EPISODE 180

*"**JFC:** The principle of Zero-G flight is to throw the plane in the air and make it believe it is in vacuum."*

[EPISODE]

[00:00:14] IP: Hello, and welcome to Episode 180 of AvTalk. I am Ian Petchenik, here, as always with –

[00:00:22] JR: Jason Rabinowitz. Ian, where are you?

[00:00:26] IP: Jason, I am in Bordeaux, France.

[00:00:29] JR: Oh.

[00:00:31] IP: Ooh. I know.

[00:00:33] JR: I have nothing interesting to say about that, but what have you been doing?

[00:00:38] IP: Well, sir, what have I been doing? Okay, so to start at the reason I'm sitting here in a hotel in Bordeaux, France, I yesterday flew on the Novespace Air Zero-G A310, alongside the German Aerospace Research Center for a set of 31 parabolic flights. It was the most amazing experience I have ever had in the air. Not even close to the next most amazing experience by far, by far.

[00:01:14] JR: I don't hate you, but I hate you for doing this without me. Because it sounds and looks from the videos I saw, freaking amazing.

[00:01:22] IP: It really is a special time. We've got a special show for you today. Not only did I get to go on the flight, which you can read about on our blog, I'll talk a little bit more about it in just a few seconds. Coming up in the show, I was able to speak with Jean-François Clervoy, who is the Chairman of Novespace, the organization that runs the actual aircraft. He is a

fascinating, fascinating guy. We scheduled about 15 minutes to chat, and we ended up talking for nearly an hour.

[00:01:56] JR: Now, was this the conversation in which you divulge that bit of information about another potential aircraft they had in mind? Or are we not even allowed to talk about that?

[00:02:03] IP: No, no. We talked in depth about that.

[00:02:07] JR: Because I have not actually heard this yet.

[00:02:11] IP: Jason will never hear it, because he doesn't listen to the podcast.

[00:02:13] JR: I don't listen to podcasts. I might actually go back and listen to this segment, because spoiler, they almost ended up with a very different aircraft than what they operate today.

[00:02:25] IP: Exactly. Not only did I talk with Jean-François and had a great conversation there, which you'll hear in a few minutes, but we also had a chance to talk with Bertrand Rameau, who is one of the eight pilots for the Novespace A310. He talked about what it's like to actually fly the aircraft and fly those parabolas. We'll come to that in a bit. I want to back up and talk about what happened beginning Saturday afternoon and how I got here, which was, there are decisions that are made based on monetary ideas and logic that seems to make sense at the time.

[00:03:04] JR: Everything seems like a great idea when you're clicking the book button.

[00:03:07] IP: Right. What I did to get here, so I'm in Bordeaux now and tomorrow, I'm going to go up to Stockholm. By the time you listen to the podcast, I will be in the office in Stockholm, having hit publish on the podcast button, to send it out to you, wonderful people listening, wherever you are.

I said to myself, oh, I'm going to be in Europe, I might as well go to the office. I should make an effort to go to the office and see some new folks. We've got some meetings to have, so it's

going to be good. What I did is I booked and I think we mentioned this briefly last week, I booked Chicago-New York, New York-Stockholm on Delta Airlines. Then I booked a separate ticket of Stockholm-Paris, Paris-Bordeaux, Bordeaux-Paris, Paris-Stockholm on Air France.

That concerned me for a variety of reasons. The first of which is, if anything happened to my Delta flight getting over here, there wasn't really any recourse to get me down to Bordeaux, because it was a completely separate ticket. I would be relying on the good graces of Air France customer service agents at an outstation.

[00:04:16] JR: Oh, yeah. The French are definitely known for bending their rules and getting you on a connecting flight when you don't deserve it.

[00:04:23] IP: That was the first risk. As it turns out, I had nothing to worry about there. I actually got “upgraded” on my Delta flight from Chicago to New York, because there was a family that was trying to sit together, so they moved me up to an empty seat in what was it? Comfort Plus. Whatever the, I guess, a little extra legroom on a CRJ900 is. That was fine. Those seats, somebody tweeted at me. They're like, “I'm so sorry. Those are terrible seats. The actual seat is a terrible seat.” I was like, “Well, how bad can it be?” Then I sat in the seat and I was like, “Oh, yeah. That's true. That's absolutely true. They are terrible seats.” The seats on the CRJ900s endeavors operating, I guess, it's the XJ registrations are these particular seats. I swear, they are designed by a human being who has never sat down before.

[00:05:13] JR: Yeah, they're not great. I spent some time on a similar CRJ, but a United special CRJ550 the other day, but I was nestled up in first class after I paid for an upgrade just to try it out, and quite comfy.

[00:05:28] IP: Yeah. I didn't get the full luxury of first class on this particular flight. I did get to sit in Comfort Plus. The thing I was bummed about is they moved me out of a window seat into an aisle. It was fine. Anyway, we landed at JFK, took a couple laps around a – took the bus from T2 to T4, took a couple of laps on T4 and boarded the flight to Arlanda. There happened to actually be a flightradar24 fan and podcast listener on the flight. I don't know if he wants me to publicize his Twitter handle or name, so I will just say, it was great to meet you. I'm glad we got to meet up and thanks for coming by and saying hi. Flight to Arlanda on a Delta 767-300.

Let's discuss for a moment what happened on that flight, which was the crew was very good. The plane itself was not. They had to reset the entertainment system six times. They had to reset the Internet twice. Multiple Economy Class galley ovens were not working. They delayed service an hour to serve everybody at once, because they had to move some of the food up into the first-class galley. Of course, they served the first-class folks first. They had to wait till – or Delta 1, I'm sorry, Delta 1 folks first. They had to wait until they were served, so that they could then cook the economy class food.

[00:06:53] JR: Yikes. I know we talked about this last week, that we're starting to get shades of the American 767 fleet. It's hit or miss on Delta with the 76s. Some of them are kept up really well. They were just recently refurbished where they installed premium select. Your aircraft may not have had. Do you happen to recall if they –

[00:07:11] IP: No, no. It had premiums left.

[00:07:13] JR: They did? Oh, that’s not great.

[00:07:14] IP: It was a well refurbished aircraft.

[00:07:17] JR: But it's getting tired.

[00:07:19] IP: But it's getting tired. Yeah, it's the behind-the-scenes things. The only other thing that I wasn't particularly fond of throughout the flight was the level of turbulence involved. Normally, turbulence doesn't bother me. The problem was it was bad enough for long enough that they kept the seatbelt sign on.

[00:07:37] JR: That's just Delta, or any US-based airline will keep it on the whole time.

[00:07:40] IP: I was like, okay, that's fine. But this is an eight-hour flight and I need to get up now. Anyway, we landed and landed early, no less. I made the transfer from terminal five in Stockholm over to terminal two via the airside bus, which was always fun to do in Stockholm,

because you get to see a whole bunch of carriers you're not going to see. Heston Aviation, some Amapola Flyg, League, Fokker 50s, all sorts of good fun stuff.

Go over, the terminal is empty. Terminal two is empty when I get there. There's no one else in the terminal. Not people who work there, not passengers. It is empty. For a minute, I think to myself, I'm like, “Am I in the wrong place? Am I supposed to be here? I'm not sure what's going on.” Luckily enough, the Starbucks, of all places, was open. I figured, okay, the terminal is actually open and I’m allowed to be here.

[00:08:30] JR: Beacon of hope.

[00:08:33] IP: Let's not go that far. Just a beacon of being open, which proved the point. Fly down on a delayed flight. The inbound was delayed coming up from Paris, so that flight was delayed. When the gate agent says, “Please, do not break down the doors,” you know things are going very well.

[00:08:52] JR: Did anyone break down the door, or were they compliant?

[00:08:55] IP: No, they were compliant. Nobody broke down the doors. That was good. Nobody on my flight at least. It was the standard Air France massive boarding, where everybody that's getting on the plane decides that they're going to boarding group, who cares? I'm getting on now. Everybody rushes to the boarding gate and the stands –

[00:09:12] JR: Did you have boarding, not boarding. Ah, you had boarding, not boarding.

[00:09:15] IP: Yeah, yeah, yeah. Oh, absolutely. Absolutely.

[00:09:17] JR: Good. Some things are back to normal.

[00:09:21] IP: Yeah, it's perfectly normal. Then make it down to Bordeaux and everything works out because my Paris-Bordeaux flight was also delayed, which meant that I didn't have to hustle to make my flight. Then I got here, and that was 21 hours of traveling, a 30-hour day, arrived here and then Monday, got to work getting ready to prep for the Zero-G flight, which included

getting a flight suit, which was fun, and going through a lot of the safety briefings again, and then just preparing for Tuesday's flight.

Then Tuesday's flight was a very early start. My start was early. The people who are on these flights performing their experiments, the plane is opened at 6 a.m. They can get to the plane as early as 6 a.m., to make sure that by 9 a.m. their experiments are ready to go. They work so hard. They're here a week before the flights, preparing the experiments. It takes three to four days to load the experiments onto the aircraft. Again, you can go to the blog to see pictures of some of these experiments and how they work and what these folks are doing. A lot of them, the experiments can weigh up to 200 kilograms. There are a few that weigh more than that, because they were grandfathered in before the new size down rules. The rule used to be 400 kilograms.

There are some big racks and some really cool stuff. One of them was the space bike, which is a bicycle that is bolted to the aircraft floor. The person who's riding the bike has all sorts of electrodes and a brain scan helmet and all sorts of things attached to them.

[00:11:02] JR: It's a pedal APU. Yeah.

[00:11:04] IP: Yeah. They're actually the APU. They pedal in microgravity. The experiment, the thing they're trying to figure out, and it's not about biking per se, but it's about the brain's control of the muscles in microgravity. How well do the muscles respond to the signals that the brain is sending? The bike is the, as it was explained to me by the scientists who designed the experiment, basically, the bike is the perfect method to study this, because you've got up and down motion, you've got circular motion, you've got left and right, and so all of those things work together to give you a really good idea of what's happening. So they can figure out what are the muscles responses to the brain in microgravity, and this is going towards studying, okay, we're going to be living and working on the moon in the next decades. We're going to be going to Mars, living and working on Mars in the next few decades. What do astronauts need to do? How do they need to do things differently and things like that? Another really cool experiment was cool flame. Not like flames are cool, but cool temperature flames.

[00:12:12] JR: Like, cool ranch?

[00:12:15] IP: Sure. Like cool ranch. How these flames propagate in microgravity.

[00:12:21] JR: Wait. There was an open flame on the aircraft as you're in a parabolic dive with micro-gravity?

[00:12:27] IP: Correct. Yes, correct. It's a close fun.

[00:12:30] JR: You had a much better Tuesday than I did. I'll tell you that much.

[00:12:33] IP: Well, I mean, at this point, probably, I mean, I'm not even going to – I'm not even going to dispute that. I'm still giddy about the thing –

[00:12:37] JR: It's not up for debate.

[00:12:38] IP: - and this is Wednesday. That experiment is just on the propagation of different fuels and different mixtures of oxygen-rich environments. Basically, if there's a fire in space, how best to put it out?

[00:12:54] JR: Is this the thing they want to know, but they're not willing to actually test in space on the space station, because fire, bad in space?

[00:13:01] IP: Fire, bad in space. It's better to learn about how bad fire is not in space.

[00:13:08] JR: Interesting.

[00:13:09] IP: Yeah. Then another one that was onboard was a refueling test. Basically, the supposition is that when we go to Mars, when we go to the moon, when we go beyond the moon, wherever we go, it might be Mars, might be somewhere else, who knows? You're going to need to start refueling ships in space. That presents a whole host of challenges. Because how do you make sure that the fuel that's in liquid form stays in liquid form as you transfer it to the other tank? They're experimenting with different mediums and how to do that, and different

pressurization techniques and all sorts of good fun stuff. Some really cool, really cool experiments onboard.

The one that was part of the space bike one, but it was a little bit different, is they had a test subject jumping during the hyper gravity. What happens in the parabolic flights is that you're flying at level flight at 20,000 feet. Then you hear the countdown one minute, 30 seconds, 20, 10, 5, 3, 2, 1, pull up. At the pull up, they pull back on the yoke, and they pull up from level up to 50 degrees nose up.

In those 20 some odd seconds, you are experiencing 1.8 Gs, and you're being pressed into whatever you're either standing, or sitting, or lying on, or whatever. In that pull up phase, and then the subsequent pull-out phase on the backend of the weightlessness, those people were jumping. I tried to do it.

[00:14:55] JR: Couldn't do it?

[00:14:56] IP: I couldn't do it.

[00:14:58] JR: I mean, I was in an elevator today that move pretty fast. I know that's more than one G, but probably not as dramatic as what was that? 1.8 Gs.

[00:15:06] IP: Yeah, between 1.8 and 2, but the goal is 1.8. I thought that was amazingly impressive. The insertion, or injection into microgravity was such a weird experience, that it's tough to describe, because you're sitting in an airplane seat, or you're laying on the floor, or you're just standing up holding on to something. Then all of a sudden, you're just floating up in the air, and you've done nothing to do this. You haven't pushed off. You haven't done anything. You just start going up. Then for 22 seconds, the feeling of weightlessness takes you over, and you just float there and move around and you don't really have any control over which way you're going, unless you've pushed off of something. Then you hear the countdown, and they pull up. All of a sudden, you go from weightless to 1.8 Gs again. Really fast.

[00:16:00] JR: I have nothing to add to this. It all sounds quite amazing.

[00:16:04] IP: That was such a weird feeling, the feeling of going from weightless to hyper gravity in an instant again. That for me was the weirdest thing. I'm not ashamed to say that my digestive system and nervous system conspired against me a little bit.

[00:16:19] JR: Uh, oh. Did you need the high tech bag?

[00:16:22] IP: I made use of the high-tech bag, very high tech. Super, super high tech back, but it went away. Then I was able to get back to work, making video and film for the fine people at home. It all worked out. It was an amazing experience. I think that having had that experience and learned about what the scientists are working on gives me a whole newfound respect for how they're doing it, having experienced that flight.

With that, I want to shift over to a pair of interviews with Jean-François Clervoy and Bertrand Rameau. We'll do them back-to-back and play those for you now. You can learn a little bit more about how it works, and how they almost ended up with a very different aircraft. Then when we come back, Jason can pretend that I hadn't yet told him and we'll talk about it after we hear from Jean-François and Bertrand. We'll be back after we talk with them.

[CONVERSATION WITH JEAN-FRANCOIS]

[00:17:24] IP: I spoke with Novespace Chairman and former astronaut, Jean-François Clervoy about the mechanics of parabolic flights. He had a lot to say about that. In the course of our conversation, I also learned that we came quite close to seeing a much different aircraft operating these flights.

[00:17:41] JFC: First of all, thank you so much for taking your time.

[00:17:42] SPEAKER 1: I appreciate it.

[00:17:43] JFC: Really appreciate it.

[00:17:45] IP: I just want to do some housekeeping very quickly. Can you tell us your name and what you do here?

[00:17:50] JFC: Okay, my name is Jean-François Clervoy. I've been an astronaut for 33 years and flew three times on both the space shuttle Atlantis and Discovery. I founded the first public flight program in Europe in 1989. Novespace to cover the management or the program when I joined the 14th group of NASA astronaut. When I came back, because of the Columbia accident, there was no more flight in the near term for me. I told ESA, I would like to manage Novespace, even part time, because their only activity is Zero-G flight and I know by heart. That's my baby.

I've been Chairman, CEO of Novespace from 2006 and 2011. Then ESA asked me to come back in the astronaut office. I was already part-time, but they wanted me full time. I named my deputy director at the time, CEO, and remained the chairman. Today, I am honorary chairman. I took some steps back, but I'm still involved a lot on all the private flights. Sometimes in the scientific flight, when I am asked to be a subject of an experiment where they need an experienced astronaut, or when I record some documentary, some shooting, or come because of a special media tech event associated to a scientific experiment.

I'm at home here, and it's an opportunity for me to touch for real weightlessness, moon gravity and mass gravity regularly even after 64 years since I was born. It's fun. For the 30th anniversary of the first Zero-G flight in Europe in 2019, 30 years since 1989, we flew with Charlie Duke. Charlie Duke is a friend who flew on Apollo 16. He told me that was 47 years since he had flown Zero-G flight. The first time of his life when he worked on Mars. Because when he was a backup of Apollo 17, he did some training in Zero-G and moon gravity, but he had never flown Mars gravity.

Here, you are involved in Zero-G scientific campaign, so you will experience only Zero-G, but this is already quite something. Basically, my career has been dedicated mostly to human spaceflight, because I consider scientific research on our plane to be part of the human spaceflight program. In most space agency, public flight is included in the Department of Human Spaceflight and space microgravity research. That was a longer description.

[00:20:35] SPEAKER 1: Perfect Jean. What was the reason to bring Zero-G to life?

[00:20:40] JFC: In fact, I knew about the Zero-G concept about the aircraft, and I was selected very young at the age of 26 as an astronaut. To get some operational experience, I was sent to a test pilot school in France, called East. East is a city where we have our flight test center and flight test to school, where I got my flight test engineer degree. You need to do the kinds of thesis at the end of the course. You can choose. I chose to do my thesis on the concept of Zero-G flight, because I am an aeronautical and astronautical engineer. For me, Zero-G flight belong both to the world of aeronautics and astronautics, because we use an aeronautic tool in the airplane to do an astrological type of research.

A colleague of mine, despite French, despite not astronauts from class, the class 85' from the French space agency, visited me in East and told me, "What are you doing?" I said, "Oh, I'm doing my thesis on Zero-G flight." Basically, how to define the best quadruplets, the four key parameters, which define a given maneuver. The given maneuver for any aircraft is the initial altitude, the initial velocity, usually the maximum possible, the number of G's for the pull up, and which angle, which pitch angle you stop the pull-up to initiate the ballistic phase. Four parameter.

Depending on the aircraft, its engine characteristic, aerodynamic characteristic is not the same. For example, for the Alpha jet, 5,000 feet, 450 knots, 5G, 70 degrees nose Earth for injection and you get 40 seconds of weightlessness. For the Caravelle, the initial altitude was 25,000 feet, but it doesn't work well for an Airbus. It's only 27, for reasons I can explain, but it's flight mechanics. Maneuver margin, limit margin, the flight, I mean all kind of – He told me, why not wait together, try to develop a program in Europe? Because at the time, the scientist who needed Zero-G flights for their research, a French-German, from any member states of ESA, used to go to Houston to fly the KC-135. At the time, NASA was operating its own Zero-G aircraft, which was the KC1 to derive a derivation of the Boeing 707, but adapted for tanking, for in-flight.

I asked the DG of the French space agency, Cones. He told me, "If you can convince German and ESA to stop going to Houston and use the plane you're going to qualify, I support you. I will help you finance the program." I visited Mr. **[Inaudible 00:23:47]**. Mr. **[Inaudible 00:23:47]** at the time was the head of the microgravity research, and head of the astronaut office at DLR. He

said, “Okay. All cool.” I visited the head of the microgravity program at ESA in Stech. I went to K **[inaudible 00:24:01]**. It was in ’88, to Stech and they said, “Okay.”

They were a bit frustrated, because going through Texas, Houston, he’s like, “You go to an exotic place for your – so it’s a pity.” Bordeaux is nice. They trusted us. It took about the one year to qualify the plane with very minor modification. No modification to the basic systems of the plane. We just added a buffer tank for the oil of the APU, which provides electricity in flight. That's it. Then we started.

I understood very quick that for about 70%, 80% of the research we do onboard, we don't need to go to space, because the time of the weightlessness and the quality of the weightlessness is good enough for the specific research science that we study. Many scientists are also scientists of experiments that need long duration. They go to the ISS. The main advantage of public flight is the researchers, the scientists are themselves on their own hardware. When you hear us we're not doing research onboard the ISS, it's a shortcut of language. It's not true. We are just operator of machines. We don't do research ourselves.

We are the eyes, the hands of the scientists. They hope that we will do the best we can to satisfy their needs. Those who do the research, who get the data, the samples, who publish are people on the ground. It's very rare that an astronaut is also involved as a scientist in a research being done onboard the ISS. The job of an astronaut consists only of being operator of complex machines, spacecraft, robotics, spacesuits, and all kinds of scientific hardware.

We are just one switching on, changing the samples, but we don't – Here in our plane, the scientists are on their own hardware. For scientists, it's very motivating. The second advantage, within six months, they have an opportunity of flight and they can get ready. As soon as you want to go to space, you need to go via the space industry. You have to ask Airbus, or Telus to design the hardware, and it takes years. 10, 20 times, 50 times the cost.

Here, it's quite easy. It's accessible from timewise, money-wise, and it's your own thing. It happens that in all fields of science, chemistry, physiology, biology, for animals, for humans, for plants, astrophysics, nuclear physics, particle physics, conversion physics, free physics, you have something to do interesting within 22 seconds. We cannot satisfy the whole demand, or

what the scientist would like to do in weightlessness. We can satisfy the whole thing, because some research need duration. 80% of the specific research in our brain doesn't need to go to space. 20% of what is done in our plane is to qualify hardware and all procedures before sending to a spaceflight.

When I say spaceflight, could be the ISS, sounding rockets, or automated the spaceship, like the photo. You have the photo. Because as soon as you are on a sounding rocket of – you need to miniaturize, make small and you need to automate. You have five platforms to do microgravity research. Two that are manned and three that are unmanned. Dropped our sounding rocket and photon capture, automated and very small. The tool where people can act ISS and Zero-G flight. Zero-G flight, again, the scientist, he knows better than us what he wants, what she or she wants.

I started running the program in ’89, when I left Europe to rejoin the 14 scoop of NASA astronaut, Novespace took over. To answer your question in short, I knew about Zero-G flight. As a flight test engineer, I had the knowledge to start from scratch that programming York, which didn't exist. I was trusted by my management to do my thing.

[00:28:29] SPEAKER 1: Amazing job.

[00:28:31] JFC: Yeah. They said, when you start from scratch in your program, it’s fun. When you take a program that has been started by somebody else, you’re taking the course, it can be interesting depending on the subject. When you start from scratch, it's like the ATV, I was, when I came back from the US in the early 2000s, I was named the Senior Advisor Astronaut of the ATV program. ATV is the acronym of Automated Transfer Vehicle. It was a huge resupply automated spaceship entirely made and controlled by Europe, for the ISS.

Designed, manufactured in Europe, launched by Ariane 5 to go automatically, autonomously, which is not the same, to the ISS. For example, the progress, the Russian Progress is an automated cargo ship, but it needs cooperation of the station to make the automated. ATV had a system of image processing to recognize, we have to go, which altitude, without having the station to give its own data. We put the bar quite high, but we succeeded quite well. Three times out of five ATVs, we dot with a precision of less than 1 centimeter. The ATV is 20 tons.

[00:29:53] SPEAKER 1: Amazing.

[00:29:56] JFC: I would try to be shorter on the next question.

[00:29:59] SPEAKER 1: That's so interesting.

[00:30:00] IP: Completely changing the subject, not entirely, but almost entirely. We're sitting in Bordeaux. The A310's behind you, there happens to be a Beluga sitting next to the A310. I know it's not here for that, but have you ever given any thought to what the perfect aircraft for Zero-G would be? If you were starting this all over again, and you had your choice of any aircraft.

[00:30:24] JFC: In fact, since we didn't get for a long time the answer from the German air force about the A310, **[inaudible 00:30:33]**, which transported the **[inaudible 00:30:35]**, this one, we were pessimistic. Airbus proposed to us to pay for the studies and the test flight to verify that the Airbus 380 could do it. It was successful. We were supposed to announce at the Paris Air Show 2013, the partnership between Novespace and Airbus to continue Zero-G flight for ESA, DLR, French Press Agency, with their own Airbus 380. I think the number two or the number three. Because they said, "We have a need for this aircraft, but that's not big enough to justify to maintain it in flight conditions." It was to arrange the top floor into a very luxurious apartment, for MEITs."

We need to find another use to contribute to the maintenance. They told us, we will organize a campaign for you, but you will have to combine two campaign in one. It is so huge, that the mid floor, I mean the main floor, you have the cargo and the two floor for passengers, the middle one is so huge, you could fit three or four times what we have in this one. They say, in order to minimize. It would have been a constraint for us, because we would have been obliged to convince ESA, DLR, to find dates where they can fly together. It's feasible.

What was a bit frustrating for us is in that case, we would have not been our own operator, because we would have not managed the training of the pilots, etc. A month or two before the Paris Air Show, the one head of Airbus told our partner, we consider that you – one other condition is we will price Novespace just the same amount you would price if you had your own

Airbus, like the $300 310. Then somebody at Airbus said, it's too kind for Novespace, because it costs far more, especially for engine seat.

Within Airbus management, they decided to review the price, the pricing offered to Novespace, to see if they could maybe price a bit more than what they promised at the beginning. In between received the answer from the German air force, okay. Because we had the head of class and the Minister of Defense talk to each other to find if it was possible, because DLR is the user. DLR has an interest to favor this transfer. In the meantime, we got a favorable answer from the German air force who said, we are ready to not put in auction that Airbus 310, which was the original plan. We will sell you at the market price. Give us a price, we will see if it's reasonable. We give a price to say okay, so we have it.

What is nice is this is our own. We operate and manage ourselves, like a airline company. We are our own operator of the plane. It's more flexible, because we don't have to make agencies agree together on the planning for when to fly. To answer your question again, in short, we have had the opportunity to look at big aircraft, which would be actually interesting only for shooting movies, where they need the big mockups.

When you fly people in Zero-G, it's dangerous to have a huge volume. Because the EuShin 76, which has a smaller floor surface than this one, has a high ceiling, more than 4 meters high. You need to assign one safety attended per passenger, ready to grab the foot. Because if you are at 4 meters when you will do the pullout, you will see during the pullout, your maximum 1, or 1 and a half meter above floor. Our plan is good. I mean, maybe we have only 220-meter ceiling height, so maybe 250 would have been ideal. Otherwise, it's fine. It's okay. It's manageable.

Beluga, we have looked at how to get a longer time. Concorde. Concorde would have given us one minute. If you use a post conversion, high angle of pitch, it's actually, you can get one minute of Zero-G. Of course, Concorde is too expensive. At the end of life, there were some Concordes still able to fly. We look at the Airbus 380, but Beluga would be definitely too big, too soon. Safety wise, not manageable.

[00:35:20] IP: Interesting, interesting. Could you explain the parabolic nature? Why can't you just fly and then dive? We get a parabola.

[00:35:31] JFC: Okay. The principle of fabric flight is to insert the aircraft into an Earth orbit. I show you. Can I?

[00:35:41] IP: Yeah, any, any. No, I have to give that back to her.

[00:35:45] JFC: We demonstrate in physics that when you are outside a uniform sphere, the gravity is the same, whatever the size of the sphere. If you are outside Earth, the gravity field is the same as if all Earth was there. Imagine the virtual ellipse orbit like this. This is the arc of an actual Earth orbit. If there were no atmosphere, you would be in weightlessness here, like when you are on orbit around the Earth.

The principle of parabolic flight is to throw the aircraft in the air and make it follow this arc of an orbit at its apogee, where velocities and altitudes are within the qualified flight envelope of the plane, given by the constructor, Airbus. In order to maximize the time of weightlessness, we give the time of ascent and descent. When I throw this pen up, the time of weightlessness is the water, because in physics, freefall doesn't necessarily start with a fall towards the floor. When you throw something in the air, it is called freefall in physics. Weightlessness is a state you are in when you are subject to gravity only. It's not the absence of gravity. It’s when the only remaining force applied to an object is gravity and nothing else. When there is no surface contact force.

In our daily life, we are submitted to gravity, which is a volume force. It applies from a distance to any grain of matter of your body, inside, outside. Or the other force we face in our daily life, our contact forces, surface forces. Why going up first is to double the time of weightlessness. The term of weightlessness is when you freefall is V divided by G. V is GT. When you throw something in the air with an angle, only the vertical component plays, which is V, sinus gamma. This is V. This is V sinus gamma. If you freefall, if I let this pen go down, the time of weightlessness is V sinus gamma, divided by G. If you throw first the object up, it's twice.

[00:38:31] IP: That makes sense.

[00:38:34] JFC: Whenever you throw something in the air, here, we can neglect the air. By the time the pen has left my hand, it is in freefall. This is rigorously the arc of an ellipse. The reason why we call it this parabola is because the gravity field is radial. Locally, here, it's always – locally, you if you consider it to be vertical, then the equations give the parabola. Actually, we should call this, if we want to be an elliptical flight. It's an arc of an ellipse. Because the gravity field is not parallel. It is radial. Over a short distance of few miles, or 10 –

[00:39:17] IP: It appears to be –

[00:39:19] JFC: It's like vertical. The principle of Zero-G flight is to throw the plane in the air and make it believe it is in vacuum. To do this, so we have the plane here, engine. An aircraft is subject to its own weight. Three, we can resume the aerodynamic force, which are by contact on the fuselage, on the wings, three forces. You have the lift. You have the drag, air drag and you have the thrust by the engine. By a specific piloting technique, you can null the sum of the those three force. You can choose an angle of attack, which makes the lift equals zero. You can adjust the thrust to exactly none the drag.

On the steady flight, these are equal, and this exactly compensate the weight on a steady flight. The lift, the equation of the list of the – it's one half. I don't know, the square of the velocity, the density of air and the coefficient of lift. This is a fixed number.

[00:40:40] IP: You got that now?

[00:40:43] JFC: Now, what you have to remember, lift is proportional to the density and square of the velocity. If you are fast, in a low-density air at high altitude, or slow in a high density, it is the same. Okay, and see that if you don't change those, the lift coefficient is proportional to the angle of attack. This is the angle of attack.

In fact, you might, let's say, the plane is going like this, this is the angular attack. It's the angle between the airflow and the angle of the plane. The equation is like this. Here you have what we call, it's about minus three degrees, something like this. Angle of attack of zero lift. Lift is zero. When you're here, look, this point the lift is zero. When the angle of attack is zero, you have some lift. That's why the aircraft is always slightly up, and the wings, when the aircraft is like

this, if you look at an aircraft, so we got them all like this. The wings up slightly. During the weightlessness, we fly here. During the whole ballistic phase, even when the plane is like this, people are asking, why don't you stall? Because many people associate stall to the angle of the plane. It's only in steady flight. Because stall is not at all linked to the pitch angle. It's linked to the angle of attack.

If you're like this, but going like this, lift can be zero. Why do we associate stall to steady flight, is because when you say 120 knots is the stall velocity, we mean, on a horizontal flight. The slower you fly, why you want to maintain in horizontal flight, the more angle of attack you need. That's why when you say the stall speed is so and so, we mean **[inaudible 00:42:52]**, we suppose we are talking horizontal flight. Okay.

When you're here, we are below the stall speed at horizontal flight, but we are not on our horizontal flight. With the **[inaudible 00:43:07]** doing the study flight, during the test flight, we reach 55 knots at the tip of the parabola. What the stall speed in steady horizontal flight is above 100. Same for this one. We are slightly below the stall speed.

We fly here. The ballistic phase is here. We are far away from stall. Now, during the pullup, during the phase, proceeding the ballistic phase, if the steady flight is here, let's say this is steady flight, we have a slight angle of attack, a few degrees to get lift, equal weight. During the pullup, we go here. We want to increase lift. We increase live by almost twice, 1.8 times to curve the trajectory, to make the velocity get an angle above, to increase the sinus gamma, to increase the sinus.

Basically, we are not close to stall, but we get closer as we do the pull up. Before you get to stall, you had vibration, you have the buffet and you have the warning and we stay below that. That's why we are at 20,000 feet. Because at 25, the engines are not powerful enough to compensate for the drag and the – Anyway, the basic thing is –

[00:44:26] IP: That is my next question. I was going to ask why the particular altitude and things like that. Then you just –

[00:44:36] JFC: Altitude and velocity, true velocity. On the ground, zero altitude. The velocity you read on the instruments is the reader one relative to air. What you read in the cockpit is called indicated airspeed. Indicated is almost never the true airspeed, even with no wind. Indicated airspeed and true airspeed are the same only at sea level, in standard atmosphere. The higher you go, the higher is a true airspeed for a given indicated airspeed. Because the curve are like this. Have you seen this before?

[00:45:15] IP: Yes.

[00:45:17] JFC: Because what is important for an aircraft is not so much the velocity. It's how much air mass comes into under the wing. We have the pitot, the pitot will receive air at a certain velocity, at a certain density. You can get the same reading, whether you are slow in dense atmosphere, or fast and low. It will be the same amount of air coming in, the flow of air mass. That's only what counts. This is what we call ISO indicated airspeed. The higher you go, the higher is the true airspeed.

In my equation here, to sinus gamma over G, what counts here is the real speed in the space, in the universe. We don't care about the air. The airspeed is important. I mean, the indicated airspeed is a concept important for the flying. In terms of astronautics, or in terms of physics, or freefall, the law of freefall, what counts is this one. The higher you are, the higher is the true airspeed for a given max speed authorized by the constructor. Whenever says, the maximum airspeed, the VMO for your plane is a 340, with a good margin and we try – we never exceed 320, 325, something like this. At that given indicated airspeed, the higher we are, the greater is the true airspeed.

[00:46:48] SPEAKER 1: The true airspeed. Yeah.

[00:46:50] JFC: The more you go in altitude, the less the engine are capable to compensate the air drag, which itself is proportional to the lift. We call it the maneuver margin. The maneuver margin, you have in aerodynamics, you have in-flight mechanics. You have two terms. The maneuver limit and the maneuver margin. These are the number of G's. The maneuver limit is the maximum number of G's that an aircraft can produce. Thanks to its aerodynamics. The maneuver margin is maximum number of G's that an aircraft can sustain, thanks to its engines.

For example, and you can see this on the graph. Of course, the maneuver limit is higher. You can't pull and get 5 G's, but you will stall, because this point is the maximum lift you can get. The maximum number of G, the number of G's lift divided by the weight. The maneuver margin is how high can I maintain my lift and stay there continuously, thanks to the engine? Because the higher the drag, drag equal residual drag, plus K lift. During the ballistic phase, the engines are close to idle, because we have to compensate only for the residual drag, because we have no lift.

During the pull up, we want a high lift. It happens that the engines on the Caravelle were capable of sustaining the 1.8 Gs, without losing total energy. Because the total energy is a sum of the potential and kinetic energy. You know about the two. One is altitude, one is velocity. If you are at the maneuver margin, at the G level that the engines can sustain, you just exchange altitude and velocity. If you pull a number of Gs above the maneuver margin, not only you exchange altitude and velocity, but you degrade the total of the two, the total energy, what we call the total energy.

That's why for the Alpha jet, so the idea is to get the maximum time of weightlessness. The idea is to quickly as quick as possible, get the angle. Because the more time you spend exchanging altitude and velocity, the less velocity remains as a start of the maneuver, at the start when you get the V sinus gamma. Even if you have a high sinus gamma, because your gamma is high, if you have only 10% of your velocity remaining, it's not interesting.

The idea is what is the highest altitude at which I can pull 1.8 G, because for all commercial, so maximum G authorized is 2.5. They are built for 2.5 max. Above 2, you have to mention in the logbook.

[00:49:55] IP: This is what we do.

[00:49:57] JFC: Just to inspect. But even at above 2, it doesn't fly – Below 2.5, you don't damage the plane, but you have to indicate it on the logbook. We don't want to reach to be above 2. That's why we take a margin by aiming only at 1.8. 1.8 at 25,000 feet, okay for the Caravelle. With this Airbus, the optimum, we wait until we have a high gamma, while the velocity

has decreased with the worse than setting at 20,000, because we would degrade the total energy. We will not just exchange altitude and velocity. It's a question of engine performance, or achieve to the type of aircraft.

[00:50:40] IP: I mean speaking very, very theoretically here. If you strapped a GE-90, exchange your CF6s for GE-90 engines, I mean 115,000 pounds of thrust. Then how have I changed how things work?

[00:50:55] JFC: That means as we put full thrust to avoid exceeding the max speed, VMO, you pull Gs, so you increase drag, so the aircraft doesn't accelerate. Or, the idea would be to maintain 340 during the whole pullup. Then at injection, to be here, instead of being 220 on our plane, would be still 340, the VMO. Why you look for high gamma?

[00:51:23] IP: I've added time.

[00:51:25] JFC: Oh, yes. A lot. A lot of time. Yeah.

[00:51:28] JFC: Each aircraft has its own optimal quadruplets of parameter, initial altitude velocity, number of Gs for the product and pitch angle at which you stop the period to insert into the ballistic. For the Alpha jet, I told you, the optimum is 5,000 feet, 450 knots and 5 Gs, 70 degrees nose up.

[00:51:50] IP: Okay.

[00:51:53] SPEAKER 1: We need **[inaudible 00:51:53]**.

[00:51:58] JFC: For the Caravelle, if we were doing only from 20,000 feet, then we could theoretically pull more than 1.8 Gs, but it's not allowed by – we're not allowed to exceed the right amount. Our velocity at the end would be less, because we are closer to the ground. We are – at lower altitude, we would be, instead of being here at the same indicated airspeed, we will be lower 25, 20,000 feet, will be here. We lose some of the V at the end. The gamma was able to sustain the 1.8 Gs the whole time. Actually, on our Airbus, it's not 1.8 the whole time. We start slowing down to 1.5 to avoid getting to the buffet, which is the pre-left of the stall.

[00:52:49] IP: Interesting.

[00:52:51] SPEAKER 1: You have buffet, which is natural. That one, you have the stick shaking, but you will never get there.

[00:52:59] JFC: One more?

[00:53:00] SPEAKER 1: I mean, we already spoke 45 minutes.

[00:53:03] IP: I'm having a great time, though.

[00:53:05] SPEAKER 1: I don't want to worry too much.

[00:53:07] JFC: How much of the time. Yeah.

[00:53:08] SPEAKER 1: I have plenty of questions, but I think I can do it with a pilot tomorrow as well. Just another question for an astronaut. You can answer very short, yes or no. After such a long time in space, what is it like for you when you return to weightlessness? Does it get boring at some time, at some point?

[00:53:27] JFC: Weightlessness never gets boring. It's always a magical sensation, because you don't feel your weight anymore. You forget you have a weight, and you can even get to the point where you forget you have a body. Especially in space when it is on a long duration. Because I am used to it, I got myself in a position is in the plane during the weightlessness, where I don't look at my body. I just look at the people and I'm just floating conscience in material.

It's fun. It's fun, because you feel freedom. You saw Einstein, weld on the door? Yeah. Because weightlessness in the sense of Newton is when the only remaining force existing on an object is gravity. In the sense of Einstein, gravity is not even a force. It's a phenomenon that curves space time continuum. Where with no force, the natural free trajectory is curved. It's very strange to not feel any more an obstacle that prevents you from perpetual freefall falling.

For me, now I see the floor. I sees that as frustrating obstacle. No, but it's fun. It's fun. Especially as I fly with on all the private flights. Each time I tell all the passengers, whoever they are, sometimes, B&M. We had the founder of Snapchat, who was worth 4 billion dollars at this, at 30-years-old. He was incognito flying with his wife. People like them. We have, okay. I tell them, we had also big chairman CEOs of big companies. Then, you will be back in childhood within a fraction of a second. The first parabola, which is mass. You hear in their cabin, like a baby in a **[inaudible 00:55:16]**. At school, how do you call the post during which you will go out and you – When you go at school, you have classrooms. In the middle of the morning or the night, you go out and you play in the –

[00:55:33] IP: Oh, recess?

[00:55:34] JFC: Recess. It will be like kids at recess. It is exactly that each time. “Ah. Hoo. Ah-ah.” This is magic. This is the magic of weightlessness.

[00:55:46] JFC: I’m so much looking forward.

[00:55:49] JFC: Yeah. What I explained to them is that on the private flight, all the benefits, the financial margin, which is about 1/3 of the ticket is given back to the space agencies, to finance more research. Because actually, those flights we do for profit. We used to do them empty before, just to give practice to the pilots. These are flights we were doing. We flew before empty. Now with people paying, it reduces the fixed cost for the research flight. We decided, although we are not at all obliged by law, we decided to contribute to the GIS, which is a known organization that takes compensation for carbon emission, which acts for education in all the inferable areas, for caritative emissions. We pay even more for compensating our carbon emissions.

Anyway, we don't fly much. We fly very little compared to any aircraft. The bottom line, people who think, but why do you – you use a plane that produces carbon emissions? We say, we fly very little. At least 30 flights per year. We more than compensate our carbon emission. We finance research with private money. We give a contribution to public research with private money, which makes that and see pay less, than if we didn't have private flights. The people are

happy. That means, when they get back home after the private flight, they tell their families, their friends, their neighbors, their colleagues, they are good ambassadors of space programs.

Because a great part of the briefing in the morning of the private flight, we explain that this is not an attraction park. It's a research lab, which sometimes organizes open door visits, where there is no hardware. I told them, you are your own hardware in the plane and we will explain, you're safe. Okay, one last question. Just a question.

[00:57:53] SPEAKER 1: Is it possible to take a picture for you?

[00:57:55] JFC: Oh, yes, yes. Of course.

[00:57:56] SPEAKER 1: Maybe in the plane?

[00:57:57] JFC: Yeah. Let's go now.

[00:57:59] IP: Yeah, sure.

[00:58:01] JFC: I don't know. Do you have any more questions?

[END OF CONVERSATION WITH JEAN]

[00:58:10] IP: I also spoke with Bertrand Rameau, one of Novespace's eight pilots. We talked about what it takes to become a Zero-G pilot, and what it's actually like to fly all of those parabolas.

[CONVERSATION WITH BERTRAND]

[00:58:20] IP: Thank you so much for joining us. Really pleasure to sit and talk with you. Start with a little housekeeping. Tell us your name and what you do here at Novespace.

[00:58:29] BR: Yup. I'm Bertrand Rameau. I'm one of the Zero-G pilot here in Novespace in seven years. We operate this Airbus 310, totally dedicated to this very special mission.

[00:58:42] IP: How did you become Zero-G pilot for Novespace? I mean, there are many of you. How did you get here?

[00:58:51] BR: We are seven right now. No, eight. Exactly eight. We introduced a brand-new one this summer. Basically, I joined the team when Novespace purchased its A310 after the 300 v2 before. At this time, Novespace has decided to operate by itself. Before that, it was operated by the French Test Centre from the Air Force.

When Novespace has decided to operate this effort by itself, they call us, some specialist of the 310. I flew the 310 for more than 10 years in the French Air Force. I was instructor examiner, etc. That's why I was called at the very beginning of the story. Basically, the eighth pilot, we are half pilot, test pilot from the industry. Adverse ATR and the French Test Center. The other part, we are standard civilian airline pilot with a different background, usually military background. We know a little bit more than usual, how to make some aerobatics or something like that.

We have a past in the military and then an experience in the airline, or airline operation, at least. This mix creates the condition for Novespace to operate safely this aircraft with the most competencies, totally different competencies on one part of flight test competencies, and another part, how to operate an aircraft in a regulated environment.

[01:00:25] IP: How do you train? You mentioned that there are distinct differences between being a regular commercial pilot on the A310, or any other aircraft and this. What's that training like?

[01:00:33] BR: The training is very, very specific for this operation. We begin on the simulator, just to learn not to fly the parabola, but to learn the music. Because as probably you noticed this morning, we divide the axes and we operate this aircraft in a very specific manner. We need to have the specific music, tempo of the parabola. We learn this tempo in the simulator. In addition, we learn as well the emergency situation, so the recovery of what can happen during this parabola. We are trained on the simulator, well, this special situation. Then we went to an aerobatic light aircraft, just to perform a couple of parabolas. To be more not efficient, but more,

yeah, to put your head down and just to learn how is 50 degrees nose up, how is 50 degrees nose down, how's the speed increase for us, etc., etc., just for familiarization.

Then we come here and we have four flights, dedicated flight without any passengers, just as we are to over the sea and let's go. You jump in a new world and that's it. We perform more or less 40, 50 parabolas just for training. Then you join some scientific campaign, or two big flights and you perform your first parabola with passengers on both, and you learn day after day, flight after flight, you need a 100,000 of parabolas to be a regular parabolic flight. It's a matter of experience, most of them. The best quality you have, you need experience for sure.

[01:02:18] IP: Describe for us what's happening on the flight deck as you go into the parabola and walk us through the whole parabola.

[01:02:25] BR: From the flight deck, first of all, we hide the windows to avoid some sun disturbance during the maneuver. When we climb, or when we dive, the sun moves and we can have reflect. To avoid this condition, we put some curtains on the lateral windows of the cockpit. It's very dark inside the cockpit and we keep only the two windshield open. Then we work a three-pilot at the same time. That mean, we divide the axis. We have the pitch axis. It will be fly by the one in charge of the accuracy of the parabola. Only push and pull, focus on that. Focus on the accelerometer to provide the best zero possible. That’s his only task. To fly the pitch, to fly Zero-Go.

The second part of the aircraft, you have the pilot who is responsible for the lateral axis, for the roll. We put two smaller lines, wires on the yoke, just to avoid some disturbance on the pitch, and we fly the aircraft like this. We keep the roll more or less at zero during all the maneuver. This pilot is responsible as well of the music, the tempo of the parabola. The third one is in the middle, sit down on the **[inaudible 01:03:43]** seat, and he's responsible for the thrust, thrust of the engine. He sets up the full thrust for the entry into the parabola. To set to good thrust during the parabola to obtain the best Zero-G on all axes during the maneuver.

Yes, we are three and we work in a very quiet environment. We just listen to music. Let's go to in scientist parabola. The G pilot, pitch pilots will pull 1.8 G during 20 seconds to reach 50 degrees nose up. Then the call out injection. We will push on the yoke. To reach a Zero-G, that’s

the most difficult part of the parabola is to pass from 1.8G to zero. Not 0.1, but 0.0001. That's our target. During the 22 seconds of the parabola, we keep this accuracy on the Zero-G. Then when we reach 50 degrees nose down, you have to become again an aircraft and pull out 1.5 at the beginning and then 1.8 to recover the situation, and to come back at the departure point, and lead to that 31 times.

[01:04:58] IP: Very good. When you're performing the maneuvers in the simulator for the first time, obviously, you're not feeling that gravity.

[01:05:06] BR: Not on the simulator. Basically, there's no G.

[01:05:10] IP: When you get to the G, how long does it take to get used to that feeling while you're operating the aircraft? Because I sat in the aircraft feeling it, thinking the entire time, there's no way I could fly an aircraft while feeling this.

[01:05:24] BR: It's totally different in the cockpit, because you know what will happen. You know exactly what will happen. Okay, the first time you feel the pressure on your body at 1.8 G and you feel the Zero-Gravity, your first injection. But really, when you are at control of the aircraft, you cannot feel it. You don't feel anything, because you are so focused on your task, you cannot think about what's happened. When you do sync in, it's very short. You are so focused on the flight to manage this maneuver. I don't say you cannot feel, but it's well behind.

You think, well, after the maneuver, you will feel, what happened? Yeah, I feel my body, etc. During the maneuver, no, it's impossible. You are so focused. You cannot imagine. You are looking at your instrument and you are focused on your instrument and that's it. Anything can happen around you, you are so focused.

[01:06:18] IP: What happens if the parabola fails?

[01:06:19] BR: There is no failure of a parabola, because when you inject the parabola, you are in ballistic. More or less, you are a stone thrown in the air. You cannot fail a parabola. What you can fail is the accuracy. The accuracy is not enough for as a scientist. Or, you go out of the ballistic and in this case, you can put the aircraft in a bad situation. That's our training. Thanks to

our training, to stay in this gravity, until we have some gate. We know these gates and we always continue the parabola until this gate, it's a gate of recovery.

For example, before 30 degrees nose up, we just consider the parabola and we come back in still on the fly. After 30 degrees, in any case, we continue. We will go through the ballistic phase, so the parabolic phase to recover the situation after. Our best security is just to go through the ballistic and to recover the situation. We have studied with Airbus, with the other, with many people. We have studied this aircraft from the tail to the nose. I think, we have a viewer, many, many cases of what happened during this maneuver. We have some not some solution, but we have some idea, how to recover. Most of the time is you go out of the parabola, you wait to exit the parabola and then you deal with the failure, like in any aircraft.

[01:07:53] SPEAKER 1: Okay. Do you get all the warnings and signals during the **[inaudible 01:07:56]**?

[01:07:57] BR: Yeah. When you're in the Zero-G phase, all the liquid, so I draw leak fuel, etc. All the liquid. The aircraft is not designed to keep this liquid floating in the manifold. Yeah, we have couple of alarms during the parabola. The role of the third pilot seated in the middle to cancel the alarm after checking. That's the one we expect. A part of that plays no special in this aircraft.

[01:08:28] IP: Is there anything about the flight tech that's been modified specifically for this aircraft?

[01:08:32] BR: No. There is no major modification in this aircraft. The only modification we introduced in this A310 is the accelerometers, where to display the information in the cockpit, so we get some to screen with a accelerometer in two different scales. One large scale to fly the pullup and pullout at 1.8 G. One very, very accurate scale to fly the maneuver by them, by itself. Part of that and of course, the cabin. The cabin is totally modified to remove the seats, put some foam everywhere and provide electricity and air for the science.

[01:09:12] IP: Does it fly any differently than an A310 that hasn’t –

[01:09:15] BR: I don't know. It's just raised on our A310. We ferry this aircraft from a border to somewhere else. It's a very standard A310. Brand-new A310. I don't know.

[01:09:27] SPEAKER 1: How easy is to communication with the ATC if you cross so many flight levels?

[01:09:31] BR: The ATC, we are very, very lucky in France to have the flight test center. We have a dedicated ATC for flight test center. We have a dedicated air traffic controller just for us. We are not restrained in an area, or dedicated area. We are in the common French area, with a low-density traffic. That mean, we are often above the Atlantic Ocean, or with Mediterranean. This ATC guys is delegated to Earth, and is responsible to avoid any conflict with any civilian, or military traffic. That's mean, he will coordinate, is seated in a ATC center, near civilian guys and he will coordinate for us. Okay, and give me this area free for the next 20 minutes. You will have Zero-G here. He's responsible to avoid any conflict for sure, any close by traffic, but as well to avoid any traffic, maybe 5,000 feet, or both are our aircraft who can see the maneuver and who can lead to some problems if a passenger just look out the windows and "Ah, what is this aircraft diving?" Yeah, he's responsible for that.

He's totally dedicated during the three hours in the air. That is our life alert. That's real specificities of the French Flight Test Center. It's made. When we fly abroad, it's not like this and it's a nightmare to coordinate and do to find some dedicated area, because we need a block of altitude of 10,000 feet, more or less, and 80 miles long for a series of five parabolas.

[01:11:17] SPEAKER 1: Do you fly anything else besides the surging –

[01:11:20] BR: Yes, of course. We operate this aircraft more or less 30, 35 flights a year. We are eight pilots. 20 flights a year for us, for each of us. My job right now is I manage a cargo airline. With two A330 and one A300-600. My colleague flies for Corsair, and we have two retired flight test pilots. One in activity, and one of us is a famous astronaut. He has some trip to the moon, if he wants to go back on the moon. No, no, we have – that's fresh air in our daily life.

[01:12:04] SPEAKER 1: Nice.

[01:12:07] BR: Yeah. Before that I was in the Air Force. I finished my career in the Air Force as a flight test – not at the flight test center. French Air Force experimentation center. I flew the 330 MRTT for the delivery, I managed a transition between Airbus to the final user. That was very interesting time. But now, it's over.

[01:12:29] IP: Well, what do you like most about flying Zero-G?

[01:12:33] BR: Zero-G, it's so different. First of all, you meet totally different people than your daily life in the airline, or even in the Air Force. Because it's not an aeronautical society. It's not an aeronautical company. We are here for space first, for science, but not to fly. It's not the goal. The goal is not to fly an aircraft. The plane is just a tool to give access to space. For us, it's the first nice things is we meet some people totally different, with another view, another point of view, another dimension. It's very interesting to be here and to meet these people from anywhere, from China, to US, sometimes a movie star. Even astronaut. That's the first thing.

The second one is a very, very small team. A pilot of more or less 50 people maximum, altogether with the cabin crew, the safety people, the doctor, etc., etc. It's a tiny world. We are all together for one mission, focused on the mission. It's good friendship since the last seven years. That's important, because we need to trust each other. When you fly the aircraft three simultaneously, we really need to trust the others, and we need to know each other very well. That's why it's another demand dimension. With good friendship, it's always a pleasure to come here and to perform this very special flight.

[01:14:09] IP: Do you always fly in the same position?

[01:14:13] BR: We turn the position. We have a series of five parabolas. Every series, we change one from position. Switching one guy, or two guys from that position, we swap, or we turn. It’s just to get them better accuracy of the parabola as a pitch pilot. We know, you need five parabolas to reach your best level. After 10, the tiredness begins and your techniques decrease, your skills will decrease slowly after the 10th parabola. That's why we turn altogether during the flight. You perform five or 10 parabolas on one position and then you change. We fly always at four pilot in the aircraft in order to be able to have fresh parabolas, to cool down five parabolas

during the flight. It's always with the same target is to get to the most accurate parabola forever. Now, we are reaching our limit, I think. The human limit.

[01:15:19] SPEAKER 1: We have just one more question about maybe the maintenance. How is the maintenance, because of the, call it high pressure of the wings and the structure?

[01:15:27] BR: With the Airbus, we have carried out a big study on the aircraft and we have divided the aircraft. Some parts have a lifecycle different than a standard operation. That means, we have some beta factors on the engine, for example. One parabola is one cycle. That means, it's equal to one landing on takeoff. Every parabola, so that means this morning, 31 parabola plus one takeoff, one landing means 32 cycles on the engine. That means 32 flights. That's a lot.

For other parts, we have some beta factor of one parabola, five cycles. We shorten the life cycle of some part. Very dedicated parts with – it was an Airbus study, and we trust them on their job. It's to ensure that we have a safe aircraft at any time. More or less, we have the same maintenance in an airline, if this aircraft fly, more or less 10 to 15 hours per day. We fly on these 35 flights a year. Yeah, really we have the more or less the same maintenance schedules and a standard airline who operate this aircraft daily.

[01:16:44] SPEAKER 1: Very interesting.

[01:16:46] BR: Over maintenance, for sure. That's the price to pay to get this aircraft to be sure that the aircraft is always in good condition for this repetitive manual, because we are in the certified envelope of the aircraft. Zero is in the middle of the flight envelope, for a certified flight envelope of any aircraft. The only thing we change is the repetitive action to stay 20 singing at zero and the repetitive action of 1.8 G, which is impossible on a standard airline.

[01:17:17] SPEAKER 1: I had a few more questions about **[inaudible 01:17:19]**. We introduced them yesterday, so you answered a lot of them.

[END OF CONVERSATION WITH BERTRAND]

[01:17:31] IP: Okay, Jason. What universe would we be living in if they had gone through with that plan?

[01:17:36] JR: I mean, an A380 Zero-G aircraft. I mean, logistically, that probably would have been an absolute nightmare. Not only just having to deal with all of the issues that come along with flying in A380 somewhere, but then operating it as a parabolic aircraft. Would you have different people experiencing weightlessness on the different decks of the aircraft? How would that even work?

[01:18:01] IP: The plan as I understand it, was to just convert the main deck to parabolic flight setup. What they would have done is they would have combined and Jean-François mentioned this. They would have combined the different campaigns. Because right now, Novespace runs campaigns. The one that I was just on was managed by the German Aerospace Research Center, the DLR, and they also run campaigns for Knesset, which is the French space agency. They run campaigns for ESA, the European Space Agency. They do different campaigns throughout the year.

Here, they would have consolidated their campaigns, because they have such a large aircraft to make it financially feasible, they would have had to consolidate these campaigns. That creates all sorts of logistical problems in its own right. The most interesting thing here, as far as this av geek is concerned, is that there are rumors, and I haven't been able to track this down. There are rumors, that video of the parabolic test flight that they performed exists. It is now my life's mission to track down this video, if in fact it does exist.

If you are listening to this podcast and you know anything about a video showing the A380 in parabolic flight, please email us, podcast@fr24.com. I'm going to look into this a lot more. Because this has taken me down a path of fascinating research that I'm thrilled to go down.

[01:19:29] JR: I would like to subscribe to your newsletter and learn more.

[01:19:32] IP: It's funny, because I often send out our weekly newsletter. Then you mentioned things that are in the newsletter as if you haven't read the newsletter.

[01:19:42] JR: I look at it sometimes.

[01:19:44] IP: Maybe you should subscribe to the newsletter. Hey –

[01:19:47] JR: Oh, I subscribe.

[01:19:47] IP: Perfect plug, this is an accidental ad. We have a weekly flightradar24 newsletter. The newsletter includes things like, what's in the podcast this week and what else happened in aviation and some of the best aviation photography. If you're not subscribed to the newsletter, you can find the show notes and click on the link that we have put there, linking you to the newsletter, or you can go to flightradar24.com and click on social and click newsletter. There, accidental ad complete.

[01:20:17] JR: Perfect.

[01:20:19] IP: What else happened to this week in aviation?

[01:20:23] JR: I think it all happened today. A lot of stuff today, like moments before we started recording, which is very odd, because usually, it's moments after. Things are happening in Russia. Some airlines are ordering some planes, some are actually returning some planes, unexpectedly. The big news out of Aeroflot is that well, they need aircraft and there's only one place they can really get them from and that would be within Russia. Today, they announced a very large order for 339 domestically produced aircraft from UAC. That would be 210 MS21, 89 SuperJet New, which I don't know what that is. I guess, it's a play on Neo or something, whatever they've done to the SuperJet to make it domestically produced completely. I guess, that's what that is. Then 40 TU-214. They'll all be coming from 2023 to 2030. Or maybe later, or maybe never. Who knows with what's going on in Russia?

Some people speculated that this means they're going to return aircraft and they need to backfill. I would argue that that's absolutely not going to happen. It's probably just they realized, like everyone else does that at some point, the Western aircraft that they've stolen will no longer be flight worthy, and they can't support them anymore. If they are fully aware, they need to build

and deploy their own aircraft and that seems to be what Aeroflot is doing. The days of Aeroflot, I guess, being a modern Western aircraft fleet airline is seemingly on the horizon of ending.

[01:21:56] IP: The whole thing is just surreal.

[01:21:58] JR: It is. They turned up the rhetoric a bit. I'll quote here from, I don't care. Whoever, whatever dingus in Russia is writing this press release. “Boeing and Airbus, which are unlikely to ever be delivered to Russia again, will be replaced by Russian made aircraft. MC21 will be the flagship of the Aeroflot fleet.” Sure, why not? I guess, it will be the default flagship of Aeroflot, because everything else is going to be grounded at some point.

[01:22:25] IP: Yeah. I mean, you’ve run out of options.

[01:22:26] JR: They got to fix something, right?

[01:22:28] IP: Yeah, you got to pick something. Why not the MC21?

[01:22:31] JR: Why not? Reminder, is it the MC – No, it’s the MC21. Sorry. Not MS21. I guess, I got that wrong. Yeah, that aircraft is not certified yet, is it?

[01:22:41] IP: It's on its way.

[01:22:43] JR: Almost. It's almost there.

[01:22:44] IP: One assumes that they'll eventually certify it.

[01:22:47] JR: Yeah, was almost there, but not quite.

[01:22:50] IP: Then you mentioned they're giving back planes.

[01:22:53] JR: I did.

[01:22:54] IP: Are they trying to get rid of the old SuperJet, so they're like, "Here, Interjet. Take them."

[01:22:58] JR: No. Suddenly, they really need those. It appears that this comes from FlightGlobal that the Russian government's actually granted the S7 Group permission to return a pair of leased 73 MAXs, because they weren't never certified to operate in Russia from the outset. They were able to get them to agree to export them to Turkey, interestingly enough. That's an interesting twist.

[01:23:22] IP: I look forward to Steve Giordano's trip to Turkey to pick them up.

[01:23:28] JR: Yes. Yeah, that's an interesting – Remind me, they were delivered to us seven – Was the MAX ever certified for flight in Russia, or certified after the grounding? I'm a little fuzzy on the timeline there.

[01:23:39] IP: It was never recertified.

[01:23:41] JR: Right. There you go. As 7 said, "Hey, we have these aircraft that we actually can't fly, because they are not certified here." I guess, that's just proof that Russia has no intention on, I guess, ever certifying the MAX for flight in Russia.

[01:23:56] IP: I mean, to be perfectly honest, I would be a lot more surprised if Russia certified the MAX out of spite, just so they could keep the planes. That seems like a lot of work to go through.

[01:24:06] JR: Yeah. Things are certainly shaping up in Russia to be drastically different than they were just three months ago. It hasn't even been that long. A lot of changes coming to Aeroflot, not by choice. I mean, no one at Aeroflot wants this.

[01:24:26] IP: That's fair. That's fair. Okay, so Russia ordered planes. They're giving some planes back and then Israel's banning planes. I saw this last week and then you listed this and remind me what's going on here, sir.

[01:24:42] JR: Well, apparently, Israel doesn't like four-engined aircrafts anymore, which is quite surprising, because I'm pretty sure there are some cargo, or freight airlines operating out of Tel Aviv, which is surprising. This comes from dandeals.com, of all places, written by Dan himself. He says, the Israel Airports Authority, IAA has announced that effective March 31st of next year, planes with four engines are banned from landing in Israel. That'd be commercial aircraft, so your 747s passenger or freighter, A340, A380s. Yeah, none of those aircraft, I believe, are scheduled, at least passenger-wise, to operate to Israel. That doesn't exclude it from happening in the future. I know Lufthansa has done that before, especially with the 340. There are freighters that fly to Israel. I'm really confused that why they would do this now. They cite issues of sustainability, environmentalism and noise concerns. Not even France has even talked about something like this before. I don't know what to make of this.

[01:25:49] IP: I mean, it seems weird that they would do this now, and without any publicity campaign around it. Because if it was a sustainability thing, they would be like, “Look, we're banning four-engine aircraft, because they're less sustainable than two-engine aircraft,” which may or may not be true, depending on a whole host of economic and flight factors.

[01:26:13] JR: Same thing on the noise side. If you put an A380 over your head, and then immediately pass out with one of United's elderly domestic 777s, that two-engine aircraft is going to be a hell of a lot louder than the A380.

[01:26:29] IP: Speaking of A380s, the first thing that comes to mind is that Emirates recently began regular service to Tel Aviv.

[01:26:37] JR: That is mentioned in the article.

[01:26:38] IP: Oh, okay. There you go. I mean, did they talk any more about that? Because one thing that comes to mind is it prevents Emirates from bringing the A380 into Tel Aviv.

[01:26:48] JR: It's suspected that that could be it. Could be a factor. That's quite a dramatic protectionism move, if that is the case, when they could just say, we no longer accept A380s here, because of space constraints, or operational constraints or whatever. Pretty much, only Emirates would be affected by that. They've gotten the extreme method here of just banning all

four-engine aircraft. I'm wondering if this is actually going to become a thing, or if this is just blustering, maybe they do it, maybe they don't. We'll keep an eye on it.

[01:27:20] IP: Yeah. I mean, yeah. We'll see how it all ends up. We've got Finnair as well, today announcing that they've needed to figure out a new way forward, with the Russian invasion of Ukraine. Then the lack of availability of Russian air space to Finnair, their whole business model, their whole long-haul business model was Helsinki is closer to East Asia, through Russian air space than any other airline.

[01:27:54] JR: Whoops.

[01:27:54] IP: Will get you there faster, and will get you there nicely. Now they can't do that. What they're doing is they're reducing the number of aircraft in their fleet. They're going to fly fewer routes, and they're going to fly two more Middle East and India destinations. They're also saying that they're going to reduce unit costs, and they're going to right size their fleet, their staff, make sure everyone's contributing to cost reductions. They didn't really mention how all of that is going to take place.

Assuming it's the case, there will be a new Finnair. I know that there was a lot of concern initially, but the impact to Finnair was, besides the Russian airlines themselves, the impact to Finnair would be the biggest, because of the Russian invasion of Ukraine. I should say, besides the Russian and the Ukrainian airlines that Finnair would be most impacted. They're figuring it out. We'll see if it works for them. They've announced their plans. Let's see if they can stick to it and make things work.

[01:28:58] JR: Yeah. I think they announced specifically that they'd be removing a pair of A350s and then the A330, maybe the other way around as well from the fleet. There are some long-haul fleet reductions as well.

[01:29:09] IP: Oh, yeah. We didn't list this, but speaking of long-haul fleet reductions, this comes from our chief short answer correspondent/chief mergers and acquisitions correspondent, Ned Russell, who was reporting on SAS's bankruptcy proceedings earlier this week. That airline, SAS is getting rid of a pair of A350s and a few A330s. One of which, I saw

before Ned's reporting, I saw in Stockholm all buttoned up. They had the engines, they had plastic over there, the **[inaudible 01:29:40]** of the engines.

[01:29:40] JR: They're all ready to go.

[01:29:42] IP: They are ready to go into storage and hopefully, be returned to the lessor when that may or may not be approved by the judge. I assume it will be. At least five wide-body aircraft. I think, two A350s and three A330s leaving the SAS fleet in the near future.

[01:29:59] JR: Yeah. A couple more things, actually, two more off agenda items I'm going to go with, because you know, I'm scrolling through Ned's Twitter feed. He's @byerussel on Twitter. There's a couple of things I forgot about here. Blue Air announced a couple of days ago that they're suspending operations, at least for probably about a week. If you've been in this industry long enough, you know that when an airline suspends flights, because of monetary reasons, they often don't come back. They're not a small airline. They have a sizable fleet, I think, of a couple dozen aircraft potentially. You got some 737 MAX. Maybe it's actually smaller than that. Maybe half a dozen. It's never great to see an airline suspend operations like that, because more often than not, they don't come back.

Other airlines have already filled the void. Ned reported that Wizz Air swooped in real quick and has added five more aircraft to its base in Bucharest, launching three new routes and adding frequencies on 30 more. That's exactly what happens when a small carrier like this takes a bit of a pause due to some issues. Another airline is going to swoop in and fill that void and Blue Air might not return. I hope they do, but might not happen.

[01:31:13] IP: Yeah. We'll know As of September 12th, whether or not they're back in action. I will say that there's, what is it? Maybe a 30% return rate for first time suspending operations. If they ever do it again, it's just not coming back.

[01:31:30] JR: Yeah, they have 14 aircraft, by the way. Five 737 MAX. Eight 6-800s, a 700 and a couple 500s. They've got more MAX 8s on order ready to be delivered. Not great. I got one more thing. This is just funny.

IP: Lay it on me.

[01:31:46] JR: Before we get our last thing. You might remember –

[01:31:47] IP: You will do the last hurrah. Okay.

[01:31:49] JR: Yeah. You might remember last year, United re-entered the JFK market years after really making a bad mistake by leaving JFK and consolidating at Newark. It was big fanfare, 767s with Polaris. They were only able to do that temporarily during COVID when overall air traffic dipped real low. Now it seems, they can't get permanent slots at JFK. Now they are threatening that they might end service at JFK in October, unless the FAA does something.

That something that United is suggesting would be lifting the cap on flights, or lifting the slot restrictions, so United can get its fair shake at JFK. They cite all sorts of things that happened in recent years, like taxiway widening and high-speed taxiways off runways. Anyone who's actually been to JFK in the last few years knows that, yeah, there have been improvements. But when push comes to shove and the weather isn't perfect, JFK is just as bad as it's ever been with your line of 45 aircraft waiting to depart at 8 p.m. It seems like a real bluff from United that, hey, if you don't do this industry changing thing at JFK, we're just going to pack up and go back to Newark. I hope that doesn't happen. I like having Newark at JFK. This seems like a real shot in the dark here.

[01:33:12] IP: I mean, given all of the commenting that United has done about Newark, it's a real smack in the face to hear them turn around and be like, “Well, you should give us special treatment at JFK.”

[01:33:25] JR: No. Buy your slots like anyone else.

[01:33:28] IP: Yeah. I mean, do they expect the FAA to play ball? Or is this just a really good poor marketing? I'm very confused as to why they would go this route.

[01:33:38] JR: I don't know. Buy yourself a time machine. Go back to 2015 and get back those 24 slots they leased out to Delta, which they can't get back. That seems like the only way to go.

[01:33:50] IP: Good luck.

[01:33:51] JR: Good luck.

[01:33:52] IP: Okay, now it is time for what is accidentally not breaking news, but not many people have talked about it yet.

[01:34:03] JR: It's weird. Really weird. Our friend of the show, Jon Ostrower, every now and then tweets out, standby for news. The airline industry stops and waits and refreshes to see what he's saying. Usually, it's really good. He's been quiet on this one, and everyone else was quiet. This has been published for a day and a half here and really no one picked up on it until just about 30 minutes ago. AIN published a piece about Boom, and the title is just, As Boom Seeks Engines, Airlines Most Supersonic Use Case. They really buried the lead. That lead would be, Rolls Royce is not going to build their engine for them.

[01:34:44] IP: That is a rented an excavator.

[01:34:46] JR: It's on the third paragraph.

[01:34:46] IP: Dug a very large hole. Put the lead down there and then bury it over.

[01:34:51] JR: It's in the fourth paragraph. The quote from Rolls is, I don't know. I'm just going to read it. Quoting here. "We've completed our contract with Boom and delivered various engineering studies for their overture supersonic program. After careful consideration, Rolls Royce has determined that the commercial aviation supersonic market is not currently a priority for us. Therefore, will not pursue further work on the program at this time." They go on to say, "It has been a pleasure to work with the Boom team, and we wish them every success in the future." Wow. I mean, that sounds nice. But that basically is Rolls Royce telling Boom to get lost.

[01:35:32] IP: Well, I mean, it says to me is if you have a few billion dollars handy, that you want to pay us to build you a specific engine, we are happy to do so.

[01:35:46] JR: They might.

[01:35:47] IP: But there's no way we're going to spend our own money building you an engine.

[01:35:51] JR: Who knows what the investing ecosystem has in store for the future? Maybe they can come up with the billions. I don't know. As it stands now, Rolls Royce will not be developing an engine for Booms overture aircraft. I don't see anyone else stepping up to the plate here to take a shot at that. That 2025 first flight was it seems exceedingly, even more than usual unlikely. Not unlikely, seemingly more impossible than usual.

[01:36:21] IP: Yeah. I mean, even if you believe that Boom has a chance at success, at developing an engine, developing an airframe, testing it, putting it into the air, I don't think anyone is under the impression at this point, at least, that the timeline that the company has used is an accurate one of their capabilities, and a realistic one of their processes, and probability of making first flight. I just don't see that happening.

[01:36:51] JR: Yeah, that's the thing. If Boom had come out with a more realistic timeline, I'd be much more willing to give them, in my eyes, the credibility that they might deserve. To stick with this deadline of three years from now having a first flight, despite not having in engine even in development, that's crazy. It's disrespectful to the industry. Though, everyone knows better. It's not possible to do that. I don't know. At this point, all we know is we know who will not build the engine. We are absolutely no closer to knowing who will, if anyone built that engine.

[01:37:25] IP: Yeah, the response by Boom to this, which I don't think has come out yet, will be very interesting to read.

[01:37:32] JR: Yeah. Looking forward to it. Haven't seen anything yet.

[01:37:35] IP: That's all, say there. This has been episode a 180 of Avtalk. We, I mean, I have had a rather enjoyable week, a maddening week getting here, but a thrilling and, and satisfying and uplifting week being here.

[01:37:53] JR: Yeah. Come on home. Your family misses you, probably.

[01:37:56] IP: Not only for – They finally let me out of the house, not only for what it was. I mean, the thing that I liked most about the flight was not the actual flight itself, though, that was beyond amazing. The thing I liked most about it was hearing afterwards, the scientists talk about their successful experiments. Because they put so much work into designing these experiments, designing the physical structures to put on the aircraft, then they have to do – I was just there taking video and pictures and floating around for a few minutes.

They're on this three-hour flight in hyper-gravity to microgravity, to hyper-gravity again, 31 times, while running equipment and experiments. To me, that was just absolutely incredible. To hear them talk about it and see the look in their eyes when they've gotten data was just the coolest thing in the world. I will leave it at that.

Episode 180 of AvTalk from Bordeaux and from New York. We will be back home next week with a much less up and down episode. I promise.

[01:39:10] JR: I get it.

[01:39:11] IP: Yeah. Thank you so much for listening, and we hope to talk to you next week. As always, I am Ian Petchenik, here, as always with –

[01:39:20] JR: Jason Rabinowitz. Thanks for listening.

[END]