Training for an Instrument Rating PART IV

BY DOUG HORTON

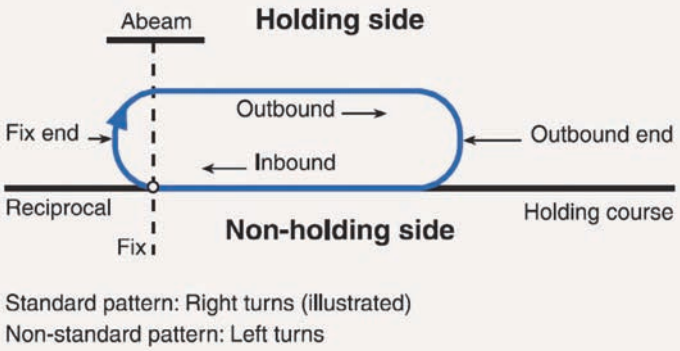
In the third part of this series we reviewed the details of VOR approaches, and we worked through the FS2004 lesson material on ILS approaches, including a solo ILS approach. I mentioned that most flight simulator pilots have flown ILS approaches, though if their flight simulator experience resembles mine, many have not known all the required details of VOR and ILS approaches, such as the required vertical profile, decision height, runway recognition requirements, and missed approach procedures. In this article we'll work through the FS2004 instrument lesson on holding, and then we'll continue to learn about requirements that are not covered in the FS2004 lessons.

FS2004 Instrument Lesson 3

The third (and last) FS2004 lesson related to attaining an instrument rating provides information on how to fly holding patterns, sometimes known internationally as "holding circuits." Here are the relevant FAA definitions for the U.S., plus an illustration of holding pattern terminology:

Holding: A procedure that keeps aircraft within specified airspace while awaiting further clearance from ATC.

Holding pattern: A racetrack pattern, involving two turns and two legs, used to keep an aircraft within a prescribed airspace with respect to a geographic fix. Standard patterns include right turns; nonstandard patterns use left turns.



STANDARD HOLDING PATTERN AND TERMINOLOGY

The ground school material for FS2004 instrument lesson 3 can be viewed through the lessons interface in the FS2004 startup screen, or to control text size and improve readability, open the material directly by browsing to **(FS2004)\FSWeb\Lessons\Instrument\InstrumentLessons03.htm**

Unfortunately, the FS2004 ground school reading provides a short and incomplete description of holding procedures. In particular, there is no discussion of the ATC communications that clear you into and out of the hold, and there is no mention of the main chore of maintaining your track during holding; namely, compensating for wind effects.

After reading the FS2004 material I suggest reviewing the excellent article about holding found in the September 2005 issue of *Computer Pilot*. Author and instructor David Ison provides a comprehensive description of holding patterns, including:

- background information about the reasons for holding,
- description of the standard holding pattern,
- nature of the "protected airspace" of holding patterns,
- ATC communications related to holding clearance and release,
- three standard ways of entering a holding pattern, and
- compensating for wind effects during holding.

There's also a very good description of holding in the FAA ***Instrument Flying Handbook***. The two parts of this free manual can be downloaded from **http://www.faa.gov/library/manuals/aviation/instrument_flying_handbook**. On the linked webpage you'll see links for separate downloading of chapters 1-7 and 8-11. The material on holding is contained on pages 10-10 through 10-13.

To review the subject briefly, entering and flying holds is challenging, and it tests your understanding of three-dimensional geometry. The FAA recommends three types of standard hold entries: Parallel, Teardrop, and Direct. The accompanying figure shows sectors (a), (b), and (c) in relation to a standard holding pattern, followed by descriptions of the corresponding standard entry procedures.

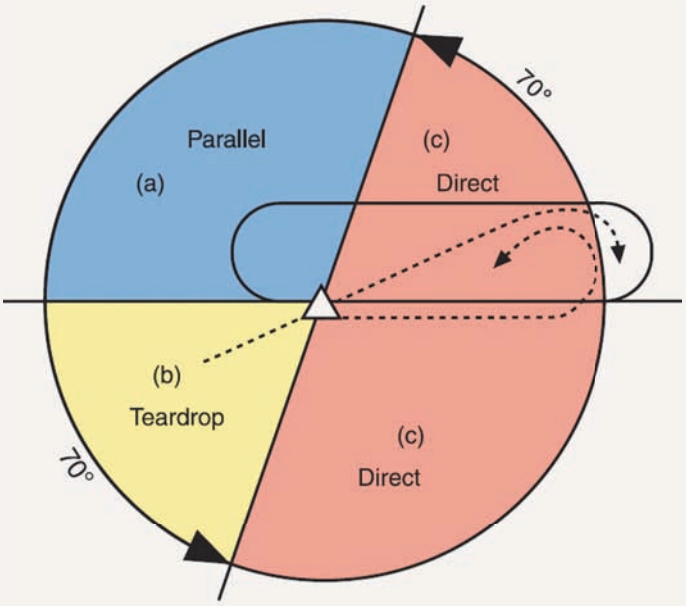


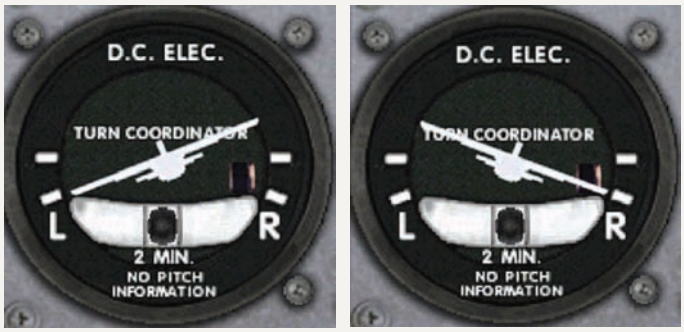
DIAGRAM OF STANDARD HOLDING PATTERN AND RELATED ENTRY SECTORS

(a) **Parallel Entry*:*** When you approach the holding fix from anywhere in sector (a), use the parallel entry procedure. Fly to the fix and then turn to a heading to fly parallel to the holding course, outbound on the non-holding side – the lower dotted track in sector (c) – for one minute, then turn in the direction of the inbound holding course through more than 180 degrees, intercept the holding course inbound, and fly to the holding fix.

(b) **Teardrop Entry*:*** When you approach the holding fix from anywhere in sector (b), use the teardrop entry procedure. Fly to the holding fix, turn outbound to a heading 30 degrees less than the outbound course heading for one minute, then turn about 150 degrees in the direction of the inbound course to intercept the inbound holding course.

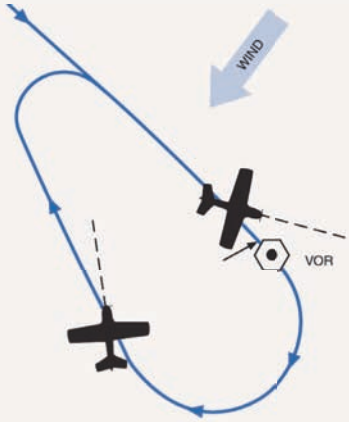
(c) **Direct Entry Procedure*:*** When you approach the holding fix from anywhere in sector (c), use the direct entry procedure. Fly directly to the fix and turn outbound to follow the holding pattern.

Standard holding patterns include right-hand turns at the rate of three degrees per second (one minute for a 180° turn), and one-minute inbound legs. The proper banks for left and right standard rate turns are shown on the illustrated turn coordinators.



TURN COORDINATOR DURING LEFT AND RIGHT STANDARD RATE TURNS

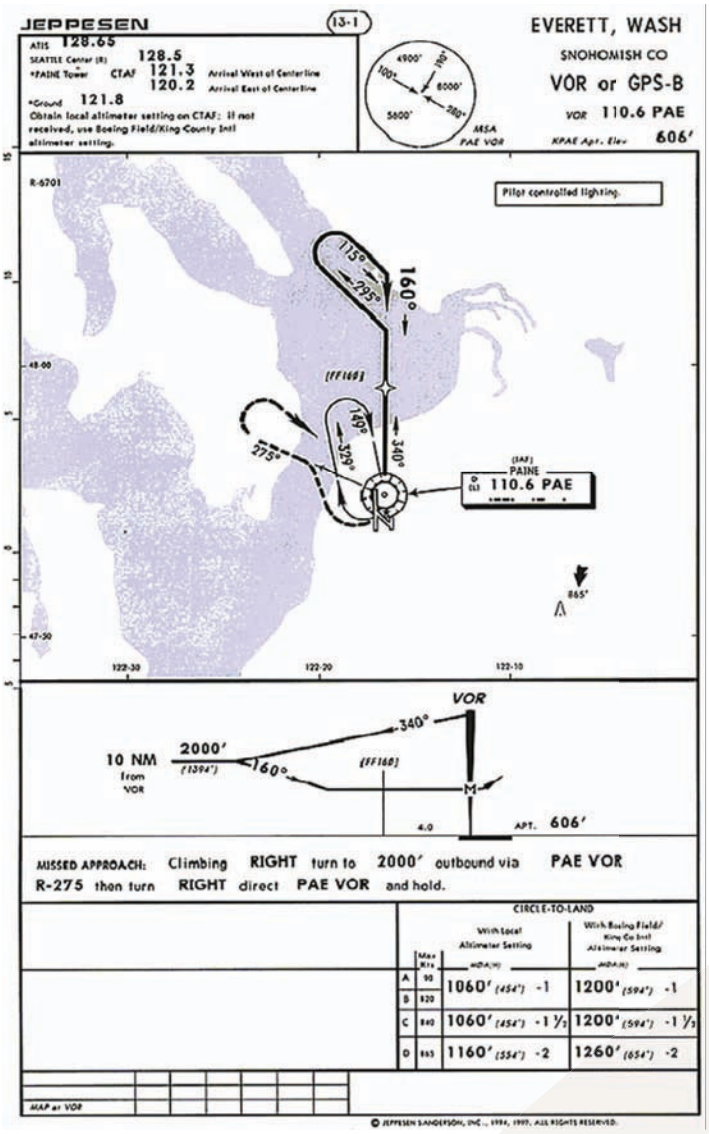
The challenge in correctly flying holding patterns is to adjust outbound and inbound headings, as well as outbound leg time, to compensate for wind effects, and meet the requirement for a one-minute inbound leg, all while remaining on the holding side. The outbound heading offset is generally about three times the inbound heading offset because the wind acts on the aircraft for three minutes during the two 180° turns and the inbound leg, which each take one minute. With compensation for wind, holding patterns become asymmetric, as shown in the accompanying illustration.



HOLDING PATTERN WITH COMPENSATION FOR WIND EFFECTS

Holding Training Flight

The FS2004 training flight on holding begins in the Cessna 172 in the air at 4000 feet, setting up for holding near Paine Field (KPAE). No charts are needed for this lesson, but the briefing provides a link to a chart for the VOR or GPS-B approach, which, by the way, has been replaced by the VOR Rwy 16R approach. Note that the chart helps provide frequencies and orientation information, but it does not show the track of your holding pattern.



APPROACH CHART USED FOR LESSON 3 ON HOLDING

You will enter a holding pattern, as directed by the instructor, make a complete circuit, and then continue practicing the holding pattern as long as you want, pressing Escape when you want to end the lesson. The instructor will help you set the navigation radios and instruments. You will need to use either the aircraft clock or another timing device for the timed portion of the holding pattern. During the flight, you'll be asked to maintain:

- Airspeed within 10 knots as assigned.
- Altitude within 100 feet as assigned.
- Headings within 10 degrees as assigned.
- Bank within 10 degrees of a standard rate turn.

I found that after the initial circuit, when I continued to practice, there were prompts contradictory to the need to begin a turn after one-minute legs. Try and see what you experience.

Ready for Checkride?

At this point, we've completed the FS2004 instrument lessons, and the checkride is next. Are we ready? In FS2004, yes. In reality, no, because the lessons do not cover many required elements of knowledge and performance, which I listed for the U.S. in part 1 of this series. For example, I previously described in part 2 training for flying steep turns and recovery from unusual attitudes while flying with reference to instruments only.

A significant instrument rating requirement not covered by FS2004 is the typical phases of an instrument flight: flight planning, weather and advisory checks, filing an IFR flight plan, obtaining an IFR clearance, instrument departure procedures, enroute procedures along airways (or direct with GPS), and transition to an instrument approach and landing. In my real instrument training I practiced these procedures during several training flights. Also, as pointed out in part 1 of this series, there's the need to complete the written exam before the checkride.

ATC Practice Flight

In several lessons, I flew "under the hood" in VFR conditions while my instructor simulated the role of ATC. I repeated and executed his directions as if he were a real controller. About two-thirds of the way through my training, it was time to "go live" within the real Air Traffic Control system. To accomplish this, my instructor prompted me to prepare and file three "back to back" IFR flight plans: West Chicago, DuPage (KDPA) to Janesville, Wisconsin (KJVL), Janesville to Rockford, Illinois (KRFD) and Rockford back to DuPage. This lesson was very intensive as it included flying four approaches while communicating with ATC.

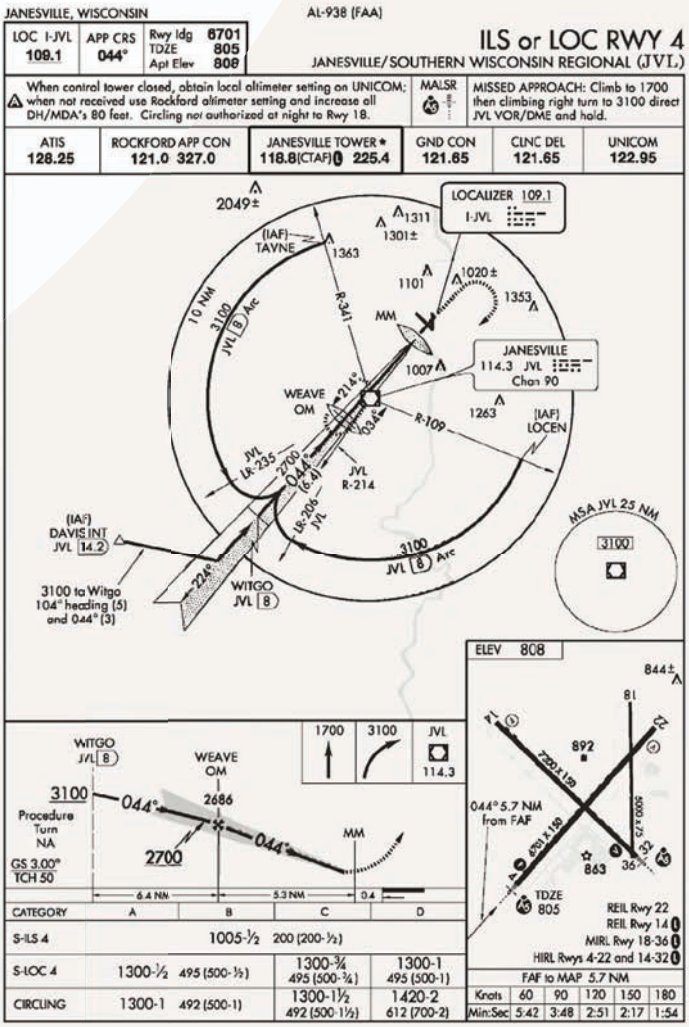
By the way, you can practice the three flights described below in FS2004 with ATC by filing IFR flight plans. The FS2004 ATC communications and menu selection will allow you to completely duplicate these flights, including the ability to "go missed" (i.e., fly the missed approach segment) and select different approaches sequentially.

DuPage to Janesville. Here is the sequence of controllers with whom I communicated during the first leg:

- **Clearance Delivery, on the KDPA Ground frequency at the time, to pick up my first clearance.**
- **DuPage Ground, to receive taxi instructions.**
- **DuPage Tower, which provided clearance for takeoff and handoff to Departure.**
- **Chicago Departure, which issued altitude and course toward Janesville.**
- **Rockford Approach, from which I received Terminal Radar Service for Rockford and Janesville, and which cleared me for my approaches, and**
- **Janesville Tower, which issued clearance to land.**

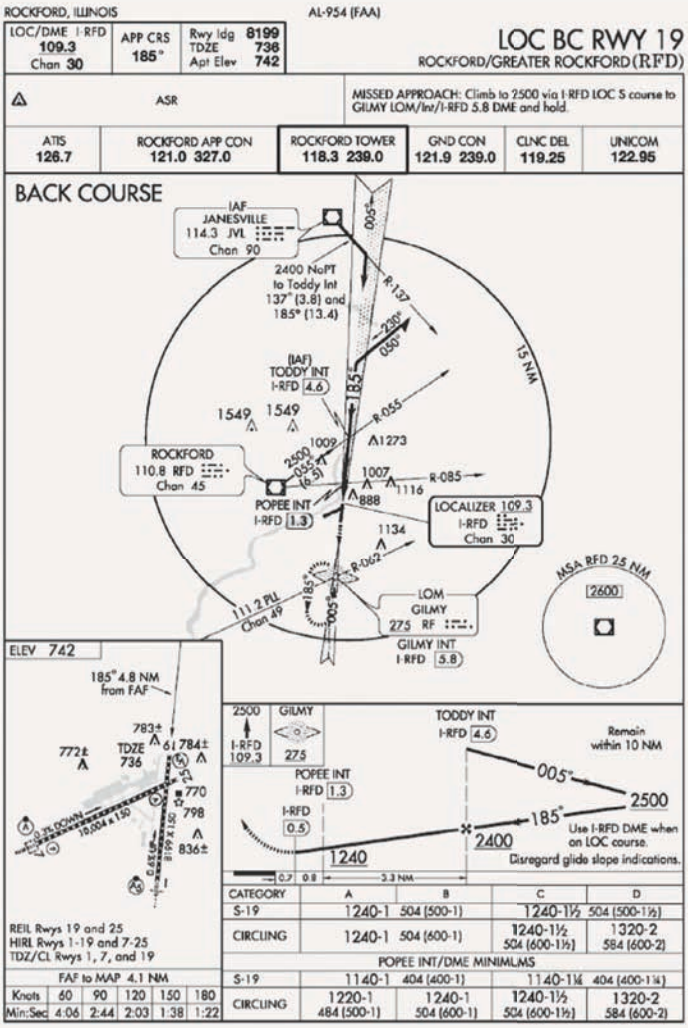
During the first flight plan I requested practice approaches for Janesville from Rockford Approach, which responded by asking what my first two approaches would be and how they would terminate. I responded that the first would be Janesville ILS runway 4 to a

missed approach, followed by the JVL VOR Runway 22 approach to a full stop and taxi-back. Accordingly, I was vectored for the ILS 4 approach via the DAVIS intersection Initial Approach fix, transitioned to Janesville Tower as directed, and I reported a missed approach after descending to the circling Decision Altitude of 1300 feet. During my climbout I was directed to contact Rockford Departure which vectored me first to the northeast then southwest to the Janesville VOR 22 approach. After hearing, "contact Tower," I was cleared to land and did so, then taxied back to the approach end of Runway 22.



APPROACH CHART FOR JANESVILLE ILS OR LOCALIZER RUNWAY 4

Janesville to Rockford. I was directed to stay with Janesville Tower during my taxi-back to Runway 22, and I received my clearance to Rockford. In FS2004, you'll need to initiate a separate flight plan. After takeoff clearance and takeoff, I was handed off to Departure, which was followed shortly by handoff back to Rockford Approach, which vectored me for the Localizer Back Course to Rockford Runway 19. After several vectors for positioning, I was vectored to intercept the back course localizer of Rockford Runway 19. The challenge during a back course approach is that the localizer needle indication is reverse-sensing. Instead of flying toward the localizer needle to center it, I had to fly to "pull the needle back" to the center of the indicator, which though it sounds simple, is difficult to master after flying normal front course approaches. On the other hand, if the aircraft is equipped with a Horizontal Situation Indicator (HSI), and if its course deviation indicator is set for the front course heading, there is normal sensing on the HSI. I urge you to challenge yourself and try this back course approach in FS2004. Take off from JVL Runway 22, set the Nav 1 radio for 109.3, identify the Morse code identifier for this approach, IRFD, then give it a try! Notice that the Initial and Final Approach Fix at the TODDY intersection is defined by the 055° radial from the Rockford VOR. Remember that you can download and print this and all other current U.S. approach plates by joining the Aircraft Owners and Pilots Association at **http://www.aopa.org/join**.



APPROACH CHART FOR ROCKFORD LOCALIZER BACK COURSE RUNWAY 19

Rockford to DuPage. Following the frequency change to Rockford Tower, clearance to land on Runway 19, and a touch-and-go landing, I received clearance back to my home field of DuPage (KDPA). After changing from Rockford Departure to Chicago Approach, I requested vectors for a practice approach to ILS Runway 2L. After becoming established on the localizer and glideslope and contacting DuPage Tower as directed, Tower asked how my approach would terminate. I requested circle-to-land on Runway 33, to land more into the wind and place the aircraft closer to its assigned tie-down spot. The touchdown zone elevation for runway 2L is 754 feet, but instead of descending on the glideslope to the straight-in Decision Altitude of 954' MSL for this approach, I stopped the descent at the circle-to-land minimum altitude of 1340' MSL, turned right, then circled to land on Runway 33.

Though I felt good about the day's training and my first real ATC flight, my instructor shared a few suggestions:

- **Reduce "chasing the needles." Make small heading changes and gradually correct the heading offset to center the needles; learn to "bracket" headings to compensate for wind during approaches.**
- **Practice making concise acknowledgements of ATC directions to reduce time on frequencies.**
- **Keep the basic instrument scan going while monitoring the approach indications, such as localizer and glideslope.**
- **Once trimmed for the preferred approach speed for your aircraft, don't change trim. Try to hold pitch and maintain position on the glideslope with small power changes. This will reduce "porpoising" down the glideslope.**

Real instrument pilots will fully understand these items, and five years later, after many more approaches, I still appreciate the need to look back at these suggestions.

Later in my training I flew a similar sequence of approaches under ATC to Janesville and Rockford, with the following approaches: JVL ILS Runway 4, JVL VOR Runway 4, Rockford Localizer Backcourse Runway 19, ASR (Airport Surveillance Radar) Runway 1, and DuPage ILS Runway 10. The difference was that, on this day, the weather included a low broken layer. When I checked the early morning weather at Janesville, the initial reported visibility was 3.4 mile with a 300-foot ceiling. I assumed that my instructor would point me toward an airport with better weather conditions. Instead, his reaction was, "it's a great day for instrument training!" and we continued the original plan. On the first approach, I removed my vision-blocking Foggles™ in time to see breaking out of the clouds and see the runway just before I was at Decision Altitude for the ILS approaches and Minimum Descent Altitude for the other approaches. What was most amazing was that I had practiced this same approach the day before with Flight Simulator, with weather set to a low ceiling, and the visual "breakout" was amazingly similar. An accompanying screenshot shows simulated breakout conditions in FS2004 that are very similar to what I saw during my real approaches.

SCREENSHOT OF "BREAKOUT" DURING DESCENT ON ROCKFORD LOCALIZER BACKCOURSE RUNWAY 19 APPROACH

Icing Practice

As I continued to work with my instructor in preparation for my instrument checkride, I scheduled another lesson to work on approaches and flying under ATC control. I filed an IFR flight plan from DuPage (KDPA) to Kenosha, Wisconsin (KENW), because my instructor indicated there were some interesting approaches we could practice at Kenosha. Also, I'd be able to communicate with several air traffic controllers during a relatively short flight to provide more practice in using proper terminology. I filed for an eastbound IFR altitude of 5000 feet from KDPA to KENW, but I was unsure of whether I'd be cleared for this altitude or not because I'd be flying near arrivals or departures from the busy O'Hare Class B airspace.

My departure clearance indicated "3000, expect 4000 in 10 minutes," so I wasn't going to be cleared for the altitude I requested. Shortly after takeoff I entered clouds at about 2500 feet as I climbed to 3000 feet. I was then directed to climb to 4000 feet, and as I leveled out at 4000 feet, my instructor said, "watch your airspeed!" I immediately became confused about my instrument readings as I saw decreasing airspeed while the attitude indicator showed level pitch and bank. At the same time, the altimeter and vertical speed indicators were steady, and I hadn't heard any change in engine sound, so there were no indications that I was losing airspeed other than the airspeed indicator. As the airspeed continued toward zero and I continued to wonder what was happening, my instructor said, "I recommend you turn on Pitot heat!"

What a lesson! I'd experienced freezing of the Pitot tube, but that wasn't all! My instructor suggested I look out from "under the hood," and I saw that the windshield and thermometer probe were beginning to accumulate ice! Of greater concern was that my wings were also accumulating some ice. My instructor suggested I report icing to ATC and request 5000 feet to see if we could get on top of the clouds and the freezing moisture therein. After ATC answered affirmatively to my request, I climbed on top of the clouds and the bright sun quickly melted the ice. Wow!

Getting the ice melted was certainly a relief, but I still faced more time in the clouds. As I began descending for my first approach, the plane began accumulated some ice again, which melted quickly as I descended below the clouds. After landing at Kenosha, the warmer air melted all the ice, but I still faced the return trip. Though I tried to get "on top," ATC left me at 4000 feet and the plane accumulated some ice on the leading edges of wings and stabilator (elevator) – enough to slow the aircraft some, but not enough to put us in danger, according to my experienced instructor. Only after landing back at DuPage did we shed all the ice and get back to the peace of being on the ground. I'm confident that my instructor didn't plan the icing exercise, and I'm confident we weren't in danger, but it was new to me and it was a most valuable and interesting training exercise. Thereafter, I've stayed out of the clouds when the temperature is below freezing!

In the Next Issue...

In the next issue we'll complete this series with discussion of the Practical Test Standards for a real instrument checkride, explore the details of my 250-mile instrument cross-country training flight, try the FS2004 instrument checkride, then debrief my real instrument checkride. I'll close the series with a discussion of how my Flight Simulator experience prepared me for my real checkride. ✈