# FLYING IFR

FIFTH EDITION


The practical information you need to fly actual IFR flights

RICHARD L. COLLINS

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Aviation Supplies & Academics, Inc.
Newcastle, Washington

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Aviation Supplies & Academics, Inc.
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# Preface
## to the Fifth Edition

This book was originally written in 1978 and has been revised several times since. In revisiting the subject in 2014 I was amazed how much some things have changed and how little other things have changed.

The biggest change has been in the instrument panel. I was recently sitting in the cockpit of a new Cirrus and the sight, first of two big blank screens and then of two colorfully filled screens, made me think back to the panel of the airplane that I was flying when I first wrote this book. By comparison, it was pretty crude. Granted, the old panel provided everything that I needed to fly instruments, but the new panel provides so much more. It also appears to be, and is, more challenging.

How much more information is on the new panel directly relates to a thought I have always had on the subject at hand: all instrument flying is IFR flying but not all IFR flying is instrument flying. If you look at flight tracking software on a good VFR day there are a lot of general aviation aircraft in the IFR system. On a scuzzy day there are far fewer GA airplanes out there working the system.

This rather defines the task. The written test and flight training concentrate mainly on IFR flying. The rules have to be learned, the charts have to be read whether electronically or on old-fashioned paper, and the theory and mechanics of this type flying have to be explored.

The finery on the instrument panel is what the pilot uses to operate in the air traffic control system and to gather information about weather, terrain and other traffic. It also contains the information that pilots of old got from the "six-pack" of mechanical instruments. It is mainly a more cohesive presentation of information but it is also a lot prettier.

Because no cloud-flying is required to get an instrument rating, a pilot might have no real experience when first rated. Thus it will take a while to become a true instrument pilot and use all the good stuff in actual weather.

I would be the last person to knock test prep courses because I have worked on them and always tried to add a little realism here and there. But the fact is the pilots who buy test prep courses do so with but one goal: to pass the knowledge test.

I did not write this book to help pilots get an instrument rating. No effort was made to cover everything on the instrument and flight test. It was written to help pilots learn to use an instrument rating with as little risk as possible, whether flying with the latest equipment or with basic old equipment.

I started instrument flying early, in the 1950s and experienced much of what is out there. I have always shared this with other pilots in magazine article, books and video productions. I have also tried to share my enthusiasm about the pleasure that can be found in well-flown flights and the true utility that can be found when using personal airplanes to move about the country. I have also tried to share my interest in weather as it applies to our flying. I have always thought that a pilot can best learn about weather while poking around inside clouds and fronts and low-pressure systems. Success at actual instrument flying is found both in controlling and navigating the airplane and in knowing everything about what is affecting the airplane and the conditions around and ahead of it.

There is no freedom quite like that found in personal aviation, whether you use it for business or pleasure. I'll share a simplistic thought on how to succeed: always know where you are, where you are going, and how well you as a pilot are performing.

I wish you good flying and a lot of it.

Richard L. Collins

# ONE
# The Foundation

One of the primary tasks in instrument flying is to get priorities straight in your mind. I observed a good example of this one day as I followed another airplane on an ILS approach in VFR conditions. The pilot ahead was having a terrible time—swooping, dipping, and making what appeared to be rather mad lunges at the ILS course with his airplane. Clearly, this pilot had no business practicing ILS approaches. The effort was purely wasteful—he had the cart before the horse. From two miles behind, it was plain to see that the pilot didn't have a strong capability at basic instrument flying. He could not assimilate the data on the panel, he could not hold a heading, and he could not maintain a constant rate of descent. These problems are rather common; in these modern times, it is easy to forget the basics as we rush headlong into flight that seems related more to vast arrays of talented computers than to one person and one machine. Regardless of an airplane's sophistication, the basic ability to fly the airplane is first in importance. If you can't fly the airplane solely by reference to instruments, with a measure of precision and confidence, there is no way to utilize all the electronic wonders. Basic instrument flying is as important today as it was to Charles Lindbergh in 1927. It is top priority.

Many years ago, when the Aztec first came out, I had one around to fly for a few days. The first order of business was some simulated instrument flying under the hood, and the first thing I did was fly a VOR approach. The airplane didn't seem to want to come down quickly enough, so I put some flaps out when passing the station on the way to the airport. That was okay. On the missed approach, though, everything went wrong at the same time. I retracted the gear and then put the flap selector in the

Up position. The nose on the early Aztecs becomes very heavy when the flaps are retracted; this is the reverse of what you usually find in a low-wing airplane, and it wasn't what I expected. Between reaching for the trim, pulling on the wheel, and wondering what in the devil was going on, I neglected the basic art of flying for a moment. The airplane began to go its own way. The safety pilot suggested I look up and fly visually to get things under control. It was embarrassing.

### Lessons

The incident yielded more than one lesson. There was a clear message about learning something about a particular airplane before operating it on instruments. Delve into basics about trim changes with gear and flap retraction and extension, learn power settings for various phases of flight, and study the machine and its operating handbook, including all the supplements that cover items like the autopilot, for things that are different or less than obvious. I certainly should not have chosen a simulated instrument approach as the first chore in the airplane when flying it under the hood. Instead, I should have flown it around for a bit, developing a relationship between my mind, my hand, and the airplane's characteristics. Every pilot/airplane relationship starts out with the pilot a stranger to the machine, almost in the role of a passenger in the left front seat, and it evolves to the point where the pilot almost becomes a part of the machine. With the Aztec, I skipped the introduction and tried immediately to develop a complex relationship. The most important lesson is to heed messages from any such evidences of problems with basic instrument flying. Be a perfectionist about it. If you can't do an excellent job under the hood, the situation is surely not going to get any better in cloud.

A license to fly instruments is proof only that the pilot was capable on the day the license was obtained. After that, it is up to the pilot to stay current. When some weakness shows up in practice (or actual) instrument flying, don't pass it off with the thought that it couldn't have been too bad "because I made it." If the flying isn't something to be proud of, take it as a mandate to practice and polish basic instrument flying.

### Two Ways

I think that we fly an airplane by reference to instruments in two distinctly separate ways. One way is natural, the other is purely mechanical. It is important to identify and use both methods to maximum advantage.

You have probably observed what might be called a "natural pilot" at one time or another—someone who flies seemingly without effort. When VFR, little time is spent looking at the panel, yet the altimeter stays glued and the nav needles dead-centered. It's the same IFR. This is done with a keen awareness of the attitude of the airplane. In smooth air, if the nose is kept "right there" and the power is correct, the altitude of the airplane will not change. If the wings are kept level, with the ball in the center, the heading will not change. It is a relaxed way to fly, a result of the ability to perceive and respond without conscious, mechanical mental effort. In VFR conditions, the view out front and to the sides combines with the sound and feel of the airplane to tell the pilot what is happening. In IFR conditions, the expanse of the view outside is compressed into the artificial horizon. The information is there, and the sound and the readings of all the other instruments in the airplane verify that things are going well. The instrument cross-check, or scan, is spoken of with reverence, but the natural pilot might not think in terms of a scan. The ability is in absorbing the big picture, in using all the human senses to fly the airplane.

### Alert

This isn't to say that the natural pilot does not scan the panel. If asked for the oil pressure, the response might come in an instant. If a generator or vacuum pump were to fail, the pilot would catch it through the instrument indication in seconds. The pilot is simply able to operate with a single-mindedness of purpose, thinking of nothing but flying the airplane, and gathering all the data on the instrument panel in a relaxed and informal manner.

### Mechanical

The instrument pilot flying mechanically might be the same person who was just (moments earlier) flying naturally, but on a different flight or a different portion of the same flight. There simply comes a time when it is necessary to fly with absolute procedural discipline. In the beginning of that early Aztec flight, I was probably flying the airplane rather naturally. I was moving along well and seeing everything. I was relaxed. Things were fine. Then, when the flaps were retracted, my mind jumped track. Instead of seeing everything, I saw nothing. I only wondered about the unexpected trim change. I did not make the required transition from natural to mechanical flying when a problem made this necessary.

At the first sign of something unusual, the clear call was for absolute attention to basic instrument flying. I should have disciplined myself to base eye and thought on the artificial horizon, and to put the airplane in a wings-level climb attitude regardless of the pitch forces required. Then I should have activated a mechanical and methodical check of the other instruments. Airspeed on the proper value. Altimeter indicating climb. Heading steady. Turn needle (or turn coordinator) steady and straight. Vertical speed indicating rate of climb. Discipline. Once that mechanical process was in place and working, I could have expanded to include missed approach procedures and navigational chores, and perhaps I could have allowed myself three seconds to ponder the reason for a trim change with flap retraction.

Some pilots never feel they have reached the point where they are flying instruments in a natural manner. There's nothing wrong with that. The mechanical way works just as well, and remember, the person who does it naturally much of the time still has to revert to mechanical means at certain times. And if you miss the cue, things are bound to get worse before they get better.

### From the Start

The beginning of an instrument flight is a time when almost all pilots fly mechanically and when the ability to concentrate on the basics is extremely important. An instrument pilot who flies infrequently might get the first dose of actual IFR as a climbing and accelerating airplane punches into the bottom of bumpy clouds. The key here is in concentrating only on flying the airplane until you are comfortable with it. A special consideration in the initial climb can be used to outline a couple of techniques.

The artificial horizon may not appear quite normal in the first phase of a climb. The depiction of nose-up attitude is accentuated by an acceleration error that makes the attitude appear more pronounced than it really is. The nose-up attitude in a Cherokee might, for a few moments, look more like what you would expect to see in a jet. A pilot might misinterpret this, lower the nose, and fly back into the ground if the indications of other instruments are not included in the deliberations. The period of initial climb into clouds is a demanding time, and a pilot must use everything available to verify that the flight is going well: pitch attitude set, wings level, positive rate of climb, airspeed correct, turn indicator correct.

First technique: A pilot can and should watch instruments during noncritical times VFR and relate the picture on the panel to the view out the windshield. As a result, any acceleration error in the artificial horizon, for example, will be a known quantity, and the pilot will know the indication when the pitch attitude is correct. That is what instrument flying is all about—knowing what it would look like if all the clouds went away.

Second technique: It is in the climb that we first put to the test the ability to look at the correct things at the proper time, get the message, and make the necessary control movements. What do we look at, and how do we demand proper performance? To begin, base on the artificial horizon, just as you would fly the correct attitude by referring to the real horizon in VFR conditions. Then grade the attitude being flown with a scan of the other instruments. When you are flying a standard instrument arrangement, a glance to the left will reveal that the airspeed is steady on the proper value; a glance to the right will show that the altimeter is moving upward. A glance down shows that the heading is steady on runway heading. The turn-and-bank or turn coordinator will verify that the airplane is indeed not turning, and the vertical speed is double verification that it is climbing.

### Attitude

On the artificial horizon, the emphasis is on attitude. It is home base for the eyes, with the scan of the other instruments verifying that the selected attitude is producing the desired results. In the case of initial climb, the desired result is climbing while flying at a predetermined airspeed. But we still use the artificial horizon as a primary reference because it tells us about bank and pitch attitude simultaneously. No other instrument on the panel does that.

### Scan

In these first moments of instrument flight, we must come to grips with some method of scanning the instrument panel. Some call it a "cross-check," a term borrowed from the military. When I worked at an Air Force contract school, much emphasis was placed on cross-checking. The emphasis was good, but nobody ever explained *how* it is done. The military did teach in terms of primary and supporting instruments—to put emphasis on the most important things at various times of flight, but there was no explanation of how much time should be spent with

each instrument. In fact, the Air Force manual stated: "It has long been known that pilots do not use any specific method of cross-checking, but that they do use the instruments which give the best information for controlling the aircraft in any given maneuver. Most of the pilot's attention is devoted to checking these important instruments." That's rather like saying most pilots don't plan a takeoff run longer than the available runway. The FAA is no more specific in reference to scanning, by stating, "There are no set rules and no single method"—all of which leaves the reader wondering what the devil to look at and how much time to spend on it.

### Experience

My experience has been, when flying instruments in smooth air, that I basically look at one thing—the most important thing (often it is the artificial horizon)—and check the rest with peripheral vision and furtive glances. Once a normal climb is established, I'm likely to look solely at the artificial horizon and satisfy the requirement of scanning with peripheral vision. The airspeed needle, on a correct value, can be seen out of the left corner of the eye; the altimeter reading, out of the right corner, is okay if it is increasing. I can see that the vertical speed is on a positive value, and the turn coordinator is visible to the lower left. At first I don't worry much about a precise heading. If the wings are level, it will remain close. The primary thing in my mind is establishing myself at the chore of flying instruments. The task is controlling the attitude of the airplane. This is done by looking at the artificial horizon. If a rate instrument suggests the need for a change in attitude, that change is made while I am looking at the artificial horizon. In short, I don't try to control the rate instruments directly.

### Second Things Second

The initial IFR clearance often includes instructions to turn to a heading after takeoff and to contact departure control. The pilot must take first things first, though, and use the first minute of the climb in instrument conditions to make friends with the airplane, to settle in with the task, and to defeat any onset of spatial disorientation. If this isn't done, success is impossible. Once it is done, call departure control and then turn to the assigned heading.

As we progress through a flight, flying becomes easier. The airplane is more familiar, and if the flight remains in cloud for an extended period of time, the clouds and the water streaking back along the windows

become friendlier. It is at this time that almost every instrument pilot lapses into more natural flying. Ease the seat back a notch and absorb all the messages from the panel. You can learn as you fly along, too, by monitoring what you look at and, if the results are good, storing this for future reference. For example, you'll note that peripheral vision works well so long as the air is smooth, but becomes more difficult to use when you're passing through turbulence. You just don't get a clear message out of the corner of an eye when the airplane is jiggling around. The call is for more glances to the other instruments, to verify that the attitude selected on the artificial horizon is doing the job.

You'll notice changes in pattern, too. For example, during a descent in smooth air, I noted that I was looking primarily at the heading indicator. The controller had assigned a heading, and that heading was occupying my attention. So long as it remained steady, I knew the wings were level. Peripheral vision verified this with the artificial horizon. I was descending to an altitude, and an occasional glance at the altimeter gave the progress on that. The airspeed was easy to interpret with peripheral vision because the needle was close to the top of the green sector on the indicator.

### Hand-Fly

You can't learn much about basic instrument flying with the autopilot doing the work, so hand-fly the airplane when in cloud. This is a fine time to practice precision instrument flying. Hold the heading and altitude precisely. Keep the navigation needles centered. Work at the division of time between instrument flying and chores such as frequency changes, consulting charts, and writing down revised clearances. Fly it perfectly for thirty minutes or an hour, and then turn on the autopilot if you wish. Begin by earning the rest.

### Basic Maneuvers

The various elements of the basic flying tasks are things that can and should be practiced. There is really nothing to instrument flying other than climbs, climbing turns, level flight, level turns, descents, and descending turns. Those are the things to work on until they are well in hand. The rest is pointless until you can fly with precision. Grade every flight, and work at the basics methodically.

### Touch

Control touch is an important part of instrument flying. For a demonstration, trim the airplane, release the controls, and then "don't touch" except as necessary to correct an instrument reading. Touch with only one finger. Nothing is likely to get far off, and you'll soon see that you could fly all the way across the country using just one finger. The airplane requires very little "flying"; it is more a matter of a pound of pressure here and a pound of pressure there—at the correct time. Contrast this with the oft-noted jut of a pilot's jaw when heading into instrument conditions. Some pilots look as if they face an instrument *fight* instead of an instrument *flight*. Back to our pilot who was having trouble with the ILS: from another airplane, it was obvious that he was making abrupt and gross corrections—and that he was fighting with his airplane.

### Fixation

Mental and visual fixation is an acknowledged scuttler of instrument pilots. Building a guard against this is part of the basic art of flying. It is often tempting to hang on one instrument—to stare. If the airplane is a hundred feet low, a pilot might look at the altimeter, add a bit of back pressure, and wait for the altitude to come up a hundred feet. All the while, the bank attitude of the airplane might be going to pot. The correct way to fly is to note the excursions and trends of instruments and then use the artificial horizon to change the attitude of the airplane in a manner that will nudge any wayward instruments toward a proper value. Don't move a control without consulting the artificial horizon, and keep an eye on the horizon during the control input. Then check results on the other instruments. This keeps the eye and mind active. It does the job.

Fixation can take many forms. We can, for example, lapse into daydreaming. The eyes are on the instruments but the brain is on the note at the bank. Or, in time of trouble, the mind might be virtually paralyzed by a problem such as turbulence or mechanical malfunction. I've found that the best cure for fixation is a thorough tongue lashing. I speak to myself frequently at such times, and rather sternly. The admonition is usually to settle down and fly the airplane. The reward offered is that all bad things will pass if the airplane is flown properly.

### Power Vs. Elevator

Power is a flight control that we use in basic instrument flying. The use of power is both very important and very simple. In a basic airplane, you really only need five settings to cover most of the things that are done, but you need to memorize them so that power can be quickly set for what you want to do. Then attention can go to the proper pitch attitude. The basic power settings are: climb, normal cruise, cruise in turbulence (maneuvering speed), normal descent, and descent in turbulence. In faster airplanes and retractables, a few more settings are needed for instrument approaches. They would be for level maneuvering or holding at reduced speed, and for final approach descents with the wheels down, in the case of the retractable.

One additional thing must be considered in relation to power. There has long been disagreement about whether power controls airspeed or altitude. The same argument is applied to the elevator control. Hopefully the instrument pilot is too savvy to fall victim to an argument on this score.

In certain situations, it is best to think of power as a primary influence on altitude, and in other situations, it is best to think of the elevator as a primary influence on altitude. For example, if you are flying level at 120 knots and the time comes to start down, you don't want to think of the elevator as the control to use. Power would be the thing then. Reduce the power to begin the descent and maintain the airspeed with the elevator. By the same token, if you're running just a tad high on the glideslope, lowering the nose a hair would be a perfectly acceptable way to make that altitude correction. Or you could back off the power a bit. Anyone who would argue with either would be nitpicking. The business about what controls what is critical only when the airplane is being flown near some extreme. Extremes are unnecessary in light airplane instrument flying and should be avoided. Just for the record, though, remember that in low-speed situations where the chips are down, using the elevator to control airspeed is what will save your tail.

### Self-Taught

One recurring thought about the basics of instrument flying is that they are not things that anyone can teach a pilot; they are things the pilot must learn through experimentation and experience. No instructor can tell exactly where you are experiencing a touch of disorientation or when there is fixation on some instrument or subject. The pilot must practice

enough to work these things out and to determine where the eyes need to look at given times. What an instructor can do is give you helpful hints, such as recommending fifteen inches of manifold pressure here and thirteen inches there, but even that must be subjected to a measure of self-discovery. The instructor also can critique your basic instrument flying, but if you can be objective, you can do an even better job there; only you know where your mind and eyes were when a mistake was made. If you don't know what you were thinking about or looking at when something went wrong, then your mind was apparently in gridlock. That means work must be done before basic instrument flying can be successful. The thinking process must be developed. The instructor can always pinpoint the result; only the pilot knows the cause.


# FLYING IFR
## BY RICHARD L. COLLINS

Richard Collins shares invaluable discussions on instrument airmanship, weather analysis, flight planning and decision making, handling equipment glitches, and that critical survival skill – partial panel flying. This fifth edition covers all aspects of modern IFR flying, including:

- Perfecting basic attitude instrument flight.
- Light airplane operation in the middle to high altitudes beginning at 18,000 feet.
- IFR flight in and around ice, thunderstorms, and at night.
- Best-practices in new, modern glass cockpits.
- Managing stress.

The only tests for which *Flying IFR* prepares the reader for are the ones encountered on actual IFR flights. Where the initial instrument checkride leaves off with the applicant receiving a "dry" instrument ticket, this book provides the information necessary to "get it wet."

**RICHARD COLLINS** has spent his life in aviation, logging 20,000 hours in almost every aircraft type. A former editor-in-chief of both *Flying* and *AOPA PILOT* magazines, he has written over 900 articles and 12 books for pilots plus many video productions. Collins has won many aviation awards and continues to do extensive research in the field of aviation safety. He is currently Editor Emeritus of *Air Facts*, an online journal, and editorial consultant to Sporty's Academy.

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7005 132nd Place SE
Newcastle, Washington 98059
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