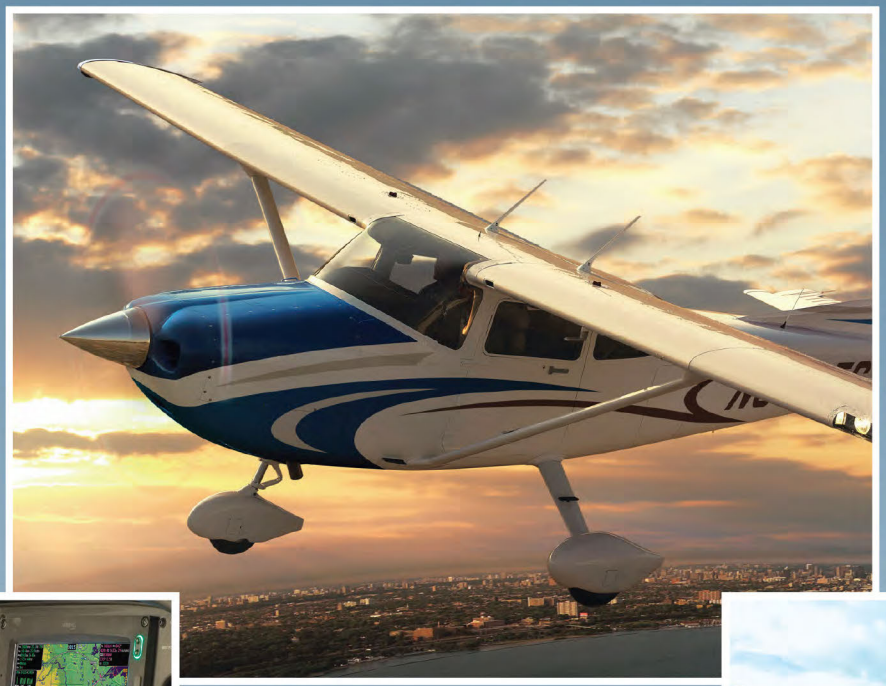
The Pilot's Manual PM 3

Instrument Flying

All the aeronautical knowledge required to pass the FAA exams, IFR checkride, and operate as an Instrument-Rated pilot

Seventh Edition



Foreword by Barry Schiff

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Aviation Supplies & Academics, Inc.
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The Pilot's Manual Volume 3: Instrument Flying

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Foreword

When it was time to take my private pilot written examination in 1955, my flight instructor handed me a pocket-size booklet. It was published by the Civil Aeronautics Administration (FAA's predecessor) and contained 200 true/false questions (including answers).

"Study these well," he cautioned with a wink, "because the test consists of 50 of these."

As I flipped through the dozen or so pages, my anxiety about the pending examination dissolved into relief. Nothing could be easier, I thought. One question, for example, stated "True or False: It is dangerous to fly through a thunderstorm." Really. (I passed the test with flying colors—but so did everyone else in those days.)

The modern pilot, however, must know a great deal more to hurdle today's more-challenging examinations. This has resulted in a crop of books developed specifically to help pilots pass tests. Unfortunately, some do little else, and the student's education remains incomplete.

An exciting exception is *The Pilot's Manual* series. These voluminous manuals provide far in excess of that needed to pass examinations. They are also chock-full of practical advice and techniques that are as useful to experienced pilots as they are to students.

The *Pilot's Manuals* are a refreshingly creative and clever approach that simplifies and adds spice to what often are regarded as academically dry subjects. Reading these books is like sitting with an experienced flight instructor who senses when you might be having difficulty with a subject and patiently continues teaching until confident that you understand.

Barry Schiff
Los Angeles

Barry Schiff has over 27,000 hours in more than 320 types of aircraft. He is retired from Trans World Airlines, where he flew everything from the Lockheed Constellation to the Boeing 747 and was a check captain on the Boeing 767. He has earned every FAA category and class rating (except airship) and every possible instructor's rating. He has received numerous honors for his contributions to aviation. An award-winning journalist and author, he is well known to flying audiences for his many articles published in some 100 aviation periodicals, notably *AOPA Pilot*, of which he is a contributing editor, and ASA publishes several of his books.

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Introduction

An instrument-rated pilot is a complete pilot. The instrument rating allows you to employ your airplane without unnecessary restrictions. Day, night, clouds, and rain become part of the territory. Of course, you will still avoid thunderstorms, icing, severe turbulence, and microbursts.

Instrument flight is the ultimate goal of the professional—and I mean "professional" with regard to attitude, not employment. To file and fly IFR within precise limits and with an in-depth awareness of the regulations, procedures, and protocols of flight makes you an accomplished pilot—not a hobbyist, but a competent, fully trained pilot.

Instrument flight is not difficult; it just requires more attention—more attention to detail and more concentrated effort to keep abreast of the situation, to make decisions, and to maintain accuracy while monitoring and managing the airplane's systems and controlling its attitude and position in space.

Instrument flight is an extension of visual flight. The principles are no different:

Attitude + power + configuration = performance (flight path and speed).

The same control equation applies, but many forget and try to fly the performance instruments. Remember: these instruments lag. They tell you what has changed after it has changed. The pilot is ahead if he or she controls the three key parameters and lets the performance fall into place. They will.

Also, in turbulence, downdrafts, and restricted visibility, the importance of controlled, accurate attitude cannot be overemphasized.

Eventually, you will reach a standard where the accuracy is there and the workload is low—you can let your personal built-in autopilot fly the airplane, and your conscious mind can observe, decide, act, and oversee the flight.

The other key to successful IFR flight is planning and preparation. Having the whole flight preplanned and pre-considered makes the in-flight workload manageable. Have the cockpit organized, the paperwork together and ordered, and the escape routes clear in your mind for each stage and possible/probable eventuality. Make sure you and your airplane are ready and equipped for IFR. Fly regularly with a check pilot, and keep yourself current with the aids and approaches that are available to you. If your airplane does not have a standby attitude indicator, you must practice partial-panel flight.

These considerations are the hallmarks of the professional—and we can be just as professional about our flying, even in our little singles and twins.

Welcome to the wonderful world of instrument flight.

David Robson

Attitude Flight

Introduction to Instrument Flight

1

Air travel becomes much more reliable when airplane operations are not restricted by poor weather or by darkness. Greater reliability can be achieved with a suitably equipped airplane and a pilot skilled in instrument flying.

The instrument-qualified pilot and the instrument-equipped airplane must be able to cope with flying in restricted visibility, such as in cloud, mist, smog, rain, snow, or at night, all of which may make the natural horizon and ground features difficult, or even impossible, to see.

As an instrument pilot, you must learn to trust what you see on the instruments. We generally use vision to orient ourselves with our surroundings, supported by other gravity-perceiving bodily senses, such as feel and balance. Even with the eyes closed, however, we can usually manage to sit, stand and walk on steady ground without losing control. This becomes much more difficult standing on the tray of an accelerating or turning truck, or even in an accelerating elevator.

In an airplane, which can accelerate in three dimensions, the task becomes almost impossible unless you have the use of your eyes.

The eyes must gather information from the external ground features, including the horizon; or, in poor visibility, they gather substitute information from the instruments.

Figure 1-1
Control and performance.

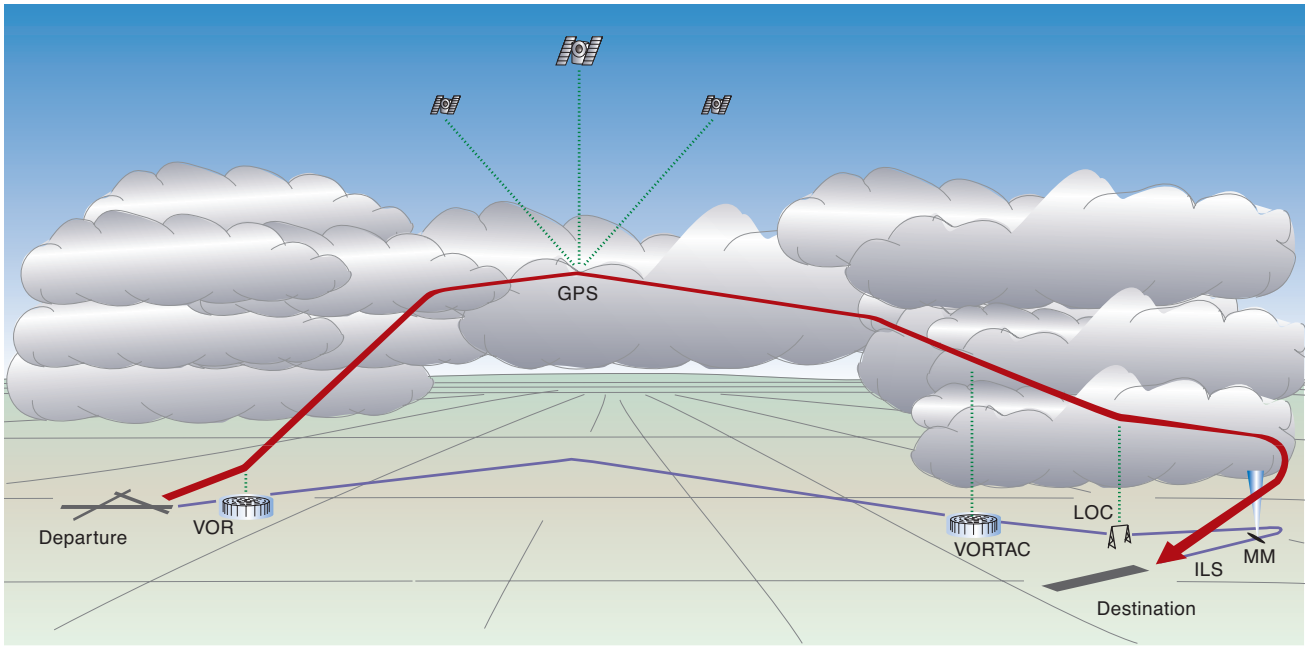

Figure 1-2 A typical flight on instruments.

Figure 1-3
The eyes and the instruments.

A pilot's eyes are very important, and the starting point in your instrument training will be learning to use your eyes to derive information from the instruments in the most efficient way. You will learn various scan patterns that gather the most relevant data for your particular flight maneuver. You will learn the three skills fundamental to instrument flight. These include how to scan the instruments (or, the instrument cross-check), understand their message (instrument interpretation), and be able to direct the airplane along the desired flight path in *instrument meteorological conditions* (IMC) (i.e., airplane control).

The Cockpit and Radio

Make Yourself Comfortable in the Cockpit

Instrument flying is much easier if you are comfortable in the cockpit and know your airplane well. Adjust the seat position prior to flight to ensure that you can reach all of the controls easily, and so that you have the correct eye position. The view from the cockpit window must be familiar when you break out of the clouds at a low altitude, following a successful instrument approach, and see the rapidly approaching runway. A correct eye position will make the ensuing landing, possibly in poor visibility, so much easier.

A Good Communications System Is Essential

Ensure that the radio communications equipment in the airplane is both adequate and fully serviceable. This is of great importance. One of your main responsibilities as an instrument pilot is to remain in communication with ATC. Under IMC, you will not be able to see other aircraft, nor will they be able to see you, hence the visual safety rule of "see and be seen" will not apply.

In instrument meteorological conditions (IMC), "see and be seen" does not apply. Communications equipment is essential.

The separation of aircraft in IMC is achieved by each pilot flying along a known route at a known altitude at known times, with ATC, in cooperation with the pilots, ensuring that there are no conflicting flight paths. Good communications are therefore essential. On the rare occasions when a radio or electrical system fails, special procedures outlined in the regulation (14 CFR 91.185) will minimize risk.

During your instrument training, there will be a fair amount of talking in the cockpit. Your instructor will be explaining things to you, and offering words of encouragement as you perform the various maneuvers.

If this cockpit communication has to be done by shouting over the engine and air noise, as it was in days past, then a lot of totally unnecessary stress will be introduced into the cockpit. A good intercom system will make life a lot easier for you and for your instructor, and will save you time and money. Speak with your instructor about this.

Attitude Flying and Applied Instrument Flying

The first step in becoming an instrument pilot is to become competent at *attitude flying* on the full panel containing the six basic flight instruments. The term attitude flying means using a combination of engine power and airplane attitude to achieve the required performance in terms of flight path and airspeed.

Attitude flying on instruments is an extension of visual flying.

Attitude flying on instruments is an extension of visual flying, with your attention gradually shifting from external visual cues to the instrument indications in the cockpit, until you are able to fly accurately on instruments alone.

Partial panel attitude instrument flying, also known as limited panel, will be introduced fairly early in your training. For this exercise, the main control instrument, the attitude indicator, is assumed to have malfunctioned and is not available for use. The heading indicator, often powered from the same source as the AI, may also be unavailable.

Partial panel training will probably be practiced concurrently with full panel training, so that the exercise does not assume an importance out of proportion to its difficulty. You will perform the same basic flight maneuvers, but on a reduced number of instruments. The partial panel exercise will increase your instrument flying competence, as well as your confidence.

An excessively high or low nose attitude, or an extreme bank angle, is known as an *unusual attitude*. Unusual attitudes should never occur inadvertently but can result from distractions or a visual illusion. Practice in recovering from them, however, will increase both your confidence and your overall proficiency. This exercise will be practiced on both a full panel and a partial panel.

After you have achieved a satisfactory standard in attitude flying, on both a full panel and a partial panel, your instrument flying skills will be applied to en route flights using navigation aids (NAVAIDs) and radar.

Figure 1-4 The full panel (left) and the partial panel (right).

Procedural instrument flying (which means getting from one place to another) is based mainly on knowing where the airplane is in relation to a particular ground transmitter (known as orientation), and then accurately tracking *to* or *from* the ground station. Tracking is simply attitude flying, plus a wind correction angle to allow for drift.

Typical NAVAIDs used are the ADF, VOR, DME and ILS, as well as ground-based radar. In many ways, en route navigation is easier using the navigation instruments than it is by visual means. It is also more precise.

Having navigated the airplane on instruments to a destination, you must consider your approach. If instrument conditions exist, an *instrument approach* must be made.

If you encounter visual conditions, you may continue with the instrument approach or, with ATC authorization, shorten the flight path by flying a visual approach or a contact approach. This allows you to proceed visually to a sighted runway.

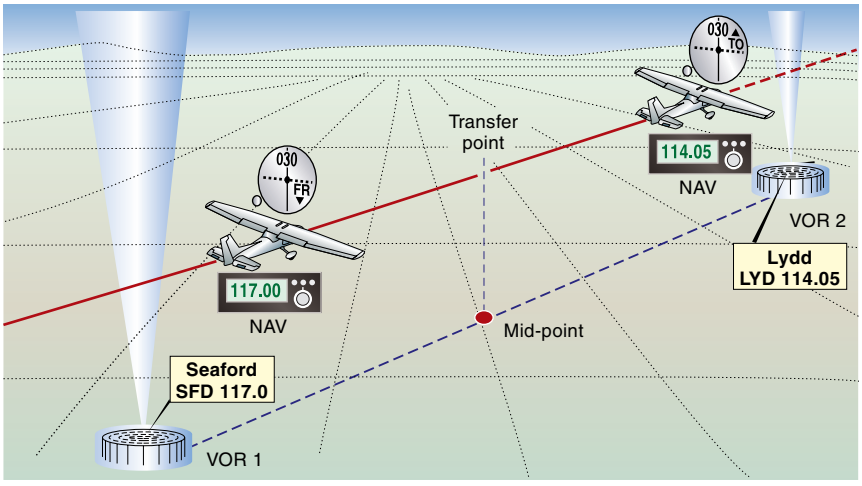

Figure 1-5 En route tracking on instruments.

Only published instrument approach procedures may be followed, with charts commonly used in the United States available from the FAA or Jeppesen. An instrument approach usually involves positioning the airplane over (or near) a ground station or a radio fix, and then using precise attitude flying to descend along the published flight path at a suitable airspeed.

If visual conditions are encountered on the instrument approach at or before a predetermined minimum altitude is reached, then the airplane may be maneuvered for a landing. If visual conditions are not met at or before this minimum altitude, execute a missed approach. Once established on the missed approach you may request another approach, hold and wait for weather to improve, or divert to an alternate airport.

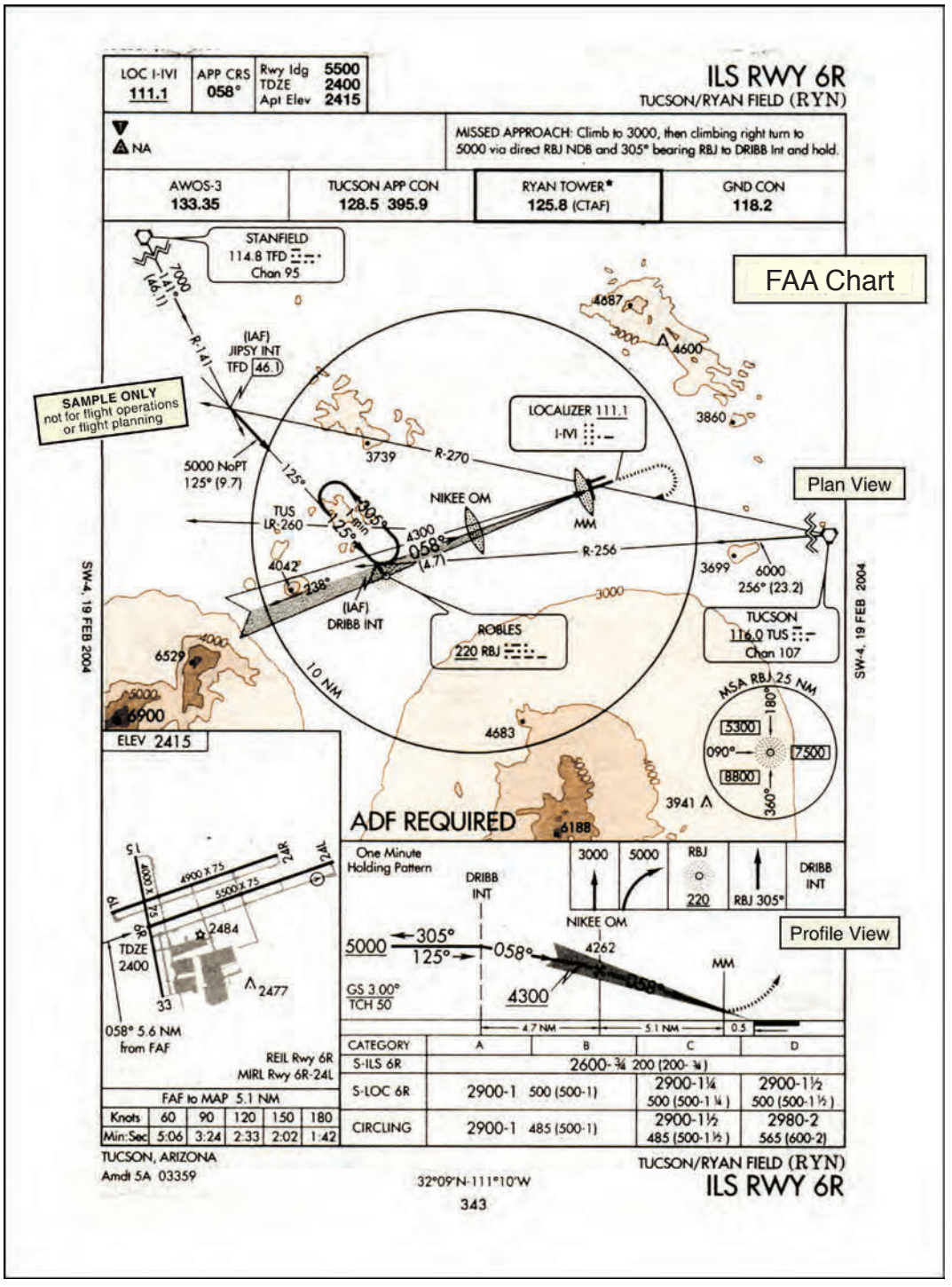

Figure 1-6 Plan and profile views of a precision instrument approach (FAA chart).

The Airplane and the Ground Trainer

Practice attitude instrument flying and procedures in a simulator or ground trainer first.

A simulator, ground trainer, or *basic aviation training device* (BATD) is an extremely valuable training aid for practicing both attitude flying and instrument procedures. It is a great time-saver. It allows certain maneuvers (for instance, climbing turns at 5,000 feet) to be practiced without having to preflight check an actual airplane, then taxi out, wait in the queue, takeoff and climb for ten minutes, and so on. It is not dependent on weather—adverse weather conditions will not stop your practice. It allows easy conversation between student and instructor without the distraction of engine noise or radio calls. Time can be frozen, while the instructor discusses points of detail before the exercise continues.

Maneuvers can be repeated without delay and without interruption. Instrument procedures, such as an ILS approach to busy JFK International Airport in New York, can be practiced repeatedly in the simulator—a situation probably not possible in a real airplane because of the heavy traffic in the New York area. Also, procedures at any airport that you are about to visit for the first time, or that you might have to divert to, can be practiced beforehand—very useful, and a great confidence builder when you are about to proceed into unfamiliar territory.

The fact that most ground trainers do not move, and experience only the normal earth-bound 1g gravity force, is not really a disadvantage for instrument training, since one of the aims of this training is to develop the ability to interpret the instruments using your eyes, and to disregard the other senses.

The ground trainer is also less expensive to operate than an airplane. This, and the many other advantages, make it an extremely valuable aid. But, it is still not an airplane!

Figure 1-7 The BATD (left) and the airplane (right).

Instrument flying in the airplane is the real thing! It is important psychologically to feel confident about your instrument flying ability in an actual airplane, so in-flight training is important. There will be more noise, more distractions, more duties and differing body sensations in the airplane. G-forces resulting from maneuvering will be experienced, as will turbulence, and these may serve to upset the inner senses. Despite the differences, however, the ground trainer can be used very successfully to prepare you for the real thing. Practice in it often to improve your instrument skills. Time in the real airplane can then be used more efficiently.

Attitude Instrument Flying

Power plus attitude equals performance.

The performance of an airplane in terms of flight path and airspeed is determined by a combination of the power set and the attitude selected. Airplane attitude has two aspects—pitch and bank, that is, nose position against the horizon, and bank angle. *Pitch attitude* is the angle between the longitudinal axis of the aircraft and the horizon. *Bank attitude* is the angle between the lateral axis of the airplane and the horizon.

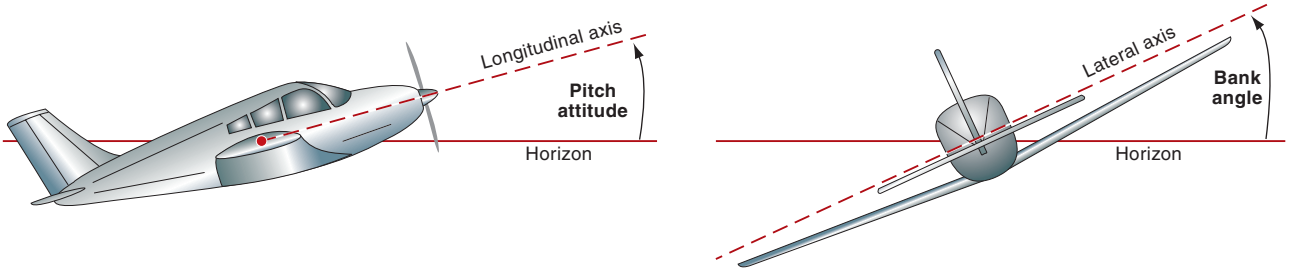

Figure 1-8 Pitch attitude (left) and bank attitude (right).

For a given airplane weight and configuration, a particular attitude combined with a particular power setting will always result in a similar flight path through the air, be it a straight-and-level flight path, a climb, a descent or a turn. Any change of power and/or attitude will result in a change of flight path and/or airspeed.

The pilot selects pitch attitude using the elevator. In visual conditions, you refer to the external natural horizon. At any time (in cloud, at night, or in visual conditions) you can select a specific pitch attitude with reference to the *attitude indicator* (AI) on the instrument panel. In visual flight, the pitch attitude can be estimated from the position of the natural horizon in the windshield. In instrument flight, pitch attitude is selected with reference to the AI, using the position of the center dot of the wing bars relative to the horizon bar. The center dot represents the nose of the airplane.

The pilot selects bank attitude (bank angle) using the ailerons. In visual conditions, you refer to the angle made by the external natural horizon in the windshield. On instruments, you select bank angle on the attitude indicator, either by estimating the

Figure 1-9
Slightly low pitch attitude and wings level.

Figure 1-10
Nose-high pitch attitude and right bank.

angle between the wingbars of the miniature airplane and the horizon bar, or from the sky pointer (or bank pointer) position on a graduated scale at the top of the AI.

Check the attitude indicator every few seconds.

Most of your attention during flight, both visual and on instruments, is concerned with achieving and holding a suitable attitude. A very important skill to develop when flying on instruments, therefore, is to check the attitude indicator every few seconds. There are other tasks to be performed, and there are other instruments to look at as well, but the eyes should always return fairly quickly to the AI.

To achieve the desired performance (in terms of flight path and airspeed), you must not only place the airplane in a suitable attitude with the flight controls, you must also apply suitable power with the throttle. Just because the airplane has a high pitch attitude does not mean that it will climb—it requires climb power as well as climb attitude to do this. With less power, it may not climb at all. *Attitude flying* is the name given to this skill of controlling the airplane's flight path and airspeed with changes in attitude and power. The techniques used in attitude flying are the same whether flying visually or on instruments.

Pitch Attitude

Pitch attitude is not angle of attack.

The *pitch attitude* is the geometric relationship between the longitudinal axis of the airplane and the horizon. Pitch attitude refers to the airplane's inclination to the horizontal, and not to where the airplane is actually going. The *angle of attack*, however, is the angle between the wing chord and the relative airflow. The angle of attack, therefore, is closely related to flight path.

Pitch attitude and angle of attack are different, but they are related in the sense that if the pitch attitude is raised, then the angle of attack is increased. Conversely, if the pitch attitude is lowered, then the angle of attack is decreased.

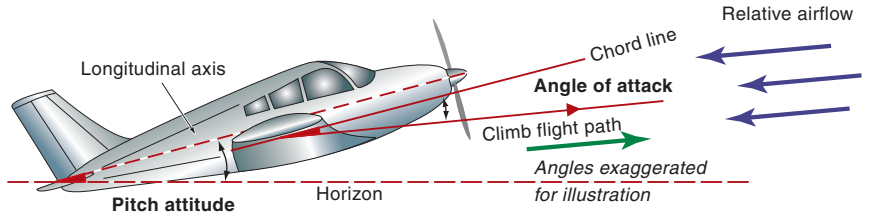

Figure 1-11 Pitch attitude and angle of attack are not the same.

An Airplane Flies Identically, In or Out of Clouds

The principles of flight do not change when an airplane enters clouds. The airplane will fly identically, and be controlled in the same way, both in clouds and in clear skies. The only difference in clouds is that the pilot loses reference to external visual cues, and must derive substitute information from the instrument panel.

When flying visually, you are already deriving a lot of information from the instruments. The exact altitude, for instance, cannot be determined from external features—you must look at the altimeter to positively know the altitude. Similarly, the precise heading is found on the heading indicator or the magnetic compass, and not by reference to external features. The precise airspeed can only be determined from the airspeed indicator. Also, to set a precise power, you must look (briefly) at the power indicator.

Coordination, in turns as well as in straight-and-level flight, is maintained precisely with reference to the coordination ball, in both visual and instrument flight, although the "seat of your pants" can also be a good guide.

The main change, it seems, when switching to instrument flying from visual flying, is to transfer attention from the natural horizon outside the cockpit to the horizon bar of the AI in the cockpit.

Instrument-rated pilots are no different from other pilots, except that they have acquired more knowledge, and can derive more information from the instrument panel. An altimeter can tell you more than just the current altitude—it also says something about the rate of change of altitude, and if the selected pitch attitude is correct for altitude to be maintained. Similarly, the heading indicator can provide heading information, but it also can tell you if the wings are banked. If the heading is changing and the ball is centered, then the wings must be banked.

The skill of instrument interpretation is not difficult, but it does take practice to acquire and maintain.

The skill of instrument interpretation (deriving all sorts of information from various instruments) will develop quickly during your instrument training. It is not difficult—it just takes practice. The airplane will fly exactly the same on instruments as when you are flying visually, and you will control it in the same way. The information required to do this is available on the instrument panel.

During instrument training, most maneuvers will be performed first in visual conditions, where the AI indications can be related to the appearance of the natural horizon in the windshield. After a satisfactory standard of visual flying is demonstrated, practice will occur in simulated instrument conditions—probably achieved by your instructor restricting your view of the outside world with a screen or hood.

Your view as the pilot, however, will remain unobstructed so that you can act as safety pilot, keeping a lookout for other aircraft, and monitoring the position of your airplane. You will concentrate on attitude flying using the instruments, interpreting their indications, and then responding with the controls. You should then be able to cope with actual instrument conditions.

A good understanding of each maneuver, and the ability to put it into practice in visual conditions, will speed up your instrument training. If you happen to be a little rusty, the first volume of this series—*Flight School*—contains detailed briefings for each visual maneuver.

Controlling the Airplane

During instrument flight, the airplane is flown using the normal controls according to the "picture" displayed on the instrument panel. From this picture, you will, with practice, know what control movements (elevator, aileron, rudder and throttle) are required to either maintain the picture as it is, or to change it.

When maneuvering the airplane, a suitable control sequence to follow (the same as in visual flight) is:

1. *Visualize* the desired new flight path and airspeed.
2. *Select the attitude and the power required* to achieve the desired performance by moving the controls, and then checking when the airplane has achieved the estimated attitude on the AI.
3. *Hold the attitude* on the AI, allowing the airplane to settle down into its new performance, and allowing the pressure instruments that experience some lag to catch up.
4. *Make small adjustments* to attitude and power until the actual performance equals the desired performance.

5. *Trim* (which is vital, if you are to achieve accurate and comfortable instrument flight). Heavy loads can be trimmed off earlier in the sequence to assist in control, if desired, but remember that the function of trim is to relieve control loads on the pilot, and not to change aircraft attitude.

Some helpful hints follow:

- Derive the required information from the relevant instrument—direction from the heading indicator, altitude from the altimeter, airspeed from the airspeed indicator.
- *Respond to deviations* from the desired flight path and/or airspeed. Use the AI as a control instrument, with power as required. For example, if you are 50 feet low on altitude, then increase the pitch attitude on the AI slightly and climb back up to altitude. Do not just accept steady deviations—it is just as easy to fly at 3,000 feet as it is to fly at 2,950 feet. A lot of instrument flying is in the mind and, in a sense, instrument flying is a test of character as well as of flying ability. Be as accurate as you can!
- *Do not over-control.* Avoid large, fast or jerky control movements that will probably result in continuous corrections, over-corrections and then re-corrections, which is often called pilot-induced oscillation (PIO). This can occur if attitude is changed without reference to the AI, or it might be caused by the airplane being out-of-trim, or possibly by a pilot who is fatigued or tense.
- *Do not be distracted* from a scan of the flight instruments for more than a few seconds at a time, even though other duties must be attended to, such as checklists, radio calls and navigational tasks.
- *Relax.* Easier said than done at the start, but it will come with experience.

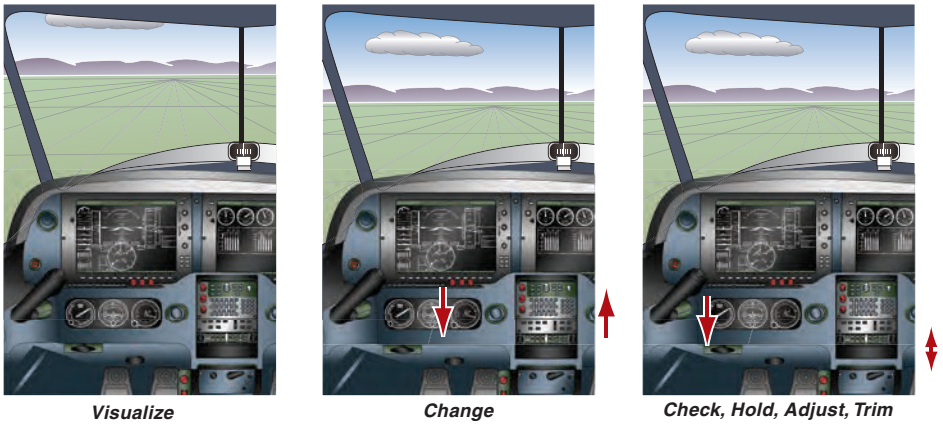

Figure 1-12 Control sequence.

Sensory Illusions

Most people live in a 1g situation most of the time, with their feet on the ground. 1g means the force of gravity. Some variations to 1g, however, do occur in everyday life—for instance, when driving an automobile. Accelerating an automobile, hard braking, or turning on a flat bend will all produce g-forces on the body different to the 1g of gravity alone. Passengers with their eyes closed could perhaps detect this by bodily feel or with their sense of balance.

A right turn on a flat road, for instance, could be detected by the feeling of being thrown to the left—but it might be more difficult to detect if the curve was perfectly banked for the particular speed. A straight road sloping to the left (and causing the passenger to lean to the left) might give the passenger the false impression that the automobile is turning right, even though it is in fact not turning at all.

Sensory illusions can lead you astray.

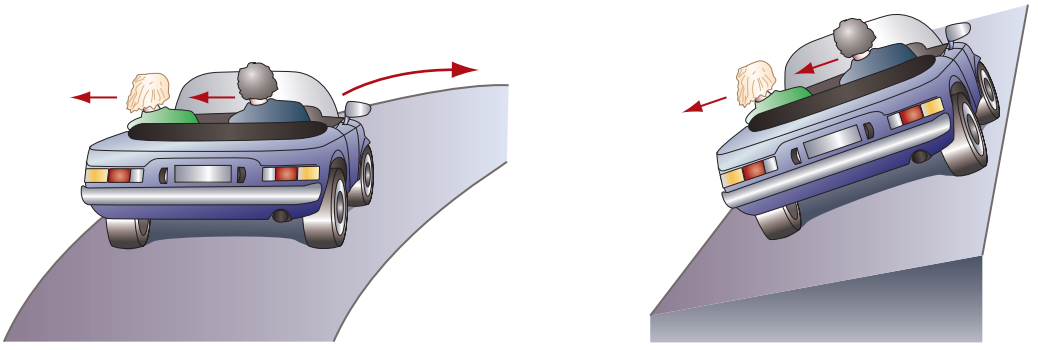

Figure 1-13 Turning right—or left leaning?

The position sensing systems of the body, using nerves all over the body to transmit messages of feel and pressure to the brain, can be fooled in this and other ways.

The organs within the inner ear, used for balance and to detect accelerations, can also be deceived. For instance, if you are sitting in an automobile traveling around a suitably banked curve, the sensing system in your ears falsely interprets the g-force holding you firmly and comfortably in the seat as a vertical force, as if you were moving straight ahead rather than in a banked turn.

The inner ear organs also have other limitations, one being that a constant velocity is not detected, nor is a gradual change in velocity. For instance, you are sitting in a train and notice another train on the next track moving past your window. Is it moving forward? Are you moving backward? Are you both moving forward but at different speeds? It is sometimes difficult to tell.

False impressions of motion can also be caused by unusual g-forces—for instance, by rapid head motion, or by lowering the head. If you happen to drop your pencil while instrument flying, don't just lower your eyes and lean down to look for it in one motion—take it carefully step by step to avoid any feeling of vertigo.

Because an airplane moves in three dimensions, there is the possibility to accelerate and decelerate in three dimensions, and this can lead to more complicated illusions. Pulling up into a steep climb, for example, will hold you tightly in your seat, which is exactly the same feeling as in a steep turn. Banking the airplane and pulling it into a turn will increase the pressure on "the seat of your pants," which is a similar sensation to suddenly entering a climb. As well as your muscles, the balance organs of your inner ear may be sending false signals to your brain. Rolling into and out of a turn may be interpreted as a climb or descent (or vice versa) by your bodily feel. With your eyes closed, it is sometimes difficult to say which maneuver it is.

A sudden change from a climb to straight-and-level flight or a descent may cause an illusion of tumbling backward. A sudden acceleration in straight-and-level flight, or during the takeoff roll, may cause an illusion of being in a nose-up attitude.

Decelerating while in a turn to the left may give a false impression of a turn to the right. Be aware that your sense of balance and bodily feel can lead you astray in an airplane, especially with rapidly changing g-forces in maneuvers such as this.

The one sense that can resolve most of these illusions is sight. If the automobile passenger could see out, or if the pilot had reference to the natural horizon and landmarks, then the confusion, and the risk of not knowing your attitude in space (i.e., the risk of *spatial disorientation*), would be easily dispelled. A false horizon seen by the eyes, however, can be misleading—such as what a pilot might see flying above a sloping cloud formation, or on a dark night with ground lights and stars spread in certain patterns, or when the natural horizon is obscured. Trust the flight instruments!

Believe only what your eyes tell you when flying on instruments.

Unfortunately, in instrument flight you do not have reference to ground features, but you can still use your sense of sight to scan the instruments and obtain substitute information. Therefore, an important instruction to the budding instrument pilot is: "believe your eyes and what the instruments tell you."

It is good airmanship to avoid any situation in flight, or prior to flight, that will affect your vision. While in clouds at night, for instance, turn off the strobe light if it is bothering you. If enough flashing light is reflected into the cockpit, the strobe can induce vertigo, or a sense of dizziness or whirling around. It is good practice to avoid strong white light, such as a flashlight, in the cockpit when night flying, so that the night adaptation of your eyes is not impaired. However, if flying in dark conditions with thunderstorms in the vicinity, turn the cockpit lights up to a bright setting to minimize the effects of nearby lightning flashes. If expecting to fly out of cloud tops and into bright sunlight, have your sunglasses handy. Protect your sight!

While sight is the most important sense, and must be protected at all costs, also make sure that you avoid anything that will affect your balance or position sensing systems.

Avoid alcohol, drugs (including smoking in the cockpit) and medication. Do not fly when ill or suffering with an upper respiratory infection (a cold). Do not fly when tired or fatigued. Do not fly with a cabin altitude higher than 10,000 feet MSL without using oxygen (or above 5,000 feet MSL at night). Avoid sudden head movements, and avoid lowering your head or turning around in the cockpit.

Despite all these don'ts, there is one very important do—*do* trust what your eyes tell you from the instruments.

The Instrument Rating Test

Detailed information of the standards required for you to obtain an instrument rating is included in 14 CFR (Part 61) and in a small publication entitled Airman Certification Standards (ACS), published by the FAA, reprinted by ASA in book form and available electronically. These standards change from time to time, so be sure that you are working from a current set of regulations and a current issue of the ACS book.

Review 1

Introduction to Instrument Flight

1. How can you avoid spatial disorientation when flying in IMC?
2. Flying visually in a clear, blue sky above a sloping cloud layer may not be as easy as it sounds. Why?
3. You are flying over a well-lit town situated on sloping ground. What sort of visual illusion could you experience?
4. How can you assist the adaptation of your eyes to darkness in the cockpit at night?
5. If you do not refer to your flight instruments, what sort of illusions or sensations can result from the following:
   - **a.** an abrupt change from climb to straight-and-level flight?
   - **b.** rapid acceleration during straight-and-level flight?
   - **c.** rapid acceleration during takeoff?
   - **d.** abrupt head movement?

Answers are given on page 631.

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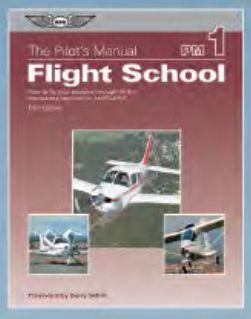

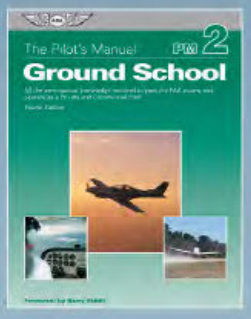

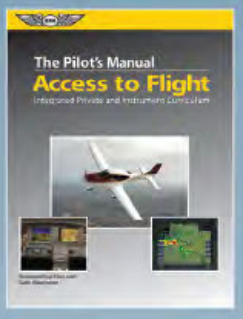

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