



**The Role of Protective Visors
in Injury Prevention During
U.S. Army Rotary-Wing
Aviation Accidents**

By

**Barbara S. Reynolds
Clarence E. Rash
Paul M. Colthirst
Melissa H. Ledford
John C. Mora
Rebecca H. Ivey**

Aircrew Health and Performance Division

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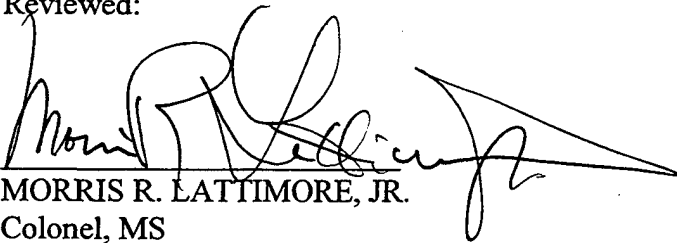
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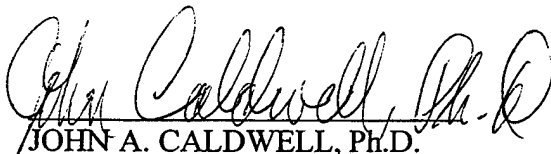
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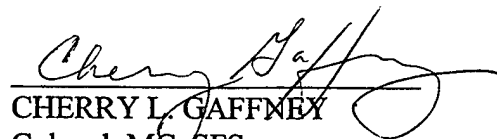


MORRIS R. LATTIMORE, JR.
Colonel, MS
Director, Aircrew Health &
Performance Division

Released for publication:



JOHN A. CALDWELL, Ph.D.
Chairman, Scientific Review
Committee



CHERRY L. GAFFNEY
Colonel, MC, SFS
Commanding

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Introduction

Accidents cost, in dollars and in lives. We cannot place a dollar value on the lives of aviators and crew. But, we can assign a dollar value to aviator training, loss of service due to injury or loss of life, benefits for injury or death, and loss of equipment and/or aircraft due to rotary-wing accidents. In the current environment of reduced funding for training and operations, rotary-wing accidents and their associated costs are an increased burden. However, this is not a new concern. An early discussion (Gaines, 1955) of rotary-wing accidents cited 1953 and 1954 accident property damage costs at \$2,981,912 and \$3,469,180, respectively. Additional costs for insurance and settlements for fatalities were estimated at more than \$1,000,000. A cost analysis of UH-1 type accidents in FY69 reported average personnel costs of an aircraft accident ranged from \$38,097 for survivable accidents to \$408,757 for nonsurvivable accidents. Similarly, two 1971 reports (Zilioli, 1971; Zilioli and Bisgard, 1971) estimated the total cost associated with the accidental death of an Army aviator ranged from \$102,670 to \$759,954. For 1996, the estimated total costs climbed to \$111,797,839. [Note: The 1996 cost estimate was based on a total of 82 accidents (8 Class A) and 16 fatalities.]

While accidents will occur, it is important to understand that injury and death are not inevitable consequences of aircraft crashes (Shanahan, 1993). Epidemiological studies have shown that up to 90 percent of crashes are potentially survivable (Shanahan and Shanahan, 1989; Hick, Adams, and Shanahan, 1982; Sand, 1978). These and other studies (Haley et al, 1982; Berner and Sand, 1971; Mattox, 1968; Bezreh, 1963) have consistently shown head injuries to be a significant factor in fatality rates.

To reduce injuries, deaths, and costs, the U.S. Army over the last few decades has placed considerable emphasis on building helicopters with improved crashworthiness protection. Crashworthiness is defined as the capability of the aircraft to structurally react during a crash in such a way as to maintain the physical integrity of the cockpit and cabin areas and, in doing so, reduce the frequency and level of injuries. The UH-60 Blackhawk and AH-64 Apache helicopters are aircraft which exhibit state-of-the-art crashworthy designs. In addition, continuing improvements have been pursued with these newer aircraft (e.g., research into new designs of improved UH-60 Blackhawk crew seats [Shanahan, 1992]), as well as in upgrading the crashworthiness of older aircraft (e.g., the retrofit of OH-58 pilot's seats [Haley and Palmer, 1994] and the investigation of the use of airbags [Strawn and Alem, 1994]).

To further reduce the probability and severity of injuries, the Army fields a number of devices collectively known as aviation life support equipment (ALSE). ALSE systems and components are designed to prevent injury, reduce injury severity, and enhance survival following a crash. Examples of ALSE systems and components include the Nomex™ flightsuit, survival vests, knives, body armor, protective gloves, and flight helmets with visor(s). The purpose of this paper is to investigate the success of protective visors in preventing and reducing the severity of head and facial injuries.

Protective visors

Visors are look-through optical media, usually fabricated from CR-39 plastic or polycarbonate materials. Polycarbonate is the preferred material due to its enhanced impact protection. The purpose of visors is to provide protection from dust, wind, sun glare, and particle fragments and, in the case of a crash, from tree branches, rocks, debris, and aircraft structural parts. It should be noted that contrary to verbiage in many documents, visors are not designed to provide "ballistic" protection. However, they are expected to provide impact resistance. (To clarify this statement, visors are designed to provide limited protection against shell fragments, but not from direct hits of shells themselves.) In more succinct terms, visors can prevent painful, serious injuries to the head and face.

In Army aviation, visors are classified as Class I or II (Figure 1). These classes are defined in military specification MIL-V-43511C, "Visors, flyer's helmet, polycarbonate." Class I visors are clear, having a photopic (daytime) luminous transmittance of 85 percent or greater. Class II visors are tinted, having a photopic luminous transmittance between 12 and 18 percent. An exception to the Class II luminous transmittance requirement is granted to the tinted visor used in the Integrated Helmet Unit (IHU) of the Integrated Helmet and Display Sighting System (IHADSS) in the AH-64 Apache. The IHADSS Class II visor has a photopic luminous transmittance between 8 to 12 percent. This lower transmittance range is needed to improve visibility of real-time imagery provided by the IHADSS helmet-mounted display. Regardless, all visors generally are held to the optical specifications for refractive power, prismatic deviation, distortion, haze, impact resistance, etc., cited in MIL-V-43511C. The test for compliance of impact resistance uses a caliber .22 T37 fragment simulating projectile at an impact velocity between 550 and 560 feet per second. The test is conducted in accordance with MIL-STD-662.

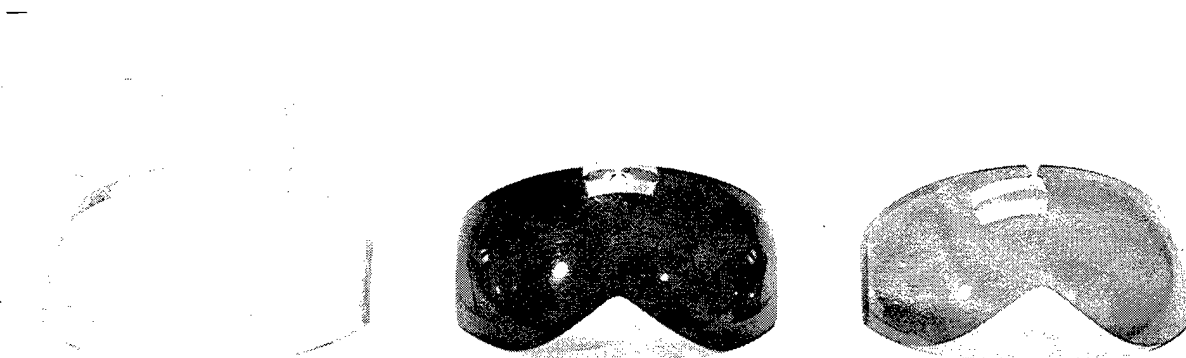


Figure 1. Examples of Class I (clear), Class II (tinted), and laser protective visors.

Another deviation from the visor classes above is special purpose visors which are designed to provide protection from lasers (Figure 1). The luminous transmittance of laser visors can vary greatly depending on the wavelengths or combination of wavelengths for which the protection is being provided. Over the years, a number of types of laser visors have been evaluated for use (Rash and Martin, 1990; Bohling and Rash, 1991; Rash, Bohling, and Martin, 1991). However, except for a brief fielding period during the Desert Shield/Desert Storm war, the authors are not aware of any official designation of laser visors. However, a number of various types of laser visors are in use among many Army aviation units.

Most, if not all, currently fielded visors are manufactured of polycarbonate. As cited previously, this material is used due to its improved impact protection. However, this protection and the overall quality of vision through the visor can be maintained only by proper care of the visor. If any signs of cracks, blurring, dulling, or crazing of the visor occurs, it should be replaced. When cleaning is necessary, the visor should be washed with soapy water or a mild glass or plastic cleaner. A soft cloth should be used to prevent scratching. Special precautions should be taken to reduce contact with organic solvents which adversely affect the polycarbonate material (USAAVS, 1972). Laser visors which use dyes mixed within the polycarbonate material to provide protection against one or more laser wavelengths can experience a degradation in this protection over prolonged exposure to ultraviolet radiation which is present in normal sunlight. Therefore, these visors should be protected from direct sunlight when not in use. Laser visors which provide protection by coating layers can be scratched easily.

Flight helmets

In Army aviation, the visors are mounted within the visor housing on the flight helmet. The use of protective flight helmets was a first step in reducing head and facial injuries. Recorded in historical aviation documents and photographs, early aviators wore helmets made of leather and fabric. Their purpose for the most part was for protection from the elements, e.g, wind, rain, and the occasional insect. Some aviators recognized the need for impact protection and wore industrial-style, hard-shelled helmets. An accident investigated in 1913 involving two U.S. Army Signal Corps pilots revealed that one of the men escaped serious injury because of the presence of his helmet (U.S. Army Board for Aviation Accident Research, 1962). However, the Army did not adopt an aviator helmet until October 1959 with the introduction of the Aviator Protective Helmet No. -5 (APH-5) (Figure 2). Today, there are four helmets currently in use by Army aviators: the Sound Protective Helmet (SPH-4) (Figure 3), the improved Sound Protective Helmet (SPH-4B) (Figure 4), the AH-64 IHADSS Integrated Helmet Unit (Figure 5), and the Head Gear Unit-56/P (HGU-56/P) (Figure 6).

The APH-5 was based on a previous U.S. Navy design. It was molded from glass fabric and polyester resin, providing force distribution and penetration resistance. Helmet fit was achieved by means of pads used to contour the helmet to the head. While maintaining previously

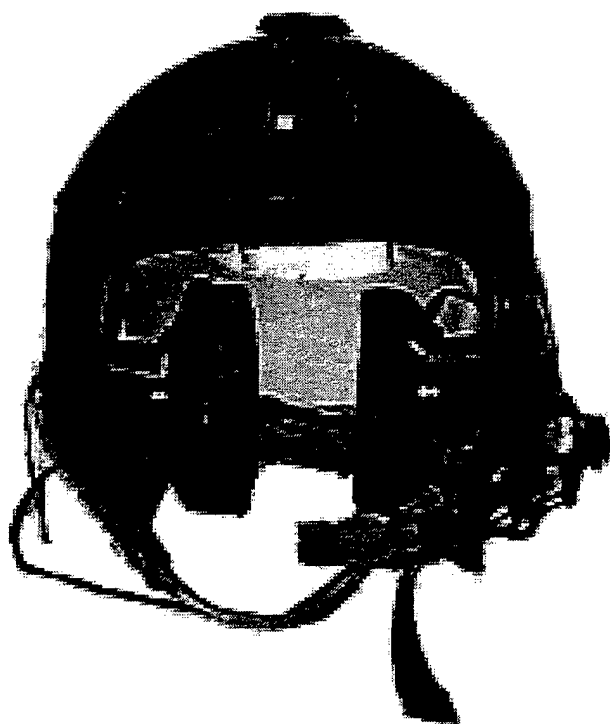


Figure 2. Aviator's Protective Helmet No. 5 (APH-5).

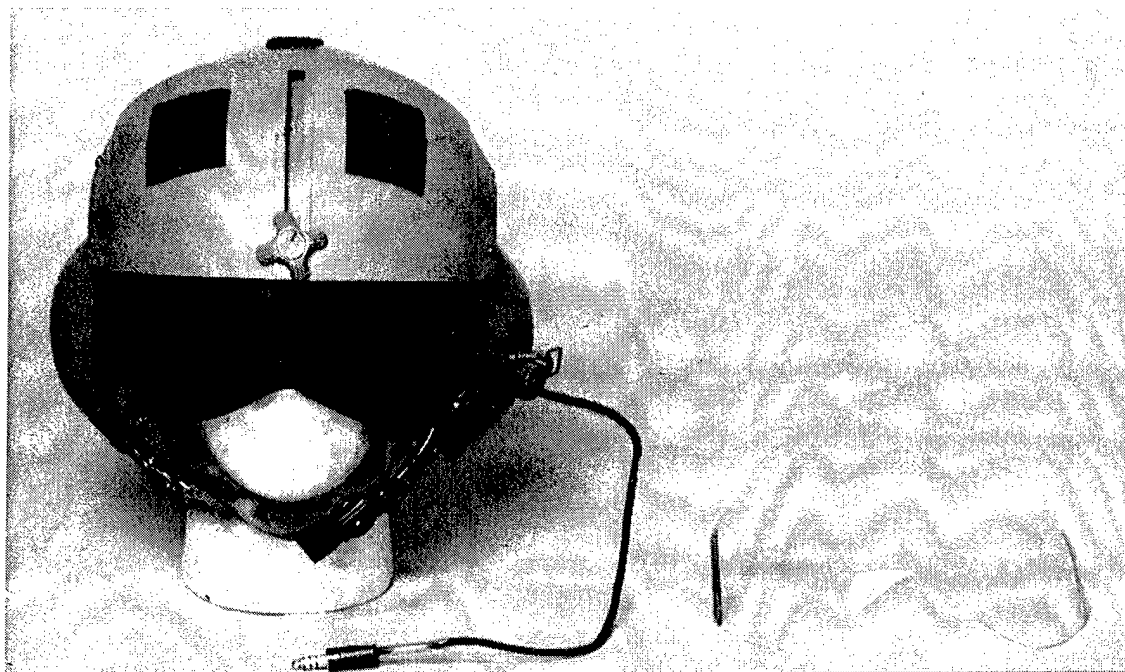


Figure 3. Special Protective Helmet No. 4 (SPH-4).



Figure 4. Special Protective Helmet No. 4B (SPH-4B).



Figure 5. Integrated Helmet and Display Sighting System (IHADSS) Integrated Helmet Unit (IHU).



Figure 6. Helmet Gear Unit No. 56/P (HGU-56/P).

available impact protection, the APH-5 provided minimal hearing protection from aircraft noise (McEntire, 1997). The APH-5 incorporated a single visor.

The SPH-4 was introduced in 1969. At that time, it provided state-of-the-art acoustic and crash protection to aircrew members. The single visor configuration was a tradeoff between weight, impact protection, electronics, etc. A maximum weight, a critical factor in fatigue and crash dynamics, was set at 3.5 pounds. The standard SPH-4 underwent two minor changes: in 1974, a thicker foam liner was used and, in 1982, a thinner shell was adopted. Post-fielding dual-visor adaptor kits were evaluated but rejected due to undue neck muscle fatigue which would be incurred. The recommended visor use at that time was to wear standard issue sunglasses under the clear visor (USAAAVS, 1975).

The SPH-4B, a vastly improved version of the SPH-4, was fielded initially in July 1991. Its outward appearance is similar to that of the SPH-4. However, its performance is quite different. It has an improved Styrofoam™ liner, new energy absorbing earcups, an improved retention system, a lighter shell of Kevlar™, an Aviator's Night Vision Imaging System (ANVIS) mount, a Thermoplastic Liner™ (TPL)™, and a dual visor assembly (Carter, 1992). The dual visor design allows the use of either or both visors. The SPH-4B is issued with a Class I (clear) and Class II (tinted) polycarbonate visor. The clear visor is mounted on the outside track, with the tinted visor being closer to the face.

The IHADSS helmet was developed specifically and exclusively for use in the AH-64 Apache attack helicopter. First fielded in the early 1980's, the IHADSS helmet incorporates a helmet mounted display and head motion sensing capability. The IHADSS helmet provides impact and acoustical protection at least equivalent to that of the SPH-4 (which was, at the time of the IHADSS fielding, the current aviator helmet). Two visors (Classes I and II) are provided in separate visor housings. While only allowing use of a single polycarbonate visor at a time, the two visor housings can be rapidly changed out using simple thumbscrews. [Note: Due to the uniqueness of the IHADSS, the visors must be custom trimmed to enable them to be lowered over the helmet mounted display optics.] The IHADSS helmet was a crashworthiness challenge because now the helmet was being used as a platform for an HMD but still had to provide the visual, acoustical, and impact protection expected from a standard helmet.

The most recently fielded aviator helmet is the HGU-56/P. Besides providing improved impact protection over the SPH-4B, the HGU-56/P moves toward an Army goal of having one common aviation helmet. The final version was fielded in 1995. The HGU-56/P (2.6 pounds) has a reduced weight over the SPH-4B (2.8 pounds). It retained the TPL™ liner and crushable earcups, but the Kevlar™ cloth shell used in the SPH-4B was replaced with a nylon and graphite cloth shell. The HGU-56/P uses polycarbonate visors, clear and tinted, mounted in a dual visor assembly. The clear visor is mounted closest to the face, reversed from the mounting in the SPH-4B. This change was initiated in hopes that future ANVIS designs would allow visor usage without degrading user performance.

There is one additional helmet in Army aviation which is designed to be worn exclusively by ground crewmen. First fielded in October 1989, it is used to provide protection during refueling operations (Rudi, 1989). Known as Helmet Assembly Rearming Refueling Personnel (HARRP), it is an adaptation of a Navy flight deck helmet. Two versions were issued: the HGU-25/P which is communications equipped and the HGU-25/P with aural protection. These helmets do not incorporate visors but use the sun, wind, and dust goggles.

Visor use

There, apparently, is no Army-wide policy on the wearing of visors. However, many units have policies or guidelines for when visors must (or should) be worn. Aviators appear not to use their visors for a variety of reasons. These reasons deal primarily with quality of vision when viewing through multiple optical surfaces, e.g., windscreens, blastshields, and sunglasses. Informal surveys imply that approximately 30 percent of aviators wear sunglasses instead of a tinted visor. Standard aviator sunglasses (N-15) consist of neutral filters which transmit approximately 15 percent of the light incident on them. They do not employ polarizing lenses. In addition, they transmit all colors equally, so all warning and caution lights are discriminable. However, the sunglasses are incapable of providing the level of impact protection against facial injury provided by polycarbonate visors.

In the description of flight helmets above, it was stated that the SPH-4 has a single visor assembly. The aviator has to choose between the clear and tinted visor, as switching out assemblies is not practical during flight. The AH-64 IHADSS helmet also uses a single visor assembly. However, the IHADSS visor assemblies have a thumbscrew method of assembly removal which greatly simplifies the switching of visors. However, the alternate assembly is rarely carried in the aircraft. Both the SPH-4B and the HGU-56/P have dual visor assemblies allowing the use of both clear and tinted visors without having to switch. This type of configuration is possible due to weight savings resulting from the use of lighter weight Kevlar™ and nylon/graphite helmet shells. However, typically, during night operation using image intensification devices such as ANVIS, visors can not be lowered without moving the ANVIS out beyond its optimum position.

A study of visor use among U.S. Army rotary-wing aviators and aircrewmen (Rash et al, 1997) found that use of visors improved when a dual visor configuration is available with the flight helmet. Aircrew wearing the SPH-4B and HGU-56/P helmets, which both have a dual visor assembly, report greater usage of visors, especially the clear visor, as compared to wearers of the single visor assembly SPH-4 and IHADSS helmets, who have to overcome the logistics of storage of the alternate visor. Additional problems affecting visor use include the inability to wear a visor when using ANVIS and the custom trimming of the visor needed with the IHADSS helmet to accommodate the helmet display optics.

U.S. Army Safety Center visor related accident data

To investigate the role of visors in U.S. Army rotary-wing accidents, a literature search was conducted of past studies on Army aviation accident/injury experience. In a study of 1214 major Army aircraft accidents over the period from July 1957 through December 1960, 35 injuries to the facial region were noted. Causation was attributed mainly to cockpit agents such as instrument panels, windshields, and control columns.

In a study of patterns of injury, to include site, frequency and severity, for accidents in the Republic of Vietnam for the period of 1 January 1961 through 30 June 1965, 756 accidents (38 designated as nonsurvivable) were evaluated (Mattox, 1968). Of these, 289 (38 percent) involved injuries. The 756 accidents involved 2,187 persons, of which 521 (24 percent) received injuries. Of the 521 injuries, 402 were in accidents determined to be survivable. Of the 402 survivable injuries, 78 were reported to include head (excluding face) injuries; 75 facial injuries were reported. The study further concluded that "the most common head injury (was) a laceration to the face."

Haley (1971) reviewed injury experience for Army helicopters from January 1967 to December 1969. A total of 2,546 accidents were reviewed, of which 2,388 were designated as survivable. All accidents involved a total of 11,334 persons. The survivable accidents involved 10,599 persons with 3,002 injuries (439 fatal). For all accidents, 774 persons received head or

face injuries. Of these head and face injuries, 592 (77 percent) were cited as the primary injury, and 275 (36 percent) were cited as the only injury.

In addition to past analyses of accidents, a search of accident data collected and maintained by the U.S. Army Safety Center (USASC), Fort Rucker, Alabama, was conducted. The parameters of the search were rotary-wing accidents, class A-C, between FY90 and FY96. The data were first narrowed with the qualifier of accidents in which aviator protective helmets were used and visor(s) were present.

The USASC records data on DA Form 2397-10-R, Technical Report of U.S. Army, when investigating all Army accidents. Part XI of this form, Personnel Protective/Escape/Survival/Rescue Data, is intended to capture data relating to use and function of life support equipment in accidents (Appendix A). DA Form 2397-10-R was required to be completed in full regardless of the accident logistics, up until 1 November 1994. After that date, Part XI, which lists the major common items of equipment worn or used by the aircrew and passengers, was required to be completed only in cases where those items had a role in the cause, prevention, or reduction of injury, or failed to function as designed. Also, data from 1991 do not reflect a complete list of accidents because of the occurrence of the Gulf War during that year. Accident investigation during this period was not conducted as it is during peaceful operations.

From the total FY90 to FY96 period, there were 1035 class A-C accidents where a helmet was recorded as being used. Of these 1035 accidents, there were 459 where the visor was recorded as in use. However, for FY95 and FY96, there were only 47 cases where the visor was listed in use. This reduction in frequency was due to a new definition imposed at that time which designated an equipment item as "Used" only when its use was tied directly to the conditions or situation of the accident.

Of the 459 accidents where visor use was noted, 149 were cases where a clear visor was in use when the accident occurred, 281 were with tinted visors, 3 were with laser visors, and there were 26 cases when it could not be determined which visor was deployed. Of the 459 accidents, 13 (only 2.8 percent) involved visor-caused injury. [Note: A visor may have produced an injury by its use, e.g., a laceration on the cheek, but still may have prevented or reduced further injuries.] The visor was attributed to preventing injury in 102 accidents (22.2 percent). In addition, visor use was cited as reducing injury in 13 (2.8 percent) of the 459 cases. In summary, for this period, the use of visors can be attributed to preventing or reducing injury severity in approximately 25 percent of the accidents where visor use could be verified.

It is difficult to extrapolate additional statistical measures of injury prevention or reduction in severity which can be attributed to visor use from the USASC data, unless notations with respect to the visor were made by the accident investigator. Therefore, arguments for such claims can be supported only by these notations provided in the investigator narratives. For this reason, the following case histories pertinent to the visor role in accident prevention and reduction in severity are recited.

Case 1: (AH-6) "In an attempted right break from a shallow dive, the low rotor rpm audio was activated. The pilot on the controls attempted to decelerate and level the aircraft and arrest the decent. The aircraft struck the ground in a nose high position and rolled and came to rest on its right side. The aircraft sustained extensive damage. The pilot was wearing a SPH-4 helmet with a tinted visor (that he was not using); instead, he was wearing tinted nonprescription glasses. His helmet was scratched and his glasses were dislodged and separated. The pilot in command who was also wearing an SPH-4, but was using his tinted visor, was treated and released having a minimal laceration to his right cheek due to a blow to his helmet that scratched the helmet and the face piece of the visor. The visor was cited as producing the laceration injury but, also, was cited as preventing a more severe injury."

Case 2: (UH-1) "During a day, multi-aircraft, cross-country deployment flight, the pilot on the controls of a UH-1 perceived a torque indicator system malfunction and made a power-on decent to a large field. The aircraft hit the ground hard, in a near vertical descent, receiving major damage. There were five personnel on board. All were wearing SPH-4 helmets with their tinted visor deployed. None received major injuries. The visor and helmet were cited as having prevented injuries for all personnel."

Case 3: (UH-1) "A UH-1 experienced a left yaw with the nose of the aircraft tucking down. The pilot responded with an reduction of power and initiated landing. But, he had a negative response. The aircraft hit hard and slid into trees. The three crew members were all wearing SPH-4 helmets and using their visors. All three helmets were scratched and indicated evidence of blows to the head. All personnel were using their visors which were cited as reducing the level of injuries."

Case 4: (UH-60) "In a multi-aircraft, fast rope insertion/extraction mission for three UH-60, two of the aircraft had a mid-air collision. Both aircraft were totally destroyed killing 6 and injuring 39 personnel. The crew chief of one of the aircraft was wearing a HGU-56/P helmet and using his tinted visor. His most severe injury was a ruptured spleen, but he sustained blows to the head that scratched his helmet. He did have contusions to the left eye orbit. It was determined the visor reduced the severity of the injury to his face, even though he was found not to be wearing the nape strap of his helmet properly."

Aviation Life Support Equipment Retrieval Program (ALSERP) data

In an effort to more closely monitor the effectiveness of aviation life support equipment in the field, the Army established the ALSERP in 1973 (AR-95-5, Change 4, dated 29 January 1973). Established at the U.S. Army Aeromedical Research Laboratory, Fort Rucker, Alabama, regulations mandate that all life support and personal equipment which was damaged or partially damaged during an aircraft accident and which caused or prevented injury is to be collected for analysis. Data are recorded on an ALSERP Helmet Review Form (Appendix B). Information

gathered from the analysis is used to identify areas of ALSE deficiencies, to aid in the product improvement of the equipment, and to develop design criteria for future life support equipment.

Because head injuries remain the predominant cause of severe and fatal injuries to Army aircrew (McEntire, 1997), helmet safety has been a major focus of the ALSERP program. In an inspection of the Army ALSERP data collected during the years 1990-1996, information on 80 mishaps was studied. Included in the data was information concerning the ALSE of 55 aviators and 25 aircrew, all wearing one of the four basic Army aviation helmets: the SPH-4, the SPH-4B, the HGU-56/P and the IHADSS (Figure 7). While information was unable to be collected in some accidents due to postcrash fires and other traumatic events, the statistics do indicate that the majority (70.8 percent) of accident victims did experience some degree of head, neck, or facial injury. Half of all air crash victims were fatalities.

For all retrieved helmets, visor damage was analyzed to determine the visor position at the time of impact. Of the helmets recovered, a majority of individuals (53.75 percent) were found to have been wearing their visor in the "up" position. [These figures include individuals who were flying with ANVIS. Because the visor cannot be deployed while using ANVIS, the visor is assumed to be in the "up" position.] Only 13.7 percent of the individuals were found to have been wearing their visors down at the time of the mishap (Figure 8). Helmets and visors too badly damaged to ascertain this information were classified as "visor position unknown." For the accidents where visor position was known, it is of interest to note that the frequency of

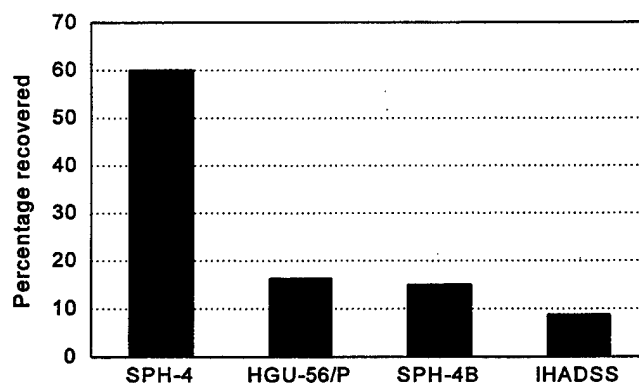


Figure 7. Helmets recovered from ALSERP 1990-1996

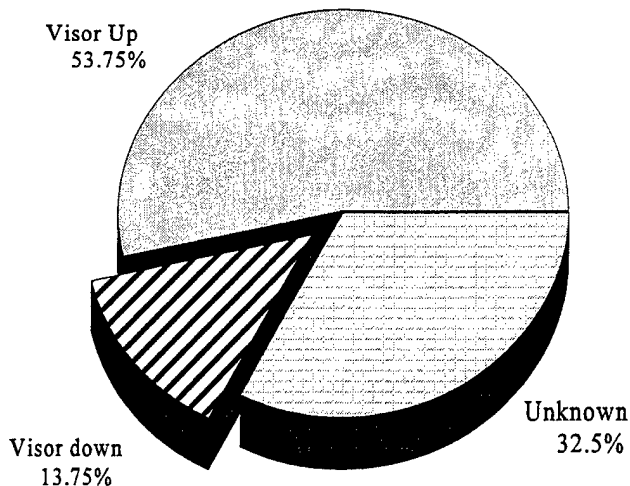


Figure 8. Visor Position for ALSERP
1990-1996 data.

head/neck and facial injuries experienced by both groups, visor up and down, was identical (70 percent) but varied drastically in severity. Those who wore their visors down frequently were reported to have minor injuries caused by the visor (often due to the visor edge impacting the cheek), but experienced fewer fatalities (18.2 percent for visor down versus 53.5 percent for visor up). This trend is consistent with results reported by Vyrnwy-Jones, Lanoue and Pritts (1988). Their study reported fatality rates of 26 percent among aviators wearing their visor down versus 34 percent for visor up.

Actual case studies from ALSERP data cited examples of visor use as related to head and facial injuries:

Case 1: (UH-60) In a 1996 accident, two Blackhawk helicopters were participating in a simulated rescue operation. A mock-up of a downed helicopter was below, surrounded by soldiers. As the two helicopters approached the crash site, the rotors of the two aircraft collided, causing both aircraft to crash from tree-top level to the ground. Six individuals were killed and sixteen wounded. Among those wounded were several whose visors were cracked and deeply gouged in the crash. One single-mounted visor was cracked at the top center, but the wearer experienced no head, neck, or facial injuries. A crew member wearing a dual visor system (with one up and the other down) also had no facial injuries in spite of the fact that his visor was scored across its width and the locking pins on his visor mount were badly bent from the impact of the crash.

Case 2: (AH-64) In another 1996 incident involving a student and instructor pilot, the failure to deploy the visor lead to facial injury. When the Apache AH-64 aircraft began to experience excessive tail-rotor vibration, the instructor pilot immediately took over the controls, but was unable to prevent the helicopter from spinning into the ground. The hard landing caused injuries to both aviators (a broken leg and abrasions). The pilot experienced an impact upon the right top part of the visor housing. The visor was up, resulting in abrasions above and below the right eye.

Other ALSERP files documented cases of aviators whose visors had prevented facial impact with the cyclic, collisions with the aircraft interior, and tree branches. Overall, visors were broken in 31 percent of all mishaps cited as preventing or reducing severity of facial injury.

Summary

Visors provide protection from dust, wind, sun glare, and particle fragments and, in the case of a crash, from tree branches, rocks, debris, and aircraft structural parts. Studies have shown that the most common head/face injury is face lacerations, and that the majority of these injuries are caused by collisions with instrument panels, windshields, and control columns. Several studies of Army aviation injury patterns cite head and facial injuries as the primary injury. Investigations of USASC accident and USAARL ALSERP databases support the premise that visors play a major role in reducing the frequency and severity of facial injuries. This premise, along with the knowledge of current U.S. Army aviator visor usage patterns, strongly supports the need to educate aviators in the importance of deploying visors during all phases of flight operations.

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Appendix A.

Part XI, DA Form 2397-10-R, Jul 94
Technical Report of U.S. Aircraft Accident, Personnel Protective/Escape/Survival/Rescue Data

**TECHNICAL REPORT OF U.S. ARMY AIRCRAFT ACCIDENT
PART XI - PERSONNEL PROTECTIVE/ESCAPE/SURVIVAL/RESCUE DATA**

**REQUIREMENTS CONTROL SYMBOL
CSOCS-309**

For use of this form, see AR 385-40 and DA Pamphlet 385-40; the proponent agency is OCSA

1. DID THIS INDIVIDUAL SUSTAIN AN INJURY OR OCCUPATIONAL ILLNESS BECAUSE OF ACCIDENT? Yes No
(NOTE: If "yes" box is checked, ensure a DA Form 2397-9-R is completed for this individual)

2. PERSONNEL PROTECTIVE/RESTRAINT/SURVIVAL EQUIPMENT

| Item | Type (1) | Re- quired (2) | Avail- able (3) | Used (4) | Pro- duced injury (5) | Al- lowed injury (6) | Pre- vented injury (7) | Re- duced injury (8) | Func- tioned as De- signed (9) | Information Codes (10) |
|-----------------------|-------------|----------------------|-----------------------|-------------|--------------------------------|-------------------------------|---------------------------------|-------------------------------|--|---------------------------|
| a. Helmet | | | | | | | | | | |
| b. Visor | | | | | | | | | | |
| c. Glasses | | | | | | | | | | |
| d. Flight Suit | | | | | | | | | | |
| e. Flight Gloves | | | | | | | | | | |
| f. Flight Jacket | | | | | | | | | | |
| g. Boots | | | | | | | | | | |
| h. Other Clothing | | | | | | | | | | |
| i. Lap Belt | | | | | | | | | | |
| j. Shoulder Harness | | | | | | | | | | |
| k. Gunner Harness | | | | | | | | | | |
| l. Inertia Reel | | | | | | | | | | |
| m. Seat/Litter | | | | | | | | | | |
| n. Survival Equipment | | | | | | | | | | |
| o. | | | | | | | | | | |
| p. | | | | | | | | | | |

3. PERSONNEL EVACUATION/ESCAPE

Information Codes

| | | | | | | | | | | |
|------------------------------------|--|--|--|--|--|--|--|--|--|--|
| a. Method of Escape | | | | | | | | | | |
| b. Location in Aircraft | | | | | | | | | | |
| c. Exit Attempted | | | | | | | | | | |
| d. Exit Used | | | | | | | | | | |
| e. Aircraft Attitude During Escape | | | | | | | | | | |
| f. Cockpit/Cabin Conditions | | | | | | | | | | |
| g. Escape Difficulties | | | | | | | | | | |

4. LAPSED TIME FOR RESCUE

Date Hour of Day Lapsed Time

5. DISTANCE FROM ACCIDENT TO ACTUAL RESCUE VEHICLE AT TIME OF ACCIDENT

| | Date | | Hour of Day | | Lapsed Time | | |
|--|------|----|-------------|-----|-------------|-----|---------------------------------------|
| | MM | DD | HR | MIN | HR | MIN | |
| a. Notification of Rescue Personnel | | | | | | | a. To Aircraft in Nautical Miles |
| b. Individual Physically Reached | | | | | | | b. To Ground Vehicle in Statute Miles |
| c. Individual Actually Aboard Rescue Vehicle | | | | | | | |
| d. Rescue Completed/Abandoned | | | | | | | |

6. PERSONNEL SURVIVAL/RESCUE

Information Codes

| | | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|--|
| a. Survival Problems Encountered | | | | | | | | | | |
| b. Means Used to Locate Individual | | | | | | | | | | |
| c. Rescue Equipment Used | | | | | | | | | | |
| d. Factors That Helped Rescue | | | | | | | | | | |
| e. Factors Complicating Rescue | | | | | | | | | | |
| f. Individual Physical Condition | | | | | | | | | | |
| g. Vehicles Actually Performing Evacuation (Specify) | | | | | | | | | | |
| h. Other Vehicles Assisting in Rescue (Specify) | | | | | | | | | | |

7. REMARKS (Use additional sheet if required)

8. NAME (Last, First, MI)

9. SSN

10. GRADE

11. SEX

12. DUTY

13. SVC

14. UIC

15. CASE NO.

a. DATE (YYMMDD)

b. Time

c. Acft Serial No.

16. OTHER ACFT SERIAL NO.

Appendix B.

ALSERP Helmet Review Form

ALSERP Helmet Review Form

1. Case No.; USAARL _____ USASC _____

2. Last name _____ SSAN _____

3. Helmet type _____ Manufacturer _____ Contract No _____

4. Aircraft type _____

Pilots position in aircraft at time of impact: left front _____ right front _____
Tandem aircraft: front _____ back _____

Passenger position at time of impact: left _____ middle _____ right _____,
front _____ rear _____. Seat orientation (facing): forward _____ side _____ rear _____

5. Was this accident fatal to the helmet wearer? Yes _____ No _____

6. Injury data:

Were head, neck, or facial injuries present? Yes _____ No _____

Was a head, neck, or facial injury, the primary or contributing cause of death? Yes _____ No _____

List the head, neck or facial injuries. _____

Other fatal injuries present Yes _____ No _____. List other fatal injuries.

7. Helmet data:

Rotated and exposed head to injury or potential for injury? Yes _____ No _____ Unk _____

Visor - Single or dual? Visor position at impact: Up _____ Down _____ Unk _____ NVG _____

Was visor cover present? Yes _____ No _____. Visor broken? Yes _____ No _____

Was the nape strap adjusted? Yes _____ No _____ Unk _____ Remarks _____

Did the nape strap fail? Yes _____ No _____ Remarks _____

Was the chin strap adjusted? Yes _____ No _____ Unk _____ Remarks _____

Chinstrap failure? Yes _____ No _____ Unk _____ Remarks _____

SPH-4 retention system attaching point failure (Clips, look into helmet)? Yes _____ No _____

1=No deformation

3=Moderate deformation

2=Slight deformation

4=Severe deformation

Left front _____ Front _____ Right front _____

Right rear _____ Rear _____ Left rear _____

ALSERP Helmet Review Form (Page 2)

8. Earcup Data: Damage? Yes No Unk

Right: Top, Bottom, Front, Back, Center
 Left: Top, Bottom, Front, Back, Center

9. Impact Damage:

Impact location: (Impact no. and damage code in appropriate blank)

D=delamination F=Fracture P=Puncture MM=material missing
G=Gouge A=significant abrasion 4mm ND=no damage

Crown: Front Left side Right side Rear
 Front: Left Right
 Left side: Front Rear Top Bottom
 Right side: Front Rear Top Bottom
 Rear: Left Right Top Bottom

Impact surface information:

| Im- pact no. | Con- cave | Flat | Wedge | Box | Hemi- corner | Rod sphere | Un- known | Impact angle | Object struck |
|--------------------|--------------|-------|-------|-------|-----------------|---------------|--------------|-----------------|------------------|
| _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ |

Permanent foam compression:

| Impact No. | Major axis (cm) | Minor axis (cm) | Area (cm ²) | Compressed thickness of liner (cm) | Uncompressed thickness of liner (cm) | % compression at greatest point |
|---------------|-----------------------|-----------------------|----------------------------|--|--|---------------------------------------|
| _____ | _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ | _____ |

Impact simulation possible? Yes No

10. Might a future operationally feasible design or material modification to the helmet likely prevent the most serious injuries? Yes No

11. What operationally feasible modification to the helmet would be recommended by the inspection team? _____

Remarks: _____