

TINA OK, so when we were talking about radar, we had a great reminder about how the origins of
SRISVASTAVA: that came right here at MIT. And in fact, physically right here, where the Stata building is located. Well, when we're talking about instrument flying, there is also a very strong connection here to MIT. So does anyone know the story of Jimmy Dolittle and his first blind flight? Yes, do you want to share?

AUDIENCE: [INAUDIBLE]

TINA Yes, you're right. He has a lot of good stories.

SRISVASTAVA:

AUDIENCE: Takeoff and landing [? just on ?] flight instruments.

TINA Takeoff and landing just on flight instruments, yes. Good, that's exactly right.

SRISVASTAVA:

AUDIENCE: He also got a doctorate here.

TINA He also got his doctorate here, that's right. You have a good understanding of him.

SRISVASTAVA:

AUDIENCE: [INAUDIBLE]

TINA So Jimmy Dolittle, before he came to MIT, was flying in the military. And he was doing a lot of
SRISVASTAVA: things. He's known for flying across the country in a very short period of time and encountering a lot of storms and weather. And being one of the first people to really rely on the instruments inside your planes-- all your flight controls-- when you're not able to look outside the airplane. And just as you said, he studied here and got his graduate degree here.

But even after that, he continued to study how a pilot could fly when the visibility outside the airplane was very difficult-- and really pioneered the concept that in a very foggy weather condition, for example, you can still successfully fly an airplane by relying on the flight instruments. And in particular, one of the most significant flight instruments is what's called an artificial horizon. So Philip already introduced that flight instrument. We'll talk about it.

And when we've discussed the six-pack, where you have these six circle flight instruments, it's

the one in the middle on the top. And we'll look in that in particular. So that artificial horizon with a little airplane on it is basically supposed to replace looking outside your windshield and seeing the real horizon. And so it's a good thing to rely on. One of the most important instruments when you're flying.

So basically, instrument flying is how you can rely on the technologies inside your airplane to avoid hitting things and to land without being able to see outside your airplane. And IFR stands for Instrument Flight Rules. And so that means that you have to follow a set of rules when there are clouds outside. Now, because pilots really need to make sure to practice and stay current, we have a situation where most of the time that people are practicing that instrument flights might be a condition where actually it is quite sunny and beautiful outside. But they're just practicing.

So the way that we distinguish it is when it's actually very foggy, very cloudy, you can't see outside-- that is described by IMC, or Instrument Meteorological Conditions-- IMC conditions. So that's when you actually have the condition where you can't see outside the airplane and then you follow your IFR, your Instrument Flight Rules. And so the goal of this whole process is to be able to fly safely, even when you can't see out the window.

So why would you want to be flying when you can't see outside the window? There are a lot of reasons for that. I've been spending a lot of time in California. And here's a familiar sight in California. If you see a lot of clouds, a lot of fog-- fog is a daily occurrence, depending on where you are, especially in the San Francisco Bay Area. And so a VFR pilot won't be able to really fly in those conditions at all.

PHILIP

It's important to remember, it's beautiful right above the fog. So you could be flying in the

GREENSPUN:

clouds for a minute and then you proceed to your destination in the desert or wherever it is.

TINA

Absolutely. So Philip was just talking about a condition just shown in this picture here, where it

SRISVASTAVA:

might be the case that there's a thin layer of clouds or fog at a low altitude. But if you were to go through that, above it, it's really beautiful up above the clouds.

And sometimes this is called VFR On Top. So you have Visual Flight Rules up on top of the clouds. It's not that you're flying in the clouds, but you have a cloud cover below you. And so if you have your instrument flight rating, then you can fly right through that thin layer of clouds or fog and be flying in a beautiful day above that.

I'd also like to point out that instrument flying makes you a better pilot. So I know this personally-- if you remember from yesterday, I talked about how after my private, basically one of the first things I did was start on my instrument flight rating. And you actually start with just learning how to be a better pilot. You start sticking to your altitude a little better.

When you're a VFR pilot, a lot of times when we talked about the different airspace, there isn't a very strict restriction on what altitude you need to be at. You're not really filing a flight plan. You could be changing your heading and wandering over one way and wandering over another way. But when you start training for your instrument, you start learning more precisely what it takes to trim your aircraft's configuration correctly, how to stay at 3,000 feet, 1-8-0 heading, whatever it is-- and actually maintain that while you're doing a number of other operations in your plane. And not getting distracted in such a way that causes you to change your heading or your altitude. So that just makes you a better pilot altogether, even in visual flight conditions.

The reason, of course, that you have to learn how to fly more precisely is because when you are in an actual IMC condition with clouds and you can't see outside your airplane, you're relying on the air traffic controllers to sequence the airplanes and make sure they don't come near each other. And so the air traffic controller is going to want to know that if they tell you to stay on a particular vector-- so an altitude heading. And they want to make sure you actually stay there, because if you start drifting off-course, you could drift into the course of another airplane that they have flying in a different direction.

So you actually are required to do some amount of instrument training, even for your private pilot-- about three hours. So that means that you have to go flying and rely purely on the instruments in order to fly. So it would be great if there is a day that has fog without an adverse weather situation so you could actually fly in true IMC conditions, where your instructor is really taking control there but allowing you to experience it. But if that doesn't happen, you can use a view-limiting device, such as foggles. So these are basically glasses you put on that fog out where you would see outside the window and only are visible looking at your controls. Or a hood that basically blocks your view of everything except the instruments.

So we've already talked about radar and ATC and working with those air traffic controllers. So those air traffic controllers are responsible for the separation of the airplanes. And they will assign specific altitudes, headings, and different routes and clearances. NavAids is short for navigational aids, like radio and GPS. And then we've already discussed just now about a

transponder.

So that xpdr just stands for transponder. And that's just basically saying that if the radar itself is unable to provide the accurate altitude of the plane, you can add on the transponder to help with the radar return. We've also discussed briefly the ADS-B-- and we will get into, when we talk about weather data, how you can build your own device to receive that ADS-B data.

So let's talk about the different phases of an IFR flight. So there's a little bit more you need to do in the flight planning stage. You also do need to file a flight plan, which we discussed isn't required for your VFR flights. And then some more things you need to do once you depart, when you're en route, and then your approach to landing.

So what Philip helped me pass out are what's called approach plates. So you'll hear that-- so it's different information that talks about-- when you're landing, they're different specific procedures. Because, again, you can't see outside the airplane, so they will create a path that you fly on that are specifically designed to avoid terrain and allow you to come in and land at the airport safely.

Although I passed out the physical piece of paper-- and a lot of people have physical pieces of paper for those approach plates-- I've also pulled up an airport. I used Bedford, my local airport. And you can go down on ForeFlight to approach and see all the different approach procedures. So I'll pass this around. And basically you can click on different approach procedures.

PHILIP Let me also add that all these plates are available free online. If you go to any source, like
GREENSPUN: SkyVector or AirNav.com, you can go to the airport and see a list of the procedures and just grab the PDF on your device.

TINA Absolutely. They're all free online. And you want to make sure you have the updated ones,
SRISVASTAVA: because sometimes they do change.

PHILIP Yeah, I meant just here for the lecture. If you just want to have it in front of you on your phone.
GREENSPUN:

TINA Yeah, absolutely. Pre-flight planning is just really important. As much as we just talked about
SRISVASTAVA: meteorology and different adverse weather conditions-- so just because you have the ability to fly in the clouds doesn't mean it's a good idea. If there is anything like thunderstorms, icing conditions, something that could impair your ability to fly safely, then it doesn't mean you

should go flying. And it's really important to understand where all the adverse conditions are and look at all that data.

So when you're doing your pre-flight planning, there's certain information about when you need to have an alternate. So the time and hour before-- an hour after your estimated time of arrival. Your ceiling-- so what's a ceiling again? That's when you have cloud cover-- so either broken or overcast clouds.

So they're saying if that ceiling is less than 2,000 feet. And then your visibility-- so how far out you can see-- three miles. And one of the biggest rules of thumb to keep in mind is that when you're doing this planning, you don't want a situation where you take off from an airport and you plan it such that the weather is going to get so bad that you can't return to that airport. So a good, safe rule of thumb is make sure that you can get back to the airport you're taking off from, in case there's any issue with your airplane or travel. You want to be able to safely get back from where you took off from.

And even though with your IFR rating, you can fly through clouds, there are still specific visibility requirements for every single approach and airport that you're coming into. It can't be a completely dense fog all the way to the ground. There is an altitude where even the big, major commercial jets have to be able to identify certain runway indicators before they're allowed to land. And if they're not able to, they have to go around or find an alternate airport. And all that specific information is on those approach plates that we'll talk about in a moment.

So you can actually file a flight plan directly on the computer or with an app, such as ForeFlight. This is what I was discussing a moment ago. This is your six-pack, again-- your flight controls. And the one right in the center at the top is that artificial horizon.

And just as Jimmy Dolittle did-- found that as a very important reference point. That's really what you want to spend most of your time looking at when you're flying the instrument. Just like when you're flying VFR, you want to spend most of your time looking out the window at the actual horizon and what's out there. You want to look at this to make sure you haven't started turning and not realized it. So we're going to get into human factors this afternoon.

But just like we talked about when we were discussing aerodynamics, your body can't really feel the difference between gravity and acceleration. And so if you start a turn but then you basically have even doubt in your flying level, your body will not notice that you're tilted. And so

that's why it's really important to keep an eye on this artificial horizon and make sure you're in fact flying straight and level when you think you are.

So we're going to talk about a lot of different safety considerations. We talk a lot about minimums with regard to what are the FAA regulations or your flight school might impose-- the place you're renting your aircraft might impose. Certain minimums-- that they don't want you to take the plane unless the ceiling is above 2,000 feet, for example. But there is also this concept of personal minimums.

And Philip and I will spend a chunk of time at the end of the course talking about our personal minimums and sharing them with you, that you might want to set your own restrictions-- that, hey, if certain things are occurring and you don't feel comfortable, you don't think it's safe, you set those restrictions to yourself. So that way, on a particular day that you're planning to fly, you don't get the get-there-itis, where you just really want to go and you decide you're going to do whatever it takes. You can refer to your personal minimums and say, hey, I have previously decided that this wasn't a good idea. So let's stick to my judgment at that time and not fly.

We're also going to discuss how, even though the FAA might require only a single pilot in command, you can actually have a different person sitting next to you, whether they're a pilot, whether they're just a friend, you can put that person to work to help you out in managing your cockpit and helping with some of the navigation, for example.

So let's talk a little bit about the approach plate. So does everybody have an approach plate, either on their computer or a physical piece of paper? Is anyone missing one?

OK, so there's a lot of information on an approach plate. And you don't need to know any of this for your private pilot. But just so you get oriented, I'm just going to give you a high level of what kind of information is on this approach plate and what we're talking about. So again, this is a situation where there could be cloud cover or you're flying in fog and so you can't see outside your airplane or you can't see the airport, but you have to safely arrive at the airport. So the approach plate provides a flight path for you to fly on to safely enter the airport's vicinity, enter the final approach, and then to a point where you can visually identify certain runway markings and land safely.

So the very top of the approach plate tells you a lot of information. So the top right corner, where it says RNAV GPS-- that's identifying the type of approach that it is. So usually, it'll tell you whether it's a precision approach or a non-precision approach. So there are different

types of instruments on your plane.

You'll see, as that iPad's being passed around, with the different ones you can click on-- there are certain instruments in your plane and at the airport that will tell you how you can land. So an ILS, for example-- an Instrument Landing System. If that is available, it can be a very precise way to land at an airport, whereas if you don't have exactly those things available, you might use a GPS or a VOR, which are different types of approaches you can fly.

It'll also tell you the runway, which is very important. Runway 16-- so that's the runway you're trying to land at. And then just below it is the airport.

So this one in particular is Port Smith, which is an airport that's basically-- if you drive to the coast from here. So it's at the border between Maine and New Hampshire, right along the coastline. And people refer to this airport as Pease. You also see a lot of very specific information-- a lot of numbers and things there.

So we've discussed a few times the concept of ADAS. So you see that ADAS-- so that's the frequency you can dial into to get the weather information at that airport. And you'll need to get the latest weather information before you enter and start doing the procedure. You also see the air traffic controller here is Boston approach, who you'll be talking to on 125.05. You see the Pease tower, or Portsmouth tower-- 128.4. And then after you land, here's the ground controller that you talk to.

PHILIP Tina, do we have to worry about those other numbers? Like 269?

GREENSPUN:

TINA Let's make it simple and say, no, you don't have to worry about those other numbers.

SRISVASTAVA:

PHILIP OK, those are for the military. That's UHF. And you won't have that in your rental Piper.

GREENSPUN:

TINA Another really important thing to pay attention to is at the top right corner is a missed approach. So if you were not able to complete the landing-- maybe you had to go around or something didn't feel safe or you lost communications when you were coming in-- and you are not able to execute the landing, then you fly a missed approach. So it tells you what to do if you weren't able to land. So it says climb to 3,000-- so 3,000 feet-- direct-- and it says this

TTATT is the name of a particular location.

So, TTATT. And then it says, and on track 165 degrees-- so that's the heading-- to IDEED and hold. So it basically says that if you weren't able to land, then you're supposed to continue straight, climb to 3,000 feet, to this TTATT location. And then on the track 165 degrees, to continue on to IDEED and hold.

So now the middle of the approach plate really tells you what to do. There a couple different points that are really interesting. So IAF-- does anyone know what IAF stands for?

AUDIENCE: [INAUDIBLE] Approach Fix.

TINA
SRISVASTAVA: Initial Approach Fix. So these are places where you can enter this pattern. So IAF-- you can enter here at ITAWT. There are a couple others here as well. So what it's saying is if you entered here at ITAWT, you're flying at 3,000 feet on heading 118 degrees to this holding pattern right here.

And every time it has these weird letters is representing another point. And then you continue straight towards the airport, to this other spot. And then here is the actual airport-- it says runway 16, where you could land right here. And if you have a missed approach, remember it said to continue straight to TTATT and then to continue on to IDEED and you can do a hold over here.

So aviators are not without a sense of humor. So let's just go through what that would be. What are the names of the points along the way? You start with ITAWT, ITAWA, PUDYE, TTATT-- IDEED.

So I'm getting a lot of chuckles. In case you missed that, it's I thought I saw a putty-tat. I did, I did see a putty-tat. Anyway, good cartoon for you there.

So that shows you a little bit of humor in this particular approach plate. The bottom of the approach plate shows the same thing, but a profile view. So this shows the altitudes as you're going.

So you start at 3,000. This is your heading, you're going along into ITAWA. And then you go down, you're descending to PUDYE. And then all the way here, where you land. And if you have to execute a missed approach, then it pictorially describes that missed approach, which is you continue straight at 3,000 feet, climb to 3,000 to TTATT and then on heading 165 to

IDEED.

And then here on the left, of course, is a picture of that runway. And it tells you what the runway looks like, the taxiways around it, the length of the runway, et cetera.

PHILIP What are the minimums? How low can you go before seeing the runway?

GREENSPUN:

TINA The minimums depend on the type of aircraft that you have. I was skipping over it because it's fairly complicated. But this whole thing down here basically indicates the minimums in terms of your visibility as you're landing.

SRISVASTAVA:

So where it says category, it's the different types of categories of aircraft. Circling means that if you were planning to land at one runway, but you circle to land at another runway. And then it has a lot of specifics depending on the actual type of aircraft.

PHILIP What about in a CIRRUS? A modern CIRRUS?

GREENSPUN:

TINA You can go ahead, Philip.

SRISVASTAVA:

PHILIP OK. So that top one is LPV. That's essentially a precision approach using the GPS. So if you have a WAAS GPS, which is the modern kind, as of about 10 years ago, you can go down to 300 feet.

GREENSPUN:

So if you don't see some indication of the airport environment, the runway lighting or something, then you can't go below 300 feet. It is time to do a missed. And it also tells you you need 2,400 feet of visibility.

TINA In this case, that 300 feet is regardless of the category, whether it's a, b, c, d, or e-- they all show that same amount. And when Philip is talking about depending on the type-- whether you're reading here the LPV, LNAV, et cetera, on the left.

SRISVASTAVA:

PHILIP Yeah, like the LNAV approach down there, towards the bottom, that would be for an older non-WAAS GPS.

GREENSPUN:

TINA So there's obviously a lot more information on this approach plate. But those are some of the key highlights so you don't get afraid when you see these. Any questions before we move past

SRISVASTAVA:

this topic? Yes.

AUDIENCE: This is a stupid question, but I've actually looked at this approach plate before and I didn't get that joke. Is there somewhere you can look up why they named them what they are? Or who named them?

TINA
SRISVASTAVA: Oh yeah, that's a good question. So basically, if you missed the joke-- the I taught I saw a puddy-tat joke. Is there a place you can look it up? I'm not sure. But I know a couple of people that write different articles about aviation. It'd be a good exercise to see if we can Google and find a couple of those articles and share where they figure out how they name all these different points.

OK, so if you want to learn-- yes, go ahead.

AUDIENCE: What are the speeds?

TINA
SRISVASTAVA: The speeds. Yeah, absolutely-- so what speed do you have to be as you're flying these different approaches? Do you want to tackle it?

PHILIP
GREENSPUN: Yeah, I'll just talk about that. If you're in a really busy airport, they may tell you to keep your speed up so that you don't clog up the works for the jet. And also autopilots don't work that well if you're going really slowly. So it's probably conventional in something like a CIRRUS to be going around 120 knots before you get to the final approach fix.

You're going to put in one notch of flaps just before. And 120 knots is the limitation on an older CIRRUS, for flaps. So you'll slow down to maybe 105 as you're going down the glide slope.

And then once you break out of the clouds-- let's say at 500 feet above the runway-- although, the minimum there was 300 above sea level, which is 200 feet above the runway. You put in the full flaps and you'll slow down to your final approach speed of 75 or 80 knots. So those would be the typical speeds on a precision approach.

TINA
SRISVASTAVA: And if you're practicing, you're new, it's OK to go a little slower. They'll tell you if there are other people behind you. Holds are a good time-- the whole point is to basically take time and slow down. They're trying to get you to wait for some reason.

So you might want to go 90 knots. The reason you don't want to go much below that is, of course, you are doing so many things in the airplane to get prepared for the approach, you

don't want to get down into very slow air speeds where you could stall as well. That could be a big issue.

So now just talking about how you go on to get your instrument flight rating. There's some good resources here to point out. And this talks a little bit about the time-- that XC just stands for Cross-Country Time. Then you actually need time and in actual IMC conditions or in simulated. So that's where you're wearing your goggles or your foggles or your hood.

And again, you can actually do a little bit of simulated flight training as well. So some places have a red bird simulator or other types of simulator where you can do some simulated flight time. Sometimes that'll save you a little bit of money, because you don't have to spend the engine hours to fly out to wherever you're doing the approach. And you can just restart very quickly.

So there could be some advantages of that. And then, Philip, you have some advice here on how you get your IFR rating.

PHILIP

GREENSPUN:

Yeah, I think if you're going to do this-- once you finish your private-- these higher performance airplanes aren't great for training. The little Pipers and Cessnas are probably better, just because they're slower. But as soon as you're going to work on the instrument rating and do transportation, then it's time to get into the CIRRUS or get into the Bonanza that you're intending to use for family transportation.

Time and type and realistic-- going with an instructor on the trips that you're actually going to do-- is invaluable for safety. I think one good way to do it is do a big cross-country trip with an instructor. Or just go to Florida, go to California, go to Alaska. And do an approach every hour. So then you go through a lot of weather systems and you get very comfortable with getting the weather information, filing flight plans, working with controllers in different situations.

TINA

SRISVASTAVA:

One other thing I would add-- it's a cool trick you might not have heard of. So whenever you're getting an instruction, you have to pay not only for the aircraft rental, but for the time of your instructor. Well, if you take an instrument flight and you practice an approach and then you just want to practice it a couple of times yourself, you can actually go up without your instructor-- without any view-limiting devices, of course-- where you can fully look outside the airplane. And you can keep flying that same approach.

So you can actually fly practice approaches without actually being in an instrument condition or

with view-limiting devices, to just practice the mechanics of the whole thing. How you deal with airspeed, who's going to start talking to you next, what do you need to do next. And I find that to be very useful.

You'll also find on that-- you heard from Sebastian yesterday about the MIT Flying Club. So there's an email list-- flying-pilots@mit.edu. So once you become a pilot, it's great to be on that list because instrument-rated pilots have to keep practicing their approaches. And so they need somebody to sit next to them to look out the airplane for other aircraft while they're wearing their view-limiting devices. And that person is called a safety pilot.

So as long as you have your private pilot license, even if you don't have your instrument rating, you can serve as a safety pilot. So it's a great way-- and cheap way-- to get a lot of practice in and see an instrument pilot at work trying to do an approach. And you can sit there and learn and look out.

PHILIP And you get to log that time as safety pilot, as if you had been flying. So it's a good way to
GREENSPUN: build up flying experience.

TINA Yeah, highly recommended.

SRISVASTAVA:

PHILIP Here's a question for you guys. So the safety pilot-- you heard about the medical certification.
GREENSPUN: Let's say the person practicing the approach has a first class medical. So they're very healthy and the FAA thinks the pilot is unlikely to have a heart attack and keel over while under the hood. Does the safety pilot need to have a current medical to serve as safety pilot? What do you guys think?

AUDIENCE: Yes.

PHILIP It's ridiculous. That person has a heart attack, the regular pilot can just take off the hood and
GREENSPUN: fly. The safety pilot shouldn't need a medical, right? As long as their last words are, you have the controls. But in fact, the safety pilot is a required crew member for that operation. So the Feds say that he or she must have a current medical.

TINA And just that joke that Philip said about-- you have the controls. I'll just take a moment to
SRISVASTAVA: explain what he's talking about. When you hand over control, you take the controls, it's important to have what's called a positive exchange of controls. So if I'm flying the airplane and I'm giving the controls to Philip, I'll say, you have controls.

PHILIP I have the controls.

GREENSPUN:

TINA You have controls. So that reconfirming-- make sure that you know who's flying the airplane so
SRISVASTAVA: that you don't result in a situation where no one's flying. Yes.

AUDIENCE: When do your hands come off the controls in that exchange?

TINA I usually keep them on up until I really know that he knows what he's doing. So I actually keep
SRISVASTAVA: it on a little bit longer to make sure he knows and he doesn't start turning in some other direction.

PHILIP I think on that third one.

GREENSPUN:

TINA The final, "You have controls."
SRISVASTAVA:

PHILIP Especially important in a helicopter.
GREENSPUN:

TINA That's when you let go.
SRISVASTAVA:

PHILIP The good thing about airplanes is you can take your hands off and the airplane just keeps
GREENSPUN: doing whatever it was doing. But the helicopter is inherently unstable. So yeah, it's important that you don't take your hands off until you hear that third acknowledgment.

TINA Yes.
SRISVASTAVA:

AUDIENCE: How long does a cross-country trip take, from here to California?

TINA So the question was how long does it take to fly from here to California? The answer really
SRISVASTAVA: depends on which type of aircraft you're flying. So a little Cessna 172 would take a long time, because it basically is twice as fast as a car. And it's as the crow flies. But if you're flying a fancy CIRRUS, you can get much faster.

PHILIP You get a headwind going west, generally. So it's probably going to take about 15 hours to get to California, maybe a little over 20 in a Cessna or a Piper. And then you'll get a little speed boost on the way back. There are various companies that offer 10 day instrument ratings. And they fly around a lot. So a couple of weeks to get to California and back is reasonably comfortable while doing flight training along the way.

TINA One of the biggest things that'll slow you down is not how fast your plane can fly, but also your own fatigue, which we'll talk about in human factors. All right are there any more questions on instrument flight or instrument meteorological conditions? Yes.

AUDIENCE: What's your opinion on the steam gauge versus the glass cockpit for [INAUDIBLE]?

TINA So the question was what's our opinion on steam gauge versus a glass cockpit? I think we know Philip's opinion here. I've actually flown both. I think that with the G1000, or glass cockpit, what's nice is you can load the approach and it'll actually show the full flight plan that you're supposed to fly for a given approach. And you can actually have a whole flight plan where you have multiple approaches, one after the other. And it puts it up there and it makes it very easy.

But I will say that to learn it-- I've actually done instrument training on both the steam gauge and the glass cockpit. And I think that steam gauge obviously keeps you on your toes a lot more. You really know what's happening. You're using your heading bug to do a lot more, because you can't enter some of these things in advance. And so I think it's really helpful to learn how to do that, just like I think, for example, your autopilot is amazing.

You should have an autopilot if you're going to fly across the country. But you shouldn't use your autopilot when you're doing flight training, because the first thing Mark Nathanson, the FAA examiner will do, will be, oh, look, your autopilot died. Now you have to learn how to fly without it.

So I think for flight training, I recommend both. The other reason I continue to fly both steam gauge and G1000 is that I fly with a lot of other friends. So we talked about the MIT Flying Club, you fly with your peers. There's also a group of women pilots-- we call ourselves The Women Pilots of New England. We basically bumped into each other in the parking lots of airports and now get together. We're actually having a dinner tonight at 6:00 PM, so if any women pilots want to join, please do.

PHILIP Or pilots who identify as women.

GREENSPUN:

TINA Sure. And these groups that you fly with on these fly-outs, it's often the case that you want to have two pilots flying in a given airplane. And one flies there. And one's PIC there and one's PIC on the way back. And so if you have a lot of friends that fly the steam gauges, which are cheaper to rent, you want to make sure you're current in that airplane if you want to fly with them.

And if you fly a G1000, you want to make sure your friends that you fly with also fly G1000s. So I fly both, because I have friends that fly both. And we want to make sure that we can fly together on these fly-outs.

PHILIP Yeah, so despite the fact that I usually fly glass cockpit aircraft, I do fly instrument approaches in R44 helicopter instrument trainers. And those are more challenging, because there's no autopilot. And the machine is inherently much less stable than the airplane. So that's steam gauges. So I wouldn't say there's a big difference.

Really, the world of instrument flying-- if you transfer your skills from the visual flying world to the instrument world-- and they do transfer very well. When you're flying visually, you're spending about 80%, 90% of your time looking out the window at the natural horizon. When you transfer that to instrument, you're spending 80% or 90% of your time looking at the artificial horizon, or attitude indicator. And if you hold a constant attitude, the rest of the instruments take care of themselves.

The experienced instrument instructors will often cover up all five of the other instruments, which gets a little harder from the glass cockpit-- a lot of Post-IIs. And have the IFR student try to hold the constant attitude as best they can. And then remove the Post-IIs after, say, two minutes. And you'll find that you've only gained a couple hundred feet and you've only lost maybe 10 degrees of heading.

The FAA has terrible advice about how to be an instrument pilot. They say scan the six-pack. So spend, essentially, one sixth of the time. You used to spend 90% of your time looking at the attitude indicator? Now, let's spend 1/6 of your time. Or spend half of your time-- look at the attitude indicator, look at these other things.

But if you actually study high-time instrument pilots or jet pilots, you'll find that they're really

focusing on the attitude indicator 80%, 90% of the time, like I said. And if they don't do that-- I actually once flew with a guy. He was an MIT grad-- he was an MIT PhD. The FAA told him to scan like this, so he does. And that airplane was all over the sky, but he was constantly recorrecting it.

And he was right within the ACS standards of about plus or minus 100 feet and-- I don't know, maybe it's 10 degrees of heading. But we were in actual conditions a Piper Arrow with pretty limited backup facilities. So that was truly terrifying, because he's somebody actually doing what the FAA says to do.

The other thing about glass cockpits that I do like is it's great for night flying, because the illumination is very uniform. So one problem with steam gauges is that, at night, some of the instruments can be dimmer or brighter than the others. I actually had a Diamond Star, a DA40-- and the attitude indicator-- which is the thing that you want to be using-- was the dimmest instrument in the panel. And that was very annoying. They were back-lit-- the instruments themselves had the lights in there. So there was really no way to adjust it.

I think you're going to find that glass panel is what's in almost every aircraft within five or 10 years, because it's just getting too expensive to maintain these mechanical gyros. If you send out a mechanical attitude indicator to be overhauled, that's \$2,000. And the glass cockpit replacement might only be \$3,000 or \$4,000. And you'll never have to touch it again.

TINA
SRISVASTAVA: When we polled earlier in terms of people who've gone flying before-- so I'm going to ask three things. Did you fly in a steam gauge airplane? Did you find in a G1000, or glass cockpit? Or have you flown in both? So, steam gauge. About half of you. And then G1000, or glass cockpit. Oh, only two or three. And then if you've done both. Only a handful. So actually, it looks like the-- well, and of course, there are a bunch of you that haven't flown at all. But the ones that have, it looks like primarily in the steam gauges. So that's good to know.

AUDIENCE: 30 years ago, they hadn't been invented.

TINA
SRISVASTAVA: 30 years ago, they hadn't been invented. All right, that's true. Well, this was great. And Philip talked a little bit about night flying. We're going to have a whole section on night flying tomorrow. But now we're going to do a break for lunch. We'll give you about 45 minutes to get food. Please come back a little bit before the hour and we'll get started right at 1 o'clock. Thanks.