



Considerations for Selecting and Using Helmets

Introduction

Wearing the proper flight gear during flight is critical for the safety of the crew members. While it can be argued that the absolute necessity of wearing a helmet, flight suit, proper boots and gloves all of the time is unnecessary, it is for that one time (that hopefully never happens to anyone) when the aircraft unexpectedly goes down. That is when all of this equipment's value may come into play. Essentially it is insurance, as are your automobile seat belts. Crash investigators often hear from crash survivors that they are able to speak to us singularly because they were wearing their Aviation Life Support Equipment (ALSE). The FAA does not mandate use, but for survivability in numerous cases, this is not an option, it is an imperative and should be considered an industry standard.

This paper focuses on helmets. The helmet is considered by some to be the most important ALSE to be worn. In many ways this is true, but there are a few more considerations than just to wear one, which we will discuss later in the paper.

Why Use Helmets?

Surprisingly, there are still helicopter companies/units that do not require helmets or they employ crew members that do not want to use them. Fortunately this is not the norm and hopefully in time professionalism will mature their perspectives. One needs to consider proper fit and characteristics for both short-term health such as survivability and shock absorption, and long-term health for hearing loss mitigation, and neck and back myalgia mitigation. Two of the three aspects, short-term health and hearing loss mitigation, are provided by the helmet.

Commonly the only characteristics of a helmet that are examined are the short-term health aspects of the helmet. This is certainly the most impressive aspect, and is supported in a study by Taneja and Wiegmann (2003). They "analyzed patterns of injuries sustained by pilots involved in fatal helicopter accidents from 1993 to 1999 by reviewing the FAA's autopsy database." This database included all helicopter accidents, including HEMS, tourism and public safety. A couple of very impressive details to come from this; 1. skull fractures were the second most common result experienced from blunt force trauma at 51% of the cases, and 2. the brain was the most common significant (62%) of the organ/visceral traumas. By examining the patterns, it is safe to say that those not wearing helmets experienced the most significant head trauma.

Choosing a Helmet

Selection

A common question is which one is the best? I do not believe there is a 'best', but there are several options based on your specific needs. There are a number of acceptable helmets to select from, the key being a reputable product based on articulated supporting test data to see how the helmet performs when compared to others. Certainly the HGU-56/P (current US Army helmet) goes through the most rigorous testing. It is built to provide adequate protection in the context of an otherwise survivable crash scenario. Understand that the Army fleet contains much larger rotary wing aircraft than our civilian fleet, and the crash kinematics and dynamics can be much more severe. These airframes are ruggedized for combat and contain crashworthy seating that provide survivability from the vertical components of the crash, but the resulting flail experienced by the crew member is much greater than non-crash worthy seating and the probability of head trauma is understandably much greater. The main complaint of this helmet is that it is seen as large and bulky. While it meets the protection requirements for the military, that does not necessarily mean it is the best for your needs. Remember, the helmet is also the base platform for your eye protection, hearing protection, communications and night vision augmentation.



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Night Vision Goggles (NVGs) have evolved into a prominent part of our night operations. So when selecting a helmet, ask the vendor about the helmet's Center of Gravity (CG), and where that helmet falls within the longitudinal and lateral risk curves established by the US Army Aeromedical Research Laboratory (USAARL), to set recommended limits for significant neck trauma in a crash. These curves are commonly known in the industry as the USAARL curves. The CG will dictate if/how much counter balance weight will be needed. This is important because the more weight added to the head, the higher the potential for neck/back problems in the future. The closer to the body's midline axis the CG is, the better. Some helmets with a centered CG and a snug nape strap may not require any counter balance weight at all. The proper CG coupled with appropriate exercises and stretches will go a long way to mitigating any future chronic neck and back problems. Excessive weight may negatively affect the cervical neck leading to disabling neck trauma and therefore, should have a break-away feature. The vast majority of the NVGs on the market have such a capability. Continue to include a break away consideration for that weight bag, camera, or other sighting devices as well.

This brings us to another characteristic of the helmet; that being the nape strap. It is imperative that the helmet has a device that can be secured below the occipital lobe (the bump on the back of your head). This prevents the helmet from sliding/rotating forward and possibly coming off in a crash.

Standards

While it is true there is no single helicopter standard that needs to be met, there are aspects that helicopter helmets address that fixed-wing helmets do not; this will be discussed further in the paper. The important thing to remember is ensure that the helmet you select meets a helicopter standard and not a fixed-wing standard.

Once you have narrowed your search down to a couple of helmets, three VERY important steps are 1. ensure that the vendor is recognized by the manufacturer, 2. ensure the vendor can accurately explain the data on the safety features of their product, and 3. examine the specifications. It is imperative to find out what the design specifications are, what test standards were used and where was the testing done. Did the helmet protect the head from the injurious G-forces? What noise levels did the ears receive and across what frequencies? What testing was performed by the visor and what is it made of? It is important to make sure they provide you with the design specifications and not generic ANSI standards. ANSI standards, such as the ANSI Z90.1 are testing guidelines; these ensure all testing is standardized. They are not test result requirements, they are test procedures. We will provide a sheet of standards used for US Army flight helmets in a future paper.

The design specifications will inform you as to what the particular helmet will allow in terms of G-forces to the head at specific velocities of impact. If a recommended standard for an automobile bumper is to protect the vehicle from any damage up to a five mile an hour impact against a solid wall, why would you accept a standard that would protect you from only a two mile an hour impact? Would you really trust the vendor who is telling you "See? It passed our test". This is the most important issue for initial/immediate survivability. It is not only critical to survive the accident, but to maintain the ability to egress the aircraft. This is defined as maintaining the head below the level of non-concussive injury and is commonly called Conscious Survivability. In Vietnam, the Army learned that they needed to make their design specifications more stringent because a number of accidents occurred that were otherwise survivable, only to have the occupants perish in the post-crash fire. These specifications will address performance pertaining to protection issues such as mechanical insult from structure and impact (the shell), hearing protection and impact attenuation (ear cups), impact attenuation (liner), helmet stability, ear cup placement and security (harness), and a comfortable fit (inner liner or suspension assembly). As mentioned above, you need to ensure this is a helmet specifically designed for helicopter use. A fixed-wing helmet does not require



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anywhere near the protection levels of a helicopter helmet. Helicopter helmets are meant for multiple tangential strikes due to the fact that once on the ground the blades continue to rotate, commonly striking objects that cause significant vibration in the aircraft. This energy translates into multiple strikes to the head. This is one of the reasons helicopter helmets are heavier than fixed-wing.

The design specifications do not only focus on short-term survivability. They should also lay out the requirements for hearing protection and visor/eye protection. Hearing protection comes primarily from the ear cups, and communications are a function of both the speakers in the ears and the microphone used. Enhancements may include inner ear speakers, a helmet edge roll-pad, etc..

Once you have decided that the offered product meets your needs, the next step is to assess the testing data provided to ensure that the helmet meets the desired design specifications as mentioned earlier. Since we mentioned the HGU-56/P, some examples of standards it has are:

Shock Absorption	MIL-DTL-87174A
Perforation Protection	MIL-H-87174
Retention System	EN966
Visor	MIL-V-43511B

I cannot stress enough that when choosing a helmet, always require the manufacturer to provide you with the final test report from a third party neutral ISO certified laboratory or recognized US Government testing facility that proves successful completion verifying the helmet truly meets the design specifications stated. Without this data, you cannot be certain of the performance of the product. Verbal claims and/or brochures are of no value in this arena.

After the Purchase

Once the helmet of choice is purchased, it needs to be properly fit. Meaning, it is important to follow the manufacturer's recommendations. In one case, a mold of the top of the head may be made and sent to the manufacturer prior to delivery of the helmet so that they may do the initial fit/sizing for a specific user. After that, fine-tuning may be done in order to eliminate any 'hot spots' to optimise the fit and security. The reason this is emphasized, is that without a good fit, the helmet will be uncomfortable and at the very least the wearer will suffer through the flight, distracting them or diminishing their performance during the mission, or the helmet may not be worn at all. After wearing the properly fit helmet for a couple of months (especially through hot months), check the fit again. Straps tend to stretch and internal padding tends to form. A simple test is to reach back and grasp the base of the helmet and pull forward across the top of the head and then from side to side. Do this yourself. Another person cannot adequately assess your neck limits and unintended strains could occur. If the helmet slides off the head, it is too loose. Related to this is the common mistake of users not properly securing the nape strap. When all is done, with a secure neck and nape strap, the helmet should be comfortable enough to be worn for several hours at a time.

Once the helmet is fit properly and in use, it is critical to remember to wear your visor down if possible, either the tinted or the clear one. In addition to protection in crash scenarios, the most common visor impacts are caused by bird strikes, but other times it is important as well such as when a crew member is on the skids during hoisting operations. There are no sunglasses that protect against that much impact with the same area of coverage. If you are purchasing a helmet with two visors, ask the manufacturer to place the clear visor on the inside. The reason for this is individuals may find the clear visor can be down and still be able to wear future NVGs at night.



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Now that short-term health has been addressed, we need to consider long-term. It is very rare that users consider this when choosing a helmet. The two most common chronic issues are hearing loss, and neck/back pain and/or neurological damage. Let us look at noise first. The helicopter crew is exposed to a wide range of frequencies and intensities such as (engine(s), drive shafts, transmissions, rotors and propellers). The Surgeon General has established 85 dBs as the generic maximum level of continuous, unprotected exposure to steady-state noise for eight hours. Obviously no helicopter operates at or below 85 dBs, so hearing protection is needed, which is mostly provided by the helmet system. Proper fit also helps here because of the fit of the ear cups and insulation of the helmet. Hearing protection is an area where helmets vary greatly. There is a way to help protect against the noise level and that is by also wearing earplugs. Certainly if funding is available, Communication Ear Plugs (CEPs) are an option. It is essentially a foam earplug with a hole drilled through it length-wise and a speaker inserted. While the communications are clear and often times the volume can be turned down, some crew members feel the CEP is putting pressure inside the ear. As many cases, this is personal preference. Finally, some individuals feel the ultimate protection is Active Noise Reduction (ANR). This is built into the helmet and works by 180-degree out-of-phase signal at the same frequency and amplitude to cancel the target ambient noise. Theoretically it cancels any undesirable noise by superimposing an inverse sound wave. At the recent Aerospace Medical Association annual meeting, it was presented that ANRs do not mitigate hearing loss like originally thought. So, at this time, there is no scientific evidence that supports this claim.

Another long-term health issue is that of neck and/or back pain. Just by virtue of having to wear a helmet weighing between two and four pounds for a long period of time, this should be expected. Combined with this is the head movement associated with flying a helicopter, often times looking down and to the side. Lastly, for those using NVGs, these add weight plus additional 'add-ons' such as batteries and the counterweight. We commonly see individuals who have been flying for several years to have neck and/or back pain, sometimes only when flying and others all the time. Neck exercises are certainly warranted in order to avoid such pain. Another is to utilize something commonly used by NASCAR drivers to support their helmets, a nomex neck support. It is similar to the pillows used by travelers on planes the wrap around the neck. In this case, it is firmer and supports the weight of the helmet without limiting the turning of the head.

Summary

Helmets are a critical component of the crew members' ALSE. When thoroughly researched, intelligently selected, and properly fit, this goes a long way to making the helmet much more tolerable to wear. To put this in a "nut shell", ensure:

- You asked for, and have been provided a copy of the helmet specifications used in testing.
- You asked for, and have been provided a copy of the complete test report
- You have sufficient information to provide your personnel a proper fit
- You always wear your visor in the down position.
- You do everything possible to protect your hearing including ear plugs.
- You are aware of potential musculoskeletal/neurological issues
- You have your helmet inspected annually by a trained ALSE professional



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Acknowledgement

I would like to thank the US Army Aeromedical Research Lab for its support in writing this paper.

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About the Author

Dudley Crosson is an Aeromedical Safety Officer (AmSO) and the Principal of Delta P, Inc. The focus of Delta P is to increase the operational efficiency and safety of the aircrew and others participating in air operations in order to ensure 'mission completion' by providing aeromedical consultation and identifying and countering aeromedical threats facing today's crew members. Dr. Crosson's PhD is in physiology and has successfully completed the ERAU's Aviation Safety Management program and the US Navy's Aviation Safety Officer school. He is a member of the CAMTS Aviation Safety Advisory Board and the Aerospace Medical Association's (AsMA) Aviation Safety Committee. Along with Delta P he is the Aeromedical Liaison for the Airborne Law Enforcement Association and an Affiliate Professor at the University of Hawaii-Hilo. Dr. Crosson can be reached at:

772.359.3680
dcrosson@delta-p.com
<http://delta-p.com>