Personal Risk Considerations

Proficiency, equipment, personal limitations, and the type of operation enter into a very subjective mix.

By Wally Roberts

THE INSTRUMENT RATING IS BY far the most challenging learning aspect for most pilots. I believe professional aerobatic pilots and engineering test pilots face challenges to skills and expertise required of few other pilots. Other than those two arenas of flying, competent instrument flying is the ultimate challenge in powered aircraft flying.

Three different ratings

Although there is but one instrument rating, there are really three very different uses of the rating. The first is for getting through some mild-mannered obscuration to VFR flight, such as a few thousand feet of stratus and, in the case of an approach, with a definite ceiling and 1-2 miles of visibility. The second is full-blown en route operations during adverse weather conditions. The third is low-visibility approach and landing operations, where there is no "breaking out," and prevailing visibility is nil, with RVR near minimums. Some flight operations involve both uses two and three in the same flight, although very low-visibility approach and landing conditions tend to occur far more often in stable atmospheric conditions.

"Makes a better pilot"

I attended a general aviation safety seminar recently where a featured speaker espoused the virtues of the private pilot getting an instrument rating. "It will make you a much better pilot," he said. He added, "You will learn to really mind the store and precisely fly the airplane." I've heard essentially the same words many times over my 40 years in aviation. I've even said them myself.

Precise control of the airplane solely by reference to instruments is only part of being a good instrument pilot. A good instrument pilot also needs to be an expert radio navigator, possess almost mystical insight into the machinations of the ATC system, have good insights into the sometimes abstract concepts of vertical and lateral obstacle clearance, and be an expert reader and interpreter of weather maps, reports, and forecasts. Further, the expert instrument pilot needs to have good situational awareness/resource management skills.

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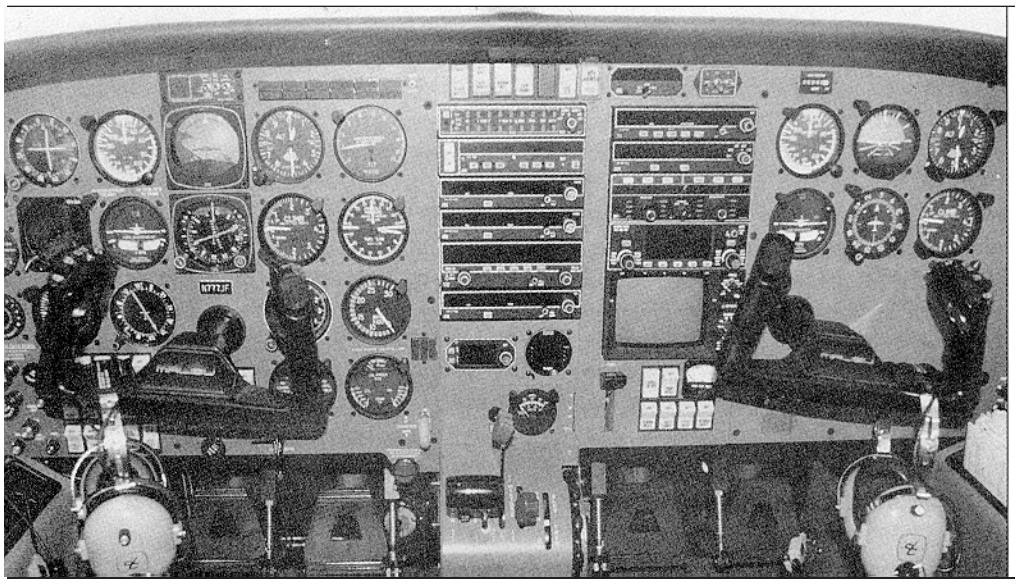
The capable airplane

When I retired from my airline career, I left behind a significant percentage of my ability to routinely tackle full-blown instrument flight operations on the ramp at TWA. The transport category jet aircraft, whether it be an early 1960s technology B-727, 1970s technology L-1011, or 1980s technology B-767, has a common element of capability among those types: the airframe and powerplant combination is designed to carry lots of payload into the jet flight levels, and at Mach numbers around 80-85 percent the speed of sound.

The awesome combination of airframe, powerplants, hot and warm bleed-air pneumatics, electrical, and electronics, combine to yield an aircraft that normally makes in-flight icing conditions of minor concern. Plus, normal jet cruising altitudes are



All tricked out for single-pilot IFR. This Piper Malibu has the King autoflight system, KLN-90B approach-certified GPS, loran, radar altimeter, radar, and Stormscope. (Thanks to Fitzgerald Auto Malls).

well above altitudes conducive to airframe icing (except big thunderstorms, which have a whole bunch of other problems if not avoided). Prolonged exposure to non-convective turbulence can often be avoided by altitude changes of a few thousand, or sometimes, quite a few thousands of feet of altitude.

Piloting such aircraft permits the luxury of not having to be virtually infallible at predicting en route weather conditions. Most of the time, only the weather at the destination airport determines whether the air transport aircraft will be able to approach and land. The en route ice, turbulence, thunderstorms, etc., can usually be avoided all together. Close circumnavigation of thunderstorms can sometimes be a gut-wrenching experience, but it's almost always done without flight into the nasty stuff, provided the pilots mind the store.

I've flown many trips out of Denver in the wintertime where the Rockies were manufacturing ice at astounding rates from the MEA to the mid-20 flight levels. By the time we entered the icing area, our indicated airspeed was 340 knots, and the engine anti-ice systems were on and ready to prevent inlet and compressor ice far beyond anything that nature could produce. The high IAS raised the temperature of the wings and tail surfaces to the point where ice could not form. On just one such flight, a Beech Kingair not more than 20 miles from our position during climb-out lost control at 20,000 feet because of severe icing conditions, and crashed out of control. That hapless pilot did not have the benefit of a jet's ram-rise airspeed nor the ace-in-the-hole of heated wing leading edges.

No big jet

I suppose you may feel by this point I'm saying it's better to walk if you don't have a great big jet. That's not my point at all. My point is the transport category jet has the most capability when it comes to overall IFR operations. But, a B-767 can't be landed out of a non-precision approach to a 2,500-foot runway. A *skillful* pilot of a Cessna 182 can depart MDA much closer to the runway than can the pilot of a B-727, because the 182 can descend much more steeply than the 727, assuming adequate visual cues are present.

The Cessna 182 can do things at non-precision minimums in the hands of a skillful pilot that can't, or shouldn't, be done in a Bonanza. The airline pilots who flew most of their careers in airplanes from the DC-3 to the DC-6, then transitioned to the early B-707s and DC-8s, lamented the loss of flexibility in low-altitude maneuvering close-in to the runway they were accustomed to in the big straight-wing piston birds.

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Money

Money is power. This is especially so with airplanes. (You already know that!) It's even more so with making light airplanes safe IFR machines. Sure, the regs only require a single VOR set, VHF com, and (usually) a transponder to fly IFR. That's fine for a "pop-up" approach to PDQ Airpark's "600 and 1" VOR IAP on a stratus-type Sunday morning. The more serious the IFR operation, however, the more serious the money supply needs to be to keep the safety target where you want it for you and your loved ones.

Not only does the money need to be applied to the equipment, it needs to be applied to the acquisition and constant maintenance of proficiency. Even if the airplane has a flawlessly maintained and operated engine, and a $50,000 avionics suite, it's back to PDQ's fluffy-cloud VOR approach if the pilot isn't as capable as the machine.

Airplane and its engine

Is it inherently unsafe to fly single-engine aircraft in instrument weather conditions? If I thought the answer to that was an unqualified "yes," I wouldn't be writing for *IFR Refresher*.

Let's start with the engine. Piston engines are inherently less reliable than turbine engines. Yet, with meticulous maintenance and *diligent* attention to engine operation on *every* flight the chance that the typical light aircraft engine will fail is very, very remote. How many of us who drive well-maintained automobiles ever have engine or critical accessory failures? On the downside is the typical aging rental aircraft operated by pilots who don't share your concerns or skills.

Another consideration with the light aircraft engine is performance at altitude. Normally aspirated engines are simply inadequate for en route IFR operations much above 8,000 feet. Even though no ice is expected en route, flying in IMC where the MEA is 10,000 feet or higher, with diminishing manifold pressure is cutting at the margins. For most serious en route IFR operations west of Denver, turbocharging is well worth the additional cost.

Avionics

For the most part the light aircraft fleet consists of airplanes that have been around for at least 10 years, and of designs that have been around much longer. However, the avionics technology has improved drastically over the past 20 years. The better avionics of today work great and generally weigh less than the stuff of 20, even 10 years ago.

(A decent airframe with a new engine and avionics is probably a bet-

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ter IFR airplane than when the subject airframe was originally manufactured.)

How would I equip my fantasy turbo-charged Bonanza or Cessna T-210 for full-up IFR ops, when I win the Big Spin?

- It goes without saying, of course, that I would opt for the best panel-mount VOR/LOC-G/S receivers. I would still have two of them, GPS notwithstanding—they are there primarily for the LOC and G/S functions.
- One best panel-mount DME (100 watts) set and two Mode S transponders. (Transponders do fail, and you've got an instant case of the plague with ATC sans transponder.)
- Two VHF com transceivers (separate from the nav receivers).
- IFR en route and approach GPS set, probably King KLN-90B.
- Slaved HSI that could be switched between #1 and 2 VOR/LOC-G/S sets and IFR GPS set.
- Fixed crosspointer display for # 2 VOR/LOC-G/S set.
- Radar altimeter that reads at least 2,000 feet.
- 2-axis autopilot/v-bar flight director with all the options, including altitude pre-select and vertical speed mode. This is a most important piece of equipment for en route single-pilot ops, and would be the best one out there, according to a consensus of the avionics gurus. (Rudder control ala yaw damper makes a three-axis autopilot, and is a good option for some light aircraft.)
- High-end Stormscope.
- Passive TCAS system that is now available for Stormscope display.
- Argus' best color moving map display.
- RMI indicator for both VOR sets, and switchable to active GPS waypoint.
- Standby electric attitude indicator with backup battery (partial panel is fine for practice, but it's flirting with death for real).
- Digital-drum altimeter.
- Second "standby" altimeter.
- Permanent antennas and jacks for handheld GPS and VHF com sets.

This stuff would all be supervised by a high-quality audio selector and intercom system. And you didn't miss it, I wouldn't have an ADF set. At this stage of the game, I could do just fine without a marker beacon set as well.

Going without

What could I do without in the above list and still feel I have the equipment to do the serious IFR task? Well, the first to go would be the passive TCAS. It costs $20,000 alone. Next would be the Argus moving map at almost $9,000. The Mode S transponders could be replaced with Mode C sets. Other than those three items, however, removal of anything else would be sending me back towards "fluffy-cloud Sunday morning" light IFR.

The most important tool for serious single-pilot IFR operations is the capable autopilot.

ILS IAP

Those of you who have followed my articles know I emphasize the use of the full ILS IAP wherever possible. I go so far as to say the first entry into an unfamiliar airport should not be done under IMC unless a full straight-in ILS IAP is used. Even though there is only one of me, I want to see the ILS displayed on the fixed crosspointer as well as the HSI, knowing it displays second LOC and G/S receiver data. The redundancy is invaluable over the long-term for assuring integrity of the ILS flight path.

Radar altimeter

The radar altimeter is an invaluable cross-check as the planet rushes up toward you during that low-vis ILS approach. It's much more useful than that, however, especially if you fly in mountainous areas. The independent confirmation of terrain clearance provided by the radar altimeter during procedure turns, DME arcs, and mountain-laden intermediate and non-precision final approach segments is invaluable. Granted, it doesn't look ahead, but if you're where you're supposed to be it doesn't need to—rather, it helps assure vertical clearance from the rocks when you are in the IAP's troughs. Sometimes altimeter settings are in error, or cold-station altimeter circumstances can eat well into the barometric margins. Skillful use of the radar altimeter can save the day.

Autopilot

The most important tool for serious single-pilot IFR operations is the capable autopilot. This is the most important item for single-pilot cockpit resource management (CRM). A "Mickey Mouse" autopilot just won't cut it. It's got to be able to faithfully fly an unrestricted ILS to 200 feet, or even 100 feet. Altitude pre-select capability not only greatly lessens en route altitude mistakes, it makes autoflight of the non-precision IAP feasible, provided the pilot is practiced and skilled at all aspects of autoflight operations.

I hear the argument about loss of skills by constant use of the autopilot "crutch." To that I say, practice those hand-flown IAPs under the hood with a safety pilot, as well as autoflight approaches. Single-pilot CRM dictates use of the autopilot to relieve workload and increase accuracy and safety during actual IMC operations. Also, good autopilots have to be expertly maintained to remain good autopilots. Avionics shops that don't really understand the matching and calibration requirements for autopilot maintenance often do more harm than good.

Pilot proficiency

Every flight of any length should be flown as if it's an en route IMC day. This is the secret to success for airline crews. Every leg of every flight is done virtually the same, whether it's CAVU or full-up IMC. Granted, visual approaches will replace 200-half ILS approaches on CAVU days, but the overall operation of the flight is little changed from the nasty days. All those hours spent flying en route IFR on nice days count handily to maintaining skills for the bad days. You've got a lot of proficiency "money" in the bank by working ATC, tuning and finessing the avionics suite, and manipulating the autopilot for all those nice-day hours. That, and a couple of hours of hood work every 90 days will do wonders to keep good skills sharply honed.

If you're a low-time pilot, part of the workup to full proficiency is to take a seasoned CFII with you for rainy and low-visibility foggy IAPs. Make sure the CFII is experienced with actual conditions and he/she fully understands your avionics and autoflight system. Otherwise, you'll have the blind leading the blind.

GPS today and in the future

Until precision DGPS comes along and is proven, the ILS IAP will continue to be the first choice for approach and landing under IMC. The standalone GPS IAP should be the second choice, and the overlay GPS IAP will follow. The actual VOR sets are there to verify GPS accuracy until wide area augmentation of GPS arrives. Occasionally, there will be loss of GPS signal. That's another reason to have the VORs and DME ready to be primary nav.

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OROCA awareness

A word of caution: with the capable airplane and turbocharging, the skillful pilot will find himself off airways much of the time. Keep in mind off-route obstruction clearance altitudes (OROCAs), especially when operating in the mountainous parts of the country. You don't want to find yourself below the OROCA when off-route unless ATC has *recently* assured you they're using their minimum instrument altitude (MIA) in your present altitude assignment. Unless you can independently verify the reasonableness of the MIA, think twice about buying into it.

Finally, for non-radar operations, always get back to a Victor airway before dropping below OROCA.

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