EPISODE 281

[EPISODE]

[0:00:07] IP: Hello, and welcome to episode 281 of AvTalk. I am Ian Petchenik, here, as always with –

[0:00:16] JR: Jason Rabinowitz. And here occasionally, sometimes, once again with Steve Giordano. Welcome back.

[0:00:22] SG: Hey, guys. Happy to be back.

[0:00:24] IP: Steve, thank you so much for joining us. We're going to spend, I think, pretty much the entire episode today on the crash of the VoePass ATR 72. We invited Steve on the show. Steve, for those that don't know, I think, deserves a bit of an introduction, and for those that have listened to the show before know who Steve is. Steve has more type ratings on more aircraft than nearly anyone on the face of the planet. He is Co-Founder and Co-Owner of Nomadic Aviation Group, which is a group of airplane people who move airplanes where they need to be, and when they need to be there, is, I think, the most general explanation I can give. Steve has flown many, many different types of aircraft.

The reason we asked Steve to come on is, really, Steve has a, I don't want to say unique, but unusual ability to describe and explain aviation terms in a way that a general audience can understand, and certainly, in a way that Jason and I can understand, and we're not the brightest bulbs in the box. Steve, thanks so much once again for joining us. One of these days, we're going to have to have you back to talk about other things, besides accidents and incidents.

[0:01:45] SG: Absolutely. I mean, you guys, first of all, you're doing yourself a disservice. You're very bright bulbs.

[0:01:50] JR: Oh, thank you.

[0:01:51] SG: I would say that you're very bright bulbs, and I always enjoy a conversation with you guys. Yes, let's talk about happy things sometime, but I think it is very important that we discuss these things when terrible things happen as well, because in this media environment that we live in, a lot of false information runs rampant. Let's be honest, especially this particular incident, which as soon as I saw the video, and I saw how clear and obvious and frightening the video looked of that ATR falling from the sky, I mean, there is just – there's no looking at that and having any sense of comfort about flying, whatsoever.

Turboprops historically get a bad rap. People are more afraid of smaller aircraft, regional aircraft, and it's frightening. I mean, the quality of the images was very good quality, and seeing something like that is just absolutely terrifying. I think we need to talk about it in a sober way and in a way that addresses all the possibilities, but at the same time, really allows people to take a step back and not rush to any type of judgment, which is so important when it comes to aviation accidents.

[0:03:04] IP: Absolutely.

[0:03:05] JR: I think what we need to do here is discuss the facts of what we know and the themes around the basics of flying, basically. What is a stall and what is a flat spin and what is icing and what's the impact on the airplane? Because we don't know a lot right now. We know the basics of what happened. We saw the video, which really sidelined me for the rest of the day. If you haven't seen it, maybe don't watch it. Do yourself a favor, because it's really, it's not great. You're right, Steve, in that airline passengers do have a fear of turboprops, especially here in the US, where there are basically next to none in commercial service with the major airlines. You have Silver, and that's about it. The majors, it would probably be a good fit for them, but you just don't see it in operation. Let's talk about what happened. Ian, do you want to take us through the hard facts of what happened?

[0:03:55] IP: On the 9th of August, flight 2283 left Cascavel to São Paulo. They departed at 11:58 local time and climbed up to a cruising altitude of 17,000 feet, 24 minutes into the flight. While cruising towards São Paulo and nearing São Paulo at 17,000 feet at 1621 UTC, so about 90 minutes into the flight, the ADS-B data that we received indicates a brief loss in an altitude, followed by a sharp gain in altitude, followed by what was a steep and then terminal descent.

From the ADS-B data, combining with the video data, or the video evidence that Jason, Steve, and I have all seen. Jason mentioned this before. If you haven't seen it, you don't have to, but the video evidence shows the ATR 72 in a flat spin, a counterclockwise flat spin.

The descent rate that the ADS-B data provides is based on the barometric change that the aircraft itself computes. It's the instantaneous computation of the barometric descent rate, or barometric rate of change. It's not an average feet per minute rate of change, so it's computing instantaneously over and over and over again. But they were at 17,000 feet when whatever happened happened. The final data received from the aircraft was 89 seconds later.

The ADS-B data also included valid true air speed data. It did not include valid ground speed data for this particular aircraft, and that's because of how the transponder was sending the set of data that it was sending. It was sending good altitude information, good position information, and good true air speed information. It was not sending good ground speed information. The true air speed shows a gradual slowing before as whatever happened began to happen at about 16:21 UTC, and then we see the indication of that vertical fall and flat spin as the true air speed drops incredibly low and almost to zero. This was an ATR 72 powered by two Pratt & Whitney turboprop engines. The aircraft was 14-years-old and it was acquired by this particular airline in 2022.

That's all we know about the flight and the aircraft. I will bring up now and we can talk about this a little bit later in our discussion, but there were SIGMETs, so indications of significant meteorological activity in the area that included icing at the altitude that that aircraft is flying and also, included turbulence and thunderstorm activity. We'll take that information and hold on to that for a minute. This is where I want to bring Steve back in and talk about what we saw in the video. We saw an aircraft that was falling nearly vertically and it was spinning. Steve, can you explain what is a stall and then how can that develop into what we saw in the video?

[0:07:17] SG: Sure, absolutely. Yeah, like you mentioned, the most important thing is to first address the facts. Our job here is not to determine the cause of this accident. There are professionals that are doing that. I can tell you that the professionals are going to start with facts all the time. Because we're not privy to flight data recorder data that was recovered at the scene, and there will be information pulled off of that that's very, very important in a very, very

short period of time. All we have are videos, observations that could be made and weather reports. You rolled those off already. We know that there was icing forecast and reported in the vicinity at the altitudes in question, and we'll talk about icing in a little bit.

Then we know that the aircraft, essentially, was out of control all the way to the ground. It didn't look like it had much in the way of forward air speed. We discern that it was following the pattern of a spin, potentially a flat spin, especially toward the end. Those are the facts. And then we also know the fact that the ATR has a history of similar responses to icing conditions, which I think we do need to go over in great detail.

Let's start with those facts. We know that the aircraft was in a stalled condition. We know that the aircraft impacted the ground with very little to zero forward air speed. We know that there was icing in the vicinity. First, let's talk about what a stall is. I think that this is the word stall means a lot of incorrect things to the general public at large, because the word stall, as it relates to something that regular people know about is an engine stalling, right? A stall is when you don't know how to drive a stick and you put it in the third instead of first and the engine stalls when you release the clutch. That is not a stall for aviation purposes, okay?

A stall when it comes to aviation has nothing to do with the engines, unless we're talking compressor stall, but we're not. We are simply talking about a stall in the sense that the aircraft wing has stalled, okay? The aircraft wing is what enables an aircraft to fly. We'll go right down to the absolute basics. You have the opposing forces of flight. You have thrust and drag, which is thrust being forward motion, drag being drag, what is holding you back from forward motion to result in equilibrium.

Then you have lift and gravity. Gravity is obvious. Everybody knows what that is. The airplane wants to sit on the ground that is attracted to the earth due to gravity. Lift is how gravity is overcome with aircraft. The way lift is generated and lift is a force, it is generated by the main wing, the wing of an airplane, which is, there are a lot of different wing shapes and a lot of different wing forms, but they all do basically the same thing. As air flows over the wing, forward to aft, right, from the front to the back of the wing. It moves out of the way of the wing. Because of the shape of the wing, which is, we refer to it as an airfoil, it has a curved section on top of the

wing, which gradually flattens out to the trailing edge. Then it is more or less flat on the bottom. That is a traditional airfoil.

As air passes over an airfoil, the air on the top of the wing travels at a faster rate of speed than the air moving below the wing on the lower side, right? That differentiation in pressure, the differential in pressure from the top of the wing to the bottom of the wing, you have lower pressure on top, higher pressure on the bottom, high flows to low, and the wing is propelled upward. It's like putting your hand out out the back of a car, right? If you tilt it upwards, the air flow over the top of your hand is faster than the air flow on the bottom. The air flow on the bottom is essentially, feels like it's pushing your hand up. What's actually happening is the low-pressure air on top of your hand is pulling your hand up. That is how lift works.

Lift is produced by, like I said, the main wing of the aircraft, it's also produced by the horizontal stabilizer. That is the smaller wing on the back of the aircraft, where the aircraft pitches. That's what you pull back on the stick, the elevators deflect. Lift is created downward from the horizontal stabilizer, which raises the nose and increases the angle of attack of the main wing. We're not going to talk about the tail right now, we're just going to talk about the main wing.

The wing producing lift is what makes the aircraft go airborne. In order to create that lift, you have to get air flow over that wing and you do that on a fixed wing aircraft through creating thrust, and that is through the engine. The engines push the aircraft forward, air flows over the wing, lift is created, the airplane flies, okay? A stall is simply that wing has lost the ability to create lift. You are talking about a stalling of lift on the wing, whenever you are talking about a stall.

There's something else that's, another term that you're going to hear when you're talking about air foils, wings, lift, and such, and that is angle of attack, okay? Angle of attack is extremely important, a concept to understand as you're learning how a wing can stall. Angle of attack is essentially the bite in the wing is taking. For example, angle of attack means at zero degrees, there is as much lift being created as to overcome the aircraft's weight and gravity. Then you have equilibrium in the lift and weight axes there and the aircraft is not climbing nor descending. Let's call that the angle of attack that the aircraft is flying in cruise and just arbitrarily, let's call

that 5 degrees. The wing is flying at a 5-degree angle of attack. You're creating exactly as much lift as you need for straight and level flight. No climb, no descent.

If you want to climb, you pitch back on the – you pull back on the stick. The angle of attack increases, meaning the angle between the cord of the wing and the relative wind increases. As you pull back on the stick, the airplane, it pitches upward and the relative wind, the ratio between low pressure on top, high pressure on the bottom becomes a larger ratio. There's more lift. And with that increase in lift, the aircraft then overcomes gravity and climbs.

Angle of attack increases all the way up until, up into the point where it can no longer create lift at all. That is the stall. For example, if you're – let's go back to the hand out the window of a car, okay. You pitch your hand up, you increase the angle of attack, right? The relative wind is coming from a steady location. What's changing is the pitch of the airfoil, which is your hand as you rotate your arm, your forearm and wrist. As you increase that pitch, you can feel that lift increasing. Well, ultimately, there's going to come a point where your hand is at such a high relative angle to the wind, at such a high angle of attack that your hand just drops, because lift is no longer being created. That is critical angle of attack, okay? Once critical angle of attack is reached, the wing can no longer produce lift and it drops.

If you take an airplane and you keep increasing the angle of attack by pitching back on the stick, climbing, climbing, climbing, eventually, you're going to reach that critical angle of attack. At that point, the wing is going to stall and that's when you lose lift.

Now, something else to keep in mind is aircraft stability. You're going to hear stability mentioned a lot when you're talking about stalls as well. What that means simply is that the center of gravity of the aircraft, in order for it to be considered stable, must be forward of the center of lift, okay? The center of lift, if you look at an aircraft, close your eyes and envision an aircraft, nose to tail, the longitudinal axis of that aircraft, the center of gravity is where you would put a string, so that aircraft would sit in not nose up, or not nose down, like a stable pitch attitude. If you take a model airplane and you put it on your finger and you balance it, the point where it balances, that's the center of gravity. It has to do with, obviously, the weight distribution of the aircraft.

The center of lift is the focal point of lift on that wing, on that airfoil. The center of lift is essentially, the string that's suspending the aircraft, the center of gravity is where it is attached to that aircraft. All aircraft in a traditional configuration need to be stable to the point where the center of gravity is forward of the center of lift. Therefore, if you were to release that aircraft on a string, you want the nose to pitch down, okay? If the center of gravity is aft of the center of lift, when it's released and the air pull first, you have an unstable aircraft. All aircraft, all commercial aircraft, are going to have a nose down, a center of gravity that is forward to the center of lift.

That is incredibly important, because once critical angle of attack has been exceeded and the aircraft stalls, the only way to recover from that is to get airflow back over the wing, back over the airfoil. That only comes through trading altitude for airspeed, period. Now, I mean, yes, of course, you could increase thrust, but there are some risks to that, and modern stall recovery techniques will involve adding power. It's very important that the critical angle of attack, the recovery technique is a nose down attitude before power is added, and that is to prevent a secondary and accelerated stall. We can talk about that in a second.

In order to recover from a stall, the stall recovery technique that is just burned into the mind of every pilot on day one, getting their private pilot license is how to recover from a stall, because that is simply when the aircraft is no longer flying, right? Lift is lost. You lower the nose, you decrease the angle of attack immediately, and then from there, you maintain straight level, wings level, so that the wings are producing lift symmetrically, and then you apply power. You trade altitude for airspeed, get the airplane back and going, and then you're recovered, and you can climb back up, and your airplane is performing normally again. That's basically a stall. That's how a stall recovery is supposed to take place.

What happens with a spin is that one wing is stalled more than the other, okay? One wing could exceed critical angle of attack, and the other wing may be close, but not quite there. When you lose lift on one side and you still have lift on the other side, what's going to happen is the wing that loses lift is going to drop, and you're going to go into, essentially, an uncontrolled descent where one wing is stalled, and the other wing is not stalled, and the aircraft is rotating. That is the spin element of a stall.

Now, spins are recoverable as well with a stable aircraft. The way an aircraft spin recovery takes place is very similar to a stall recovery, except by using the rudder, the pilot makes an input in the opposite direction of rotation to stabilize the aircraft, and essentially, the goal is to just get airflow back over the wing of the aircraft, so that the airplane is flyable again. A spin recovery and stall recovery, basically the same thing, except you have the element of getting symmetry of airflow back over the wings in a spin scenario.

[0:19:35] JR: We are now experts in aerodynamics and lift and drag, and stalls and flat spins, and how to get out of it. Let's talk a little bit about icing, because that's been one of the primary talking points about this accident. Steve, what is icing and what's the impact on the airplane? I think we all suspect like, oh, it's icing. It's ice on the airplane. But it's a serious matter. How turboprops deal with it, I know is different than a jet aircraft. Tell us how.

[0:20:07] SG: Yeah. Before I get into icing, let me just add one quick correction. A spin and a flat spin are not the same thing. A spin is, as I described, a flat spin would be the same thing with the exception that the aircraft is unstable, right? The nose does not point down, and it becomes difficult, if not impossible, to lower the nose and regain that airflow and that control. A flat spin, the aircraft is in a spin, but it is turning flat, and the nose is not dropping to permit that airflow to come back. I will also say that I haven't seen enough evidence to say that this aircraft was in a flat spin. It looks like, in the final moments it was in a flat spin. That may not have been the case all the way down. Let's not assume that the aircraft was in a flat spin all the way down, because the implication of that would be either that the aircraft has a CG aft of limits, or some inability to deflect the elevators to get the aircraft to move nose down.

Anyway, let's go back into icing now. Icing. Ice is an enemy to all aircraft, for two reasons. The main reason is that buildup of ice on the wing of an aircraft interferes with airflow over the airfoil. As you know, as I just said, airflow over the airfoils, what creates lift. Anytime you're changing the shape of the wing, you're affecting the airflow. When ice accumulates on a wing, you could potentially be affecting the airflow in ways that create a higher angle of attack, even at a pitch attitude that would be more or less normal, because you're now disturbing that air as it blows over the wing.

Ice accumulation on the wing is the primary reason that ice is problematic. Then there are secondary reasons as well. Obviously, ice adds weight to an aircraft. It's not as much of a factor the weight on an aircraft added due to ice, is not as much of a factor on large transport category aircraft, such as the ATR. It's definitely more of a factor when you're out there buzzing around in a Cessna 172 and your weight tolerances are much closer. That said, it certainly doesn't help, right? Because weight is the counterpart to lift. By adding weight, you need more lift. Not only are you potentially creating less lift with an iced-up wing, due to the fact that the airfoil shape has changed, but you're also requiring to produce more lift, because the aircraft is heavier.

Is it 500 pounds heavier, 1,000, 1,500? I don't know the answer to that. I mean, rhyme icing, which is the – it basically looks like refrigerator frost is not very heavy. It's aerated. Whereas, clear icing, heavier, icicle type icing is significantly heavier. I would go ahead and say that at this time, it's not as important to really think about the addition of weight due to icing. In this particular case, I think that the focus really needs to be on the disturbance of airflow over the wing.

Now, we have countermeasures for ice on all transport category aircraft, okay? Those countermeasures can be broken down into two main categories, anti-icing and de-icing. Pretty much every aircraft has some form of both. More modern jets don't really have de-icing. It's pretty much all anti-icing, so let's talk about the different countermeasures that exist on aircraft at large. First of all, all aircraft, all aircraft have the most basic forms of anti-icing and that is heated probes, okay? The pitot tube on the front of the aircraft that measures indicated airspeed and the static ports on the side of the aircraft and the angle of attack veins, if so equipped, are heated with electrical power from the aircraft's electrical system. By applying heat to those surfaces, that's an anti-ice measure, right? Anti-ice just means that it's hot, so ice will never accumulate on those surfaces due to the temperature being raised.

Additional types of anti-ice exist on engines, on large jet aircraft that generally heats the inlet guide veins on an engine, on a turbine engine, because ice can become troublesome as it passes through an engine. There's also the air inlet, that ring, that metallic looking ring that's around the front of any jet engine nacelle is heated as well. That's not heated electrically in most cases, it's heated through bleed air, which is air removed in the combustion process – prior to the combustion process as it's compressed by the compressor section of an engine.

A little bit of hot air is bled off of the engine before it's compressed and it's inserted into the bleed air system and it's directed into these little outlets, these little valves, if you will, in the leading edge of a wing, in the leading edge of an engine nacelle. That heat applied to those surfaces is anti-icing.

On jets, commercial jets, the leading edges of the horizontal stabilizer, vertical stabilizer, and main wing are all anti-iced. If you ever see the leading edge of a wing, or any of the control surfaces on an aircraft and it looks metal, metallic, shiny in some cases, it's generally an anti-iced wing. Meaning that ice can never accumulate on those surfaces when the anti-ice is turned on, because the temperature is higher due to either electric, or bleed air.

Turboprops don't have anti-icing, and there are certain reasons for that. Although there are a few turboprops that may have a leading-edge anti-icing, the more common solution that we see is de-icing. What de-icing is, just as you would expect, is it is the removal of ice after it has accumulated. The main reason that turboprops are de-iced versus anti-iced on the wing is because you just don't have enough air flow, because of the slower speeds to eliminate ice at the surface and prevent it from re-freezing as it rolls back onto the wing.

In other words, if you were to anti-ice an aircraft going 200 knots, the water that hits the leading edge won't freeze, however, it will flow back onto the wing to the non-anti-iced portion of the wing and then freeze. That could be a huge problem, obviously. That is something that we should talk about with regard to this aircraft. Instead, these slower aircraft are equipped with de-ice boots, okay? You'll hear the term boot. What that is is they are simply rubber panels that are affixed, that are permanently mounted to the leading edge of the main wing and the horizontal and the vertical stabilizer. When activated, they inflate like balloons and they don't just inflate directly. They have, it looks lumpy. It looks like, imagine the surface of a wing with horizontal lines.

[0:27:13] IP: We have a good video that we can put in the show notes of the de-icing boots in action on the ATR, so that people can know exactly what Steve's talking about here.

[0:27:21] SG: Yeah. In order for those boots to be effective, they can't be activated until a significant amount of ice accumulates on that wing. What happens is is up to the flight crew to monitor the leading edge of the wing visually. When a certain amount of ice has formed, they activate the boots. The boots are on a timed cycle, where bleed air is taken off of the engine and used to inflate those boots. They inflate, it changes the airflow around the wing and then it physically moves the ice as well. Then it usually flakes off and breaks off and then falls to the ground. That is the ice removal system on the ATR. It exists like that on a lot of other smaller turboprops, as well as the Dash 8. Even our IAI jet has leading edge boots as opposed to an anti-ice system. You do see it on jets as well, though it's far more uncommon.

[0:28:15] JR: When you're preparing for a flight, you're putting together your flight plan, you're researching the route for the day and you see a SIGMET that says, severe icing in this region. How does it change your mentality going into that flight? Are you doing something differently? Are you preparing differently? What are you looking out for when you're preparing and then operating that flight?

[0:28:34] SG: First and foremost, most of the time these days, I'm flying jets. That's a very important distinction, because jets are going to fly above the freezing levels in air that is not only generally clear without visible moisture, without clouds where there's actual water droplets floating around in the sky, you're above all that. If there are clouds, they're generally ice crystals because the temperatures in the high 30s and low 40,000 flight levels. You're talking about negative 30, negative 40 degrees Celsius air, and it's just too cold for ice to accumulate on the leading edges.

With jets, the only time that icing is really worth noting is when it's a part of the departure or arrival sequence of the flight, where you may be in aircraft, or you may be in icing conditions for an extended period of time. On a turboprop, their cruising altitudes are much, much lower, and it's definitely possible on a turboprop, and not even possible. I mean, it's somewhat normal on a turboprop to be flying at a flight level where there is ice accumulation at cruise, and that seems to be the case with this particular aircraft.

[0:29:47] JR: Yeah, this aircraft was cruising at, I think, only 17,000. They were right in the sweet spot for icing.

[0:29:52] SG: Right in the center of it, absolutely. It is, you never – I don't care what aircraft you're in, you never want to spend any time in a place where severe icing, I mean, any icing, let alone severe icing is being reported. Again, back to the de-ice and anti-ice in jets, it's also not quite as critical, because we have anti-icing systems and we're also in, not only does ice never accumulate on jets, we're only in the icing environment for the most part for a much, much more limited amount of time. Turboprops, you just can't always escape it.

I mean, again, I'm not going to backseat. I'm not going to make any necessarily observations about, about what they did or didn't do. If I were planning a flight in an area where there was severe icing reported and my altitude was through those levels, for one, our dispatch would need to be aware of this and either root around the areas of reported icing, or ensure that the aircraft has the capability of cruising at a level above, or below the freezing level where all this was being reported.

If the aircraft is too heavy to get above 17,000 feet and icing was 10,000 to 17,000 feet, I mean, it would be irresponsible to dispatch an aircraft to go fly in that, unless you knew that it could be out climbed, or out outmaneuvered through the aircraft's performance. That's one adaptation I would take. Severe icing is not an extremely common SIGMET. In fact, it's quite rare. It's like severe turbulence. It's, you see it, but not very often. When you see it, it should set off alarm bells the pilot's mind.

[0:31:35] JR: Yeah. In this case, some of the few facts we do have out of Brazil do indicate that this aircraft did have all of its systems operational for this flight. It's not like they knowingly dispatched this aircraft without any deicing equipment. We do know that at least. It's one of the few facts we do have and more, of course, will be trickling out as they did recover the flight data recorder and the voice recorder as well.

[0:32:00] SG: Well, let's talk real quick about icing and how icing has in the past, led to accidents that looked very similar to this. There's another form of icing, tailplane icing, which could be essentially, which was implicated in a Colgan crash, the Q 400, as well as the crew was blamed extensively on in that particular accident, because they did not appropriately initiate a proper stall recovery technique.

One theory leading to what could have possibly happened here? How this aircraft could have gotten into a stalled state is if icing initiated the stall, the likelihood that it was not recognized until it was too late is pretty high. I say that, because, I guess, there was reports that there was a radio transmission by the crew stating that they were in ice and they were looking for change in an altitude. okay. They were aware that there was icing, but the severity of this situation, it doesn't seem that it was on the forefront, because any pilot can deviate from a clearance by declaring an emergency, right?

If the crew had reached a point where it was a dire emergency to get out of the ice, you just get out of the ice and answer to ATC later. I don't know. I mean, again, I haven't heard much beyond the reports of that the crew did request an altitude change due to icing. In this particular case, one of the things that we see time and again, especially in turboprops is pilots cruising with the autopilot engaged aren't necessarily getting the feedback, the touch feedback that the aircraft could be increasingly taking on a very significant amount of ice. That's one thing that immediately stands out was the autopilot engaged. That's one of the things that the investigators will focus on early.

I am not actually type rated on the ATR. I'm type rated on the Dash 8, which is similar in a lot of ways. I have read that since some previous accidents, the ATR procedures have mandated that flight in icing conditions is made with the autopilot disconnected. That is for that, essentially haptic feedback from the controls.

[0:34:15] IP: That's interesting, because I mean, we can also – you mentioned the Colgan flight, but we can go back to 1994 and the American Eagle flight that crashed on its way to Chicago. That was, icing was also implicated heavily in that crash. I mean, it's when coupled with, as Jason mentioned, a lot of aircraft, or a lot of airlines in the US could benefit from turboprop usage, that was really the deciding factor and has been for the lack of turboprop usage in US airlines.

See, before we started recording, you mentioned you wanted to talk about tradeoffs in aircraft design and how aircraft are designed for specific missions. I think this is a good way to move

into that and how we talk about what is the mission profile of a particular aircraft and how do those tradeoffs work?

[0:35:11] SG: Absolutely. This is something that I hold dear to me this concept. Because you see a lot of people, and going back to the 737 MAX and I mean, not to get into too many examples of how this happens, but people are very quick to point out an aircraft, a particular aircraft as a bad aircraft. I think that that's a bad description for any aircraft. Aircraft are purpose built, okay. When you're dealing with the laws of physics, everything is a tradeoff. Literally, everything is a tradeoff.

What the aircraft manufacturers do is they provide a variety of options of different aircraft for different missions, and they all have strong points and they all have weaknesses. The fact that the ATR, or turboprops are dangerous, or bad, or poorly designed, or I'm never going to fly on those, I mean, I think that that's an unfair statement to make. Because the reality is turboprop aircraft are great aircraft in a lot of ways. They are built to operate very efficiently on shorter range routes. The reality is these aircraft, they fly slower. That's one reason they're not quite as efficient on longer flights. I mean, if you can get somewhere in an hour versus two and a half hours, obviously, getting there in an hour is going to be more efficient, even if you're burning a significant amount of fuel.

Turboprops, the advantage with turboprops is that they burn very comparatively to turbojet, or turbofan aircraft. Because they burn so much less fuel in moving shorter distances at slower speeds, you can move, I don't know what an ATR 72 has, 50 seats roughly. You can move 50 people, or 60, 70 people, whatever it holds, a shorter distance to where it's not going to make a huge difference in the timing. If you're flying, the ATR trues out, I believe, in around 250 knots, so to speak, right? I mean, the Dash 8's max is 242, it cruises at 230 true, 220, 230. I mean, that's slow, considering that the true air speed of a jet is 440, right? 430, 440, 450 knots, true air speed. It's a little bit more than half of the speed.

When you're talking about rootings over airways and if you're moving 500 nautical miles, it might save you 15 minutes to fly a jet, but the reality is you're going to burn significantly more fuel, because the fuel burn on turbojet aircraft is exponentially higher than that on turboprop. Turboprops are perfectly situated for flying the shorter haul markets that are higher density,

carry more people, and so forth efficiently. Now, the downside to turboprops is because you're moving slower, because a turboprop engine is just not going to propel an airliner as fast as a turbojet, or a turbofan, you need a bigger wing, right? I mean, you need a big, heavy, square, non-swept wing. It doesn't have the air speed to generate the lift required of a swept wing aircraft.

Based on that, a turboprop aircraft is far more susceptible to ice accumulation. They also don't fly as high. I mean, they cruise in the mid-20s, versus the high 30s. Again, it puts an aircraft in an area where it's more susceptible to icing. You can't say the ATR is a bad aircraft, because it's more susceptible to ice. It's more susceptible to ice than a jet, because of its design and its design is that way for a purpose. I mean, there are certainly shortcomings, obviously. It's problematic clearly in circumstances where there is severe icing. Therefore, I think crew training is very important, a real hard look at deicing systems and their effectiveness.

Going back to the American Eagle accident, the ATR accident, which was very similar in appearance to this particular incident, a lot of changes happened after that. For one, the ATR's deicing boots on the leading edge of the wings, the surface area was increased. The reason being, the cause of that accident was moisture flowing back from the leading edge of the wing and forming a ridge on the main wing in front of the ailerons, which caused an airflow disruption that rendered the ailerons ineffective. In order to overcome that one solution that was put in place was that an airworthiness directive was released and the surface area of those leading edge deice boots was increased so that it deices a larger physical area on the front of the wing to prevent that flowback. That was a change.

Other changes implemented had to do with recovery procedures and techniques. Those techniques were essentially, flying with the autopilot disengaged, avoidance of severe icing and training in upset recovery stall and upset recovery.

[0:40:16] IP: Steve, I think that we should leave it here for now. The CENIPA investigators, which are part of the Brazilian Air Force, are in possession of both flight data recorder and the cockpit voice recorder. They've said that they'll have a preliminary report in the next 30 days, which is standard for these types of investigations. We've got as much information as we have

now, until we have the preliminary report. When we have that, we'll certainly be revisiting this and hopefully, we'll have Steve back to discuss this a little bit further.

I want to thank Steve for his insights as always, breaking things down into ways that even Jason and I can understand. Hopefully, this has been a helpful discussion for folks that are seeing this and then hearing a lot of things about this crash that might not be necessarily accurate. Steve, thanks so much again for joining us. We really appreciate it.

[0:41:08] SG: Absolutely. Happy to be here. Thanks again.

[0:41:10] JR: Thanks as always, Steve.

[0:41:11] SG: All right, Jason.

[0:41:12] IP: This has been Episode 281 of AvTalk. We're going to leave it there for the show for this week. We'll be back next week with a normal show. We certainly hope so. Thank you all so very much for listening.

[END]