

Adam Kress

Hi everyone and welcome back to another episode of Aerospace Unplugged. I'm your host, Adam Kress. On today's episode, we'll be diving into the fascinating history and evolution of black boxes in aviation. Now people throw around the term black boxes, but what does that really mean?

We're talking about flight data recorders and cockpit voice recorders on aircraft. We'll talk about why these critical devices were first developed, their role in ensuring flight safety, and their importance in accident investigations. But we're not stopping there. We'll also look at how black boxes have transformed over the years from early flight recorders to the cutting edge connected safety technology of today. Come along as we explore the groundbreaking advancements driving aviation safety now and into the future with connected recorders paving the way for real time data gathering and analysis.

So joining us today on the podcast is Borka Vlacic. She's with Honeywell Aerospace Technologies and she's a Director of Product Management overseeing these cockpit voice recorders and flight data recorders. Also with us today is Steve Leeper. He works for a company called Curtiss-Wright that Honeywell works with closely and he's a flight recorder product line manager. So Borka, Steve, thanks for joining me today.

Borka Vlacic

Thanks for having us.

Steve Leeper

Thank you.

Adam Kress

All right, let's dive right in here and learn some about flight data recorders. I'll ask this to each of you and Steve, maybe go first. Why were black boxes first developed? What was the problem they were trying to solve?

Steve Leeper

Well, from the Curtis Wright perspective, development of flight recorders started back in 1953, 54, shortly after the comet air disaster. The founders of Penny and Giles, were the company that Curtis Wright acquired a while back, were instrumentation engineers and they realized that there was a need to do something to record an instrument, an aircraft. They started developing a recorder.

It was a wire-based recorder, minimum number of parameters that allowed some sort of level of recording capability on the aircraft. That over the years has evolved.

Adam Kress

Okay, Borka, how about from the Honeywell side? How did they get into this business? And again, was there a tipping point or a need or an incident that happened that kind of propelled the company to get involved in this?

Borka Vlacic

So flight data recorders and cockpit voice recorder are originally developed to help investigators figure out a cause on an aviation accident, to learn from that, put some recommendation and that way try preventing it from happening again. And ultimately they are developed to improve aviation safety. And Honeywell has been really big over the years in that. Honeywell is in recorder business for about over 60 years, same as Curtiss-Wright.

And we have developed several generation of light recorders. And this most recent generation that we have developed, we decided to develop a couple years ago to develop it with our partner in collaboration with Curtiss-Wright. So we bring to market the most advanced and best product we can.

Adam Kress

Okay, so Borka, how have black boxes actually contributed to improving aviation safety over the years?

Borka Vlacic

Over the years as technology improved, we are able to record more data and we are able to improve capacity of the storage. How much data we gonna place in crash protected

environment, which investigators later on can recover and use to learn from that event. So at very beginning, I think Steve started with that. We were recording in 70s, probably maximum 100 parameters on the plane. And now we are recording like in most recent newer aircrafts about 3,500 parameters in flight data recorder. And for cockpit voice recorder, it started like with 10 minutes, 30 minutes, two hours today.

We are recording amazing 25 hours of cockpit voice, crew, captain, copilot, and ambient noise in the cockpit, inside crash protected environment. All the data are really invaluable for investigators, but they also use for preventive maintenance.

Adam Kress

Okay. Steve, when an accident happens and the black box is actually recovered, what's the process that investigators go through to extract that data and draw conclusions from it?

Steve Leaper

Well, it very much depends on the cause of the accident and the effect on the recorder. I don't think any two accidents will be the same. There may be an accident over land, there may be an accident over sea, there may be an accident that involves pressure from sea, there may be an accident that involves fire. Fire can be a different types of conditions.

The flight recorders have evolved over the years to protect against impact, spike penetration, crushing, high temperature fire which is 1100 degrees C, low temperature heat fire 260 degrees C and lots of deep sea pressure. So there's lots of different scenarios that you're protecting the memory from and it really is just the memory that we're interested in.

All the electronics around the outside of it is essentially or could be destroyed or could be disposable. So depending on the scenario, if it's in water, then usually it's taken from the accident site in distilled water, is then dried out for a period of time to make sure, and this is more relating to solid state memory these days. The memory devices aren't going to have any impact of water damage. Similarly with fire, where devices may be burned or the boxes sustain damage. It's basically mechanically sound that the electronics is then operational by testing in various ways. All that before it's powered up.

And then once it can be powered up, then it's a recovery process typically using specialized techniques that prevent overwriting and erasing of any data because the last thing you want to do is start losing data when you power it up. So there are lots of tools that we provide the accident investigators to support that and then once they get that information

out of the recorder, whether it's a voice recorder or a data recorder, it's put back through replay software to reconstitute the actual parameters and the audio recordings.

Adam Kress

Borka, you had mentioned that there's way more parameters now than there used to be with flight data recorders and cockpit voice recorders. How has the technology overall been evolving from the early days to what we see now?

Borka Vlacic

So technology really advancement helped to advance flight recorders also from very pioneer days when people were recording, I think started in 30s, then in 50s, sometimes people recorded about 50 parameters. At beginning it was just only 10 and they used the photographic paper rolling in dark ambient. So that's probably where name black boxes comes from.

And that take just 10 parameters to record them. However, as later on, think late 50s, beginning of 60s, magnetic tapes were use and with development of solid-state memory - that was big breakthrough. Then solid-state memory started to be using, which really reduced probability of breaking moving parts during an event or a crash. So preservation of the data, reliability of the data with solid state memory just improved. And since the technology advanced, then, so it's state memory capacity start increasing density, getting higher parts, more than more and more data we start recording.

Most recently to adding a fact that we are recording more data and we are recording data more reliable. We look in most recent development in technology as connectivity to start improving faster access to the data. So it's all about getting to data, reliable data, more data, and getting sooner, faster to data. That's what all technology aid improve and revolutionize all the industry of the recorders.

Adam Kress

Steve, what would you say in terms of, you know, just the most important ways that technology has evolved with black boxes?

Steve Leaper

Well, think from Curtiss-Wright's perspective, we used to have different types of recording devices on an aircraft. There was a quick access recorder that recorded a superset of data that was used on a regular basis to fine tune the operations of the aircraft. The flight recorder was tended to be carried around and only used in the event of an accident. These days, we've got so much capability within the recorders and the recorders are being matched to the evolving architectures of the aircraft.

These days, as Borka was saying, they're network-based, some of them, so information is being picked up across the aircraft network. Others are dedicated to acquisition systems. We're integrating more capability into the recorders, such as health and usage monitoring, so that you can take what used to be essentially a brick that was carried around on the aircraft and use that more in not only the operations, but also the safety of the aircraft. Health and usage monitoring, for example, you're looking at different sensors than what a flight recorder would normally do. Curtiss-Wright is integrating that into its recorder so that we can look at helicopter drive trains and various other areas of the aircraft and start to predict by running algorithms on ground stations when there may be an issue with something mechanical. The flight recorder, it's got so much data in it these days that it can be used for a whole multitude of things and that's only going to aid safety.

Operationally with the connected recorder we could start to look at how the aircraft is being flown whether anything is happening out of the norm so that it could provide automatic alerts to somebody on a ground station saying there's an issue with this aircraft, it's deviated from a flight path or from normal conditions, start to look into it while it's still in the air. So, it's better all the way around. It's improving all the time.

Adam Kress

Yes, so I've heard the term used, black box in the cloud, right? Or black box of the sky. So that refers to the connected nature of those recorders. Can you just explain, Borka, a little bit what distinguishes the connected from the unconnected recorder?

Borka Vlacic

So when we had started development, the most recent generation of our recorder together with our partner, we decided to use the latest technology, not only to meet requirements that are put in front of us, but to make it more powerful, to enhance that box and connect it. What does it mean to connect it? We develop in Honeywell our proprietary RTAR software, is real time access recording. And that software enables connecting recorders and start

sending data from recorders through satellite network, through the cloud, to data center on the ground. So that allows anybody interested like investigator, operators, maintenance crew, to have a data on the ground available almost real-time and having data so quickly is invaluable from them. They can take action, preventive action, and definitely reduce probability in happening incidents in a flight if they take a preventive action on the maintenance while aircraft is still flying. They can decide to take regulatory action or take maintenance action. And that definitely facilitates a faster investigation. If investigators have on hands very quickly box, they don't have to wait for sometimes months to uncover physical box, especially if accident happened over water, we know all that sometimes take long time recovering that boxes and getting to that data. So for investigators, it's really invaluable to get data faster.

Adam Kress

Steve, what are you hearing from operators that have been implementing the new connected black box? I'm curious what their reaction is and just the value that they've drawn from it.

Steve Leaper

To be honest, I think that's more of a question for Borka. We are providing the hardware solution with the RTAR capability in it. I would have thought an operator, from my perspective, would be welcoming any access to data while the aircraft is in the air. But I'll let Borka embellish on that.

Borka Vlacic

So what we hear from our customers, from operators and end user about Honeywell recorders, and now our common recorders that we supply is very, they are simple, they are reliable, they are easy to use, easy to install, and easy to upgrade. And they are really primarily easy to use. I will get that to last part of connectivity, but want to say why we together, with Curtiss-Wright went way out to make sure that our latest generation of the flight recorder is in the same form and shape to be easy for operators to install it. When they have to replace box or when they plan to upgrade due to new recommendation, they really have no impact on the aircraft. They don't need to change wiring, connectors, anything. They just in same form. So they are really easy to upgrade and replace. What is

really to use is they get data very quickly. They use same tools that we developed for previous generation recorders.

And once when we update the tools to read out recorder, we make sure that they are backwards compatible so users can keep using for all Honeywell recorder same tools. And lastly, what you ask is what about connected recorders they implemented? Very important for them. We do not encrypt any data. We allow them to quickly get to the data and make them really simple and easy for our customer to use it. They have all kinds of ideas that they've fed back to us, how they can make use of this timely access to the data to improve training, to improve procedure, to improve maintenance, and not to even talk about investigators, how valuable that is in many situations.

Adam Kress

Yeah, sure. it's not a stretch to say that when utilized to its full extent, these new connected black boxes are increasing safety even during flight, aside of if an investigation unfortunately would have to happen. But there's so much that could be done to prevent it that it's increasing safety overall.

Borka Vlacic

Definitely recorders are there to improve safety and connected up much more closer, one step closer to bring it to the highest standard.

Adam Kress

Excellent. So where is it all headed from here then? Now we've connected the flight data recorders, but Steve, I'll start with you. mean, how do you envision the evolution of black boxes now moving forward over the next 10 or 20 or 50 years?

Steve Leaper

That's a very good question and one I'm often asked. I think there will always be a need for a flight recorder on the aircraft. Aircraft in different markets, shall we say, in the defense market there's more security of information. Although excellent investigators in the commercial world don't like encryption of recordings, in the defense world that may be more applicable.

In the commercial world, certainly evolving and allowing the transmission of the information from the aircraft, whether it's voice or whether it's data and potentially the expansion of image in years to come so that you can actually see what's happening in the cockpit. That, I believe, is where the recorder systems will be evolving.

Adam Kress

Borka, what do you think? Any other different ideas about where the technology might be headed next?

Borka Vlacic

Yeah, so I think the technology advancing will keep advancing recorders, flight recorders, definitely. And if I'm looking at cockpit voice recorder, I would say that voice recognition techniques are going to get more advanced. And that's going to help for cockpit voice recorder to get automatically maybe on the board, analyze, or cause some flags or alerts, then definitely there is, we will see in the future more integration between flight data and cockpit voice. So that integration will allow for more comprehensive analysis for investigator or of overall situation on the aircraft and what was going when we integrate all that together.

We will see probably real-time monitoring, more of that, with a lot of data being available. And that will allow alerts to be sent automatically when we see real-time monitoring. And Steve was already talking about, for sure, every day enhancing privacy of the data and enhancing cybersecurity, enhancing that side that's going to happening.

And with more data, more transmission, we will see more of a virtual recorder. And that is a little bit more distant future. What Steve said, I think there will be for a long time hardware on the board because it has been proven as invaluable tool.

Adam Kress

Well, I wanted to say thank you again to both of you for joining us today. And like always, thank you to our listeners out there as well. We'll catch you all again on the next episode of Aerospace Unplugged.