FUEL ICING INCIDENT

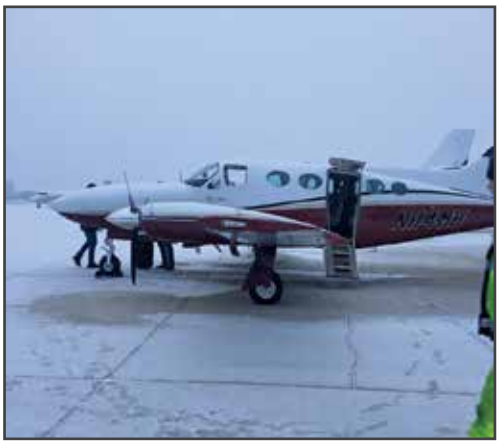
by Brad Falbert, TTCF Member

I'm a private pilot, flight instructor, and 1980 414A owner from Atlanta, with about 1,800 hours flight time. I have a story to share that might help our members avoid a serious incident. I was due to fly to DuPage Airport in Chicago (KDPA) from my home airport Peachtree Dekalb in Atlanta (KPDK) on Sunday January 27, and return on Wednesday January 30. Prior to my departure date I was monitoring the forecasted weather carefully as a polar vortex was expected for the Upper Midwest. Surface temperatures of -15 F were expected on Tuesday and Wednesday.

My 414A is pressurized, of course, and I routinely fly at FL180 – FL230. The beauty of a pressurized twin is the increased airspeed at higher altitudes, as well as flying above some weather non-pressurized aircraft have to fly through or avoid. But higher altitudes also mean colder temperatures aloft. For example, ISA at FL230 is -31 C, although it frequently isn't that cold.

Concerned about the extreme cold forecast, I called my local shop to ask the manager what he thought about flying in these temperatures. He said, "Don't be concerned, you fly high and cold anyway." Not to be anything less than careful, I also asked the FBO at DuPage when I landed whether they thought I'd have an issue. Once again, "No problem!"

I've learned that Continental engines really don't like to start in the cold.



The bitter cold polar vortex can create a number of flight hazards for Twin Cessna pilots. Study up and be prepared.

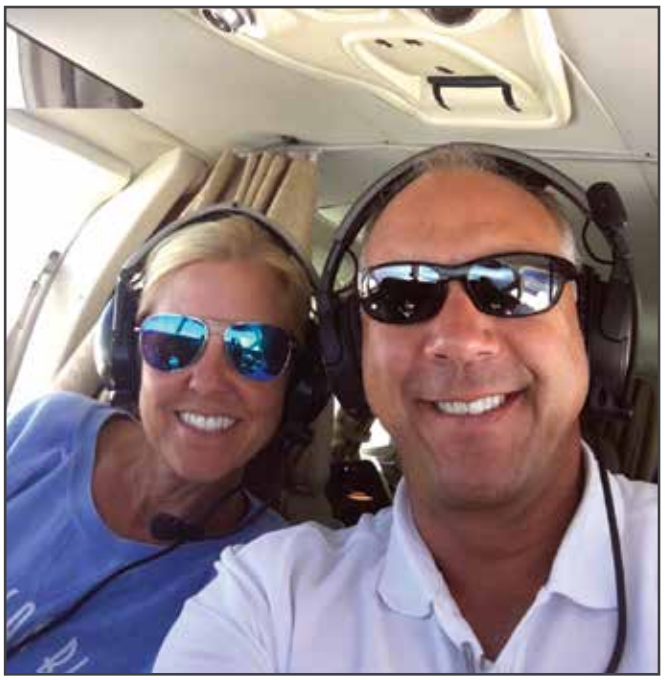
Anything 20 F and colder makes it nearly impossible. So, when I landed in DuPage, I had the plane topped off and put in the 60 F hangar.

On Wednesday, I arrived with a business associate at 9AM ready to return to Atlanta. The car's temperature gauge read -20 F. That is -29 C, ON THE GROUND! I conducted the preflight in the hangar. As usual, everything was normal including no water in the fuel when sumping. We got in, shut the door, and they pulled us out into the frigid air.

Still a little concerned about how my finicky Continental cylinders would handle the cold — (I have had to replace three due to cracking even though I treat them with kid gloves) — I was careful to keep the engine cowls closed on the ground, and to extend the run-up to ensure the oil temperature and pressure, as well as cylinder head temperatures, were in the green before takeoff.

On takeoff the engines seemed OK, although they sounded a little labored in the cold. I had filed for FL210, but asked ATC if I could level off at 10,000' temporarily due to my concern about the extreme cold. I then began the enroute checklist which included leaning the mixture. That is when problems started. One of the engines was beginning to shake like it was becoming out of balance.

This was the second flight since a new cylinder was installed and I was worried it was beginning to come apart. Since the shaking started when I began leaning the engine, I pushed the mixture back in to see if it would help, and it did, for a minute. In retrospect, this wouldn't have changed the situation if it were a mechanical problem in the engine, but it was all I could come up with at the time.



My wife and me in our 414A on a more enjoyable sunny day!

By then, I was about 25 minutes south of Chicago near Kankakee, IL. I told the controller that I was concerned about one of my engines and asked for a possible diversion airport. He reported Kankakee (KIKK) about 10 miles back to the north. I told him the shaking had subsided and that I'd continue on.

A couple of minutes later, the right engine started shaking much worse than previously. I became seriously alarmed and called "pan, pan, pan" on the radio and told the controller I needed to get on the ground NOW! He immediately vectored me back to Kankakee and to his credit gave me position guidance all the way. He asked the nature of the problem and I told him the right engine was surging and was shaking so bad I thought failure was imminent. He asked for fuel and souls on board.

In the field of complete white that was Illinois that day, finding the airport was difficult, but I finally spotted it about five miles away. Miraculously someone had actually plowed the runway that day. I set-up for a landing, and to my amazement, just as I got into the pattern, both engines started running perfectly. I put the plane onto the runway without an issue, taxied to a nearby hangar as instructed by the

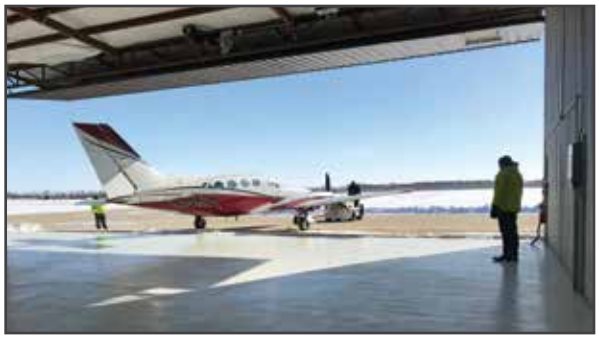
local crew, and radioed the controller to let him know I was on the ground safe. "Thank God," was all he said.

I had them push the plane into an open hangar and they very kindly dropped us off at an Enterprise rental car location. We drove to O'Hare and took Delta home. I had over an hour to think about what happened while driving.

Why did the engines suddenly recover as I entered the pattern as if nothing had happened at all? Could it have been fuel icing?

Fuel icing. How many of you can talk intelligently about the issue? If you're a turbine guy, you know to put Prist into the fuel every time to keep it from freezing at FL410 and to keep the microbes from forming, right? How about you AvGas guys? When do you worry about fuel icing?

In the back of my mind I remembered a sliver of training on the issue. I pulled out my Simcom 414 training book and in the fuel system section I found this sentence, "In extreme cold, a fuel additive may be required to prevent fuel system icing." That was it. OK. But how cold? It didn't say. Neither did the AFM. So, I went online to look up fuel system icing. There was conflicting information but I found a piece that said dissolved water in AvGas can begin to freeze at -35 C, and that AvGas itself will freeze at around -55 C.



Pulling the 414 out of a 60 F degree hangar into -20 F air (-29 C).

I don't know if a standard lapse rate existed that day, but if it did, the temperature at 10,000' would have been -49 C since it was -29 C on the ground (2 degrees colder per 1,000'). My OAT was reading colder than -30 C.

I didn't have one drop of water in my samples. It wasn't free water in the fuel that was freezing, it was DISSOLVED water at those temperatures. Fuel leaves the fuel tank and goes on top of the engine where the fuel distributor "spider" sends it to each cylinder. Each of these tubes is subjected to the direct ram air into the cowling, in my case colder than -30 C air.

My right engine, and maybe both, was losing power because the dissolved water in the fuel was freezing in the injectors or the fuel lines or both, causing one or more cylinders to be dragging along. This is what caused the heavy shaking, and not a mechanical

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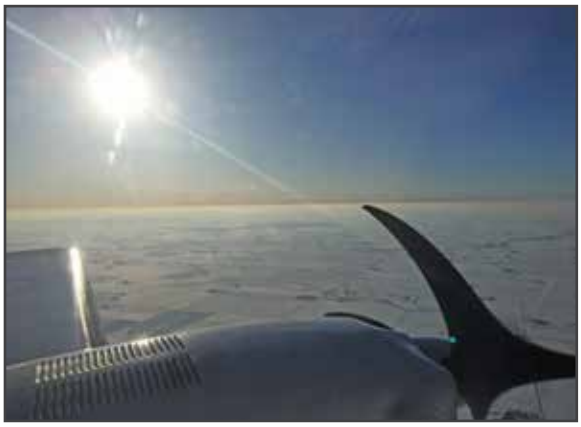

The frozen Indiana landscape after the polar vortex settled in.

problem. Of course, when I descended to 1,000 feet or so, the freezing stopped and the engines began to run smoothly again.

What if I had continued up to FL210? What if I had stayed at 10,000'? How long before one or both engines would have quit completely?

I drove up with my wife a few days later, when it was in the 40s(!), and we flew the plane home without one hiccup. I did have a local mechanic inspect the engines before we left, and he could not find any problems including any cracked cylinders.

A few weeks later I was contacted by the FAA. Mike Brockel with the DuPage FISDO was assigned the incident to find out what had happened. I told him the story, and he called me a few days later with some additional information on fuel icing, specifically Advisory Circular AC 20-113 from October of 1981. I would note that even in the AC it doesn't give exact temperature advice for when to include a fuel additive or how. (Editor's Note: *This AC is available on the Technical page of our website, along with Cessna Service letter ME 73-25 which discusses how to use Isopropyl alcohol to prevent fuel icing. The latter states -29C is the temperature below which fuel icing is a concern.*)

I have several takeaways from the experience. First, I will tell you that if I think it will be colder than -30C at any time during a flight in the future, I will have a fuel additive or I just won't go.

Second, training about flying in extreme cold is rare. There are fewer and fewer turbocharged piston aircraft flying in the flight levels, but this group needs to be aware of the threat.

Third, I think it is important to view ATC and the FAA as an important resource. I didn't know that making a "pan" call would result in a phone call from the FAA, but am very appreciative of Mr. Brockel's efforts to further educate me on the topic of fuel system icing in response.

Lastly, don't ever be afraid to make a "pan" or "mayday" call if you are in trouble. Again, and again, it seems that reluctant pilots get over their head and are afraid to ask for help, sometimes with fatal consequences. I thank the unnamed controller, and Mr. Brockel, for their help!