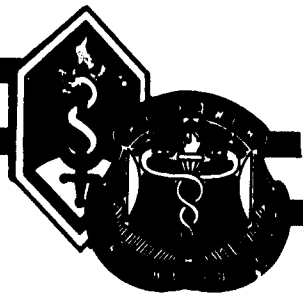
USAARL Report No. 93-24



U.S. Army Aviation Epidemiology Data Register: Prevalence of Refractive Error Among U.S. Aircew Members

By

Kevin T. Mason
and
Samuel G. Shannon

Impact, Tolerance, and Protection Division

and

Robert H. Schrimsher

Prime Technology

June 1993

United States Army Aeromedical Research Laboratory
Fort Rucker, Alabama 36362-5292

Notice

Qualified requesters

Qualified requesters may obtain copies from the Defense Technical Information Center (DTIC), Cameron Station, Alexandria, Virginia 22314. Orders will be expedited if placed through the librarian or other person designated to request documents from DTIC.

Change of address

Organizations receiving reports from the U.S. Army Aeromedical Research Laboratory on automatic mailing lists should confirm correct address when corresponding about laboratory reports.

Disposition

Destroy this document when it is no longer needed. Do not return it to the originator.

Disclaimer

The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other official documentation. Citation of trade names in this report does not constitute an official Department of the Army endorsement or approval of the use of such commercial items.

Reviewed:

JOHN V. BARSON
LTC, MC, SFS
Director, Impact, Tolerance,
and Protection Division

ROGER W. WILEY, O.D., Ph.D.
Chairman, Scientific
Review Committee

Released for publication:

DAVID H. KARNEY
Colonel, MC, SFS
Commanding

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release, distribution unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) USAARL Report No. 93-24	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION U.S. Army Aeromedical Research Laboratory 6b. OFFICE SYMBOL (If applicable) SGRD-UAD-IE	7a. NAME OF MONITORING ORGANIZATION U.S. Army Medical Research and Development Command
6c. ADDRESS (City, State, and ZIP Code) P.O. Box 620577 Fort Rucker, AL 36362-0577	7b. ADDRESS (City, State, and ZIP Code) Fort Detrick Frederick, MD 21702-5012
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 0602787A PROJECT NO. 3M162787A879 TASK NO. BH WORK UNIT ACCESSION NO. 144

11. TITLE (Include Security Classification)
U.S. Army Aviation Epidemiology Data Register: Prevalence of Refractive Error Among U.S. Army Aircrew Members

12. PERSONAL AUTHOR(S)
Kevin T. Mason, S. G. Shannon, and Robert H. Schrimsher

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final	FROM _____ TO _____	1993 June	20

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Visual acuity, aviation personnel, aviation medicine, databases, epidemiology, refractive error
06	04		
05	09		

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The U.S. Army aviation branch is making final funding and planning decisions on the fielding of a contact lens program for Army aircrew members. This report stratifies the prevalence of refractive error by aviation duty position, service component, and rank.

There is an increasing prevalence of refractive error in the higher ranking aircrew members, paralleling increasing age with rank promotion. Comparing service components, the prevalence is higher in the reserve component and civilian forces than active duty forces. Within the aviator service component cohorts, there has been a significant upward trend in the annual period prevalence of refractive error from 1986 through 1992, especially in the Army Reserve and National Guard cohorts. This upward trend may be related to the observed upward trend in the average age of Army aircrew members as a group from 1986 through 1990.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Chief, Scientific Information Center	22b TELEPHONE (Include Area Code) (205) 255-6907 22c. OFFICE SYMBOL SGRD-UAX-SI

DD Form 1473, JUN 86 *Previous editions are obsolete.*

SECURITY CLASSIFICATION OF THIS PAGE
Unclassified

Table of contents

List of tables

Military relevance

The U.S. Army is at a critical juncture in the final planning and decision phases for fielding contact lenses to aircrew (Karney, 1991; Lattimore, 1991). The U.S. Army Aeromedical Research Laboratory (USAARL) studied 582 aircrew members (450 in the Desert Shield/Desert Storm operations) wearing contact lenses in the operational environment. The studies confirmed the contact lens option may solve partially the problems of spectacle incompatibility with certain aircraft and aircrew devices (Bachman, 1988; Lattimore and Cornum, 1992).

An element of planning is quantifying the requirements. How many aircrew members have refractive error and require vision correction to 20/20 by spectacles or contact lenses? One study partially answered this question (Schrimsher and Lattimore, 1990). The study was a descriptive analysis of spectacle wear by Army aviators, stratified by age and component.

The career cycle of aircrew members is linked to their rank more so than their age. The Office of Aviation Proponency, U.S. Army Aviation Branch, Fort Rucker, Alabama, requested an expeditious study of the requirement for vision correction stratified by rank and component for all classes of aircrew.

The U.S. Army Aviation Epidemiology Data Register (AEDR) was queried to answer the question. This report compiles the prevalence of refractive error among aircrew members by duty position, rank, and service component during the period 1 July 1991 to 30 June 1992. There are data tables for aviators, aeroscout observers, aerial fire support observers, flight surgeons, aeromedical physician assistants, and air traffic controllers.

Information on class 3 aircrew members (crew not at aircraft controls) is not entered into the AEDR at this time. Class 3 aeromedical records are reviewed at the local flight surgeon office level. The prevalence of refractive error in this group must be determined by medical record review in the field.

Background

Spectacle wear is the traditional method of vision correction for aircrew members. There are problems with spectacle wear. The increasing design complexity of modern electro-optical and visionic systems may preclude spectacle wear. Contact lenses are used as an alternative method to correct vision. They now are fielded in many international military air forces. Contact lens wear is not free of problems. Table 1 compares the potential problems of spectacle and contact lens wear in the operational aviation environment.

Table 1.

Comparison of potential problems with spectacle and contact lens wear in aviation.

Category	Spectacle wear problem	Contact lens wear problem
Personal	Limit field-of-view Aberrations caused by optics Frame discomfort Facial injury in mishap or facial impact	Lens discomfort or lens lost Corneal and conjunctival infection Corneal injury in mishap
Environmental	Lenses fogged, dirty, or scratched Lens reflections	Dirt under lens Lens dehydration
Operational	Compatibility problems with: Chemical defense equipment Night vision goggles Laser/flash blindness protection devices Helmet mounted sighting systems Frame displacement by physical forces of flight or hostile action	Requires medical specialist and equipment support Lens displacement by physical forces of flight or hostile action

An essential element of planning for either spectacle wear or contact lens wear is understanding the prevalence of refractive error among aircrew members. For comparison with this study, Table 2 shows the prevalence of refractive error in other aircrew member cohorts found by literature review (adapted from data found in Schrimsher and Lattimore, 1990; Miller et al., 1989; Froom et al., 1992).

Table 2.

Prevalence of refractive error in other aircrew member cohorts.

Aircrew cohort	Year	Flying duty class	Prevalence of refractive error
U.S. Army, active duty	1989	Aviator	22%
U.S. Army Reserve	1989	Aviator	28%
U.S. Army National Guard	1989	Aviator	35%
U.S. Air Force	1989	Aviator	27%
U.S. Air Force	1989	Navigator/WSO	52%
U.S. Air Force	1989	Other aircrew	40%
Israel Air Force	1992	Aviator, on entry	9%
Israel Air Force	1992	Aviator, at 10-year career point	18%

The AEDR is a family of related databases storing demographic and medical findings of U.S. Army aircrew members. One component, the flying duty medical examination (FDME) file, is a VAX mainframe computer database. It has 178 physical parameter data fields and an additional, variable number of history data fields per record. The data elements of annual FDMEs for aviators, flight surgeons, aeromedical physician assistants, aeroscout observers, aerial fire support observers, and air traffic controllers are entered into the database. The database has over 275,000 FDMEs from 1986 to the present. The AEDR contains detailed information on aircrew vision parameters. Vision correction is required if the uncorrected visual acuity is not 20/20 with no more than one error on the 20/20 line by Snellen chart (Department of the Army, 1989). The manifest refraction of the correction is in the database.

Methods

The AEDR was searched for all records for the period 1 July 1991 through 30 June 1992. We extracted only the first FDME record found since some aircrew members have two FDMEs submitted in one 12-month period for interim events such as aircraft mishap or serious illness. The extracted records were sorted by unaided visual acuity, aviation duty, service component, rank, and corrective lens flag. Thirteen records with no rank were removed from the data set. Student aviators, 275 records, were removed from the data set since they have an 18-month rather than a 12-month time period to accomplish a FDME. The final data set of 22,267 encounters was cross tabulated. Refractive error was defined as the finding of requiring corrective lenses to obtain a visual acuity of 20/20 with no more than one error on the Snellen chart 20/20 line.

Results

Table 3 shows a summary of prevalence of refractive error during the period of 1 July 1991 through 30 June 1992, derived from the tables in Appendix A through Appendix D. There is a higher prevalence of refractive error among Army Reserve, Army National Guard, and civilian aircrew members than among the active duty force in all occupations except flight surgeons and aeromedical physician assistants.

Table 3.

Summary of prevalence of refractive error by service component and duty position.

Component	Active duty	Army Reserve	National Guard	Civilian
Aviator	23.5%	37.4%	39.2%	69.7%
Aeroscout	21.5%	50.0%*	33.2%	N/A
Flight surgeon	74.2%	73.3%	74.0%	N/A
ATC	29.6%	0.0%**	39.2%	67.2%

* Number of encounters in this cell is small, N=4.
** Number of encounters in this cell is small, N=4.

Appendixes A through D present the cross tabulations of the prevalence of refractive error by aviation occupation, service component, and rank. The tables show a consistent upward trend

in the need for refractive error correction with increasing rank in all groups, paralleling the observations of increasing prevalence with age by a previous study (Schrimsher and Lattimore, 1990). This is expected due to the correlation between increasing rank and increasing age.

Table 4 compares the annual period prevalence of refractive error in U.S. Army aviator service component cohorts between the 1990 aviator study (Schrimsher and Lattimore, 1990) and this study in 1992. An analysis of variance of the data presented in Table 4 shows there was a significant increase ($p<0.0001$) in the number of aviators requiring refractive error correction in all components from 1986 to 1992. A definite upward trend is seen in the Army Reserve and National Guard. The trend is less evident in the active duty cohort. This upward trend may be related to the appearance of a bimodal age distribution curve for Army aviators beginning in 1986. A marching cohort of older aviators emerged. By 1989, 50 percent of U.S. Army aviators exceeded the age of 38 (Mason, 1991). A larger proportion of middle-aged aviators would create a greater need for refractive error correction. With an older marching cohort now moving out of the Army since 1991 (Shannon, 1993), the upward trend in refractive error may level off or reverse, assuming entrance vision standards do not change.

Table 4.

Summary of prevalence of refractive error in U.S. Army aviator cohorts.

Component	1986	1987	1988	1989	1992
Active duty					
N=	13,410	14,237	12,038	14,352	11,399
Percent	21%	23%	23%	22%	23%
C.I.*	±0.69%	±0.69%	±0.75%	±0.63%	±0.77%
Army Reserve					
N=	1,949	2,578	2,211	2,237	1,867
Percent	25%	27%	28%	28%	37%
C.I.	±1.9%	±1.7%	±1.9%	±1.9%	±2.2%
Army National Guard					
N=	5,137	5,726	5,562	6,759	5,825
Percent	28%	32%	33%	35%	39%
C.I.	±1.2%	±1.2%	±1.2%	±1.1%	±1.3%

* C.I. is the confidence interval for the proportion.

Summary

The U.S. Army aviation command is making final funding and planning decisions on the fielding of a contact lens program for Army aircrew members. This report provides data requested by the planners. It stratifies the prevalence of refractive error by aviation duty position, service component, and rank.

There is an increasing prevalence of refractive error in the higher ranking aircrew members, paralleling increasing age with rank promotion. Comparing service components, the prevalence is higher in the reserve component and civilian forces than active duty forces. Within the aviator service component cohorts, there has been a significant upward trend in the annual period prevalence of refractive error from 1986 through 1992, especially in the Army Reserve and National Guard cohorts. This upward trend may be related to the observed upward trend in the average age of Army aircrew members as a group from 1986 through 1990.

References

Bachman, W. G. 1988. Extended-wear soft and rigid contact lenses: operational evaluation among Army aviators. Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory. USAARL Report No. 88-17.

Department of the Army. 1989. Army regulation 40-501, medical fitness standards. Washington, DC.

Froom, P., Yoram, B., Erel, J., Davidson, B., and Shochat, I. 1992. The incidence of myopia in the Israel Air Force rated population: A 10-year prospective study. Aviation, space, and environmental medicine. 63: 299-301.

Karney, D. H. 1991. Memorandum for Commander, U.S. Army Medical Research and Development Command, Fort Detrick, Maryland, Subject: Contact lens decision in-process review.

Lattimore, M. R. 1991. Decision briefing to the AMEDD technical committee on contact lenses, 11 December 1991. Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.

Lattimore, M. R., and Cornum, E. L. S. 1992. The use of extended wear contact lenses in the aviation environment: An Armywide study. Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory. USAARL Report No. 92-35.

Mason, K. T. 1991. Stratified cardiovascular disease screening in U.S. Army aircrew. Paper presented at the 64th annual scientific meeting of the Aerospace Medical Association, May, at Cincinnati, Ohio.

Miller, R. E., O'Neal, M. R., Woessner, W. M., Dennis, R. J., and Green, R. P. 1989. The prevalence of spectacle wear and incidence of refractive error in USAF aircrew. San Antonio, TX: Brooks Air Force Base School of Aerospace Medicine. USAFSAM-TR-89-28.

Schrimsher, R. H., and Lattimore, M. R. 1990. Prevalence of spectacle wear among U.S. Army aviators. Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory. USAARL Report No. 90-13.

Shannon, S. G. 1993. Trends in U.S. Army aviator age distribution. Unpublished data. Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.

Appendix A

Prevalence of refractive error among aviators.

Table A-1.

Prevalence of refractive error by military rank for active duty aviators*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
W1	1,229	1,180	49	4.0%
W2	2,360	2,130	230	9.8%
W3	1,364	1,088	276	20.2%
W4	1,048	468	580	55.3%
O1	395	356	39	9.9%
O2	783	688	95	12.1%
O3	2,245	1,795	450	20.0%
O4	1,132	749	383	33.8%
O5	670	247	423	63.1%
O6	162	20	142	87.7%
O7	3	0	3	100.0%
O8	6	0	6	100.0%
O9	2	0	2	100.0%
Total	11,399	8,721	2,678	23.5%

* Prevalence period is 1 July 1991 to 30 June 1992

Table A-2.

Prevalence of refractive error by military rank for Army Reserve aviators*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
W1	90	82	8	8.9%
W2	431	365	66	15.3%
W3	246	140	106	43.1%
W4	306	104	202	66.0%
O1	39	33	6	15.4%
O2	110	82	28	25.5%
O3	289	220	69	23.9%
O4	211	107	104	49.3%
O5	121	33	88	72.7%
O6	23	3	20	87.0%
O8	1	0	1	100.0%
Total	1,867	1,169	698	37.4%

* Prevalence period is 1 July 1991 to 30 June 1992

Table A-3.

Prevalence of refractive error by military rank for Army National Guard aviators*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
W1	311	295	16	5.1%
W2	1,527	1,070	457	29.9%
W3	830	417	413	49.8%
W4	1,078	372	706	65.5%
O1	167	148	19	11.4%
O2	543	463	80	14.7%
O3	703	537	166	23.6%
O4	360	181	179	49.7%
O5	219	54	165	75.3%
O6	78	5	73	93.6%
O7	7	0	7	100.0%
O8	2	0	2	100.0%
Total	5,825	3,542	2,283	39.2%

* Prevalence period is 1 July 1991 to 30 June 1992

Table A-4.

Prevalence of refractive error for Department of the Army civilian and contract civilian aviators*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
Civ	621	188	433	69.7%

* Prevalence period is 1 July 1991 to 30 June 1992

Appendix B.

Prevalence of refractive error among aeroscout observers and aerial fire support observers.

Table B-1.

Prevalence of refractive error by military rank for active duty aeroscout observers and aerial fire support observers*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
O2	1	1	0	0.0%
O3	1	1	0	0.0%
E1	3	3	0	0.0%
E2	9	7	2	22.2%
E3	44	37	7	15.9%
E4	172	142	30	17.4%
E5	104	80	24	23.1%
E6	50	34	16	32.0%
E7	11	5	6	54.6%
E8	1	1	0	0.0%
Total	396	311	85	21.5%

* Prevalence period is 1 July 1991 to 30 June 1992.

Table B-2.

Prevalence of refractive error by military rank for Army Reserve aeroscout observers and aerial fire support observers*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
E4	2	1	1	50.0%
E5	2	1	1	50.0%
Total	4	2	2	50.0%

* Prevalence period is 1 July 1991 to 30 June 1992

Table B-3.

Prevalence of refractive error by military rank for Army National Guard aeroscout observers and aerial fire support observers*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
O2	1	1	0	0.0%
E1	1	0	1	100.0%
E3	9	8	1	11.1%
E4	45	36	9	20.0%
E5	106	69	37	34.9%
E6	39	21	18	46.2%
E7	1	0	1	100.0%
Total	202	135	67	33.2%

* Prevalence period is 1 July 1991 to 30 June 1992

Appendix C.

Prevalence of refractive error among flight surgeons and aeromedical physician assistants.

Table C-1.

Prevalence of refractive error by military rank for active duty flight surgeons and aeromedical physician assistants*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
W2	6	3	3	50.0%
W3	10	5	5	50.0%
W4	2	1	1	50.0%
O1	4	1	3	75.0%
O3	73	18	55	75.3%
O4	61	19	42	68.9%
O5	26	4	22	84.6%
O6	16	0	16	100.0%
Total	198	51	147	74.2%

* Prevalence period is 1 July 1991 to 30 June 1992

Table C-2.

Prevalence of refractive error by military rank for Army Reserve flight surgeons and aeromedical physician assistants*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
W3	1	0	1	100.0%
O1	2	2	0	0.0%
O3	1	0	1	100.0%
O4	5	1	4	80.0%
O5	3	1	2	66.7%
O6	3	0	3	100.0%
Total	15	4	11	73.3%

* Prevalence period is 1 July 1991 to 30 June 1992

Table C-3.

Prevalence of refractive error by military rank for Army National Guard flight surgeons and aeromedical physician assistants*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
W2	3	1	2	66.7%
W3	9	5	4	44.4%
W4	1	1	0	0.0%
O3	12	3	9	75.0%
O4	17	5	12	70.6%
O5	11	2	9	81.8%
O6	24	3	21	87.5%
Total	77	20	57	74.0%

* Prevalence period is 1 July 1991 to 30 June 1992

Appendix D.

Prevalence of refractive error for air traffic controllers.

Table D-1.

Prevalence of refractive error by military rank for active duty air traffic controllers*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
O3	2	0	2	100.0%
W2	1	1	0	0.0%
W3	1	0	1	100.0%
E1	6	4	2	33.3%
E2	36	30	6	16.7%
E3	114	94	20	17.5%
E4	475	344	131	27.6%
E5	171	122	49	28.7%
E6	271	188	83	30.6%
E7	158	96	62	39.2%
E8	25	9	16	64.0%
E9	1	0	1	100.0%
Total	1,261	888	373	29.6%

* Prevalence period is 1 July 1991 to 30 June 1992

Table D-2.

Prevalence of refractive error by military rank for Army Reserve air traffic controllers*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
W2	1	1	0	0.0%
E4	1	1	0	0.0%
E6	1	1	0	0.0%
E7	1	1	0	0.0%
Total	4	4	0	0.0%

* Prevalence period is 1 July 1991 to 30 June 1992

Table D-3.

Prevalence of refractive error by military rank for Army National Guard air traffic controllers*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
O4	1	1	0	0.0%
W2	9	6	3	33.3%
W3	1	0	1	100.0%
W4	1	0	1	100.0%
E1	1	1	0	0.0%
E2	2	2	0	0.0%
E3	9	6	3	33.3%
E4	37	27	10	27.0%
E5	29	23	6	20.7%
E6	33	18	15	45.5%
E7	19	6	13	68.4%
E8	6	0	6	100.0%
Total	148	90	58	39.2%

* Prevalence period is 1 July 1991 to 30 June 1992

Table D-4.

Prevalence of refractive error for Department of the Army civilian and contract civilian air traffic controllers.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
CIV	180	59	121	67.2%

* Prevalence period is 1 July 1991 to 30 June 1992

Initial distribution

Commander, U.S. Army Natick Research, Development and Engineering Center
ATTN: SATNC-MIL (Documents Librarian)
Natick, MA 01760-5040

U.S. Army Communications-Electronics Command
ATTN: AMSEL-RD-ESA-D
Fort Monmouth, NJ 07703

Commander
10th Medical Laboratory
ATTN: Audiologist
APO New York 09180

Naval Air Development Center
Technical Information Division
Technical Support Detachment
Warminster, PA 18974

Commanding Officer, Naval Medical Research and Development Command
National Naval Medical Center
Bethesda, MD 20814-5044

Deputy Director, Defense Research and Engineering
ATTN: Military Assistant for Medical and Life Sciences
Washington, DC 20301-3080

Commander, U.S. Army Research Institute of Environmental Medicine
Natick, MA 01760

Library
Naval Submarine Medical Research Lab
Box 900, Naval Sub Base
Groton, CT 06349-5900

Director, U.S. Army Human Engineering Laboratory
ATTN: Technical Library
Aberdeen Proving Ground, MD 21005

Commander
Man-Machine Integration System
Code 602
Naval Air Development Center
Warminster, PA 18974

Commander
Naval Air Development Center
ATTN: Code 602-B (Mr. Brindle)
Warminster, PA 18974

Commanding Officer
Armstrong Laboratory
Wright-Patterson
Air Force Base, OH 45433-6573

Director
Army Audiology and Speech Center
Walter Reed Army Medical Center
Washington, DC 20307-5001

Commander/Director
U.S. Army Combat Surveillance and Target Acquisition Lab
ATTN: DELCS-D
Fort Monmouth, NJ 07703-5304

Commander, U.S. Army Institute of Dental Research
ATTN: Jean A. Setterstrom, Ph. D.
Walter Reed Army Medical Center
Washington, DC 20307-5300

Commander, U.S. Army Test
and Evaluation Command
ATTN: AMSTE-AD-H
Aberdeen Proving Ground, MD 21005

Naval Air Systems Command
Technical Air Library 950D
Room 278, Jefferson Plaza II
Department of the Navy
Washington, DC 20361

Director
U.S. Army Ballistic
Research Laboratory
ATTN: DRXBR-OD-ST Tech Reports
Aberdeen Proving Ground, MD 21005

Commander
U.S. Army Medical Research
Institute of Chemical Defense
ATTN: SGRD-UV-AO
Aberdeen Proving Ground,
MD 21010-5425

Commander, U.S. Army Medical
Research and Development Command
ATTN: SGRD-RMS (Ms. Madigan)
Fort Detrick, Frederick, MD 21702-5012

Director
Walter Reed Army Institute of Research
Washington, DC 20307-5100

HQ DA (DASG-PSP-O)
5109 Leesburg Pike
Falls Church, VA 22041-3258

Harry Diamond Laboratories
ATTN: Technical Information Branch
2800 Powder Mill Road
Adelphi, MD 20783-1197

U.S. Army Materiel Systems
Analysis Agency
ATTN: AMXSY-PA (Reports Processing)
Aberdeen Proving Ground
MD 21005-5071

U.S. Army Ordnance Center
and School Library
Simpson Hall, Building 3071
Aberdeen Proving Ground, MD 21005

U.S. Army Environmental
Hygiene Agency
Building E2100
Aberdeen Proving Ground, MD 21010

Technical Library Chemical Research
and Development Center
Aberdeen Proving Ground, MD
21010--5423

Commander
U.S. Army Medical Research
Institute of Infectious Disease
SGRD-UIZ-C
Fort Detrick, Frederick, MD 21702

Director, Biological
Sciences Division
Office of Naval Research
600 North Quincy Street
Arlington, VA 22217

Commander
U.S. Army Materiel Command
ATTN: AMCDE-XS
5001 Eisenhower Avenue
Alexandria, VA 22333

Commandant
U.S. Army Aviation
Logistics School ATTN: ATSQ-TDN
Fort Eustis, VA 23604

Headquarters (ATMD)
U.S. Army Training
and Doctrine Command
ATTN: ATBO-M
Fort Monroe, VA 23651

Structures Laboratory Library
USARTL-AVSCOM
NASA Langley Research Center
Mail Stop 266
Hampton, VA 23665

Naval Aerospace Medical
Institute Library
Building 1953, Code 03L
Pensacola, FL 32508-5600

Command Surgeon
HQ USCENTCOM (CCSG)
U.S. Central Command
MacDill Air Force Base, FL 33608

Air University Library
(AUL/LSE)
Maxwell Air Force Base, AL 36112

U.S. Air Force Institute
of Technology (AFIT/LDEE)
Building 640, Area B
Wright-Patterson
Air Force Base, OH 45433

Henry L. Taylor
Director, Institute of Aviation
University of Illinois-Willard Airport
Savoy, IL 61874

Chief, National Guard Bureau
ATTN: NGB-ARS (COL Urbauer)
Room 410, Park Center 4
4501 Ford Avenue
Alexandria, VA 22302-1451

Commander
U.S. Army Aviation Systems Command
ATTN: SGRD-UAX-AL
4300 Goodfellow Blvd., Building 105
St. Louis, MO 63120

U.S. Army Aviation Systems Command
Library and Information Center Branch
ATTN: AMSAV-DIL
4300 Goodfellow Boulevard
St. Louis, MO 63120

Federal Aviation Administration
Civil Aeromedical Institute
Library AAM-400A
P.O. Box 25082
Oklahoma City, OK 73125

Commander
U.S. Army Academy
of Health Sciences
ATTN: Library
Fort Sam Houston, TX 78234

Commander
U.S. Army Institute of Surgical Research
ATTN: SGRD-USM (Jan Duke)
Fort Sam Houston, TX 78234-6200

AAMRL/HEX
Wright-Patterson
Air Force Base, OH 45433

John A. Dellinger,
Southwest Research Institute
P. 0. Box 28510
San Antonio, TX 78284

Product Manager
Aviation Life Support Equipment
ATTN: AMCPM-ALSE
4300 Goodfellow Boulevard
St Louis, MO 63120-1798

Commander
U.S. Army Aviation
Systems Command
ATTN: AMSAV-ED
4300 Goodfellow Boulevard
St. Louis, MO 63120

Commanding Officer
Naval Biodynamics Laboratory
P.O. Box 24907
New Orleans, LA 70189-0407

Assistant Commandant
U.S. Army Field Artillery School
ATTN: Morris Swott Technical Library
Fort Sill, OK 73503-0312

Mr. Peter Seib
Human Engineering Crew Station
Box 266
Westland Helicopters Limited
Yeovil, Somerset BA20 2YB UK

U.S. Army Dugway Proving Ground
Technical Library, Building 5330
Dugway, UT 84022

U.S. Army Yuma Proving Ground
Technical Library
Yuma, AZ 85364

AFFTC Technical Library
6510 TW/TSTL
Edwards Air Force Base,
CA 93523-5000

Commander
Code 3431
Naval Weapons Center
China Lake, CA 93555

Aeromechanics Laboratory
U.S. Army Research and Technical Labs
Ames Research Center, M/S 215-1
Moffett Field, CA 94035

Sixth U.S. Army
ATTN: SMA
Presidio of San Francisco, CA 94129

Commander
U.S. Army Aeromedical Center
Fort Rucker, AL 36362

Strughold Aeromedical Library
Document Service Section
2511 Kennedy Circle
Brooks Air Force Base, TX 78235-5122

Dr. Diane Damos
Department of Human Factors
ISSM, USC
Los Angeles, CA 90089-0021

U.S. Army White Sands
Missile Range
ATTN: STEWS-IM-ST
White Sands Missile Range, NM 88002

U.S. Army Aviation Engineering
Flight Activity
ATTN: SAVTE-M (Tech Lib) Stop 217
Edwards Air Force Base, CA 93523-5000

Ms. Sandra G. Hart
Ames Research Center
MS 262-3
Moffett Field, CA 94035

Commander, Letterman Army Institute
of Research
ATTN: Medical Research Library
Presidio of San Francisco, CA 94129

Commander
U.S. Army Medical Materiel
Development Activity
Fort Detrick, Frederick, MD 21702-5009

Commander
U.S. Army Health Services Command
ATTN: HSOP-SO
Fort Sam Houston, TX 78234-6000

U. S. Army Research Institute
Aviation R&D Activity
ATTN: PERI-IR
Fort Rucker, AL 36362

Commander
U.S. Army Safety Center
Fort Rucker, AL 36362

U.S. Army Aircraft Development
Test Activity
ATTN: STEBG-MP-P
Cairns Army Air Field
Fort Rucker, AL 36362

Commander, U.S. Army Medical Research
and Development Command
ATTN: SGRD-PLC (COL Schnakenberg)
Fort Detrick, Frederick, MD 21702

MAJ John Wilson
TRADOC Aviation LO
Embassy of the United States
APO New York 09777

Netherlands Army Liaison Office
Building 602
Fort Rucker, AL 36362

British Army Liaison Office
Building 602
Fort Rucker, AL 36362

Italian Army Liaison Office
Building 602
Fort Rucker, AL 36362

Directorate of Training Development
Building 502
Fort Rucker, AL 36362

Chief
USAHEL/USAAVNC Field Office
P. O. Box 716
Fort Rucker, AL 36362-5349

Commander, U.S. Army Aviation Center
and Fort Rucker
ATTN: ATZQ-CG
Fort Rucker, AL 36362

Chief
Test & Evaluation Coordinating Board
Cairns Army Air Field
Fort Rucker, AL 36362

MAJ Terry Newman
Canadian Army Liaison Office
Building 602
Fort Rucker, AL 36362

German Army Liaison Office
Building 602
Fort Rucker, AL 36362

LTC Patrice Cottebrune
French Army Liaison Office
USAAVNC (Building 602)
Fort Rucker, AL 36362-5021

Australian Army Liaison Office
Building 602
Fort Rucker, AL 36362

Dr. Garrison Rapmund
6 Burning Tree Court
Bethesda, MD 20817

Commandant, Royal Air Force
Institute of Aviation Medicine
Farnborough, Hampshire GU14 6SZ UK

Commander
U.S. Army Biomedical Research
and Development Laboratory
ATTN: SGRD-UBZ-I
Fort Detrick, Frederick, MD 21702

Defense Technical Information
Cameron Station, Building 5
Alexandra, VA 22304-6145

Commander, U.S. Army Foreign Science
and Technology Center
AIFRTA (Davis)
220 7th Street, NE
Charlottesville, VA 22901-5396

Director,
Applied Technology Laboratory
USARTL-AVSCOM
ATTN: Library, Building 401
Fort Eustis, VA 23604

Commander, U.S. Air Force
Development Test Center
101 West D Avenue, Suite 117
Eglin Air Force Base, FL 32542-5495

Aviation Medicine Clinic
TMC #22, SAAF
Fort Bragg, NC 28305

Dr. H. Dix Christensen
Bio-Medical Science Building, Room 753
Post Office Box 26901
Oklahoma City, OK 73190

Commander, U.S. Army Missile
Command
Redstone Scientific Information Center
ATTN: AMSMI-RD-CS-R
/ILL Documents
Redstone Arsenal, AL 35898

Director
Army Personnel Research Establishment
Farnborough, Hants GU14 6SZ UK

U.S. Army Research and Technology
Laboratories (AVSCOM)
Propulsion Laboratory MS 302-2
NASA Lewis Research Center
Cleveland, OH 44135

COL John F. Glenn
U.S. Army Medical Research
& Development Command
SGRD-ZC
Fort Detrick, Frederick, MD 21702-5012

Dr. Eugene S. Channing
7985 Schooner Court
Frederick, MD 21701-3273

USAMRDC Liaison at Academy
of Health Sciences
ATTN: HSHA-ZAC-F
Fort Sam Houston, TX 78234

Dr. A. Kornfield, President
Biosearch Company
3016 Revere Road
Drexel Hill, PA 29026

NVEOD
AMSEL-RD-ASID
(Attn: Trang Bui)
Fort Belvior, VA 22060

CA Av Med
HQ DAAC
Middle Wallop
Stockbridge, Hants S020 8DY UK

Commander and Director
USAE Waterways Experiment Station
ATTN: CEWES-IM-MI-R
Alfrieda S. Clark, CD Dept.
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Brazilian Army Liaison Office
Building 602
Fort Rucker, AL 36362

Dr. Christine Schlichting
Behavioral Sciences Department
Box 900, NAVUBASE NLON
Groton, CT 06349-5900

COL C. Fred Tyner
U.S. Army Medical Research
& Development Command
SGRD-ZB
Fort Detrick, Frederick, MD 21702-5012

Director
Directorate of Combat Developments
ATZQ-CD
Building 515
Fort Rucker, AL 36362