will assist in supplying information for future modifications.

AIRBORNE OPERATIONAL REQUIREMENT AND HUMAN RESPONSE
TO PARACHUTING INTO DROP ZONES AT 10,000 FT
MEAN SEA LEVEL ELEVATIONS

OBJECTIVE

To determine the safety and effectiveness of standard air delivery equipment at high drop zone elevations. To develop new injury prediction statistics for operations at high elevations. To medically monitor the service test at these elevations.

BACKGROUND

Current air drop equipment has been designed for use at drop zone elevations of less than 3,000 feet. Military contingency missions throughout the world include areas with drop zone elevations in excess of 10,000 feet. It is not known whether current sea level standard air delivery equipment will safely and efficiently deliver troops and equipment into these high elevation drop zones.

METHODOLOGY

Monitor all activities and parachute jumps at 6,000 and 10,500 drop zone elevations. Pre and post jump physical examinations. Utilization of post drop event/injury questionnaire. Administer Evans high altitude symptom questionnaire. Record all meterologic and environmental conditions. Analyze all trajectory and impact data obtained by Yuma Proving Ground. Relate injuries and the biomechanical aspects of their etiology with environmental factors. Develop injury probability tables.

STATUS

The final report, "Medical Aspects of the Engineering and Service Test of Standard Air Delivery Equipment (Personnel) at High Drop Zone Elevations," USAARL Letter Report No. 71-1-3-1, January 1971 has been approved and published as Annex A to TECOM Report 8-EG-065-000-002/003, April 1971. A paper "Parachuting Impact Injuries at High Drop Zone Elevations: Environmental Effects" was presented to the NATO-AGARD Symposium on Linear Acceleration of Impact Type. The paper was published by NATO, AGARD-CD-88-71, December 1971. The study demonstrated that when safety took precedence over the tactical situation injury rates, using standard equipment and experienced parachutists, were four times higher than found at sea level. It

was also demonstrated that in the tactical situation injury rates up to 70/1000 jumps can be expected at drop zone elevations over 6,600 feet MSL.

THE STATISTICAL ANALYSIS OF DIAGNOSIS AND DISPOSITIONS OF PILOTS AND NAVIGATORS SEEN AT USAFSAM

OBJECTIVE

To determine if there are statistical differences in the diagnoses made on pilots versus navigators when matched by age, rank, flying hours, and other factors.

BACKGROUND

Clinical evaluation of pilots and navigators is often biased by the physician and presupposition that pilots and navigators all too often have diseases unique to their particular rating.

METHODOLOGY

To statistically analyze 8,000 clinical records of pilots and navigators with over 25,000 independent medical, dental, and psychological diagnoses. Clinical data from the consultation service, USAF School of Aerospace Medicine is being used.

STATUS

Data collection is complete, statistical analysis is complete, and a final report, "Statistical Analysis of Disease Diagnoses in Pilots and Navigators," is awaiting publication.

ACQUIRED LEFT BUNDLE BRANCH BLOCK STUDY

OBJECTIVE

To study the natural history, epidemiology, and clinical nature of acquired left bundle branch block as it occurs in otherwise healthy flying personnel.

BACKGROUND

Left bundle branch block is currently disqualifying for flying duty. Many young and otherwise healthy aviation personnel develop this electrocardiographic finding without evidence of heart disease. Their loss from the flying environment is costly and reduces the effectiveness of the aviation program.

METHODOLOGY

The study has three phases. Phase I is a retroactive study of 65 patients seen over a 14 year period. Phase II is a clinical evaluation of patients with acquired left bundle branch block with thorough testing and selected coronary angiography. Phase III is a long term follow up of all patients.

STATUS

Phase I - Preparation of report.
Phase II - Report complete, study ongoing, in excess of 45 patients have had catherization with almost all having normal findings. Most returned to flying status.
Phase III - Ongoing.

MEDICAL, PHYSIOLOGIC AND HUMAN FACTORS OF LONG RANGE, LARGE SCALE AERIAL TROOP DEPLOYMENTS

OBJECTIVE

To delineate those factors associated with transmeridian, large scale troop deployments that will have a degrading effect on combat units and individual soldier performance, efficiency, and combat effectiveness. To study the identified parameters in detail and arrive at pragmatic operational solutions that can be implemented into existing contingency plans, deployment doctrine and medical operations annexes. To recommend implementation of solutions.

BACKGROUND

Current national and international policy, military strategy and tactics, and aviation technology would indicate that large troop deployments of the future will be made by aerial means. Problems inherent in protracted aerial flight among combat personnel are not known.

METHODOLOGY

Study selected large scale long range deployments with the intent of identifying environmental, psychological, physiological and operational problem areas.

Develop experimental protocols to study specific problem areas.

Collate experimental results into operational recommendations.

STATUS

Paper presented at 27th ASAMP, AGARD, NATO, September 1970.
USAARL Report No. 71-10.
Additional reports in preparation.
Operation Freedom Vault, March 1971, Fort Bragg-Korea, observed.

Operational Aeromedical Problems and the Role of Human Factors in Tactical Deployments, Proceedings of the 19th International Congress of Aviation and Space Medicine, Tel Aviv, Israel, 30 October 1971. A protocol has been developed to study the problem of sleep loss and time for sleep recovery. A joint project is in preparation in association with NASA-AMES Research

Laboratory, California and a series of experiments to identify physiological and psychological performance factors as well as sleep loss. The independable variables will include but are not limited to exposure to altitude, environmental noise, dehydration, high density seating, long period of sitting without exercise and transmeridian translocation. Liaison and coordination has been established with NATO, other US Army Agencies, NASA, FAA, University of Alabama and the US Air Force.

ENVIRONMENTAL EFFECTS ON ATTACK HELICOPTER CREW TASK PERFORMANCE IN THE NATO THEATER

OBJECTIVE

To define and discuss:

Attack helicopter missions.
Attack helicopter crew tasks.
The machine induced environment.
The mission induced environment.
Anticipated effects on crew performance.
Effect of altered performance on mission.

BACKGROUND

The attack helicopter role in a mid to high intensity NATO conflict will create environmental conditions that could prove deleterious to crew task performance. The Assistant for Research, Dr. K. C. Emerson, Office of the Assistant Secretary of the Army requested USAARL through the US Army Medical Research and Development Command to prepare a document discussing the environment and its effects.

METHODOLOGY

Ad hoc Aviation Center Team effort under the direction of SGRD-UAE.

STATUS

Work began in January 1971 with support of all agencies. Ten complete individual manuscripts or reports were received, collated, edited and USAARL Report Number 71-21, "Environmental Effects on Attack Helicopter Crew Task Performance in the NATO Theater", was published in May 1971. This has been delivered through channels to the Long Term Defense Study Group, NATO. Phase II of this study has begun with the integration of the results of the study into a NATO working paper along with a study on submarine, attack fighter, tank and other definitive operations. The Phase II group met in April 1972, Bonn, Germany. The eventual result of this entire effort is to define areas of productive, needed and precedent research and development that will increase or enhance task performance in a hostile military environment.

DESIGN, DEVELOPMENT, OPERATIONAL EVALUATION AND FABRICATION OF A MODIFIED "G" SUIT FOR USE BY PARAMEDICAL PERSONNEL IN THE TREATMENT OF SHOCK

OBJECTIVE

To develop a simple means of treating shock by paramedical personnel.

BACKGROUND

Shock may be defined as a state of circulatory collapse, frequently associated with insufficient return of blood to the heart and manifested by persisting deficiency of blood flow to the peripheral tissues.

The insufficient return of blood to the heart is associated with pooling of blcod in the venous system; as the blood pools in the venous system the pulse rate increases and the arterial blood pressure decreases eventually leading to the death of the patient unless treatment is initiated.

Since all shock treatment takes time, an expeditious way of returning the pooled venous blood into the arterial circulation would benefit the patient and result in a reduction of mortality and increase survival time sufficiently so the patient could reach adequate medical treatment facilities. The simplest, most inexpensive and least time consuming treatment method is the principle of external counter-pressure ("G" suit) applied to the abdominal area and lower extremities. The result of counter-pressure to these areas would result in decreasing venous pooling, control of abdominal hemorrhage, (if present) and allow blood to recirculate and perfuse tissue. External counter-pressure to elevate blood pressure is not new. It was first described in 1903 by Crile and recently Cutler and Doggit reported several case histories of combat casualities whose blood pressures were maintained only by the addition of "G" suits to the treatment regime despite heroic medications and blood transfusions.

However, the current "G" suit is expensive and cannot be reasonably or conveniently used by paramedical personnel on an Army-wide basis.

METHODOLOGY

An air bag will be designed conforming to the lower half of

the human body and capable of sustaining a pressure of 60 - 80mm Hz.

STATUS

The initial design is not complete. Different manufacturers will be approached for a prototype model.

GENERAL PARACHUTE AND FLIGHT MEDICINE SUPPORT FUNCTIONS

OBJECTIVE

To provide an easily accessible, investigatory and consultative function to government agencies in the area of parachute and operational flight medicine.

BACKGROUND

Inquiries and requests for answers to operational problems are received daily that often require literature searches, short experiments, field evaluations, in-flight evaluations of aviators undergoing diagnostic work ups and attendance at related IPR's and Material Need (MN) working groups (AVSCOM, CDC, AMC).

METHODOLOGY

Consultative service, well defined experiments, on-site evaluations, specification and document reviews, coordinative and liaison function, are some techniques used to provide practical solutions to operational problems.

STATUS

Projects without formal precis under this function include:

Parachute Injury Questionnaire
Evaluation of the Parachutists Helmet
Medical equipment airdrop evaluations in mountainous terrain
Educational function to DAET, USAAVNS, USAFSAM
Evaluation of unusual parachute activity induced injuries
Consultant and board member to Flight Surgeon Review Board, Aviation Medicine Consultation Service, Lyster Army Hospital

GENERAL BIOAERONAUTICS SUPPORT FUNCTION

OBJECTIVE

To provide direct aeronautical support, to investigate, evaluate, monitor and advise on the dynamics of Army aircraft and related systems during flight and crash sequences.

BACKGROUND

Effective accident investigation, understanding of the medical and human factors aspects of accident injuries and fatalities and the in-flight evaluation of prototype aircraft subsystems that have a physiologic man - machine interface is predicated on a knowledge of an adequate aeronautical engineering and aviation experience. This support is best provided by experienced Medical Service Corps aviators with degrees in engineering and who preferably are qualified safety officers.

METHODOLOGY

Ongoing coordination, review, and support of in-house projects and same support on request to other Army agencies.

STATUS

Evaluation of the British Rescue Device, final letter report completed.
Evaluation of Maximum Sitting Height in U-10A Aircraft, final letter report completed.
Determination of Maximum Sitting Height in C-45 Aircraft, final letter report completed.
Participation in UTTAS Medical Evacuation Role MN development.
Aeronautical support of Rotor Downwash studies.

GENERAL LIFE SUPPORT EQUIPMENT FUNCTION

OBJECTIVE

To provide biomedical capability to managers charged with the development and procurement of life support equipment and to pursue the goal of better life support equipment for the Army aircrewman.

BACKGROUND

Approximately twenty (20) Army major command staff agencies are involved in development and support of the Army life support equipment effort. A formal biomedical input is not available to most of these agencies. This deficit has, in the past, resulted in acquisition of life support equipment with gross biomedical inadequacies.

METHODOLOGY

An ongoing effort to remain abreast of current and planned developments in the life support field and incorporate biomedical concepts in all development stages from concept formulation through the engineering and service testing phases as well as product improvements of current equipment. Because of the limited manpower involved, the effort is implemented primarily through staff procedures.

STATUS

Continuing formal and informal contact is maintained with other Army agencies involved with life support equipment and with similar organizations in the other services and with industry. On request, represents The Surgeon General at IPR's, MN developments and program reviews. Provides a representative to Navy APSET, SAFE, and Air Force Life Support Equipment Program.

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY

1. Agency Accession: DA OD 6736
2. Date of Summary: 72 06 30
Report Control Symbol: DD-DR&E(AR)636

3. Date Prev Sum'ry: 71 06 21
4. Kind of Summary: D. Change
5. Summary Scty: U
6. Work Security: U
7. Regrading: NA
8. Dis'n Instr'n: NL
9. Specific Data-Contractor Access: X Yes ☐ No
10. Level of Sum: A. Work Unit

No./Codes	Program Element	Project Number	Task Area Number	Work Unit Number
a. Primary	62110A	3A069110A	00	107
b.				
c.	CDOG 114(f)			

11. Title: (U) Medical Research Applied to the Problems in Army Aviation (03)

12. Scientific and Technological Areas: 001300 Aircraft; 016200 Stress Physiology; 016800 Toxicology

13. Start Date: 64 06
14. Estimated Completion Date: Cont
15. Funding Agency: DA
16. Performance Method: C. In-House

17. Contract/Grant: a. Dates/Effective: Expiration: b. Number: Not Applicable c. Type: d. Amount: e. Kind of Award: f. Cum. Amt.

18. Resources Estimate		a. Professional Man Yrs	b. Funds (In thousands)
Fiscal Year	Preceding 72	15	62
	Current 73	12	75

19. Responsible DoD Organization
Name: US Army Aeromedical Research Laboratory
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Responsible Individual
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20. Performing Organization
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Principal Investigator (Furnish SSAN if U.S. Academic Institution)
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Associate Investigators
Name: Jordan, J. E., MAJ
Name: Blackstone, E. H., MAJ DA

21. General Use: Foreign Intelligence Considered

22. Keywords (Precede each with Security Classification Code): (U) Aircraft; (U) Biochemistry; (U) Clinical Medicine; (U) Life Support; (U) Pharmocology; (U) Stress Physiology; (U) Toxicology; (U) Recording Devices; (U) Telemetry; (U) Computers; (U) Human Volunteers; (U) Personnel Selection (Medical)

23. Technical Objective, 24. Approach, 25. Progress (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)

23. (U) To provide the US Army information about those variables found in Army aviation which influence the health of the aviator.

24. (U) To apply accepted medical research methods in Army aviation to fulfill the above objective.

25. (U) 71 07 - 72 06 Progress is shown by: USAARL Report 71-22 describing the Neurological Effects of INH; a joint laboratory report with the US Army Engineer Waterways Experiment Station concerning downwash information from US Army helicopters; the imminent publication by Natick Laboratories of a major anthropometric study of Army aviators in which data were collected at Fort Rucker with the sponsorship and support of USAARL; the completion of data collection of a study to evaluate the use of miniature swine as a model for the treatment of burn shock; the completion of a study in dogs to evaluate the physiological and anatomical effects of electrosleep; the development of several elegant computer techniques to portray periodic physiological information (EEG, EKG, etc.) in the frequency and time domains. Progress is also reflected by studies of muscle glycogen phosphorylase; the heart rates of student parachutists during free fall; and tests to evaluate fire protective clothing for Army aviators.

*Available to contractors upon originator's approval

DD Form 1498, 1 Mar 68 — Previous editions of this form are obsolete. DD Forms 1498A, 1 Nov 65 and 1498-1, 1 Mar 68 (for Army use) are obsolete.

GENERAL DETAIL SHEET

TITLE: Medical Research Applied to the Problems in Army Aviation

OBJECTIVE:

To provide the US Army information about those variables found in Army aviation which influence the health of the aviator.

BACKGROUND, METHODOLOGY, STATUS:

Statements concerning the above for this area of research can be found on the following pages numbered 21 through 39.

RECOMMENDATIONS:

It is recommended that research in this area be funded on a continuing basis.

THE RESPONSE OF THE DYNAMIC BIOMECHANICAL PROPERTIES OF HUMAN SKIN TO UNEQUAL FORCE FIELDS

OBJECTIVE

Objective is to delineate facts for evaluating impact injury to human skin due to aviation accidents and illucidate parameters for life support equipment where injury to human skin is a possible consequence.

BACKGROUND

The biomechanics of human skin are complex. Its behavior has only recently begun to be understood. Many problems still exist because of its complex composite elastic nature. Among these are methods of testing the response of skin. The stress strain curves exhibited by placing elastic adhesive bandages (or complex composite structures) upon the skin are totally unknown. In minor injury, they occur following the innocuous placement of a post operative dressing.

METHODOLOGY

Properties of stress strain curves will be obtained for the composite elastic adhesive bandages. A variety of different shaped templates and elastic adhesive bandages will be attached to the stem of the abdomen, skin, thigh and upper back of human volunteers. Any calibration tension will be exerted. Response of dynamic biomechanical properties of human skin to unequal force fields will be evaluated.

STATUS

The majority of the work on this project has been deferred pending completion of the porcine burn shock project. The majority of equipment and supplies (including the Tenius Olson purchased by Bioengineering & Evaluation Division) has been obtained. Many of the strain gauges and some of the apparatus must still be obtained. In addition, the scheduling of the FM recorder with Bioengineering will be necessary. Because of the limited expertise in this field, several conferences with that elite group have been conducted.

THE TREATMENT OF PORCINE BURN SHOCK

OBJECTIVE

The objectives of this project are to determine the efficacy of various intravenous fluids now in common use in the treatment of burn shock, to establish the swine as a burn shock model and to utilize this model in developing a closed loop process control system (automated and semiautomated patient analysis and treatment) for burn patients.

BACKGROUND

Many intravenous solutions (crystalloid and colloid) continue to be used in the treatment of burn shock. The mechanism of use is not completely understood, and the role of sodium ion requires further illucidation.

METHODOLOGY

Miniature swine are prepared for the porcine burn shock experiments by pre-burn splenectomy, centro-urine catheterization, aortic catheterization and suprapublic cystostomy. Under anesthesia these animals receive a third degree flame burn of 40-50% of the body surface. A 48-hour period of intensive care is conducted utilizing vital signs, centro-catheterization pressures, cardiac output, blood chemistries, urine chemistries, body weights, etc. The experimental animals are treated in one of six experimental categories.

STATUS

Active experimenting and data collection are complete. Data reduction and statistical analysis will require several months to complete. Part of this extended period is due to the failure of an on-line cardiac output computer.

EFFECTS OF ELECTROSLEEP ON REM & STAGE 4 SLEEP

OBJECTIVE

It is intended to determine if the electrosleep machine has any effects on the recovery sleep of deprived humans.

BACKGROUND

REM and Stage 4 sections of sleep are the two most critical parts and increase at the expense of other stages when sleep deprivation occurs. Evidence points to the fact that this is a physiologic release phenomenon. It is suggested that the electrosleep currents might result in an artificial release manifested by less post deprivation increase.

METHODOLOGY

Human volunteers will be sleep deprived for 40 hours and given electrosleep or sham applications during this time. Continuous EEG recordings for 36 hours will follow. The records will be scored for sleep stages and comparisons made.

STATUS

The start of this project must await final data analysis of a prior study of the safety of the machine. Meanwhile, study design and logistic requirements are being completed. Because of limitations of the USAARL facilities it is necessary to perform the study at Brooke Army Hospital, Fort Sam Houston, Texas. Coordination with personnel at Brooke Army Hospital is in progress. Assuming favorable results of the above study, it is anticipated that work will begin in May 1972.

EVALUATION OF THE ELECTROSLEEP MACHINE

OBJECTIVE

The aim of this project is to assess the effects of the machine on normal organisms and determine its safety for human use.

BACKGROUND

Electrosleep has been applied to humans since 1903. Until recently use has been confined to the USSR, but five groups in the USA are now involved. Although minor physiologic and biochemical changes are reported by the Russians, no adequate study of its side effects exist.

METHODOLOGY

Dogs will be given a series of electrosleep applications. Their physiologic, biochemical and pathologic reactions will be compared to a matched control group of dogs. Any differences noted will be evaluated.

STATUS

Data collection is completed. Data analysis is in progress.

INVESTIGATION OF THE ROLE OF NOREPINEPHRINE

OBJECTIVE

The aim of this project is to provide physiologic confirmation of the widely held theory that norepinephrine release causes REM sleep.

BACKGROUND

In a series of pharmacological and lesion experiments from 1963 to 1966, Jouvet and his group obtained evidence that a small midbrain nucleus, the locus ceruleus, was responsible for REM sleep. They postulated that the neurohumor responsible was norepinephrine. No further work has been done including a total absence of direct physiologic recording. Although contrary evidence has been obtained, the theory is still widely accepted.

METHODOLOGY

Microelectrodes will be inserted into the cat locus ceruleus and recordings made. The normal function and the function in REM sleep will be studied. If the theory is correct a marked difference should be apparent.

STATUS

Necessary equipment has been acquired and consolidated. Necessary completion of the shielded Faraday Room for recording has been completed. The animals have been acquired and are adequately conditioned. The project is now in progress.

BIOCHEMICAL MEASURES OF STRESS AND/OR FATIGUE

OBJECTIVE

To determine the relationship of the relative concentration of deacylated phospholipids in plasma to stress and fatigue producing situations encountered by Army helicopter pilots.

BACKGROUND

Changes have been observed in phosphotidylglycerol and phospholidic acid concentrations in the plasma of subjects subjected to high centrifugal acceleration and stress producing conditions in high performance aircraft. Most phospholipids from the plasma are thought to be produced and destroyed by the liver. As the turnover rate is slow, fatigue and/or stress analysis may be possible after the fact.

METHODOLOGY

An automated system for digesting and analyzing deacylated phospholipids has been constructed. Column chromatographic separations of mixtures of deacylated phospholipids may be included in the automated system. Paper chromatography may be used with smaller samples. Microsomes and lysosomes are isolated from rat liver and tested for phosphotidylglycerol after the rats have been subjected to fatigue and stress producing situations. This system provides the best chromatograhic control for testing results obtained from plasma. Also, the effect of stress hormones will be tested. Plasma will be prepared from Warrant Officer Candidate student pilots at varying times during their flight training. Correlations will be tested between phosphotidyglycerol concentration and flying hours, check flights and instructor pilot evaluations.

STATUS

The results of initial studies have been published in USAARL Report No. 69-12 (Automated Column Chromatographic Analysis of Deacylated Phospholipids). Further refinement of the automated chromatographic system is in progress. All plasma phosopholipid fractions will be identified by the use of known standards with the column chromatographic technique.

STUDIES OF MUSCLE GLYCOGEN PHOSPHORYLASE, AN ENZYME ACTIVATED IN THE PHYSIOLOGICAL RESPONSE TO STRESS AND FATIGUE

OBJECTIVE

This study is designed to investigate the mechanism of action of glycogen phosphorylase with the coordinate goal of determining the function of pyridoxal-5'-phosphate in catalysis, if such a function exists.

BACKGROUND

The problem of physiological stress and fatigue in the military is obvious. A major physiological response to a stress situation is the release of the hormone epinephrine. Under such conditions, the enzyme glycogen phosphorylase is one of the prime sites of action of epinephrine. The activation of phosphorylase, by epinephrine through the effect of 3'5'-cyclic adenosine monophosphate on phosphorylase b kinase is well known. Little is known, however, about the mechanism of the enzyme ultimately affected, glycogen phosphorylase. This enzyme catalyzes the formation of glucose-1-phosphate from glycogen and occupies a key position in metabolism. Under conditions of physiological stress, in which there is a requirement for large amounts of energy, the activation of phosphorylase and its ability to supply glucose-1-phosphate to the glycolytic pathway demonstrates the importance of this enzyme system. Furthermore, the absolute requirement of this enzyme for pyridoxal-5'-phosphate, a vitamin B_6 derivative, suggests that, as in the other pyridoxal enzymes, the coenzyme may be directly involved in the catalytic process. This study will be concerned with the effects of pH and temperature on the kinetics of "altered" muscle glycogen phosphorylases. It is expected that the use of pyridoxal-5'-phosphate derivaties to form active "altered" phosphorylases will distinguish between a structural or catalytic role for the prosthetic group and identify the chemical groups in the enzyme responsible for activity.

METHODOLOGY

The following research plan will be utilized: (1) Synthesis of various pyridoxal-5'-phosphate derivatives, purification by column chromatography, and identification by thin layer chromatography and nuclear magnetic resonance spectroscopy. (2) Resolution and reconstitution of rabbit muscle holophosphorylase with the synthesized pyridoxal-5'-phosphate

derivatives. (3) Determination of the effect of pH and temperature on the kinetic parameters of these active "altered" phosphorylases. This will involve a standard spectrophotometric assay procedure.

STATUS

Parts 1 and 2 of the research plan are complete. Studies to determine the effect of pH and temperature on the kinetic parameters of active "altered" phosphorylase are underway.

DETERMINATIONS OF DRUG ABUSE FROM BIOLOGICAL SPECIMENS

OBJECTIVE

To provide an estimate of the best means of detecting LSD drug abuse beyond the period of acute symptomatology and high plasma drug concentration.

BACKGROUND

An objective means for the detection of LSD drug abuse has become a critical requirement for aviation safety. The documentation of "Flashbacks" in individuals following a single dose of LSD necessitates prompt elimination of these personnel from aviation duties. The minute dosage and metabolism of LSD are peculiarities which impede detection in biological specimens. This constraint must be researched to allow for attempts to establish estimates of the prevalence, incidence and relative risks involving LSD abuse. These data could support command action to prevent LSD abuse. The elimination of high risk personnel would conserve aviation safety.

METHODOLOGY

The following research plan will be utilized: (1) Carry out pilot tests of known spectrophotogluorometric procedures for LSD detection in plasma to determine the best method; (2) Carry out similar studies of the methods for the detection of creatine phosphokinase in spinal fluid and free fatty acids in plasma; (3) Develop a spectrophotogluorometric method for the detection of 2-oxy-LSD in plasma in bile; (4) Carry out *in vivo* studies in dogs of LSD clearance and 2-oxy-LSD formation using the above methods; and (5) Utilize animal study data as the basis for the development of a method for the determination of the incidence, prevalence and relative risk of drug abuse in Army aviation personnel.

STATUS

This project has been terminated by command decision. The results of preliminary *in vitro* studies have been published in USAARL Report No. 72-9 (Studies of Fluorometric Assay Procedures for Lysergic Acid Diethylamide).

CORRELATIVE PHYSIOLOGY OF HUMAN IMPACT ACCELERATION ($-G_X$)

OBJECTIVE

To investigate the effect of the crash environment of human physiological functioning.

BACKGROUND

Little is known of the dynamic physiological response of the human in the crash environment. Proper design of helicopter and automobile crash protective gear will depend upon knowledge of the human response to the crash.

METHODOLOGY

Electroencephalograms, electrocardiograms, and respiratory rate will be monitored using controlled $-G_X$ accelerations of human Army volunteers exposed to acceleration of up to 10g with rates of onset at two levels, 250g/sec and 500g/sec. Changes in the three physiological parameters will be correlated with inertial accelerometer rate gyro, and photographic data.

STATUS

Twenty-seven (27) acceleration runs were made with both physiological and inertial instrumentation of human volunteers in FY 69. Analysis of the electroencephalogram is proceeding under separate precis. EEG data has been recorded on a strip chart to review for arrhymias. A histogram of heart rate response to acceleration has been made using analog methods. Digital histogram programs are in preparation. A hybrid program for analyzing rate response in "faster than real time" has been developed at the US Air Force Academy. The respiratory tracings may not be usable for respiratory dynamics, but as histograms of breath duration may be important. So far only visual scanning has been done.

TIME SERIES ANALYSIS OF THE IMPACT ACCELERATION ($-G_X$) ELECTROENCEPHALOGRAM

OBJECTIVE

To study the effects of impact acceleration on human electrical brain activity.

BACKGROUND

Very little is known of the acute dynamic human electroencephalogram alterations in head injury. Post-traumatic EEG's demonstrate "slowing" (or frequency changes) proportionate to injury. Knowledge of the dynamic alterations in the human brain electrical activity may provide criteria for selection of and evaluation of human head protective gear.

METHODOLOGY

Army volunteers will be subjected to $-G_X$ accelerations with velocities of onset at 250 and 500 g/sec and peak attained forces up to 10g. A full EEG will be recorded upon selection of each subject for baseline purposes. A 4 lead EEG will be recorded 30 minutes prior to each acceleration run, during the run, and 30 minutes post run. Comparisons will be made and changes keyed to inertial data.

STATUS

Twenty-seven (27) acceleration runs were made with both physiological and inertial instrumentation of human volunteers in FY 69. The EEG records have been reviewed by one neurologist. Selection of 12 excellent or good quality recordings has been made for initial computer analysis. Time series analysis computer programs have been prepared for examining the non-stationarity of the frequency content of the data with comparisons among leads and between time periods. Digital filters have been developed for use during analog-to-digital conversion of the raw data due to a high content of extraneous signal. Contour and three-dimensional plotting packages have been developed for graphically depicting non-stationarities. A technique for vastly improving the signal to noise ratio of the data using statistical regression techniques in the frequency domain has been developed. All data have been digitized, calibrated, and final analysis is being performed.

USAARL DATA PROCESSING PROGRAM LIBRARY

OBJECTIVE

To establish a program library of checked-out, easily usable computer programs which are applicable to greater than one-time use.

BACKGROUND

Investigators at a biomedical institution should be able to have easy access to any computative method appropriate to the solution of a research problem or question. Often these methods will involve analog, digital, or hybrid computation. Since these problems amenable to computer processing may often require programs of similar nature, a library of prepared programs should be provided.

METHODOLOGY

Statistical and data reduction programs will be added to the library as the needs of the investigators at the laboratory dictate. In cases in which required programs exist commercially, or can be acquired by purchase, they will be purchased. Some specialized needs will arise for which programs will have to be developed from scratch.

STATUS

Seventy or more statistical and general data reduction programs have been developed or purchased with full coding and documentation provided. The documentation resides in the USAARL Library while the actual programs are stored on digital magnetic tape or cards. A general purpose analog-to-digital program has been developed for use on the Sigma 2/Sigma 7 computer system at the University of Alabama. From NASA's Cosmic services programs for time series vibration analysis, human thermal stress analysis, contour plotting, Cal-Comp plotting and Fortran flow charting have been purchased, modified and documented. Computer requirements have been evaluated at USAARL and a document prepared, Data Automation Requirement, which was submitted to the Office of The Surgeon General, Washington, D.C. This has been approved and specifications for the equipment written. DA approval should come by the end of FY 72, with equipment arriving in about one year. An incremental, 22" Houston Instruments

Plotter with a tape drive has been leased to speed up the enormous quantities of digitally generated plotting being done. USAAAVS 360/50 has been utilized more and more at no cost to the Laboratory. The Time Sharing system at Rome Air Development Center has been utilized to a small extent, primarily for training purposes.

CARBON MONOXIDE STUDIES OF THE TH-55 AT FORT WOLTERS

OBJECTIVE

Fort Wolters, after having previously detected carbon monoxide intoxication in a fatally injured pilot, asked USAARL to investigate the source of high concentrations of carbon monoxide found in the cockpit of the TH-55 helicopter.

BACKGROUND

Fort Wolters experienced carbon monxide in cockpits of the TH-55, and USAARL was asked to discover the reasons.

METHODOLOGY

A Beckman carbon monoxide analyzer with a digital print-out was used. Samples were obtained with Ambu bags.

Preliminary tests were undertaken to establish a protocol for detailed tests and to give a rough evaluation of the extent of the problem and forecast the degree of testing required. The aircraft was studied under various ground and hover conditions which simulated normal usage.

STATUS

The original tests at Fort Wolters found the CO contamination to be due to a faulty heater exchange system. Investigators from USAARL went to Hughes to evaluate a new heater system. Recent tests conducted at Fort Wolters have shown the new Hughes heating system to have eliminated the carbon monoxide contamination problem.

This project has been completed. The impetus provided from this study has led us into the investigation of CO indicators and a general study of CO in Army aviation.

STUDY ON THE EFFECT OF STRESSES ON ARMY AVIATION PILOT PERFORMANCE - PHASE I
(with special emphasis on visual performance and hypoxia)

OBJECTIVE

The objective of this project is to establish and utilize a pilot performance test that will critically evaluate the effects of hypoxia, hangover and other drugs in an environmental chamber with simulated pilot visual performance tests.

BACKGROUND

As Army aviation continues to grow and aircraft performance becomes more advanced, problems of hypoxia are brought more into focus. Since oxygen systems are removed from most Army aircraft and surface ceilings are increasing, it makes this problem even more acute in helicopters where visual performance with marginal lighting and irregular missions frequently characterize the operational environment.

From a literature study which was conducted it was shown that there have been varying results as to the effects of hypoxia and the aftereffects of alcohol on cognitive function, visual inputs and psychomotor performance.

METHODOLOGY

All available equipment will be reviewed to determine which will be best to carry out a critical pilot performance test. When this equipment has been acquired a suitable experimental design will be established.

STATUS

Literature review has been completed. Equipment and personnel have been assembled. It is anticipated that data collection will begin some time around the first of June.

THE AIR AMBULANCE: A STUDY OF ITS USE AND UPGRADING OF EQUIPMENT AND CREWS - PHASE I, II & III

OBJECTIVE

The purpose of this study is to objectively examine the air ambulance for use as a rescue and rapid transit transport vehicle of critically injured patients. The care the patient receives from the medical personnel on board the helicopter will be given special emphasis.

BACKGROUND

Although the use of helicopters in medical evacuation has grown to major proportions, a literature review quickly shows there is a gross lack of communication in this area. The need for a critical review is obvious if the air ambulance is to be improved.

METHODOLOGY

An evaluation of equipment, training and mission of the military and civilian personnel used for medical evacuation (air ambulance).

Development of mission oriented training test for the delivering of acute medical care by medical crews.

Study selection and/or evaluation of upgraded equipment in medevac helicopters.

STATUS

A literature review has been completed. A working ad hoc committee met for two days to discuss use and upgrading of helicopter peripheral equipment and crews in medical evacuation. Steps presently are being taken to disseminate this information and to get recommendations for improvements.

THE EVALUATION OF THE DRAGER PORTABLE VENTILATOR KIT FOR USE IN CONJUNCTION WITH HELICOPTER EVACUATION

OBJECTIVE

The Army has a need for a better portable ventilator to be used in helicopter evacuations. This investigation will determine if the Drager portable ventilator kit fulfills the Army's needs. Things to be evaluated in the testing are portability, the parameters of the ventilator and its reliability under field conditions.

BACKGROUND

Several NATO nations are presently utilizing the Drager portable ventilator.

No literature has yet been found of previous Army research in the evaluation of portable ventilators or the Drager portable ventilator kit, in particular.

The instruction and technical manual provided by the manufacturer of the unit will serve as a guide to the unit's use and testing. One aim of the evaluation is to compare specifications claimed in the technical manual with tests to be carried out in this laboratory.

METHODOLOGY

All the operation testing will be carried out at ground level, 3000 feet, 6000 feet and 9000 feet.

Some of the specific information provided by the testing will be pressure level at which valve initiates inspiration or expiration, mean pressure, rate of flow, change in flow rate with time, change in pressure with time and the percent of oxygen in inspired air.

STATUS

This study has been completed and results are forthcoming.

THE EVALUATION OF THE "DETECTOR" CARBON MONOXIDE INDICATOR

OBJECTIVE

This study is designed to evaluate the "Detector" carbon monoxide indicator as a warning system in Army aircraft.

BACKGROUND

Reports from the Primary Helicopter Training Center at Fort Wolters, Texas, have indicated that the "Detectors" they have installed in their helicopters behave erratically.

A report issued by the FAA in 1966 on the same indicators states that they operate adequately within aviation safety perimeters.

METHODOLOGY

Several "Detector" CO indicators are subjected to several CO concentrations for various periods of time. The color change initiated by the CO on the indicators is then evaluated.

Data obtained from these tests are then compared to the safety levels for CO in aircraft as established by the FAA.

STATUS

All background material has been received and evaluated. The experimental design has been determined and is now operational. The testing of the indicators is now underway.

STUDY OF CARBON MONOXIDE IN AVIATION

OBJECTIVE

The aim of this project is to test the various aircraft that are presently being used by the military for any carbon monoxide that may be present.

BACKGROUND

There have been many new advances in aviation technology in the last few years, and many of the new weapon systems and aircraft productions have never been tested for the presence of toxic gases. The weapon systems and engine exhaust of these productions are potential sources of toxic gas hazards.

Previous investigations of some military aircraft have found CO levels in the aircraft to be at unsafe levels.

METHODOLOGY

This study will test a given sample of the aircraft that is currently being used at Fort Rucker. The aircraft will be tested in configurations and positions as stated in MIL-STD-800.

STATUS

This project is essentially an extension of the CO studies conducted on the TH-55 helicopter. Studies of the TH-55 helicopter have been completed. No further immediate studies are projected. The study capability still exists, should a problem arise in the future.

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY

1. AGENCY ACCESSION*	2. DATE OF SUMMARY*	REPORT CONTROL SYMBOL
DA OD 6733	72 06 30	DD-DR&E(AR)636

3. DATE PREV SUM'RY	4. KIND OF SUMMARY	5. SUMMARY SCTY*	6. WORK SECURITY*	7. REGRADING*	8A. DISS'N INSTR'N	8B. SPECIFIC DATA-CONTRACTOR ACCESS	9. LEVEL OF SUM
71 06 21	D. Change	U	U	NA	NL	☒ YES ☐ NO	A. WORK UNIT

10. NO./CODES:*	PROGRAM ELEMENT	PROJECT NUMBER	TASK AREA NUMBER	WORK UNIT NUMBER
a. PRIMARY	62110A	3AO62110A 819	00	50
b. CONTRIBUTING				
c. CONTRIBUTING	CDOG 114(f)			

11. TITLE (Precede with Security Classification Code)*

(U) Research of Visual Problems Medically Significant to Army Aviation (04)

12. SCIENTIFIC AND TECHNOLOGICAL AREAS*

001300 Aircraft; 012000 Optics; 012900 Physiology

13. START DATE	14. ESTIMATED COMPLETION DATE	15. FUNDING AGENCY	16. PERFORMANCE METHOD
64 05	Cont	DA	C. In-House

17. CONTRACT/GRANT

a. DATES/EFFECTIVE: EXPIRATION:

b. NUMBER:* Not Applicable

c. TYPE: d. AMOUNT:

e. KIND OF AWARD: f. CUM. AMT.

18. RESOURCES ESTIMATE	a. PROFESSIONAL MAN YRS	b. FUNDS (In thousands)
FISCAL YEAR PRECEDING 72	3.5	16
FISCAL YEAR CURRENT 73	3.8	34

19. RESPONSIBLE DOD ORGANIZATION

NAME:* US Army Aeromedical Research Laboratory

ADDRESS:* Fort Rucker, Alabama 36360

RESPONSIBLE INDIVIDUAL

NAME: Bailey, Robert W., COL, CO

TELEPHONE: (205) 255-5107

20. PERFORMING ORGANIZATION

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ADDRESS:* Biophysics Division
Fort Rucker, Alabama 36360

PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)

NAME:* Crosley, J. K., MAJ

TELEPHONE: (205) 255-4408

SOCIAL SECURITY ACCOUNT NUMBER:

ASSOCIATE INVESTIGATORS

NAME: Braun, E. G., MAJ

NAME: DA

21. GENERAL USE

Foreign Intelligence Considered

22. KEYWORDS (Precede EACH with Security Classification Code) (U) Aircraft; (U) Pharmocology; (U) Human Factors Engineering; (U) Protective Equipment; (U) Man-Machine Relations; (U) Human Volunteers; (U) Psycho; (U) Optics; (U) Stress Physiology; (U) Bioengineering; (U) Personnel Selection (Medical); (U) Weapon Effects

23. TECHNICAL OBJECTIVE,* 24. APPROACH, 25. PROGRESS (Numbered individual paragraphs identified by number. Precede text of each with Security Classification Code)

23. (U) To provide information about the visual sensory modality which has medical importance for US Army aviation.

24. (U) The approach will involve the employment of sound visual research practices in studying vision in its current and potential use in Army aviation.

25. (U) 71 07 - 72 06 Progress is shown by: USAARL Report 72-3 describing Static Comparison of Vertical Tape and Vertical Light-Emitting Diode Displays; USAARL Report 72-15 concerned with Improving US Army Aircraft Propeller and Tail Rotor Blade Conspicuity with Paint. Progress also has been made in the following areas: high intensity xenon flashtube lighting system; evaluation of color vision requirements of numerous aviation-oriented MOS's; research concerning lighting standards for all Army rotary wing aircraft; technical guidance for the development and evaluation of eyewear, designed to provide laser protection for the aviator; evaluation of sample surface hardness coatings for plastic materials; evaluation of a neodymium helmet visor was performed in the area of luminous transmittance, optical distortion, and optical integrity; in-flight study of the rotor-mounted radar Helicopter Multifunction System (HELMS); a photometric analysis of the interior/exterior lighting, and distortion study of the canopy of the AH-56A (Cheyenne); an analysis of the parimetric characteristics of the DH-132 tanker helmet, and comparison to the standard helmet; evaluation of the Bausch and Lomb hydrophilic contact lens; and the evaluation of a plastic ophthalmic frame as a possible replacement for the present aviator standard metal flying goggle.

*Available to contractors upon requestor's approval

GENERAL DETAIL SHEET

TITLE: Research of Visual Problems Medically Significant to Army Aviation

OBJECTIVE:

To provide information about the visual sensory modality which has medical importance for US Army Aviation.

BACKGROUND, METHODOLOGY, STATUS:

Statements concerning the above for this area of research can be found on the following pages numbered 42 through 48.

RECOMMENDATIONS:

It is recommended that research in this area be funded on a continuing basis.

PHYSIOLOGICAL OPTICS (OPTICAL DEVICES)

OBJECTIVE

The objective of this study is to investigate existing problem areas as they pertain to the vision of the Army aviator. This includes such areas as spectacle lenses, spectacle frames, and the spectacle insert for the aviator CB mask.

BACKGROUND

Certain problems exist with presently available spectacles and lenses for the aviator. These primarily concern comfort while wearing the helmet, safety, lens breakage, cost, field of view, retention, and weight.

This Laboratory, in cooperation with the US Army Optical Activities Branch, Fitzsimons Army Hospital, Denver, Colorado, has undertaken a series of flight evaluations of various optical eyewear.

METHODOLOGY

Personnel on active flight status have been chosen to participate in the evaluation of several types of plastic spectacle frames as a possible substitute for the present gold-filled aviator's flying goggle. Another group of aviators have been provided with a pair of clear corrective plastic lenses and a pair of tinted (15% transmission) corrective plastic lenses to determine the relative merits of this material as compared to conventional crown glass.

It is anticipated that a spectacle insert will be designed by this Laboratory for incorporation into the aviator CB mask. A previous study has shown an undesirable reduction in the normal field of view when wearing the presently available insert.

STATUS

A group of aviators requiring visual ophthalmic correction have been selected and examined prior to their participation in an evaluation of the Bausch and Lomb hydrophilic contact lens. This program is designed to investigate the military potential of this type of lens in the aviation environment.

A study designed to evaluate a plastic ophthalmic frame as a possible replacement for the present aviator standard metal flying goggle has been delayed for a period of time. Prototype frames ordered from the Shuron-Continental Optical Company were due to be delivered in April 1972. However, a manufacturer's strike, which had been in progress for approximately three months, is now settled and delivery is expected in June 1972.

VISIBILITY CRITERIA ASSOCIATED WITH ARMY AVIATION

OBJECTIVE

The object of this study is to evaluate some of the controllable variables that influence the visual information input to the Army aviator in flight.

The study has, to date, been divided into the following areas of investigation:

a. Reflection characteristics of painted, non-functional portions of aircraft interiors and their effects upon visual information input.

b. Cockpit instrument lighting for night flying and the requirements for dark adaptation integrity and mission accomplishment.

c. Aircraft conspicuity (day and night) as a function of visual variables relating to the use of paints and/or high-intensity lighting.

d. Optical characteristics of visual aids and surfaces such as visors, windscreens, special spectacles, windows, gas mask face shields, etc., and their relationship to the performance and perceptual input of the visual mechanism as it affects flight control.

e. Critical viewing distances of instrument groups in the cockpit and the resultant effect upon the older aviator.

f. General support projects to include fundus photography for chloroquine retinopathy and INH studies, and an evaluation of a flash suppressor for the XM-18 and XM-28 weapon systems.

g. Photometric measurements of proposed light emitting diode vertical tape aircraft instruments.

h. The use of retroreflectors as a means of marking runways and heliports.

BACKGROUND

Observations made while flying in current Army aircraft indicate a need to reduce unwanted light reflections (glare) in

the windscreen. This glare originates primarily with the personnel being evaluated concerning tuberculosis, the long term use of chloroquine, analysis of possible lenticular changes in animals resulting from electrosleep studies, and possible exposure to injury-producing levels of ionizing radiation are photographed. The performance of aviators can be adversely affected by the presence of excessive muzzle flash associated with the night firing of aircraft-mounted weapon systems. The accompanying degradation of dark adaptation when exposed to this flash creates a hazardous situation which could lead to the loss of personnel and aircraft.

Present mechanically-operated vertical engine instrument displays have demonstrated a possible problem with reliability. Efforts to advance technology have resulted in the use of light emitting diodes as a potential replacement for the mechanical tape.

Pilots making nighttime approaches to both fixed wing runways and heliports depend upon lighted displays to assist them in alignment for landing and to provide guidance during taxi or hover operations. Retro-reflectors have been installed and evaluated as an aid in these operations.

METHODOLOGY

Conspicuity studies involving high-intensity lighting and external paint schemes to optimize contrast and conspicuity are studied in the field subsequent to laboratory pilot models and literature reviews. Similar methods are employed to study methods of eliminating bothersome reflections. Photographic and subjective techniques are also employed in these studies. Secondary glare sources in the windscreen are also studied by photometric methods and Duntley Black Spot Method. Lensometric evaluation is employed to evaluate the distortions of similar magnitude are evaluated in the flying environment. The effects of instrument lighting levels are evaluated in the laboratory and in the field to determine the effects of these lighting systems on the photo receptors of the eye. The response of the aviator to weapon muzzle flash is evaluated with a specially designed field photometer. Photometric measurements of ophthalmic lens reflections combined with field evaluations provide sufficient data for determining the effectiveness of non-reflective coatings. Field studies are conducted on materials designed to provide increased scratch-resistance to stretched acrylic aircraft windscreens and also plastic ophthalmic lenses. Measurements from the design eye level to clusters of critical aircraft instruments are taken

for each type of aircraft and provided to eye clinics throughout the Army. Photometry is performed to determine the physical light characteristics of aircraft instruments including those utilizing light emitting diodes. Retro-reflectors are installed on runways and heliports and their effectiveness evaluated through aviator in-flight response.

STATUS

A decision has been reached to equip all Army aircraft with a high intensity xenon flashtube lighting system which will provide separate day and night light levels for anticollision purposes. Recent coordination between this Laboratory and the US Army Aviation Systems Command, St. Louis, has resulted in a document outlining the performance specifications for this system. Special radiometric equipment has been obtained to provide the capability for measuring the luminous output of Army high intensity flashing or steady-burning lamps.

In-flight research conducted at Ft. Rucker and Ft. Wolters, Texas has provided sufficient data to warrant a request for relief from new FAA nighttime lighting standards for all Army rotary wing aircraft. It has been shown that the required intensity levels are too bright for safe usage at night, and more acceptable levels have been established. It is anticipated that these results will trigger a reevaluation of their position by the FAA.

Upon request, this Branch evaluated the color vision requirements of numerous aviation-oriented MOS's. This information will provide a basis for possible changes in present standards pertaining to color vision requirements for these personnel.

An in-flight study was performed to determine a means for enhancing the conspicuity of airplane propellers and helicopter tail rotors through the use of paint. The results indicate that the standard paint schemes in use are not maximally effective. A report, presently being printed, recommends a new scheme which is significantly superior in providing visual stimulation.

This Laboratory is providing technical guidance for the development and evaluation of eyewear designed to provide laser protection for the aviator.

Upon request from Combat Developments Command (Aviation), a study was conducted to determine the degree of protection from nuclear flash provided by the standard N-15 helmet visor.

Equipment has been ordered to enable this Branch to conduct visual examinations while the patient is in the dark-adapted state. This will permit the determination and measurement of physiological changes ("night myopia") known to occur in a large percentage of the aviator population. The results of this study may indicate the need for special ophthalmic lens during certain night operations.

Sample surface hardness coatings for plastic materials have been received from several sources and will be evaluated to determine their relative merit. Information from this study will be of value in determining methods for reducing surface scratching and abrasions in such aviation items as ophthalmic lens, helmet visors, and aircraft canopies and windscreens.

Upon receipt of a Nikon biomicroscope (slit lamp), a program was initiated to improve the recommended technique for photographing the eye. In addition to 35 millimeter photographs, a Polaroid back was adapted to the instrument. This has provided the means for instant photographs and is much more suitable for certain requirements.

An evaluation of a neodymium helmet visor was performed in the areas of luminous transmittance, optical distortion, and optical integrity as requested by the US Army Aviation Test Activity, Edwards AFB, California.

An in-flight study of the rotor-mounted radar Helicopter Multifunction System (HELMS) was conducted in conjunction with the USA Aviation Test Board.

A photometric analysis of the interior/exterior lighting, and a distortion study of the canopy was completed on the AH-56A (Cheyenne) helicopter at Yuma, Arizona.

A final Laboratory report was written concerning a photometric evaluation of four prototype aircraft vertical tape instrument displays utilizing light-emitting diodes.

In support of a Laboratory effort regarding the DH-132 Tanker Helmet, this Branch has completed an analysis of the perimetric characteristics of this helmet in comparison to the standard helmet.

Equipment is presently being fabricated which will provide a sensitive method for determining whether spatial distortion might be expected by the helicopter gunner when employing a helmet-mounted sighting device.

A feasibility study has been initiated to investigate the use of small rubber bands applied to the spectacle temple as an expedient means of tightening a loose-fitting frame.

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY

1. AGENCY ACCESSION	2. DATE OF SUMMARY	REPORT CONTROL SYMBOL
DA OD 6739	72 06 30	DD-DR&E(AR)636

3. DATE PREV SUM'RY	4. KIND OF SUMMARY	5. SUMMARY SCTY	6. WORK SECURITY	7. REGRADING	8a. DISP'N INSTR'N	8b. SPECIFIC DATA-CONTRACTOR ACCESS	9. LEVEL OF SUM
71 06 21	D. Change	U	U	NA	NL	☒ YES ☐ NO	A. WORK UNIT

10. NO./CODES:	PROGRAM ELEMENT	PROJECT NUMBER	TASK AREA NUMBER	WORK UNIT NUMBER
a. PRIMARY	62110A	3AO62110A 819	00	119
b. [illegible]				
c. [illegible]	CDOG 114(f)			

11. TITLE (Precede with Security Classification Code)

(U) Research of Psychoacoustical Problems Medically Significant to Army Aviation (05)

12. SCIENTIFIC AND TECHNOLOGICAL AREAS

001300 Aircraft; 021000 Radio Communications; 000200 Acoustics

13. START DATE	14. ESTIMATED COMPLETION DATE	15. FUNDING AGENCY	16. PERFORMANCE METHOD
60 07	Cont	DA	C. In-House

17. CONTRACT/GRANT

a. DATES/EFFECTIVE: EXPIRATION:
b. NUMBER: Not Applicable
c. TYPE: d. AMOUNT:
e. KIND OF AWARD: f. CUM. AMT.

18. RESOURCES ESTIMATE		a. PROFESSIONAL MAN YRS	b. FUNDS (In thousands)
FISCAL YEAR	PRECEDING 72	4	86
	CURRENT 73	5	94

19. RESPONSIBLE DOD ORGANIZATION

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NAME: DA

21. GENERAL USE

Foreign Intelligence Considered

22. KEYWORDS (Precede EACH with Security Classification Code) (U) Aircraft; (U) Conversion Techniques; (U) Man-Machine Relations; (U) Human Volunteers; (U) Protective Equipment; (U) Recording Devices; (U) Weapon Effects;

23. TECHNICAL OBJECTIVE, 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)

(U) Acoustic Detection; (U) Electronic Engineering; (U) Communications; (U) Information Theory; (U) Radio Communications

23. (U) To provide information about sound which has medical import to US Army aviation.

24. (U) The approach will be twofold. One will entail the physical description of the critical sound stimuli found in US Army aviation. This will involve descriptions at the generators or sources as well as descriptions of subsequent changes that may be precipitated by various propogating media. The second approach will involve studying the effects of these sounds on human receivers. Both approaches will employ valid research practices.

25. (U) 71 07 - 72 06 Progress in this area is reflected by reports on the following topics: The Effects of Air Inlet Modifications on the Sound Spectra of US Army CH-47C Helicopter Auxiliary Power Unit Noise; Impulse Noise of One-Half and One-Quarter Pound TNT Charges When Detonated in a Corrugated Steel Drainage Pipe; Noise Spectra of the Synthetic Flight Training System, Model 2B24; and Real-Ear Sound Attenuation Characteristics of Hearing Protective Devices Available Through Federal Supply Channels. The advanced voice communication system has been completed and is being tested in UH-1 and CH-47C helicopters. The noise cancelling microphones are being tested with the newly developed communication systems.

*Available to contractors upon originator's approval

GENERAL DETAIL SHEET

TITLE: Research of Psycho-Acoustical Problems Medically Significant to Army Aviation

OBJECTIVE:

To provide information about sound which has medical importance to US Army aviation.

BACKGROUND, METHODOLOGY, STATUS:

Statements concerning the above for this area of research can be found on the following pages numbered 51 through 59.

RECOMMENDATIONS:

It is recommended that research in this area be funded on a continuing basis.

ACOUSTICAL AND VIBRATION ENVIRONMENT OF U. S. ARMY AVIATION PERSONNEL

OBJECTIVE

The objectives of this work are to determine noise and vibration spectra of the various environments in which U. S. Army aviation personnel are required to perform their duties. These data will be used not only as a basis for the design and supply of protective equipment, but also as a means for improvement of future equipment designs.

BACKGROUND

Due to the wide variety of acoustic problems in the U. S. Army and the need for effective solutions, it is necessary to have a knowledge of the characteristics of the acoustic environments of Army personnel.

Octave-band analyses have been useful for damage risk criteria and noise survey problems. The human ear response, on the other hand, is more analogous to third-octave spectra information. Also, for certain engineering purposes it is required to obtain narrow-band analyses. Therefore, three types of analyses will be desirable for adequate descriptions and treatment of acoustic problems.

For the above-stated reasons, it is desirable that three types of analyses be applied to noise data. This complete investigation of the characteristics of various acoustic environments will furnish valuable information not only for damage risk criterion applications, but also engineering applications of noise abatement programs.

In addition to acoustic measurements, there is also a need for the measurement of vibration spectra. Vibration and acoustics are very closely related and it is difficult to effectively solve acoustic problems without precise vibration measurements, since vibrators are often the acoustic source. Recent efforts to investigate the noise sources in Army aircraft so that new designs may be applied for noise reduction cannot be accomplished without complete vibration information. Also, there is a need to investigate the effects of vibration on the health and performance of personnel.

METHODOLOGY

Samples of noise data will be recorded with a precision magnetic tape recorder with a 70 dB signal-to-noise ratio. The analyses of the recordings will be done in the Laboratory with octave-band and third-octave band filters and real-time narrow-band instruments. Statistical descriptions of the mean sound pressure levels and standard deviations of the third-octave and octave-band data will be provided. For certain outdoor measurements, a precision fourteen-channel tape recorder will record data from multi-positions simultaneously.

The recording of vibration data will be made with the fourteen-channel recorder and play back in the Laboratory for narrow-band analyses. The wideband capabilities of this recorder from DC to 600,000 Hertz will cover adequately the vibration spectra that may affect the equipment or the human performance.

STATUS

Octave-band, third-band, and narrow-band analyses have been completed and reported on. Further analyses are presently being performed.

HEARING PROTECTION DEVICES EVALUATION

OBJECTIVE

The objectives are to: (a) maintain readily available data, recorded under USASI Z24.22 (1957) standardized procedures, of the attenuation offered by standard helmets, earmuffs and earplugs used by Army aviation personnel; and (b) estimate the protective properties of prototype equipment that will be considered for use by Army aviation personnel.

BACKGROUND

Since World War II, there has been an increase in the interest and effort to perfect devices for the protection of personnel from harmful high sound pressure levels. The effort has resulted in the development of earplugs, earmuffs and helmets designed for sound attenuation.

Although the present prototype ear protection devices seem to reflect an asymptote in the rise of efficiency realized in the 1950's and early 1960's, there is still a need to properly evaluate the attenuation characteristics of all prototypes and standard equipment worn by Army aviation personnel. The real-ear method of psychophysically testing the effective attenuation at the human ear is the method presently preferred.

It is important to maintain available data about the attenuation characteristics of all standard and proposed equipment. These data are necessary for ascertaining noise levels in which personnel can safely operate. This information is invaluable to medical personnel who prescribe devices for the adequate protection against noise. Such information, therefore, is in constant demand by laboratories concerned with noise problems, Army agencies responsible for design of helmets, medical personnel, and private manufacturers of Army aircraft.

METHODOLOGY

Psychophysical measurements of attenuation will be made. The procedure will be in line with the USASI Z24.22 (1957) standards.

STATUS

In anticipation of a change of the standard method for testing real-ear attenuation, plans are in progress for the purchase of a reverberation room. A study of ear protective devices suitable for tank personnel has been completed.

EFFECTS OF DISTORTION IN MILITARY COMMUNICATION SYSTEMS

OBJECTIVE

The purpose of this investigation is to study the effects of the following three important variables:

a. Type of microphone

b. Environmental noise level

c. Distortion on the intelligibility of military communication systems.

Objectively, an attempt will be made to show the theoretical limits communicating in noise with idealized systems, to estimate the relative efficiency of present systems and to make recommendations on methods to improve the present systems. The hypothesis of this project is that systems with low distortion are the most suitable for communicating in high noise levels.

BACKGROUND

During the early development of telephone communication systems, Bell Laboratories did extensive basic research concerned with the investigation of speech intelligibility parameters. The results of this research have shown that the process of communicating with speech is complex. Volumes have been published on the analyses of speech. The complex analyses have not yielded simple basic constituents that a layman may easily synthesize for practical application. It was only through close coordination of scientists in the field of psychophysics and engineers who designed the communication systems that the Bell Telephone achieved its successful application of the results of their basic research. The present networks of the telephone cables which transmit reliable messages around the world is a manifestation of the success.

The development of radio and intercommunication systems in military and commercial aircraft has not had the same degree of success. It is difficult to state the precise reasons for the arrested progress of the military applications. This project is proposed as an attempt to probe some of the causes of the present inefficient systems.

The prinicipal investigator has had training and research experience in the field of speech communication. From 1952 to 1957 he was associated with the Ohio State Research Foundation conducting research concerned with investigating parameters of speech communication in noise. The most significant contribution was the publication entitled "Perception of Multiple-Choice Intelligibility Items in the Presence of Simulated Propeller-Type Aircraft Noise." This was a long term empirical study of multiple-choice words as a tool for expedient measurements in research applications. Close approximation of the functions was determined to be a system of Poisson equations.

Articulation indices have been computed by Bell Laboratories. Most of the basic research of the analysis of speech may be found in Speech and Hearing, 1929, by Harvey Fletcher.

METHODOLOGY

Three types of microphones will be used. An omnidirectional condenser microphone, a military type noise cancelling dynamic lip microphone, and an inertial contact transducer, to be placed on the head of the speakers, will serve as transducers for picking up speech of talkers. Each of these microphones will be fed into systems of low distortion and recorded.

Each talker will be fitted with the three microphones for simultaneous recording of lists of phonetically balanced (PB) words. A list of words will be spoken under four environmental conditions. The talkers will speak under a condition of quiet and three levels of ambient white noise. The sound pressure levels of the noise will be 100 dB, 110 dB, and 120 dB (re 0.0002 dyne/cm^2). Recordings of simultaneous pick-ups from each of the three microphones will be presented to listeners who will be instructed to write down the words. Samples of listeners will be divided into six groups. Each of three groups will listen to one of the three microphones with amplification conditions of frequency and amplitude distortion. The frequency distortion will be a filtered band-pass of 200 Hz - 6,000 Hz. Scores of each group of listeners will be the measure of the intelligibility of the experimental conditions.

Type of Microphones: The three types of microphones chosen for the experiment are various types usually discussed in most controversies about selection of proper transducers for transmitting speech in noise. The omnidirectional condenser microphone is extremely linear throughout the speech frequencies.

The noise cancelling dynamic microphone is a type presently used with military helmets. The contact microphone receives the vocal signal via bone conduction. It represents a type of transducer that is frequently suggested by layman to replace the conventional lip microphone. The simultaneous recording of the same speech signal with the three types of microphones will serve to make a direct comparison of the relative efficiencies of the three.

Environmental Noise Levels: The ambient sound pressure level of environments in which the speech is picked up by the microphone is a very important variable of the communication situation. A range of ambient SPL quiet, 100 dB, 110 dB and 120 dB (re 0.0002 dyne/cm^2) is chosen because it is an approximation of the dynamic range of most aircraft noise. The variable will furnish valuable information about the relative performance of the three microphones in a wide dynamic range.

Frequency and Amplitude Distortion: Most aviation communication systems have characteristics that introduce amplitude and frequency distortion. The width of the passed band of frequencies is usually less than the width of the speech spectrum. Also, often the dynamic range of the speech signal is distorted by peak clipping. The 200 - 6,000 Hz bandpass filtering and the 20 dB clipping are considered to be a conservative estimate of the two types of distortion.

An experiment of this design will provide the necessary supplement to the existing knowledge of the speech communication process for subsequent application to the military communication systems in Army aircraft.

STATUS

The assembly of two portable experimental transmitter and receiver sets has been completed. A contract for the purchase of a new Bimorph noise cancelling microphone has been completed. An Electret noise cancelling microphone has been received and is being evaluated and compared with the newly developed Bimorph noise cancelling microphone. Tests of the experimental systems and microphones are in progress. System noise and speech intelligibility are being investigated.

ARMY AVIATION AUDIOMETRY PROGRAM

OBJECTIVE

The purpose of this program is to perform precision audiometric tests of a large sample of Army aviation personnel. The results of these tests will serve not only as valuable information about the status of hearing among Army aviation personnel, but also will serve as a basis for the ameliorization of the automatic audiometric testing conditions in U. S. Army aviation. This will be accomplished by the establishment of a more reliable audiometer calibration program, and the introduction of trained personnel with an MOS for operating audiometers.

BACKGROUND

A survey of audiograms of U. S. Army aviation personnel has revealed that a large percentage of young Army aviation personnel have hearing losses. The reliability of these data must be tested with a program of rigidly controlled instrumentation and testing procedures that will yield dependable data about the magnitude of hearing losses among U. S. Army aviation personnel. If the results of such tests show a significant difference between the health records data and the experimental data, there will be a recommendation for an ameliorization of audiometer calibration and audiometry in the U. S. Army.

METHODOLOGY

The first task will be to determine the proper audiometer for the making of precision audiograms. The audiometer may be chosen from several sources. Presently, the possibilities are the Rudmose ARJ-4, the Rudmose ARJ-5 or some of the new models of automatic audiometers developed by Grason-Stadler Company, Inc. After a suitable audiometer has been chosen, the testing program will proceed. The next task will be a treatment of the data to determine whether or not the differences between the health records data and the experimental data are of significance. If the differences are significant, then recommendations will be made as to how an improvement of audiometry may be accomplished. The requirement for having trained personnel with an MOS for audiometry and requirement for improved audiometer maintenance and calibration will be the primary recommendations. The acoustical environments of audiometric testing facilities in the Army will be investigated.

STATUS

A search of 1,000 health records has been made and the statistics concerned with hearing loss of various degrees as a function of frequency and age has been compiled. These statistics indicate that there is a severe hearing loss problem among U. S. Army aviation personnel. Also, the reliability of various audiometers has been investigated. Plans for the selection of a suitable audiometer for a program of precision audiometry are in progress. Requests for additional personnel with audiometric training will be made.

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY

1. Agency Accession: DA OD 6733
2. Date of Summary: 72 06 30
Report Control Symbol: DD-DR&E(AR)636

3. Date Prev Sum'ry: 71 06 21
4. Kind of Summary: D. Change
5. Summary Scty: U
6. Work Security: U
7. Regrading: NA
8. Dissem Instr'n: NL
9. Specific Data-Contractor Access: Yes / No
10. Level of Sum: A. Work Unit

Program Element: 62110A
Project Number: 3A062110A 819
Task Area Number: 00
Work Unit Number: 118

Contributing: CDOG 1120(9)

11. Title (Precede with Security Classification Code): (U) Research Psychology Applied to Medically Significant Problems in Army Aviation (06)

12. Scientific and Technological Areas: 001300 Aircraft; 009400 Man-Machine Relations; 013400 Psychology

13. Start Date: 65 02
14. Estimated Completion Date: Cont
15. Funding Agency: DA
16. Performance Method: C. In-House

17. Contract/Grant
a. Dates/Effective: Expiration:
b. Number: Not Applicable
c. Type: d. Amount:
e. Kind of Award: f. Cum. Amt.

18. Resources Estimate

Fiscal Year		a. Professional Man Yrs	b. Funds (in thousands)
Preceding	72	5	105
Current	73	7	52

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21. General Use: Foreign Intelligence Considered

DA

22. Keywords (Precede Each with Security Classification Code): (U) Military Aircraft; (U) Human Factors Engineering; (U) Man-Machine Relations; (U) Psychology; (U) Bioengineering; (U) Pharmacology; (U) Computers; (U) Safety Engineering; (U) Human Volunteers; (U) Recording Devices; (U) Stress Physiology; (U) Aeronautics

23. Technical Objective, 24. Approach, 25. Progress (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)

23. (U) To provide US Army aviation information that is medically important about the human factor in the aircraft man-machine system with special emphasis on the performance of this human factor and the variables that influence it.

24. (U) The approach will involve the application of current research techniques applicable to the objective as well as developing new techniques as required.

25. (U) 71 07 - 72 06 Progress is shown by: USAARL Report 72-11 describing the USAARL Helicopter In-Flight Monitoring System; USAARL Report 72-3 which reports the results of a study comparing prototype vertical light emitting diode displays with vertical tape displays; USAARL Report 72-12 which provides information about a number of parameters related to Army aviation in RVN as the results of a study concerned with the effect of differential velocity on the time prediction of motion. Progress has also been made in the area of recording and video taping visual and psychometer performance in the airborne environment. Progress is also reflected by the initiation, design, or data acquisition in the areas of pilot performance on landings, field dependence, autorotation accidents, effects of alcohol on performance, plotting flight data, gapping digital magnetic flight tapes void of inter-record gaps, and statistical analysis of flight data.

*Available to contractors upon originator's approval

DD Form 1498, 1 Mar 68 — PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE. DD FORMS 1498A, 1 NOV 65 AND 1498-1, 1 MAR 68 (FOR ARMY USE) ARE OBSOLETE

GENERAL DETAIL SHEET

TITLE: Research Psychology Applied to Medically Significant Problems in Army Aviation

OBJECTIVE:

To provide US Army aviation information that is medically important about the human factor in the aircraft man-machine system, with special emphasis on the performance of this human factor and the variables that influence it.

BACKGROUND, METHODOLOGY, STATUS:

Statements concerning the above for this area of research can be found on the following pages numbered 62 through 71.

RECOMMENDATIONS:

It is recommended that research in this area be funded on a continuing basis.

HELICOPTER IN-FLIGHT MONITORING SYSTEM

OBJECTIVE

The objective of this project is the construction and implementation of a system capable of simultaneously measuring and recording pilot and aircraft performance in the operational environment.

BACKGROUND

The simultaneous objective quantification of operational pilot and aircraft performance in rotary wing flying has seldom been done. An ability to do such quantification, however, would provide an efficient and effective means of assessing a wide range of variables which may effect aircraft performance and mission accomplishment. The range of variables which could be systematically studied with such quantification could include the various physiological and psychological states which the pilot brings with him to the flying situation, various aircraft configurations which affect involved aerodynamics, various display and control man-machine interfaces, a host of environmental factors which influence both man and machine, and the interactions of these variables.

Very limited quantified information with regard to this range of variables is currently available. A few studies have investigated pilot performance for a given aircraft in a limited number of maneuvers, but lack data relating the measured performance to resultant aircraft performance. It is possible that relatively wide individual differences in operator performance in certain areas might be tolerated providing the aircraft does not exceed the limits of determined flight envelopes which must be maintained for safe and successful mission accomplishment.

A small number of studies have quantified both aircraft and pilot performance. These studies, for the most part, have been concerned with performance differences with a modified aircraft, for some limited number of maneuvers or the assessment of flight capabilities and limitations of aircraft performing given maneuvers. These represent the systematic study of only a few of the many variables which must be explored if maximum utilization of pilot and aircraft are to be realized. The studies have also relied on photographic techniques which inherently reduces flexibility and creates certain problems in data reduction and analysis.

METHODOLOGY

This project is concerned with the construction and implementation of an airborne system capable of simultaneously measuring and recording both pilot and helicopter performance in all degrees of freedom. All measures will be collected in analog or digital electrical form, thus eliminating the use of photographic techniques for data acquisition. The data will be reduced and analyzed by ground-based digital computers. Such a system will provide a flexible research tool which will greatly facilitate the investigation of a wide variety of variables which may affect human performance, e.g., variations in material configurations; the effects of environmental variables on both the human component and the aircraft systems; the effect of human performance of various physiological and psychological states; and the interactions of these variables as they affect aircraft performance.

STATUS

System components have been acquired for both ground and aircraft installations and have been installed.

Software for binary to decimal conversion of in-flight measures of performance has been completed and work on statistical software for analyzing these measures is continuing.

Calibration data tapes are being analyzed with necessary modifications to slopes and derived normals being performed.

Property required for the transmitters and receivers of the ranging system has been leased. Associated antennas have been erected and power for same will be installed soon.

A technical report describing the Helicopter In-Flight Monitoring System has been published (Ref. USAARL Report No. 72-11).

STATIC COMPARISON OF VERTICAL TAPE AND VERTICAL LIGHT EMITTING DIODE DISPLAY

OBJECTIVE

The objective of this study was to compare vertical tape and vertical LED displays on a number of parameters.

BACKGROUND

The Army currently employs vertical tape instruments in the OV-1C and OV-1D aircraft which are multi-engine reconnaissance aircraft. These vertical tape instruments are first generation types of vertical displays. The state-of-the-art of some vertical instruments has improved. It is now possible, in some displays, to use inferred movement vertical displays rather than the vertical tape. The reliability of these inferred movement displays is estimated to be many times higher than the type of vertical tape currently used in the OV-1 aircraft. In addition, considerable weight reduction should be experienced due to solid state construction of the inferred movement displays.

The type of inferred movement display under consideration as an alternative to the vertical tape display is a light emitting diode display which resembles a vertical tape instrument in facial design, but in which a stack or column of light emitting diodes replaces the vertical tape. Before an inferred movement display can or should be substituted for a vertical tape display, systematic evaluations must be done, not only to ascertain the good points or advantages of light emitting diode displays, but also to uncover any shortcomings of these displays.

This study evaluated light emitting diode displays in three areas: (1) an experimental comparison of a light emitting diode display and a vertical tape display to discover if any differences between these two types of displays existed with respect to reading speed and accuracy; (2) a human factors design criteria evaluation to ascertain whether displays submitted for study met military specifications and/or empirically determined specifications for size and proportionality of facial characteristics; (3) a photometric evaluation of the light transmitting characteristics of the light emitting diode and vertical tape displays.

METHODOLOGY

This study was performed in three parts. The first part consisted of comparing a prototype light emitting diode vertical display with a current vertical tape display, for reading speed and accuracy, under two viewing angles, three levels of illumination, and two time conditions. In addition, absolute errors in reading were greater for the LED display than they were for the vertical display. Time conditions and angles did not have a significant effect, while illumination level for the the LED's was of importance.

Part II consisted of a human factors facial design evaluation for one vertical tape display and four prototype LED displays.

Part III consisted of a photometric evaluation of the four LED displays.

STATUS

The results of this study have been published in USAARL Report 72-3.

VIETNAM RETURNEE QUESTIONNAIRE

OBJECTIVE

The objective of this project was to gather certain information from Army aviators about Army aviation as it existed and operated in RVN.

BACKGROUND

USACDCAVNA, HUMMRO, USAAAVS, and USAARL were interested in obtaining information about selected topics related to Army aviation in RVN. Consequently, they developed a questionnaire to cover these topics.

METHODOLOGY

A questionnaire was given to Army aviators shortly after returning from RVN. This was then returned to HUMRRO who made it available for evaluation. This ongoing questionnaire is modified when a sufficient number of responses to a question have been received or pertinent questions need to be added.

STATUS

Responses to 300 questionnaires have been punched on cards and particular responses analyzed. A report on this data has been published in USAARL Report No. 72-12.

DIFFERENTIAL VELOCITY AND TIME PREDICTION OF MOTION

OBJECTIVE

This study is designed to determine the effects of training differences, and differential velocity on time prediction of motion.

BACKGROUND

Predictions as to when two moving objects will reach an intersection are frequently made by everyone. In many instances, such predictions are critical because errors can be costly in terms of lives and dollars. Minimal information is available on how accurately people perform this task and the effects of training and differential velocities.

METHODOLOGY

An inferred movement display was utilized. Target vectors capable of various velocities moved toward one another at right angles. Subjects made time predictions as to the arrival of each target vector at the intersection point. The time predictions were converted to absolute and constant error for analysis.

STATUS

Data collection and analysis has been completed on two groups of subjects. The results have been published in USAARL Report 72-14.

ATTITUDES OF AVIATION WARRANT OFFICER CANDIDATES

OBJECTIVE

To assess the attitudes of aviation Warrant Officer Candidates toward several factors relating to the Army and flight training with an attempt to detect shifts in attitude as a function of time in the program.

BACKGROUND

Pilot behavior is important to Army aviation, and attitudes are characteristics which serve to identify or explain behavior. Therefore, the study of attitudes may be important in evaluating behavior patterns and detecting problem areas. These areas may then be modified to alter attitudes and consequent behavior.

METHODOLOGY

Aviation Warrant Officer Candidates will be sampled in a cross-sectional sampling design using a sentence completion test. Responses will be factor analyzed and correlations will be computed between attitudes and time in program.

STATUS

The survey has been administered to 375 Aviation Warrant Candidates. The subsequent data has been punched on cards. Factor and multiple discriminant analyses have been performed on these data and interpretation is being performed. A report will be coming out within the next year.

INSTRUMENT FLIGHT PREFERENCE AND FIELD INDEPENDENCE

OBJECTIVE

The objective is to investigate group differences in the mode of perception of IFR qualified aviators who like and dislike IFR flight.

BACKGROUND

It is a basic assumption of psychology that people vary to some degree in their perception of the world. One of the perceptual areas in which persons differ is in their ability to recognize and separate an item from the field which surrounds it. Some have termed this ability field independency. It has been demonstrated that an individual's mode of perception can be discriminated along a continuum of field dependence---field independence with the Embedded Figures Test and the Rod and Frame Test.

The principle perceptual difference between Visual Flight Rules (VFR) flight and Instrument Flight Rules (IFR) flight is that the latter must be performed independent of a visual ground or horizon reference. It is possible that the perceptual processes required for IFR flight can be placed on a continuum, because persons flying IFR must perceive and manipulate an aircraft without regard to the background by which it is surrounded. It is commonly accepted that aviators vary with respect to their aptitude, ability, and skill in performing IFR flight and it is possible that the above variables may be dependent in part upon perceptual differences in a person's field dependent---independent mode of perception as ascertained by the Rod and Frame Test and the Embedded Figures Test.

METHODOLOGY

The subjects will be 20 instrument rated Army aviators. They will be assigned to one of two groups on the basis of their stated preference for actual instrument flight. One group will consist of pilots who have stated that they enjoy instrument flying. The other group will consist of pilots who express a discomfort or a lack of confidence, preference, or interest in performing instrument flight.

These groups will then be tested by way of the Rod and Frame Test and the Embedded Figures Test. The results of these tests will be analyzed to ascertain if these groups can be considered different on mode of perception as measured by the tests.

STATUS

The necessary perception tests have been acquired. Collection of preliminary data indicated changes in the test device were required before proceeding further. These changes will be incorporated in the near future, after which data acquisition will resume.

OPERATIONAL MEASURES OF PILOT PERFORMANCE DURING AUTOROTATIONS

OBJECTIVE

The objective of this study is to investigate pilot and aircraft performance as related to autorotational maneuvers.

BACKGROUND

Currently, autorotation is the only in-flight escape system available to the helicopter pilot. For this reason, research into mechanisms which affect this maneuver is very important. Preliminary investigations into accident data records show that a significant number of problematic landings associated with this maneuver could be attributed to human factor errors, leaving the question of what factors are associated with such pilot performance.

METHODOLOGY

This study is being conducted in two phases. Phase I involves a review of autorotational accidents. Information derived from these reports will provide cost figures and should yield information as to variables common to various types of aircraft, weather conditions, time of day which may be contributory factors to these accidents.

Phase II will involve measuring both pilot and aircraft performance during autorotation. Initial variables to be studied relative to performance during autorotation will include environmental conditions and individual differences.

STATUS

The accident data for over 1200 autorotational accidents during a 2 1/2 year period from 1967 to 1969 was found to lack the accuracy required. Thus, arrangements have been made to acquire more recent and accurate information on a later time frame. This data should be available soon.

Preparatory work for Phase II which includes detailed study of the autorotational envelope has been accomplished. The various subsystems for performance measure acquisition and recording are in the process of being acquired and implemented.

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY

1. AGENCY ACCESSION	2. DATE OF SUMMARY	REPORT CONTROL SYMBOL
DA OD 6735	72 06 30	DD-DR&E(AR)636

3. DATE PREV SUM'RY	4. KIND OF SUMMARY	5. SUMMARY SCTY	6. WORK SECURITY	7. REGRADING	8A. DISP'N INSTR'N	8B. SPECIFIC DATA - CONTRACTOR ACCESS	9. LEVEL OF SUM
71 06 21	D. Change	U	U	NA	NL	☒ YES ☐ NO	A. WORK UNIT

10. NO./CODES	PROGRAM ELEMENT	PROJECT NUMBER	TASK AREA NUMBER	WORK UNIT NUMBER
a. PRIMARY	62110A	3A062110A 819	00	100
b. (Contributing)				
c. (Contributing)	CDOG 114(f)			

11. TITLE (Precede with Security Classification Code)

(U) Research of Bioengineering Problems Medically Significant to Army Aviation (07)

12. SCIENTIFIC AND TECHNOLOGICAL AREAS

001300 Aircraft; 002400 Bioengineering; 013300 Protective Equipment

13. START DATE	14. ESTIMATED COMPLETION DATE	15. FUNDING AGENCY	16. PERFORMANCE METHOD
66 12	Cont	DA	C. In-House

17. CONTRACT/GRANT

a. DATES/EFFECTIVE: EXPIRATION:

b. NUMBER: Not Applicable

c. TYPE: d. AMOUNT:

e. KIND OF AWARD: f. CUM. AMT.

18. RESOURCES ESTIMATE

FISCAL YEAR	a. PROFESSIONAL MAN YRS	b. FUNDS (In Thousands)
PRECEDING 72	7	168
CURRENT 73	7	145

19. RESPONSIBLE DOD ORGANIZATION

NAME: US Army Aeromedical Research Laboratory

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RESPONSIBLE INDIVIDUAL

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TELEPHONE: (205) 255-5107

20. PERFORMING ORGANIZATION

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PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)

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TELEPHONE:

SOCIAL SECURITY ACCOUNT NUMBER:

ASSOCIATE INVESTIGATORS

NAME: Braunohler, W., MAJ

NAME: Knapp, S. C., LTC DA

21. GENERAL USE

Foreign Intelligence Considered

22. KEYWORDS (Precede EACH with Security Classification Code) (U) Aircraft; (U) Man-Machine Relations; (U) Bioengineering; (U) Escape, Rescue and Survival; (U) Human Volunteers; (U) Protective Equipment; (U) Stress Physiology; (U) Thermodynamics; (U) Safety Engineering; (U) Anthropometry; (U) Electronic and Electrical Engineering

23. TECHNICAL OBJECTIVE, 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)

23. (U) Provide US Army aviation with sound and timely bioengineering information to solve operational problems generated in the interface of the physical and life sciences.

24. (U) The techniques employed will vary, depending on the problem area, but will be based on sound accepted experimental methodology designed to provide the required information as expeditiously as possible.

25. (U) Progress in this area is reflected in the publication of reports concerning engineering tests of lightweight underwear of winter flight clothing (thermal protection); preliminary results, conclusions and recommendations in reference to bump protection evaluation of the standard T56-6 and prototype DH-132 combat vehicle crewman's helmet; and preliminary results, conclusions and recommendations from the evaluation of helmet flammability - DH-132 and T56-6 helmets. Work of national interest continues to biologically validate the physical test methods used in the evaluation of thermal protective clothing. USAARL has been nominated to the Z-90 helmet committee and work continues in the development of improved protective headgear. An orthopedically sound VSTOL crew seat is under development and the Army/Air Force helicopter vibration study continues.

* Available to contractors upon originator's approval

DD FORM 1498 (1 MAR 68) PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE. DD FORMS 1498A 1 NOV 68 AND 1498-1 1 MAR 68 (FOR ARMY USE) ARE OBSOLETE

GENERAL DETAIL SHEET

TITLE: Research of Bioengineering Problems Medically Significant to Army Aviation

OBJECTIVE:

Provide to US Army aviation medically pertinent information derived from research of bioengineering problem areas.

BACKGROUND, METHODOLOGY, STATUS:

Statements concerning the above for this area of of research can be found on the following pages numbered 74 through 91.

RECOMMENDATIONS:

It is recommended that research in this area be funded on a continuing basis.

DEVELOPMENT OF A RECORDING THERMOCOUPLE INSTRUMENTED ANTHROPOMORPHIC DUMMY

OBJECTIVE

To develop a test bed for evaluating thermal protective clothing systems which will provide data which can be used to accurately predict burn injury.

BACKGROUND

The project to develops military standard method for evaluation of thermal protective clothing systems requires, for full clothing ensemble evaluation, the development of an instrumented manikin which will "wear" clothing ensembles in a reproducible thermal environment. The manikin must be instrumented with many rugged, responsive thermal sensors to provide an accurate time-temperature/heat flux history during exposure to a simulated post-crash fire. The sensors should be the same as those used in the laboratory to evaluate clothing system fabrics and components. These sensors must be adequately calibrated.

METHODOLOGY

Initial design concepts are under review and to date no firm decisions have been made. Tentatively, fiberglass manikins will be instrumented with many thermocouples, each with its tip buried in a patch of skin stimulant. The thermocouples will be hard wired to a data acquisition system which is in the initial design stages. Initial emphasis will be on the development of adequate sensors for use in such a system. Various sensors, eg., skin simulants, bare thermocouples, calorimeters, will be calibrated against pig skin using the bioassay technique developed for the project to evaluate thermal protective underwear.

A burn model will be developed and used to evaluate data from the sensors.

STATUS

Initial studies validated the overall concept. Full scale calibration studies of prospective sensors have been planned for summer 1972. The animals and equipment for these studies are on order. A search for new and improved sensors is underway. These new sensors will be evaluated as they become available.

BIODYNAMIC EVALUATION OF PROTECTIVE HEADGEAR

OBJECTIVE

Design, validation, and continuing evaluation of current evaluation methodologies in the development of new methodologies specific for the needs of Army aviation in regard to head protection.

To determine the potential bump and impact protection provided the wearer by aircrewmen's protective helmet. To evaluate the degree to which various helmet protective systems meet the technical performance criteria outlined in Z-90.1 safety standards, appropriate MN's and to evaluate the adequacy of the existing standards.

BACKGROUND

The development, evaluation, quality control, and investigative techniques used in the study of the impact protective aspects of aircrew protective headgear is currently being done under contract with civilian organizations. Standard test methods currently employed use 7-90.1 methodology. This methodology is designed for helmets for civilian use, ie., motorcycle etc., helmets. Until recently there was no responsive military operationally oriented helmet evaluation facility capable of making biodynamic physiologic judgements about design, construction, or development of aircrew protective headgear. There was no facility charged with evaluating biodynamic aspects of head injury causation or injury prevention during aircraft crashes.

METHODOLOGY

Evaluations will be conducted in comparison to standard helmets, available standards, and alternate protective systems. The helmet systems will be subjected to various tests to include weight, bump and impact protection, center of gravity determinations, effects of POL products, temperature extremes, and retention in order to make a judgment of the relative protective merits of various systems. Coordination and liaison has been established with all interested or responsible federal and civilian agencies.

STATUS

Methodologies for helmet retention and impact testing are continually being developed. Coordination and liaison has been established with all interested or responsible federal and civilian agencies. The evaluation facility is 98% complete and helmet work is being conducted. By direction, the Armored Vehicle Crewman's helmet and prototypes developed under an established MN are being evaluated. SGRD-UAE has been appointed to voting membership to the American National Standards Institute Z-90.1 Helmet Committee and will chair a sub-committee on Effects of Chemicals on Head Protective Devices. A paper, "Some Mechanisms of Parachutists Helmet Loss" is in preparation.

BIODYNAMIC EVALUATION OF UH-1 MEDICAL ATTENDANT SEAT

OBJECTIVE

To urge development of new UH-1 attendant seat design.
To determine best occupant restraint configuration of present seat design.
To recommend superficial design changes to present UH-1 medical attendant seat that will lessen crash hazards and provide occupant with more restraint.
To determine ultimate loading capability of seat.

BACKGROUND

The UH-1 medical attendant's seat is a lightweight aluminum tubular structure that has been implicated in causing a number of injuries and fatalities during a crash sequence because of poor crashworthy design. The seat is considered to be unsafe in even moderate crash environments. Neither stress analysis nor results of dynamic testing exist in present Army literature. No Army agency is currently interested in developing a new seat design or modifying the present one.

METHODOLOGY

Static stress analysis.
Dynamic tests.
Review of test results and design recommendations.

STATUS

The final report, "Dynamic and Crashworthy Evaluation of the UH-1B, C, D, H, Medical Attendant's Seat", USAARL Report Number 72-07 was published in January 1972. The authors presented the data, results, conclusions and recommendations of this study to the Government Seat Meeting, Oklahoma City, November 1971. A simple modification kit was developed that will increase occupant restraint and remove some dynamic loading from the seat. The basic seat was found to be of very poor crashworthy design and it is recommended that the seat not be incorporated into any new aircraft or retrofitted into current aircraft.

MK-J5 MARTIN BAKER EJECTION SEAT DEVELOPMENT

OBJECTIVE

To provide medical monitoring and evaluation of the Grumman MK-J5D ejection seat during the various phases of testing and development by request of TECOM.

BACKGROUND

The ejection seat presently being used in the Mohawk aircraft has been associated with an unsatisfactory incidence of spinal injuries. During the past 36 months, a new ejection seat has been in the process of development and testing to allow safe, rapid emergency egress from the Mohawk aircraft.

METHODOLOGY

Three pilots were selected for their respective sitting heights and x-rayed while seated in the improved seat. The distance from the middle of the vertebrae to a line paralleling the thrust axis was then measured and recorded. The angle between the vertebrae and thrust axis was computed and recorded.

STATUS

All engineering acceptance evaluations on the Grumman MK-J5D ejection seat system has been completed. After a careful evaluation by USAARL it was found that the proposed system was obsolete in respect to the mission characteristics of the OV-1 Mohawk and that more advanced operational egress systems are available.

The Aviation Center Team has taken the position on the basis of the operational OV-1 (Mohawk) fatality/injury experience 1961-1971 (USAARL Staff Study) that the improved MK-J5D system retrofit be halted and that a more advanced operational egress system be installed.

As part of TECOM's limited acceptance testing of the MK-J5D systems on x-ray analysis of the spinal alignment of seated crewmembers was completed with the major finding that the 5th and 95th percentile sitting height aviators were more predisposed to spinal fracture than the 40th percentile due to poor seat design. It was also concluded however, that a marked improvement had been made in respect to the Standard MK-J5(A,B) ejection seat. A final report, "Evaluation of the Grumman MK-J5D Ejection Seat in Respect to Spinal Alignment, USAARL Report No. 72-10, has been published.

The conclusions of the x-ray analysis of spinal alignment are based on static conditions. USAARL is attempting to further define and substantiate the predisposition of crew members to spinal fractures by using a computer model of the spine developed by Dr. King Liu, Tulane University.

DEVELOPMENT OF A CRASHWORTHY TROOP SEAT FOR THE UTILITY TACTICAL TRANSPORT AIRCRAFT SYSTEM (UTTAS)

OBJECTIVE

To develop through a joint USAARL-USAAAVS and contractual effort a biodynamically sound crashworthy troop seat for UTTAS, prove it statically, and submit it to AVSCOM and Eustis Directorate Air Mobility Laboratory for dynamic evaluation and field service tests.

BACKGROUND

Current utility passenger and troop carrying helicopter seats do not meet the crashworthy standards available with current technology and as outlined in the "Crash Survival Design Guide", Technical Report 71-22. Excessive morbidity and fatality rates result during the crash sequence. UTTAS is a new aircraft system under development as a follow on to the UH-1. This aircraft is programmed to incorporate the latest in crashworthy design. One exception to the original design was a crashworthy troop seat.

METHODOLOGY

An engineering development proposal and report, authored by Mr. Joe Haley of USAAAVS has been modified and revised by USAARL and USAAAVS to incorporate the latest human tolerance and orthopaedic design criteria. A joint program to fabricate aft facing and one forward facing flight worthy items has been initiated through a contractual effort. USAARL will evaluate the prototypes using static strength analysis thus refining the energy absorbing/attenuating characteristics. The seats will be flight evaluated for anthropometry, comfort, safety of egress, ingress and human factors in the USAARL JUH-1H helicopter. The seats will then be delivered to AVSCOM or the Safety and Survivability Branch, Eustis Directorate, Air Mobility Laboratories for dynamic strength evaluations.

STATUS

Engineering drawings complete. Contractual work is in progress.

BIOENGINEERING DESIGN EVALUATION OF AH-56A ROTATING GUNNER'S SEAT AND EGRESS SYSTEM

OBJECTIVE

USAARL has been requested by TECOM to assist in the Army preliminary evaluation Phase II (APE II) and research and development acceptance testing (RDAT) phases of the AH-56A. Bioengineering has been assigned the task of evaluating ingress/egress, nystagmus and potential disorientation in the gunner's seat.

BACKGROUND

To evaluate certain potential bioengineering problems related to the AH-56A Cheyenne rotating gunner's seat and egress system.

METHODOLOGY

Several pilots underwent a cloverleaf target acquisition flight course during which eye movements were recorded and voice recordings made. This data will be correlated with a contractual mathematical model.

STATUS

Bioengineering has successfully completed task assigned for completion during APE II and RDAT. The only problem remaining is to correlate the acquired data with that of the mathematical model proposed by the Department of Biomedical Engineering, Drexel University.

MATHEMATICAL MODEL OF THERMAL TRANSFER THROUGH SKIN

OBJECTIVE

To determine mathematical relationships between heat input and resultant burn production in skin and to verify Alice Stoll's relationships between temperature and tissue damage.

BACKGROUND

Although there has been a considerable amount of experimental work done on burn production and thermal protective clothing, there is a great deal of disagreement over the interpretation of the results. This disagreement arises as a result of the incomplete understanding of the nature of burn production and the factors involved in thermal protection in a given environment. Hopefully, a computer model of the thermodynamic factors involved in burn production and thermal protection will provide valuable insights into the nature of these problems, as well as improved methods for testing thermal protective clothing.

METHODOLOGY

An initial computer program using constant parameters of conductivity, density, and heat capacity (simulating a uniform material), with heat conduction in only one direction will be written to determine whether or not an iterative method of computation will give accurate answers. Furthermore, this program will determine the increment sizes of time and distance. After these parameters have been determined a final program with heat conduction in two dimensions and with three layers of skin, will be written. The results of this program will be correlated against burn data as presented by Stoll, Hardy, and Knox. The results of these correlations should show relationships between heat input and burn production.

STATUS

The first computer program has been written and "debugged". Accurate values for the parameters of time and distance have been found. Both one and two dimensional solutions have been completed. Errors in the computed temperature profiles are very small. Preliminary analysis using the two dimensional model indicates that edge effects are small and that a one dimensional solution is sufficient. The programs are being documented for transmittal to a contractor who will provide mathematical support for the Thermal Analysis Program. Additions to the programs of tissue damage and coupling of the thermal environment to the skin are under development.

ARMY - AIR FORCE VIBRATION STUDY

OBJECTIVE

To establish the time course of pathologic musculoskeletal changes to the intervertebral disc, surrounding bone, and ligamentous structures.

Identification and classification of hard tissue remodeling dynamics as a result of chronic exposure to low frequency environments.

Identification of critical frequencies in terms of injury potential.

Investigate methodology of isolating critical frequencies.

BACKGROUND

The effect of vibration as a work hazard effects both military and civilian occupations. While the military aviator experiences vibration in all aircraft, it is greatest in the helicopter environment. The results of long term, low frequency vibration are not known; however, recent studies on animals at Wright-Patterson Air Force Base indicate the musculoskeletal changes to the intervertebral disc to take place. Chronic vibration of various character and frequency effects the musculoskeletal system in a number of ways.

A recent study on 128 pilots disclosed that 87.5% suffered from back pain generally sometime after 300 hours of flying time. Pilots with slight pathologic condition of the spinal column began to complain of recurrent low back pain after 50 to 100 hours of flying time. The average figures cited in this study indicates the threshold of appearance of "pain" occurs when one flies four to five hours per day, 40 to 50 hours per month.

METHODOLOGY

Two primary investigators will be needed: one to monitor the clinical studies and the other to coordinate biochemical analysis (Air Force). Test subjects will have preliminary and ongoing biochemical analysis. Orthopaedic and x-ray techniques will be used clinically.

By random sampling a group of 25 helicopter student aviators with no history of musculoskeletal injury will be studied at various phases in their training.

At Fort Wolters prior to any flight training.

At Fort Rucker prior to graduation.

At Fort Rucker 30 months of flying or after removal from flying status, or after an aircraft accident. A control group of age matched subjects will be followed.

STATUS

Initial clinical, x-ray and biochemical examinations have been performed on 42 helicopter pilot students prior to flight training. Administrative measures are being taken to ensure adequate follow up. In July and August 1972 the pilots will be reexamined upon completion of flight training.

A bone mineral analyzer has been ordered using the photon absorption technique. The same method was used to determine bone loss during the Apollo XIV and IV flights. A series of studies have been proposed to determine the effect of total body vibration on bone density.

BIOENGINEERING AND THERMAL EVALUATION OF NOMEX UNDERWEAR

OBJECTIVE

To determine the technical characteristics of Nomex underwear and the standard-issue underwear, and make a comparative evaluation of their ability to protect test animals from skin burns when exposed to severe fire conditions (10-16 BTU/Ft^2/Sec).

BACKGROUND

Department of the Army has decided that winter aviator crewmen's uniforms will consist of the Standard A (Nomex) flight suit supplemented by Nomex underwear, an intermediate jacket and a heavy jacket. In order to determine the suitability of Nomex underwear for Army use, it must be compared with standard-issue underwear now being used with the Standard A flight suit. SGRD-UAE has been tasked by TECOM through MRDC to support USAGETA, Fort Lee, Virginia, in the Bioengineering Test of Nomex Underwear for the Winter Flight Clothing Systems.

METHODOLOGY

Test animals (domestic white pigs), protected by various clothing ensembles over small areas of the loin were exposed to high thermal loads (10-16 BTU/Ft^2/Sec) from a flame gun. Time-temperature data will be correlated with gross and microscopic evaluation of tissue (skin) damage. Results will reveal whether Nomex underwear gives a significant increase in thermal protection compared with standard-issue underwear.

STATUS

Project entitled Bioengineering Test of Lightweight Underwear of the Winter Flight Clothing System: Thermal Protection is complete. Results were published in USAARL Report No. 71-19. This report has been included as an appendix to the final TECOM report "Engineering Test of Lightweight Underwear of Winter Flight Clothing System", November 1971.

EVALUATION OF THERMAL PROTECTIVE CLOTHING TESTING METHODS

OBJECTIVE

Development of a military standard method utilizing state-of-the-art data collection and evaluation procedures for the evaluation of thermal protective clothing systems.

BACKGROUND

Current textile and clothing flammability testing methodologies do not adequately test the completed clothing ensemble. While a number of test methods for small pieces of fabric are available and while ensembles have been "tested" by dragging them through a fire pit, no standard method has adequately integrated known principles of textile testing with human biology of burns.

METHODOLOGY

Phase I, a feasibility study of fire simulation in a furnace-like container has been completed and a letter report prepared. Phase II, a study to establish the correlation between physical thermal sensors and tissue damage (burns) has been prepared and accepted. In Phase II the pig will be used as a bioassay substrate against which it will serve to calibrate the performance of the sensors. A mathematical burn model will be developed to quantitatively predict the severity of burns from sensor output. Based on the analysis reported in Phase I and laboratory constraints a thermal source will be designed, built and evaluated. The final burn model will be used to evaluate the temperature and heat flux data from an instrumented helicopter fire. Predicted escape times associated with specific degrees of skin damage will be calculated.

STATUS

Phase I has been completed. After an eight month delay in negotiating Phase II the project was resumed in December 1971. In preparation for the accomplishment of Phase II a thermal laboratory has been designed and equipment ordered. Construction of the laboratory is scheduled to start in mid May 1972. The experimental animals have been ordered and a treatment schedule has been formulated in cooperation with the Veterinary Branch. A request for proposals (RFP) to provide mathematical analysis and modeling support for this project has been sent out and a meeting with prospective contractors has been held. Final preparations for the instrumented helicopter fire are being made. A thermal source is being constructed.

ORTHOPAEDIC VSTOL AIRCREWMEMBER SEAT DESIGN

OBJECTIVE

The objective of this project is to develop and validate an orthopaedically sound helicopter crew seat that meets or could incorporate all other human factors, engineering and crashworthy requirements. Goals in orthopaedic design are to reduce involuntary anti-gravity muscle activity in both static and dynamic (vibration) conditions through optimization of seat angles and measurements (surfaces) and providing arm, leg and neck support. Seat-control configuration (angles and adjustments) will be analyzed and optimized to the extent that is possible in the current UH-1 helicopter.

BACKGROUND

Due to the character of helicopter vibrations, aircrewmembers are prone to undue involuntary anti-gravity muscle stimulation, and therefore fatigue. The relationships between the seat back angle and the preferred lumbar and thoracic bend angles have not been determined. Accurate seated joint positional data is necessary for man-machine interface studies.

METHODOLOGY

Comfort, EMG action potentials of the anti-gravity muscles, tolerable sitting time, force distribution and egress time will be recorded in the standard UH-1H seat-control configuration and compared to prototype configurations and variations of standard configurations under static and dynamic (vibration) conditions.

STATUS

Equipment is being ordered.

GENERAL HUMAN DYNAMICS SUPPORT FUNCTION

OBJECTIVE

To provide orthopaedic and biomechanical support to government agencies charged with aircraft cockpit subsystems design. To conduct orthopaedic and biomechanical research, investigations, evaluations and to advise on man's physiologic response to his mechanical environment (vibration, restraint, seat design, etc.).

BACKGROUND

Most medical input into aircraft subsystem design centers around man's acoustic, visual, and temperature environments. There has been essentially no orthopaedic input or evaluation of these systems. The result has been empirical design criteria for seat configuration, vibration levels, control force requirements, etc. Pilot fatigue and chronic orthopaedic disease has been related to these empirical design criteria.

METHODOLOGY

Provides consultant and support function to agencies charged with investigating, evaluating and developing aircraft subsystems where a mechanical man-machine interface occurs.

STATUS

Liaison and consultant status to USAAAVS and Aviation Test Board. Review of MN's proposed specifications, new design criteria.

GENERAL SAFETY DESIGN SUPPORT FUNCTION

OBJECTIVE

To provide a liaison, consultative, review and investigatory capacity to government agencies requesting bioengineering input into safety design. To eliminate mortality and reduce morbidity in aircraft accidents by defining man's tolerance to impact and recommending modification to or the design of approved crashworthy aircraft system.

BACKGROUND

This branch is often asked to review material specifications for medical/physiologic acceptance and to act in a consultative role to Army agencies (USAAAVS, TECOM, Test Board (Avn) AVLABS, etc.). These projects do not necessarily carry formal precis and are of short duration but are of great importance to the total program.

METHODOLOGY

On going professional and technical operational support for life support equipment utilized by Army aviation.

Biomechanics, centering around estimates of human tolerance for specific points of impact against the body. Theoretical simulation of occupant kinematics by the use of mathematical models. Statistical considerations, including severities and frequencies of particular types of injury. Experimental analysis by laboratory or field impact tests. Human factors. Comparison of alternate designs.

STATUS

Member status - Federal Seat Committee.
Continual Review - Test Board reports, AMC specifications.
Participation in OH-13 Seat Cushion Project.
Preliminary Evaluation of Energy absorbing seat cushions.
Liaison and technical support of USAAAVS.
Evaluation of the biodynamic aspects of UH-1 seat meeting for USAAAVS.
Evaluation of the shoulder harness - seat belt maintenance program in Army aircraft as it relates to restraint system failures causing injury or death in aircraft accidents.
UTTAS MN development.

GENERAL BIOINSTRUMENTATION SUPPORT FUNCTION

OBJECTIVE

To develop, evaluate, and recommend instrumentation and data trains for psychophysiological monitoring. To support and advise all investigators in data recovery and handling.

BACKGROUND

There are times when initiating a research project that the investigator is faced with questions such as: What is the best (or least costly) instrument to monitor parameter X? Who make monitors for Y? Does USAARL have any instruments to record Z? There are often considerable delays in projects, especially by new personnel while these and other questions are asked. In the interest of improving efficiency and the quality of data collection and analysis it seems wise to support all USAARL personnel with a central source of information and advice on state-of-the-art bioinstrumentation. It should be emphasized that this project is not intended to supplant the excellent rapport USAARL personnel have with each other and the excellent advice and technical assistance already provided by the Electronic Shop. It is proposed as an intermediary between existing programs to facilitate the flow of information.

METHODOLOGY

Phase I will be to set up a fairly complete, actively updated file of Bioinstrumentation. Phase II will be to inventory USAARL's present resources with a view toward avoiding unnecessary duplication in future purchases. Phase III will be to design and test data acquisition systems for commonly monitored parameters. These systems will then be available for rapid deployment in support of individual projects or tests. Phase IV is the continuing education of branch personnel through meetings, short courses and conferences with manufacturers in order to stay abreast of developments in the instrumentation industry. Close coordination with the Electronics Shop will be carried out on all technical matters.

STATUS

Phase I has progressed to the point where over 380 items are now on file and coded on IBM cards for later retrieval. A computer printed directory is available which includes extensive subject and company address lists. Phase II is in the

planning stage. Some items of equipment including a four channel scope, TV Tape Recording System, 14 channel FM tape recorder, signal generator and 14 signal conditioners are available to support immediate projects and initiate Phase III. A precis has not as yet been written. The Electronics Shop has looked into the file with a view toward adopting a standard filing system. Branch personnel have attended demonstrations of ION Flow devices, calculators, data acquisition equipment and other electronic instrumentation as part of Phase IV. Specifications for instrumentation to equip the thermal laboratory have been written.

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY	1. AGENCY ACCESSION	2. DATE OF SUMMARY	REPORT CONTROL SYMBOL
	DA OE 6731	72 06 30	DD-DR&E(AR)636

3. DATE PREV SUM'RY	4. KIND OF SUMMARY	5. SUMMARY SCTY	6. WORK SECURITY	7. REGRADING	8a. DISB'N INSTR'N	8b. SPECIFIC DATA-CONTRACTOR ACCESS	9. LEVEL OF SUM
71 07 01	D. Change	U	U	NA	NL	YES ☐ NO	A. WORK UNIT

10. NO./CODES	PROGRAM ELEMENT	PROJECT NUMBER	TASK AREA NUMBER	WORK UNIT NUMBER
a. PRIMARY	61101A	3A061101A91C	00	285
b. CONTRIBUTING				
c. CONTRIBUTING	None			

11. TITLE (Precede with Security Classification Code) Investigation of New Generation Microphones for the Improvement of Military Voice Communication Systems (23)

12. SCIENTIFIC AND TECHNOLOGICAL AREAS

009400 Man-Machine Relations; 003900 Communications; 000200 Acoustics

13. START DATE	14. ESTIMATED COMPLETION DATE	15. FUNDING AGENCY	16. PERFORMANCE METHOD
71 07		DA	C. In-House

17. CONTRACT/GRANT

a. DATES/EFFECTIVE: EXPIRATION:

b. NUMBER: Not Applicable

c. TYPE: d. AMOUNT:

e. KIND OF AWARD: f. CUM. AMT.

18. RESOURCES ESTIMATE		a. PROFESSIONAL MAN YRS	b. FUNDS (In thousands)
FISCAL YEAR	PRECEDING 72	1.5	80
	CURRENT 73	1	35

19. RESPONSIBLE DOD ORGANIZATION

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SOCIAL SECURITY ACCOUNT NUMBER:

ASSOCIATE INVESTIGATORS

NAME: Mozo, B. T.

NAME:

DA

21. GENERAL USE

Foreign Intelligence Considered

22. KEYWORDS (Precede EACH with Security Classification Code)

(U) Aeronautics; (U) Aircraft; (U) Audition; (U) Communication; (U) Psychology

23. TECHNICAL OBJECTIVE, 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)

23. (U) To systematically explore the effects of two types of new generation microphones on aircraft voice communication systems. Present systems have excessive noise and the potential application of this approach is to develop a new generation of systems that will solve the present noise problems in voice communication systems that have caused loss of hearing.

24. (U) The approach will be to compare each of two new generation noise cancelling microphones with a laboratory standard condenser microphone. Transfer function between two laboratory microphones in a field of noise will be performed. This will establish an ideal transfer function from which comparisons may be made of other transfer functions with the use of the prototype noise cancelling microphones. This test will give the overall frequency characteristics of near-field and far-field response.

25. (U) 71 07 - 72 06 A Bimorph noise cancelling microphone was developed in a period of one year. Presently, it is being tested in the Anechoic Chamber with a Fast Fourier Transform instrumentation and also in the field in US Army helicopters. Testing with first generation experimental voice communication system (amplifier, transmitters and receivers) is in progress.

*Available to contractors upon originator's approval

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THE INVESTIGATION OF NEW GENERATION MICROPHONES FOR THE IMPROVEMENT OF MILITARY VOICE COMMUNICATION SYSTEMS

OBJECTIVES

The purpose of this investigation is to study the characteristics of new generation noise cancelling microphones and their effects on the improvement of military voice communication systems. The primary objectives are: (a) Determine the noise cancelling characteristics of far-field sounds; and (b) Measure the frequency response of near-field sounds.

BACKGROUND

Recent investigations of the sound pressure levels of aircraft voice communication system output have shown that they produce hazardous acoustical environments. The high distortion of the voice communication systems plus the high environmental noise in which the aviation personnel work are the primary causes of excessive sound pressure levels from the voice communication systems. Each stage of the total system from the microphone to the earphone must be investigated in order to solve this acute problem. This project will be devoted to the task of the investigation of the effects of microphone improvement. Three types of new generation noise cancelling microphone will be investigated: (a) a Biomorph, - a type of ceramic microphone; (b) an Electret, - a type of condenser microphone; and (c) an improved M-87, - a type of dynamic microphone.

METHODOLOGY

The three types of microphones will be tested with an artificial mouth for the near-field frequency response characteristics. The far-field cancellation characteristics will be tested in an anechoic chamber with a distant sound source.

A second type of test will be conducted in various operational situations under two extreme acoustical environmental conditions. Verbal messages such as standard PB Word Lists will be transmitted from a UH-1 helicopter and a CH-47 helicopter. An environment of extremely high sound pressure levels will be represented by the CH-47 acoustical environment. It will also serve to test the high frequency cancellation characteristics effectiveness in the presence of the high frequency peaks at 1500 Hertz peculiar to this aircraft. The lower acoustical environments will be simulated with the UH-1 helicopter noise.

A third method for testing the microphone will be explored with the use of a Fast Fourier Transform analyzer. Real-time narrow-band analyses will be used in the investigations of the actual signal-to-noise ratio and distortion of some critical low amplitude consonant sounds.

STATUS

Preliminary tests have shown that the Biomorph and Electret noise cancelling microphones are superior to previous military noise cancelling microphones. The probability of success is extremely high and this whole project promises to be a very economical one in terms of the cost as compared to the expected payoffs. The main problem will be to get these breakthroughs accepted as standard equipment.