

# HELICOPTER ERGONOMICS – A PILOT’S VIEW

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## **Abstract**

It is widely recognized that human factors contribute either directly or indirectly to a majority of aircraft accidents and incidents. Moreover, the design of the flight deck and systems can influence the crew performance. When pilots read that human factors are a major contributing factor, they always think “this could have been me”. Discomfort of the flight deck is something to deal with on a daily basis. To shed a different light on this matter we ask questions, and hope to help the engineers, manufactures and operators to understand our everyday struggle.

## **1. INTRODUCTION**

The ECA, European Cockpit Association, is representing over 40.000 pilots in Europe, striving for the highest levels of aviation safety.

Helicopter pilots perform their duties in highly stressful, fatiguing and damaging environment. They operate in conditions with high noise levels, vibrations, lack of ergonomics in the design of cockpits and seats, many times with poor cabin air quality or thermal isolation.

While many of these issues are covered by different European regulations – they are not adequately implemented in helicopter flight decks.

Significant improvements have been made for the wellbeing of workers in the EU, and nowadays transport workers across different sectors benefit from better and healthier work conditions. Bus, train or lorry drivers perform their duties under watchful regulations that ensure their health in the work environment is protected. The rules guard them from

early fatigue and give the best presupposition to carry out the work in a safe and efficient way.

On the contrary, current certification specifications for rotorcraft do not cover these aspects in a proper manner.

By asking questions we hope to shed some light on the items we struggle with on a daily base. We believe that engineers and manufactures make dazzling designs, but the starting point (or end point) of the design criteria are many times incorrect. Also, the operators should better understand that given the versatile character of helicopter machine, there is no one-fit-all solution for the pilots-gear.

## **2. PILOT SEATS**

The pilots’ seats are the most obvious man-machine interface. We see different issues with helicopter seats, which we would like to address.

The three major issues are the adjustment possibilities, the tilt angle and the seatbelts.

## 2.1. Seat adjustment

Every pilot has his or her own body that has to fit in the cockpit. We are all looking for the seating position which will give us the best posture for hand and feet on the controls. What is also important is the correct eye height for an easy scan of the instruments and at the same time good visibility outside without not too much movement of the head.

What is important is that you have independent up/down and forward/aft movement of the seat. Sometimes these movements are combined.

Lumbar support for the lower back is not always available, and when available – not very comfortable.

Pilots use special pillows which they use to counteract this.

## 2.2 Tilt angle

Different research papers on seat and tilt angles suggest that the best angle is between 5 and 10 degrees backwards for a pilot to cope with the different forces on the body and neck.

Most seats have a fixed tilt angle which is insufficient. Some seats have the possibility to adjust the tilt, but this is mostly insufficient.

This results in a pilot sitting too straight, which will give a strain on the body and neck. A common complaint by helicopter pilots is pain in the lower back and neck.

As creative as some pilots are they have special cushions to give them a better tilt during the flight (one for under the legs and one for the back). All of this while taking

the safe operation of the helicopter into account.



*Figure 1; Seat cushions for better tilt angle. As this is pilot gear and not part of aircraft it becomes easier to get approved for flight. © ECA*

## 2.3 Seat belts

There is always a tension on the seat belt to make sure it is pulled towards the seat. While this of course is a must, this tension is sometimes too high, resulting in pilots experiencing pain in the shoulders.

Once again pilots take matters in their own hands and start using clips to lower the tension, but still maintaining the important task of the belts, to protect during a crash.

## 2.4 Conclusion

Helicopter pilots have identified and tried to adapt the shortcomings in cockpit design. But help from engineers and manufacturers, and recognition of the need for improved ergonomics, is what we need today. As a first step, we need to accept that ergonomics is a major design criteria, just as important as crash worthiness. Therefore, a question:

## *Why is crash worthiness the major design criteria for the seats, and not ergonomics?*

We fully understand that crash worthiness is important, but if we make ergonomics as important engineers and manufactures are capable of making seats giving us the best of both worlds.

### **3. VIBRATIONS**

Eliminating vibrations is a challenging task for engineers. But still today, pilots are experiencing too high levels of vibrations that disrupt operations and may impair safety. Operating a helicopter with vibrations creates a lot of inconvenience.

#### **3.1 Landings**

Not every helicopter vibrates at the same level, but with some helicopters it can be quite severe. Especially when there is hardly or no wind during the final landings phase.

Sometimes it is so severe that it becomes impossible to read the instruments during this difficult and important part of the flight. The most severe situation is that you see two helidecks while there is only one. This is most likely because the eyeballs start to vibrate.

We all can image that this is a safety issue but on top of it - it is an ergonomic issue which should be addressed.

#### **3.2 Cruise**

Vibrations during the landing are the worst in intensity but they could also happen during the cruise flight. This could result in cockpit doors vibrating in their door frame which gives a rattling sound.

Although this is less of a safety issue, in longer flights this can result in impaired

health of the crew, such as headache or discomfort. Related to this, some pilots take a pain killer like aspirin, as a standard before each flight.

#### **3.3. Conclusion**

As discussed, vibrations are not just a safety issue, but also an ergonomic issue. Luckily manufactures came with very clever and good working vibration absorbers to counteract most (not all, and not always) vibrations. We therefore have the following question:

### *Why are vibration absorbers optional?*

Give hard figures for the vibration levels in the cockpit and do not use subjective criteria like "it should not interfere with flight safety". The pilot must bet the most important part in the helicopter so eliminating vibrations should not be optional. Manufacturers are encouraged to use less subjective criteria and introduce absorbers as the default technology.

### **4. DUAL RATED**

In Europe 90% of all operators have less than 5 helicopters, mostly different types. But also with the big operators, like the HEMS or the Offshore operators at one base they have to operate different types of helicopters.

As the operators face a very competitive market, they are forced to make pilots dual rated.

There is a reason why dual rating for commercial fixed wing operations follows a more conservative approach. A Boeing or an Airbus (or other type) aircraft have a completely different cockpit philosophy. If you suggest dual rating, you most likely not be taken seriously.

We fully agree, and ask a question why are we doing it within the helicopter world? We also fly helicopter types from different manufactures with different philosophies.

#### 4.1 Oops-moments

During my 25 years of flying I had a few *oops-moments* which can be related to being dual rated.

I was making an approach at night with heavy rains, bad visibilities and low cloud cover to a platform in the middle of the North Sea. At the moment I came out of the clouds I wanted to switch on the windscreen wipers, but instead I decoupled the auto pilot. At night with bad weather one thing you do not want to do is decouple the auto pilot. The reason why I did it - was that at that moment I was dual rated. In one helicopter my switch for the windscreen wiper was on the cyclic, but with the other helicopter - I was flying the switch at the same place on the cyclic was to decouple my auto pilot.

My sixth sense fooled me, I was in the other aircraft.

A comparable situation I had was with my landing or swivel light. The movement of the china-head to operate the swivel light can be completely opposite.

This has the effect that you can't find your light when you switch it on. Especially with moisty weather when you switch on the light the visibility becomes worse. Because of that you only can switch on the light at the last moment. When you have to look for your light when you are close to the obstacle called *landing place* it is not handy. It resulted in numerous go-arounds.

This is surely a safety issue, as the interface with the machines, ergonomics, is different within each manufacturer.

#### 4.2 Conclusion

We fully understand the complexity of designing a helicopter but to prevent the issues discussed we see an urgent need for more requirements on commonality. A question therefore:

### ***Why are there not more requirements on communality?***

Probably this is more an issue for the regulator, but for the critical switches like the Auto pilot switch and the landing - this could be a safe thing to regulate.

## 5. PILOT GEAR

The strong point of the helicopter is its versatility. We can do a lot of different types of job, each with its own hazards. To be able to cope with the hazards and to protect the human against the sometimes hostile environment – pilots wear protective gear.

For one operation this means wearing helmets, sometimes with night vision goggles, and for the other operation - wearing survival suits. Flying over water you must wear heavy life-vests sometimes with the steel oxygen bottles.

What you have to wear depends on the type of operation and the operator you work with. Wearing the protective gear can be an important hinder during a routine day of flying.

It is not only uncomfortable, but it can have effect on ergonomics. Not only your movements can be hindered, but the gear you are wearing can also influence your scan.

Therefore, the following plea:

***Make the protective gear more ergonomic and comfortable***

healthier life for the people who operate them, the pilots.

## **6. HOLISTIC VIEW**

Helicopters are beautiful machines, combining a lot of cleverly designed equipment into one machine. We fully understand that as engineer and manufacturer you are proud of all those pieces and we also understand that operators are proud on the fact that they can operate these machines, even with a profit.

But pilots have to deal not with certain pieces but the whole machine and mostly under pressure.

So the question during a test “does this equipment do what it was designed for” is relevant but insufficient. It makes sense when the pilot has to operate it combined with other equipment. The same goes for the protective gear the pilot has to wear. Don't just look at its function, but also does it hinder the pilot.

Therefore, we have one remark:

***Take a holistic point of view of the end product.***

This paper is a result of an enormous amount of experience in operating these beautiful machines, called helicopter. It is sadly also based on years of investigations in incidents and accidents, resulting in numerous losses of lives. Not only from passengers but also from pilots some of whom I called friends.

We hope this paper sparks a discussion on ergonomics and leads to higher standard of safety. It also so means a