Updated: May 2013

AVIATION PERSONAL PROTECTIVE EQUIPMENT




Overview

Personal protective equipment (PPE) consists of clothing and equipment that provides protection to an individual in a hazardous environment. Aviation PPE can be broken down into four categories;

1. Fire-Resistant Clothing– NOMEX Flight Suits, NOMEX Flight Gloves, Boots and under garments.
2. Protective Head Gear– Flight Helmets and Hard Hats.
3. Hearing Protection– Ear Plugs and Helmet aided earmuffs or the use of Communication Ear Plug (CEP).
4. Eye Protection– Helmet visors, Goggles or Safety Glasses.

History

Personal Protective Equipment can formally be traced back to WWI pilots wearing goggles, scarfs, steel helmets and flight jackets made out of leather to protect pilots from flying debris such as oil thrown out by the rotary engines. During WWII we continued to see the evolution of flight suits and PPE which came about from long flights and high altitudes creating bone chilling cockpits. Fast forward to today and we have numerous variations of flight suits, helmets, hearing protection, survival vests and a myriad of other aviation PPE that is constantly evolving and adding to the list of options and choices operators have to fulfill their PPE requirements.

Background behind Nomex: Nomex is the trademark name for the E. I. Du Pont de Nemours and Company (Du Pont) family of aromatic polyamide (Aramid) fibers. Nomex was developed by Du Pont in the early 1960's and commercially produced in 1967 with the cooperation of the DoD. Worldwide, more commercial and military FR garments are made of Nomex than all other fiber types combined. These fibers have a flame resistance due to their molecular structure, which allows them to withstand temperatures up to 400°C (752° F). Instead of melting, they form a protective char when exposed to flames. Nomex also quickly self-extinguishes when removed from flame sources. Afterward, it retains much of its original strength and abrasion resistance without excessive shrinkage, which decreases the likelihood that it will break open. Nomex garments made of equivalent weight cloths have much more wear endurance than garments made of natural fiber or natural fiber blends.

Flight Helmets: In 1913, two American Army Signal Corps aviators were involved in a crash of their aircraft. It was later determined that the use of a steel helmet prevented one of them from suffering serious injuries. The investigation team recognized the potential of safety helmets for aviators, and ran with it. In fact, a steel helmet was designed for experimental use in aircraft near the end of World War I. From that uncertain genesis, you never see a military helicopter pilot anywhere in the world today without a helmet.

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FLIGHT HELMETS

Why? Helmets work. They save heads and, subsequently, lives. And yet, their overall use by commercial and private helicopter pilots in the civilian market is conspicuously low, as verified by surveys and accident statistics. The aviator flight helmet, consisting of a one-piece hard shell made of polycarbonate, Kevlar, carbon fiber or fiberglass must cover the top, sides (including the temple area and to below the ears) and the rear of the head. The helmet shall be equipped with a chin strap and shall be appropriately adjusted for proper fit; helmets should be individually fitted for maximum protection. Flight helmets for helicopter usage must conform to a national certifying agency standard such as DOT, Snell, SFI or an appropriate military standard, or appropriate equivalent standard. Examples of Flight helmets currently approved for helicopter applications are the SPH-5, HGU-84P, SPH-4B and the HGU-56P manufactured by Gentex, Alpha 200, Alpha 400 and Alpha Eagle (900) manufactured by Interactive Safety Products and the MSA Gallet LH050 (single inner visor), LH150 (single outer visor) and the LH250 (dual visor--one inner and one outer).

PROPER WEAR (Always refer to your helmet user manual for specific instructions)

- When donning the helmet, ensure the nape strap pad is completely pulled down and that its attachment tab is taut. Failure to do so will decrease helmet stability and may cause injury to the wearer.
- Ensure the chain strap and nape strap are tight prior to flight.
- Visors should be worn down at all times except while using Night Vision Goggles.
- Earcups shall be adjusted so that they cover the wearers ears, are centered on the ear and create a seal around the ear. Earcup spacers may need to be added.

CARE & MAINTENANCE (Always refer to your helmet user manual for specific instructions)

- To keep the helmet in satisfactory operating condition, the user should perform preventive maintenance to discover all deficiencies and have them corrected as soon as possible before additional damage or failure occurs. The preventive maintenance procedure consists of pre-flight and post-flight inspections.
- Preflight inspections– Users are looking for delamination's, cracks and holes on the surface and edges of the helmet. On the inside users are looking for the condition of the liner, retention straps, ear cups and communication wiring.
- Users should keep the helmet clean. A soft cloth and a mild soapy solution is recommended to clean helmet shells, and visors. Other components should be wiped down with a damp cloth.
- Helmets should be stored in a soft padded helmet bag to ensure damage does not occur during travel.

REFERENCES

- Interagency Helicopter Operations Guide-Dated: June 2009
- GENTEX HGU-56 Operation and Maintenance Instructions

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FIRE RESISTANT CLOTHING

Fire occurs in 47 percent of commercial aircraft accidents, 32 percent of military accidents and 26 percent of general aviation crashes.

Fire Resistant Clothing– Used to protect aviators from flash fires and to identify material that will char and not melt to the skin of the aviator. Flight suits char at 700 to 800 degrees.

Fire resistant material- NOMEX, Aramide, Polybenzimidazole, Kevlar, or blends thereof.

Warning: Nylon or other synthetic underwear will melt underneath NOMEX and cause life threatening burns to the trunk and groin. Most synthetic underwear fabrics melt at or below 350 degrees and ignite at 450 degrees and above.

PROPER WEAR

- **Flight Suits**– Flight suits are to be properly tailored for each aviator so that it covers the maximum area of skin. This includes sleeves long enough to reach the first knuckle on the thumb before securing snugly over the flight gloves at the wrist. The pant legs shall be long enough to completely cover the boot tops while in a seated position. The slide front fastener closure should sit high on the throat. During the wear of a two-piece flight suit its recommend that the individual tucks the outer shirt into the pants.
- **Boots**– Boots should be fitted properly and laced up fully to the top. Aviator boots shall provide stability, retention during high G-forces and protection from lacerations and burns. Boots shall be constructed of or a mixture of leather and / or fire resistant materials such as NOMEX.
- **Flight Gloves**– Gloves are to be worn under the sleeves of the flight suit.
- **Undergarments**– T-shirts, Socks & Underwear shall be worn normally and be constructed out of cotton, wool, or fire resistant material.

CARE & CLEANING

Warning: Avoid wearing a flight suit during routine ground duties due to possible contact with grease, oil, paint, glue and other combustible materials.

- Flight suits should be washed with mild soap on a permanent press cycle and then rinsed completely to remove all soap.
- Softeners can be used in the rinse cycle.
- Do not use Bleach as it will breakdown the fire retardency of the garment.
- Do not use Starch as it destroys the fire retardency of the garment and is known to burn.
- Dying temperatures for flight suits and gloves should not exceed 180 degrees. Use a permanent press setting on the dryer or air dry the articles at room temperature.
- Dry cleaning may be used and is recommended for flight jackets.

REFERENCES

- Interagency Helicopter Operations Guide-Dated: June 2009

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HEARING PROTECTION

Hearing protectors are available in five categories:

Earplugs, CEPs, Earmuffs, noise attenuating Aviation Headsets and Helmets.

A Forest Service study of helicopter noise found that sound levels inside helicopters during operation are loud enough to cause significant damage to unprotected ears if continued over a long period of time. Further, ground crew station noise is loud enough to cause irreversible hearing damage with exposures of as little as 2 hours per day in some people, and will certainly cause irreversible hearing damage to most people exposed for 8 to 10 hours per day. Anyone exposed to helicopters during landing, hover, or takeoff at distances as great as 200 feet for more than 4 hours per day will exceed safe noise limits.

UNDERSTANDING THE NRR RATING

The NRR is a single-number rating which is required by law to be shown on the label of each hearing protector sold in the United States. The values of sound attenuation used for calculation of the NRR are determined in accordance with ANSI S3.19-1974, American National Standard for the Measurement.

Using the NRR:
if a protector has an NRR of 17 dB and it is used in an environmental noise level of 95 dBC, the noise level entering the ear could be expected to be 78 dBA [95 - 17 = 78] or lower in 98% of the cases if the protector is worn according to manufacturers specification.

—Hearing protection should be used in workplaces exceeding 85 decibels—

NOISE LEVELS

Painful:
150 dB = Rock Concerts at Peak
140 dB = Firearms, Air-Raid Siren, Jet Engine
130 dB = Jackhammer
120 dB = Amplified Music at 4-6 ft.,
Extremely loud:
110 dB = Machinery, Model Airplanes
100 dB = Chain saw, Pneumatic Drill
90 dB = Lawnmower, Shop Tools,

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100 dB = Chain saw, Pneumatic Drill
90 dB = Lawnmower, Shop Tools,

Very loud:
80 dB = Alarm Clock, Busy Street
70 dB = Vacuum Cleaner
60 dB = Conversation, Dishwasher
40 dB = Quiet room30 dB

Moderate:
50 dB = Moderate Rainfall
40 dB = Quiet room

Faint:
30 dB = Whisper, Quiet Library

REFERENCES

- Interagency Helicopter Operations Guide-Dated: June 2009
- FMS 5700 Aviation Management para. 5716.31–Dated: April 10, 2009
- http://www2a.cdc.gov/hp-devices/pdfs/calculation.pdf

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EYE PROTECTION

Eye injury is a significant health problem in the United States, second only to cataract as a cause of visual impairment. Each year more than 2.5 million eye injuries occur and 50,000 people permanently lose part or all of their vision. **Ninety percent (90%) of all eye injuries can be prevented by using protective eyewear.**

The IHOG manual states that: Goggles, or other approved safety eyewear, shall be worn while performing ground duties in or around operating helicopters. A helicopter flight helmet with visor down may be utilized in lieu of a hard hat and goggles when radio communications with the pilot is necessary via a radio connected through the helmet.

PROPER EYE WEAR

Besides debris and objects damaging your eyes what about the harsh effects of the sun? Here is a list of suggestions the FAA has created for those looking to buy new sunglasses,

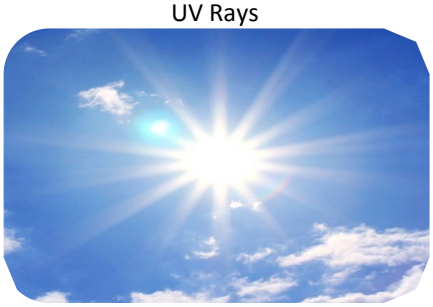
Lenses: Sunglasses that incorporate 100% UV protection are available in glass, plastic, and polycarbonate materials. Glass and CR-39® plastic lenses have superior optical qualities, while polycarbonate lenses are lighter and more impact resistant.

Tents: The choice of tints for use in the aviation environment should be limited to those that optimize visual performance while minimizing color distortion, such as a neutral gray tint with 15 - 30% light transmittance.

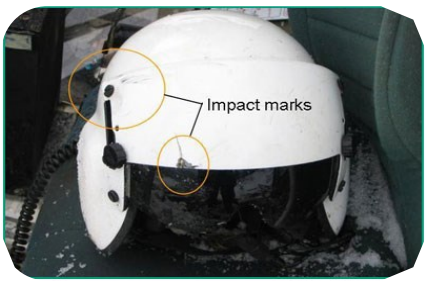
Polarization: Polarized lenses are not recommended for use in the aviation environment. While useful for blocking reflected light from horizontal surfaces such as water or snow, polarization can reduce or eliminate the visibility of instruments that incorporate anti-glare filters. Polarized lenses may also interfere with visibility through an aircraft windscreen by enhancing striations in laminated materials and mask the sparkle of light that reflects off shiny surfaces such as another aircraft's wing or windscreen, which can reduce the time a pilot has to react in a "see-and-avoid" traffic situation.

REASONS WHY

UV Rays



Flying Debris



REFERENCES

- Interagency Helicopter Operations Guide-Dated: June 2009
- FMS 5700 Aviation Management para. 5716.31–Dated: April 10, 2009
- http://www.faa.gov/pilots/safety/pilotsafetybrochures/media/sunglasses.pdf

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SURVIVAL VEST

Presently the biggest proponent of survival vests is the US Department of Defense. The purpose of a Survival vest is to aid crewmembers in the survival phase during a unplanned event and to provide a location to secure mission specific items like a aviators personnel weapon. It has been found that survival aids can be very complementary and increase the likelihood of recovery. Out of all of the pieces of equipment that can aid a surviving aviator none can be more important then the communication device. In todays world almost every pilot has a cell phone and in most parts of the US we can get reception. Notice the word most, operators should always have secondary communication devices such as Beacons, Satellite phones, and /or radios that can use repeaters to make contact with a operators flight operations department.

BEST PRACTICE

If an operator issues survival vests to crewmembers the operator should have a training program and appoint a Aviation Crewmember Equipment Manager or Aviation Life Support Equipment (ALSE) Manager. It is imperative that flight crewmembers understand the proper wear and functions associated with their equipment. A 12 to 18 month inspection program should be established and managed for the survival vests due to the medical supplies and associated batteries that are perishable . Every operator should develop a standard for the location of generic items such as the first aid kit so that each crewmember can easily locate these items in an emergency situation. Certain items may be environment specific such as HEEDS bottles or emergency breathing systems which require additional training and consideration. A suggested Survival vests to use is the Tac Air G2 from Aerial Aviation-Safety-Tactical at http://aerialmachineandtool.com

RECOMMENDED COMPONENTS OF A SURVIVAL VEST

1. Built in: extraction harness, weapon holster, flotation device & adjustable pockets.
2. Vacuum seal internal survival components
3. Fire starter kit
4. Compass
5. MS 2000 Strobe light
6. Signaling devices (Mirror, Flares, Whistle, dye)
7. Survival Knife (ASEK from Ontario Knife)
8. Emergency Radio / GPS Radio Beacon
9. Flash Light

Survival Vest First Aid Kit-

A. 2 pair of rubber patient gloves

B. 1 bottle of iodine

C. Israeli tourniquet bandage

D. Band-Aids, gauze, trauma wrap

E. Tylenol 10 Ea

F. Bacitracin 1 tube

G. Lopermide 10 Ea

H. Doxycyclene 10 Ea

I. 1 role of Medical tape

REFERENCES

- Interagency Helicopter Operations Guide-Dated: June 2009
- US Army TC 3-04.72, FM 3-04.500, AR95-1 & the US Army Air Warrior Program

CONCLUSION

U.S. military services train helicopter crew members to use aviation life-support equipment (ALSE) on every flight and include, minimally, a Nomex flight suit, fire-and chemical-resistant gloves, leather boots, and a helmet with visor. The helmet and visor are considered the most critical because numerous studies show that head injuries are the leading cause of death in U.S. Army helicopter accidents. Although an argument might be made that military missions are different from civilian flying, military accidents that do not involve weapons fire are surprisingly similar to those of their civilian brethren in root causes. There are certainly more similarities than differences.

If an accident occurs and you are unconscious or badly injured, you are of no help to your passengers and significantly reduce their chances for survival. Passengers look to their pilot(s) for leadership and direction after a crash, and they are far less likely to do as well without you. After all, you are the activity authority (flight) figure, you have the survival training knowledge, and you are familiar with the emergency gear, the emergency locator transmitter (ELT), and rescue protocols. An unconscious pilot is just one more demanding burden on the survivors, who may have limited abilities or knowledge and are probably dealing with shock, confusion, and trauma themselves. Your need to perform and provide leadership after an accident has occurred, you should not be underestimated. Your own survival, as well as theirs, could depend on it.

One study conducted by the U.S. Army concluded that head injuries occurred in approximately 70 percent of helicopter accidents. And many of these accidents occur at relatively slow speeds, meaning that they are probably survivable, if the crew is properly protected.

PPE related accident reports on the following pages

ACCIDENT REPORTS

Accident-05/15/2013

A Central Otago pilot has escaped with his life and a lucky lid after his unattended helicopter took off, crashed and the tail rotor grazed his helmet. Dan Perriam, from Tarras, was reported to be shocked but unhurt following the accident involving the Robinson R22 last month. He could not be reached for comment, but his father John Perriam said he was extremely lucky. "If he wasn't wearing his helmet he wouldn't be here today," he told NZ Newswire on Wednesday. Civil Aviation Authority spokesman Matthew Shore said unattended helicopters flying off on their own was not unusual. There had been at least two or three so far this year, he said. However, Mr Perriam had been extremely lucky in that the rotor "scuffed" his helmet. "He was really lucky, it could have been horrific." There were no hard and fast rules about whether helicopters should be left unattended while running. Some helicopter makers recommended shutting them down but others didn't. Helicopters could be taken out of gear, but if they vibrated a lot they could slip back into gear, Mr Shore said. "The throttle automatically powers up and away they go." Mr Perriam has filed a report about the crash to the authority, which will decide if it needs further investigation.

Accident-C-GZHC 03/12/2009

On March 12, 2009, a Sikorsky S-92A helicopter with 16 passengers and 2 flight crew on board was en route from St. John's, N.L., to the Hibernia oil production platform when, 20 min after departure from St. John's, the flight crew noticed an indication of low oil pressure to the main gearbox. The crew declared an emergency and diverted the flight back to St. John's. Approximately 30 NM from St. John's, the helicopter impacted the water and sank in 178 m of water. There was one survivor and 17 fatalities. Although not fatally injured during the impact sequence, both pilots received severe injuries due in part to striking their heads/faces against the instrument panel. Neither pilot on the occurrence flight was wearing head protection. The Canadian TSB investigation into this occurrence (A09A0016) is ongoing.

REFERENCES

- http://news.msn.co.nz/nationalnews/8659254/helmet-saves-otago-helicopter-pilots-life
- Article: Aviation Safety Letter, Transport Canada issue 2 / 2010

ADDITIONAL ACCIDENT REPORTS

Accident-N123CK 04/13/2006

On April 13, 2006, approximately 1840 central daylight time (CDT), a single-engine Robinson R44 II helicopter, N123CK, was destroyed when it impacted the ground following an in-flight collision with power lines during takeoff from the Gillespie County Airport (T82), near Fredericksburg, Texas. The commercial pilot and one passenger sustained serious injuries, and two other passengers were fatally injured. The helicopter was registered to IL Falconiere Holdings LLC, of Austin, Texas, and operated by the pilot. Visual meteorological conditions prevailed, and a flight plan was not filed for the 14 Code of Federal Regulations Part 91 personal flight. The flight was originating at the time of the accident, and according to local authorities, its destination was to a private ranch near Austin, Texas. The cabin area was completely destroyed by a post impact fire that consumed the forward portion of the helicopter, including most of the flight instruments. No evidence of circuit breakers or warning lights was identified. The tail boom and tail rotor were attached to the fuselage, but not burned. A power line was found wrapped around the rotor head and passing around the tail rotor gearbox. The burned and warped main rotor blades remained attached to the rotor head. One main rotor blade was bent rearward; the other was bent upward and rearward. The engine was still attached to the rear section of the fuselage frame, and exhibited little impact damage, but was extensively damaged by fire. The forward portion of the main fuel tank was destroyed by fire. The auxiliary tank was unattached and located adjacent to the engine area; airport personal stated that they removed the fuel cap and drained approximately one gallon of fuel during the wreckage recovery.

Helicopter manufacturer Robinson Helicopter Company issued a safety notice seven years ago, advising all occupants of Robinson R44 to don a fire-retardant Nomex suit. Reference: http://www.robinsonheli.com/service_library/safety_notices/rhc_sn40.pdf The recommendation came after the manufacturer learned of several cases where helicopter passengers had survived an accident, only to be severely burned after the crash.

REFERENCES

- www.initialfix.com
- http://www.robinsonheli.com/service_library/safety_notices/rhc_sn40.pdf

ADDITIONAL ACCIDENT REPORTS

Accident-N5542Z 08/19/2012

On August 19, 2011, about 1155 eastern daylight time, a Daher Socata TB10, N5542Z, was substantially damaged when it collided with trees and a construction dumpster during a forced landing after takeoff from Brookhaven Calabro Airport (HWV), Shirley, New York. The certificated private pilot/owner and a passenger were fatally injured, and a pilot-rated passenger was seriously injured. Visual meteorological conditions (VMC) prevailed, and no flight plan was filed for the personal flight that was conducted under the provisions of Title 14 Code of Federal Regulations Part 91. According to witnesses, their attention was drawn to the airplane during its takeoff roll. The pace was described as "slow" and "anemic" as the airplane used almost the entire length of the runway, which was 4,222 feet long, before it took off. They described the airplane as it climbed slowly to tree-top height, in a nose-high pitch attitude, and disappeared from view. Moments later, a large smoke plume appeared out of the trees a short distance beyond the airport boundary. A witness who stood on his back porch, said the airplane appeared above the trees at the back border of his property, and that the sound of the engine was "really loud." The airplane descended over his back yard and below the height of his one-story house in a left 30-degree bank. The airplane then pitched up, climbed over the house, and struck a tree and a construction dumpster in front of the house, where it burst into flames. The witness then described his efforts to extinguish the fire and assist the occupants of the airplane. Preliminary radar data from the Federal Aviation Administration (FAA) revealed the airplane climbed to 200 feet mean sea level (msl) and accelerated to 63 knots groundspeed before the radar target was lost in the vicinity of the crash site. The pilot/owner held a private pilot certificate with a rating for airplane single engine land. His most recent FAA third class medical certificate was issued on August 1, 2003. He reported 18 total hours of flight experience on that date. The wreckage was examined at the accident site on August 20, 2012. The airplane was largely consumed by post-crash fire.

REFERENCES

- NTSB database
- http://newyork.cbslocal.com/2012/08/20/ntsb-investigating-small-plane-crash-in-suffolk-county/