The Pilot's Manual

Instrument Flying

Earn an Instrument Rating and safely fly under IFR and in IMC

Eighth Edition

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Foreword by Barry Schiff

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The Pilot's Manual: Instrument Flying
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Eighth Edition

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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 titles.

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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

1 Introduction to Instrument Flight
2 Instrument Scanning Techniques
3 The Instruments
4 Straight-and-Level Flight
5 The Straight Climb and Descent
6 Turning
7 Unusual Attitudes
8 Normal Instrument Flight on a Partial Panel
9 Suggested Training Maneuvers

1

Introduction to Instrument Flight

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.

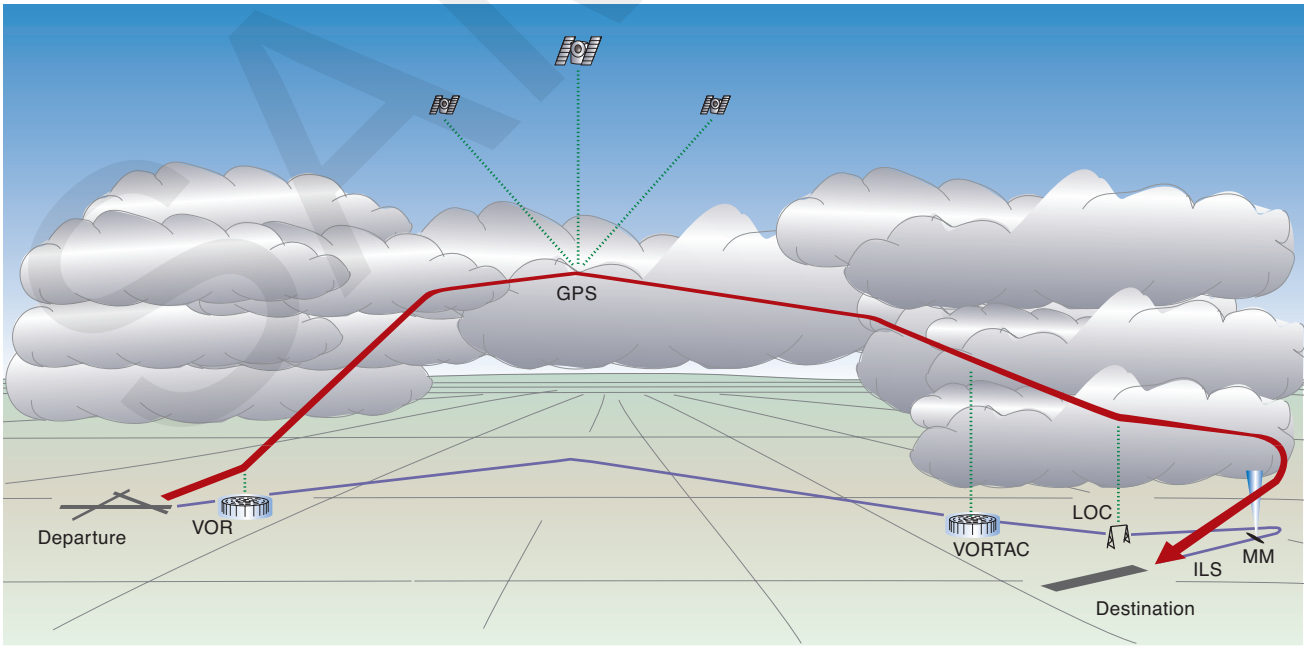

Figure 1-2 A typical flight on instruments.

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 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.

AERONAUTICAL DECISION MAKING AND RESOURCE MANAGEMENT

Aeronautical decision making (ADM) is a systematic approach to the mental process used by pilots to consistently determine the best course of action in response to a given set of circumstances. More simply, ADM is what a pilot intends to do based on the latest information he or she has. Ongoing research has identified six steps to good decision making in an aviation environment—a foundation which was taught during your private pilot training:

1. Identify personal attitudes hazardous to safe flight.
2. Learn behavior modification techniques.
3. Learn how to recognize and cope with stress.
4. Develop risk assessment skills.
5. Use all available resources.
6. Evaluate the effectiveness of one's ADM skills.

Two important components of ADM are crew resource management (CRM) and single-pilot resource management (SRM). Both can generally be defined as the ability of the pilot(s) to effectively use all of their available resources, which are categorized as human resources, hardware, and information both onboard the aircraft and from outside sources. This can include ATC, autopilot, and weather reports (to name a few). The principle difference between the two is that CRM is the effective use of resources available to the flight crew, cabin crew, and maintenance personnel (as typically seen in airline operations), while SRM applies to single-pilot operations and the ability of the single-pilot to manage all available resources both prior to and during flight. A primary goal of SRM training is to help you as a pilot maintain situational awareness by managing the automation and associated aircraft control and navigation tasks, which can become more stressful during IFR operations.

As an instrument pilot applicant, you will be required to demonstrate competence in resource management (CRM/SRM) appropriate to the aircraft and tasks outlined within the Airman Certification Standards (FAA-ACS-8).

There are several good resources available on the topic of ADM through FAASafety.gov and the WINGS program. You are encouraged, as part of your training, to sign up for an FAASafety.gov and WINGS program account to further your knowledge on the topic of ADM and your overall proficiency as a pilot.

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.

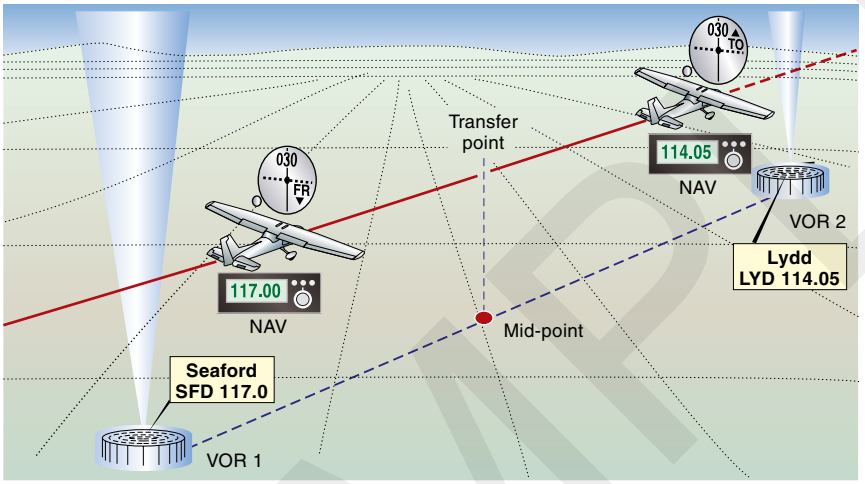

Figure 1-5 En route tracking on instruments.

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.

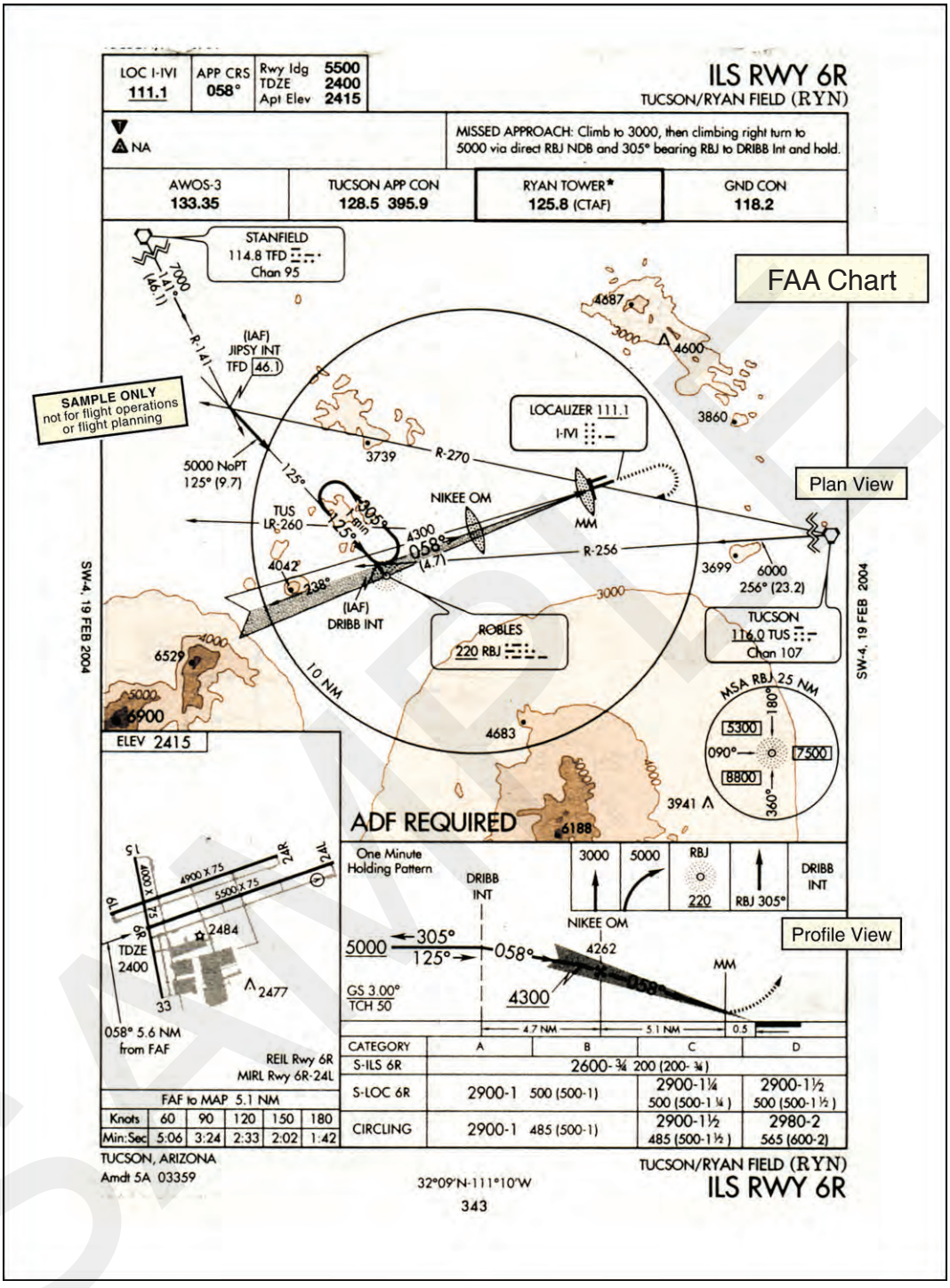

Figure 1-6 Plan and profile views of a precision instrument approach (FAA chart).

The Pilot's Manual
Instrument Flying

Earn an Instrument Rating and safely fly under IFR and IMC

An Instrument Rating opens new doors—enabling a pilot to fly more, day or night, in clear or cloudy weather. A pilot with an Instrument Rating is a skilled aviator who has demonstrated mastery of the airplane's instrument systems and can use preflight and enroute information, aeronautical decision making (ADM), and their knowledge of procedures and regulations to execute a safe flight. *The Pilot's Manual: Instrument Flying* provides everything a pilot needs to earn their Instrument Rating and fly safely under instrument flight rules (IFR) and in instrument meteorological conditions (IMC).

The eighth edition of *Instrument Flying* covers all of the required knowledge and skills outlined in the Airman Certification Standards to pass the FAA Knowledge Exam and checkride for the Instrument Rating, from basic attitude instrument flying to IFR procedures. Students will also learn effective preflight planning, navigation, and meteorology. Clear text and hundreds of full-color illustrations simplify complicated IFR procedures and maneuvers such as holding patterns, intercepting and tracking a course, and flying an approach with crosswinds. This edition has been updated to reflect upgrades to the National Airspace System (NAS) infrastructure, new navigation technologies, and changing weather services available to pilots.

Also included are study questions and answer keys to aid home or classroom study and an extensive glossary of aviation acronyms.

Foreword by Barry Schiff. This book is part of The Pilot's Manual Series—used by leading universities as their standard classroom texts.

Also available in The Pilot's Manual Series:

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Master the flight maneuvers required for private, commercial, and instructor certification

Ground School
Pass the FAA Knowledge Exam and operate as a private or commercial pilot

Multi-Engine Flying
Add a Multi-Engine Rating to your pilot certificate

Access to Flight
An integrated Private Certificate and Instrument Rating curriculum

Airline Transport Pilot
Complete the ATP CTP and become an aviation professional

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