Flying the ILS

Although it looks like a DC-3, it's a DC-2. Douglas Aircraft Company manufactured only 156 DC-2s before introducing the DC-3.

An ILS is an ILS is an ILS.

Well, not exactly. Here follows eight ILS approaches, each differing from the other in some manner. As you fly these approaches, hopefully without benefit of the autopilot, except for the final flight, you can't help but notice that tracking the localizer and glide slope is getting easier and easier. As you come to the end of this section, you might find that keeping the needles centered within half a dot is no longer much challenge.

The only method to achieve that level of flying, is "flying by the numbers." Without consistency little success can be achieved. While flying, keep a chart near at hand that contains the important flight settings. Here's the chart that I use for the FS2002 C182 Nav Trainer. Note that the power settings are only approximate and will vary with altitude, but they are a good place to begin.

<table>
<thead>
<tr>
<th>C182 Nav Trainer Flight Settings (FS2002)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C182 Nav Trainer</strong></td>
</tr>
<tr>
<td>Climb</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>--------------------</td>
</tr>
<tr>
<td>Cruise-Level, 5000 ft</td>
</tr>
<tr>
<td>Cruise-Descend</td>
</tr>
<tr>
<td>Approach-Level</td>
</tr>
<tr>
<td>Approach-Descend</td>
</tr>
<tr>
<td>Approach-Glide Slope</td>
</tr>
</tbody>
</table>

Click here to print the table. Note that your flight settings may vary slightly.

Prepare a chart similar to this for each aircraft you fly. Add a Manifold Pressure column if the aircraft has a constant speed propeller. Print this, or make your own, and fasten it to a piece of cardboard. Construct such a chart for every aircraft that you fly and keep them next to your monitor for easy access.

* * *

The ILS Approaches

Before beginning the ILS approaches, firmly understand the meaning of DH, Decision Height. The DH is the lowest height to which the approach can be conducted by instrument reference alone. From that point on you must be able to see either the runway or the approach lights and be able to execute a safe visual landing. If not, a missed approach is required.

NOTE: YOU WILL GET THE GREATEST BENEFIT FROM THIS SECTION IF YOU FLY EACH APPROACH A SECOND TIME BEFORE MOVING TO THE NEXT FLIGHT. FLYING EACH A THIRD TIME IS EVEN BETTER. ALL FLIGHTS ARE VERY SHORT.

* * *
"Florida?" I repeated, dumbfounded.

"Yeah," The Boss answered, "Mrs. Grayson wants her ferrets flown down there, to Palatka, to be with her for the winter—wants personal handling, know that they won't be sitting out beside the baggage compartment of some plane in this subfreezing temperature."

It had all happened so fast. Florida looked mighty good now after the fourteen-inch snowfall in New England a few days back. I was ready to go in an hour. Mrs. Grayson's chauffeur had brought the ferrets to the airport with their cage, and I left for Palatka in my C182 Nav Trainer.

Ferrets delivered, I was now at the motel, pool-side to be exact, enjoying the warm sun and beautiful temperature. Life was good.

"Sir, are you the charter pilot?" The desk clerk had approached with a sheet of paper in his hand. "A fax for you," he said, handing it to me, and left.

"Tried reaching you since early this morning. Please answer your phone. Had to get the motel fax number from your Boss."
"I'll be there in an hour. Need a flight to Gainesville. Want to catch a sunset hot air balloon ride tonight."

It was boldly signed "Counter." Very boldly signed.
The weather was going to change in a few hours, be uncharacteristically overcast. I'd get Counter to Gainesville, but wondered whether he'd be ballooning tonight or not. I grabbed my towel and headed for the room to change. Maybe it would be a bumpy flight.

**Larkin airport, Palatka, Florida to Gainesville, Florida.**

Larkin airport, 28J, Palatka, Fla. to Gainesville, Fla., KGNV, with ILS approach to Runway 28. Click the image to access the complete flight-information package.

This first flight is easy and enjoyable. The flight begins at Larkin airport in Palatka, Florida, 28J, with a destination of Gainesville, Fla., KGNV. The ILS approach is to Runway 28. Click on the image above to download the flight-information package, kayl-gnv.zip.

The zip-file includes the IFR chart, the approach plate for ILS Rwy 28 at Gainesville, and this text description of the flight.

We proceed west from Larkin, tracking to the Gainesville VOR, GNV, but intersect the localizer to Gainesville's Runway 28. before reaching GNV. We turn right to track inbound to Gainesville with a straight-in landing to Runway 28. The flight requires some modest VOR and DME work.

As usual, do nothing until you have gone through the step-by-step details of the flight with this text and your charts. Only by doing this will you both understand the purpose of each step, but you will visualize them in your mind, a critical part of instrument flight.
- Set the flight simulator weather conditions to 400 ft overcast, cloud tops at 10,000 ft., and one-half mile visibility. The wind is calm.
- Move the aircraft to Larkin Airport, Palatka, Fla., Runway 27, airport 28J, and retract the flaps to 0°.
- Tune the Nav-1 receiver to Gainesville's localizer, 111.3 MHz., Ident-GNV.
- Set the VOR-1 OBS to 285°, the localizer track to Runway 28.
- Tune the Nav-2 receiver to the Gainesville VOR, 116.2 MHz., ident GNV. Fly the first leg with Nav-2.
- Set the VOR-2 OBS to the vicinity of 260°. You will center the needle with the OBS after takeoff and track to GNV VOR until intercepting Gainesville's localizer.
- Switch the DME to Nav-2.
- Takeoff from Runway 27, climbing out with a very slight left turn to 260°.
- When your VOR-2 comes alive, and warning flags disappear, readjust the OBS as necessary to center the needle. Observe that a TO flag is showing and then ident the VOR, GNV.
- Track that Gainesville radial. ATC has cleared you to 4000 ft. Climb at 90 kts., then cruise at 110 kts. after reaching your assigned altitude.
- You will intercept Gainesville's Runway 28 localizer at the 24.4 DME point., before reaching Gainesville VOR, about 7 min. into the flight.
- Ident the localizer before you turn right to intercept, I-GNV.
- Fly Nav-1. Turn right to heading 285° on intercept to track inbound to Runway 28, keeping the localizer needle centered.
- Begin your descent to 2100 ft. on localizer intercept. Descent rate should be no more than 500 to 700 fpm.
- You are about 14 NM from the FAF when intersecting the localizer.
- Retune Nav-2 to Ocala VOR, 113.7 MHz., OCF.
- Set VOR-2 OBS to 017°, to identify the Dante Intersection.
- At Dante Int., when the VOR-2 needle centers, descend to 1700 ft.
- You are now 6.0 NM from the OM.
- Slow to 75 kts. and drop one notch of flaps.

It's vital to stabilize the approach well before beginning your descent down the ILS.

- Readjust the VOR-2 OBS to 006°—a FROM flag should appear. When that needle centers you are at the FAF for the Runway 28 approach. Monitor its progress as a back-up of your relative distance to the FAF, Wynds intersection.
- Maintain 1700 ft. until intercepting the glide slope.
- The Outer Marker beacon will sound out dashes at the FAF, and the Blue OM light will appear on the marker beacon receiver's indicator.
- Stay on the glide slope and localizer until you reach your DH of 322 ft. Don't look away from the gauges until very shortly before reaching the DH, about one-half mile from the runway.
- You've heard this before. Don't chase the needles; they will be very sensitive as you near the runway. Just try to keep them from moving.
• Gainesville's Runway 28 TDZE, Touch Down Zone Elevation, is 122 ft., 200 ft. below your DH. It should be an easy coast in from there if you've stayed on top of the needles.
• Remember, on an ILS, the TDZE is the important elevation, not the field elevation. The Runway 28 TDZE at Gainesville is 30 ft. lower than the field elevation, a very significant difference. Take a look at the plan view of the airport on the approach plate to see the difference.
• Nice start on an easy flight, if a little busy.
• Flight time: About 20 minutes.

* * *

Monroe County, Monroeville, Alabama to Pensacola Regional, Florida

Monroe County airport, Monroeville, Ala. to Pensacola Regional airport, Pensacola, Fla. with an ILS approach to Runway 17. Click the image to access the complete flight-information package.
This flight is also easy and enjoyable, with some intersection work thrown in for a change of pace. The flight begins at Monroe County airport, KMVC, Monroeville, Ala. with a destination of Pensacola Regional airport, KPNS, Pensacola, Fla. The ILS approach is to Runway 17. Click on the image above to download the flight-information package, mvc-pns.zip.

The zip-file includes the IFR chart, the approach plate for ILS Rwy 17 at Pensacola, and this text description of the flight.

We proceed southeast and then south from Monroe County airport to the PENS I intersection. Then it's a left turn for a straight-in ILS approach to Pensacola's Runway 17. The flight requires some modest VOR/DME work to identify intersections.

As usual, do nothing until you have gone through the step-by-step details of the flight with this text and your charts. Only by doing this will you both understand the purpose of each step, but you will visualize them in your mind, a critical part of instrument flight.

- Set the flight simulator weather conditions to 500 ft overcast, cloud tops at 10,000 ft., and one-mile visibility. The wind is calm.
- Move the aircraft to Monroe County's (Monroeville, Ala.) Runway 21, airport KMVC, and retract the flaps to 0°.
- Tune the Nav-1 receiver to Monroeville VOR, 116.8 MHz., Ident-MVC.
- Set the VOR-1 OBS to 160°.
- Tune the Nav-2 receiver to the Saufley VOR, 108.8 MHz., ident NUN.
- Set the VOR-2 OBS to 188°.
- Switch the DME to Nav. 1. This will monitor distance from MVC VOR.
- Fly Nav-1. Takeoff from Runway 21, climbing out with a left turn to intercept MVC's 160° radial. Intercept with a very shallow angle; you are very close to the VOR.
- ATC has cleared you to 5000 ft. Climb at 90 kts., then cruise at 110 kts. after reaching your assigned altitude.
- Pay close attention to VOR-2. The OFF flag will be showing because the aircraft is out of range of the NUN Omni (range is 39 NM). Turn on and leave on the VOR-2 ident so that you will hear when it becomes active. Check that the OFF flag is no longer visible before relying on this gauge.
- Fly Nav-2. When the VOR-2 needle centers, turn right to 188° and track that radial southward. The DME will read 23 to 24 NM at the course change.
- Descend to 4000 ft.
- After intercepting NUN's 188° radial, retune the Nav-1 receiver to Crestview VOR, 115.9 MHz., Ident CEW.
- Set the VOR-1 OBS to 263°.
- When both the VOR-1 and VOR-2 needles center, you are at PENS I intersection. The DME should read about 30 NM from CEW.
- At PENS I intersection immediately turn left to a 166° heading.
• Retune the Nav-1 receiver to 111.1 MHz., Pensacola's localizer frequency for Runway 17, Ident I-PNS.
• Fly Nav-1. Track the localizer inbound.
• The DME will read 19-20 NM, about 13-14 NM to the FAF.
• Descend to 1700 ft. Descent rate should be no more than 500 to 700 fpm.
• Reset the VOR-2 OBS to 052°, to identify the Brent Intersection.
• Brent intersection is the FAF for the ILS approach to Runway 17. There is no OM.
• Check that the Nav-2 receiver is still tuned to Saufley VOR, 108.8 MHz., Ident NUN.
• Drop one notch of flaps and slow to 75 kts.
• Maintain 1700 ft. until intercept of the glide slope, shortly before arrival at the Brent intersection.
• The DME will read 5.9 NM at Brent intersection, with both VOR-1 and VOR-2 needles centered.
• Reduce power and descend down the glide slope upon intercept.
• Stay on the glide slope and localizer until you reach your DH of 321 ft. Don't look away from the gauges until very shortly before reaching the DH, about one-half mile from the runway.
• DH is 321 ft. Don't descend below that point if the runway is not in sight. You will reach the DH near the Middle Marker, amber light on the panel, alternating dots and dashes sounding from the speaker.
• Pensacola's Runway 17 TDZE, Touch Down Zone Elevation, is 121 ft., 200 ft. below you at the DH. It should be an easy coast in from there if you've stayed on top of the needles.
• Land and take satisfaction in the challenge of a busy flight.
• Flight time: About 36 minutes.

* * *
My laptop computer was open in front of me. I was at my motel after a charter to bring a WW II history buff to visit the Holocaust Memorial Museum here in St. Petersburg. I spotted The Boss's e-mail message right away. Short and to the point, it read: "Nothing this morning, check back after lunch."

The AOL Instant-Messenger Icon flashed as I was about to disconnect. I clicked on the Icon, but didn't recognize the screen name, "TheWildOne." I opened the message.

It was from Counter.

I read Counter's message, wondering the nature of his present crisis.

"I have to be at McKechnie Field today in time to see the Pittsburgh Pirates play. They head north for the regular season after this game," the e-mail began. "The Buccos have always been my team ... a baseball team with heritage. Can't watch them play in New England since they're in the National League. Only American League sissies up there."

McKechnie Field was in Bradenton, not far south of St. Petersburg, across Tampa Bay, but a long drive around the inlet. McKechnie had been the Pirates' spring-training home for over thirty years. I went back to the e-mail.

"The Pirates will be back in the hunt again for division championship, and maybe more. With their history, it's only a matter of time. Earned their name in 1890 because they 'Pirated' a star player from the Philadephia A's. So much nostalgia surrounds the Bucs, I gotta be at the game. Hey, what other team can boast all this?"
• They played the first World Series game ever in 1903, against the Boston Pilgrims.
• Honus Wagner, Pirate shortstop, was the first player to have his signature branded in a Louisville Slugger. He never batted below .300 for his first 17 years as a big leaguer.
• Honus Wagner was also in the first class to be inducted into the Hall of Fame. Babe Ruth, Ty Cobb, Christy Mathewson and Walter Johnson were the other original members.
• Pirate Bill Mazeroski was the first player to decide a World Series with a home run in the 7th game. It happened against the Yankees and was one of the greatest moments in World Series history.
• The Bucs have the most players with 3000 hits; Honus Wagner, Paul Waner and Roberto Clemente.
• The Pirates have the most batting championships, with twenty-four.
• The Pirates always struggled for attendance. In their first stadium, Recreation Park, one game showed a paid attendance of six, plus eleven hanger-ons, for a total of seventeen in the ball park.
• Forbes Field was home for the Pirates for sixty-one years, from 1909 to 1970. With a twelve-foot brick outfield fence, it was a "Man's" field.
  o Left-center field was so deep, 457 ft., that the batting cage was stored there during ball games.
  o That deep center field allowed a lot of room for triples and inside-the-park home runs. Pirate "Chief" Owen Wilson set the major league record for triples (36) in a single season in this park.
  o The right-field roof was an 86 ft. high target for many Major League sluggers. Ten different players launched eighteen home runs over that roof. Pirate Willie Stargell led the charge with seven round-trippers.
  o Babe Ruth was another legendary long-ball hitter to clear that roof. As he finished his career with the Boston Braves, on May 25, 1935, Ruth hit three home runs against the Bucs. His last four-bagger, number 714, cleared the right field roof. Babe Ruth was the first to launch one over the roof, too.
  o Pitchers had a challenging task in Forbes Field. In its sixty-one year history, there was never a no-hitter thrown.

I thought about Counter's e-mail. He sounded a believer in the Pittsburgh Pirates.

I loved baseball, too, and McKechnie Field was the place to watch it played the way it should be: In the sun and on the grass.

St. Petersburg, Florida to Sarasota/Bradenton, Florida
St. Petersburg Int'l airport, Fla. to Sarasota/Bradenton Int'l airport, Fla. with an ILS approach to Runway 14. Click the image to access the complete flight-information package.

The previous flights were easy, but pretty busy during the ILS approach. This flight is less busy, but with some interesting variations. The flight originates at St. Petersburg Int'l airport, KPIE, Fla. with a destination of Sarasota/Bradenton Int'l airport, KSRQ, Fla. The ILS approach is to Runway 14. Click on the image above to download the flight-information package, pie-srq.zip.

The zip-file includes the IFR chart, the approach plate for ILS Rwy 14 at Sarasota, and this text description of the flight.

We proceed southwest from St. Petersburg, KPIE, and intercept Sarasota's ILS at a rather sharp angle. Again, no OM, but must rely on a VOR radial and DME distance for the FAF. We have a nice long straight-in ILS approach to Sarasota's Runway 14. The flight requires some modest VOR/DME work to identify intersections. Also, simulated ATC instructions will be given in the form of change of altitude at certain DME distances.

As usual, do nothing until you have gone through the step-by-step details of the flight with this text and your charts. Only by doing this will you both understand the purpose of each step, but you will visualize them in your mind, a critical part of instrument flight.
Set the flight simulator weather conditions to 400 ft overcast, cloud tops at 10,000 ft., and one-mile visibility. The wind is calm.

Move the aircraft to St. Petersburg's Runway 17L, airport KPIE, and retract the flaps to 0°.

Tune the Nav-1 receiver to Sarasota's localizer, 111.3 MHz., Ident I-FFV.

Set the VOR-1 OBS to 136°. as a reminder of runway heading.

Tune the Nav-2 receiver to the St. Petersburg VOR, 116.4 MHz., ident PIE.

Set the VOR-2 OBS to 188°. Fly the first leg with Nav-2.

Switch the DME to Nav-2. This will monitor the distance from PIE VOR.

Fly Nav-2. Takeoff from Runway 17L, climbing straight out to intercept PIE's 188° radial.

NOTE: You may be surprised to see that the VOR-2 needle indicates a left turn to intercept the 188° radial. That is because of the location of the VOR on the field relative to the runway. Ignore that for the moment and climb straight out until intercepting the 188° radial, about 0.6 NM on your DME.

ATC has cleared you to 4000 ft. Climb at 90 kts., then cruise at 110 kts. after reaching your assigned altitude.

When the DME reads 16.0 NM from PIE, descend to 3000 ft. Before descending verify that the DME is switched to Nav-2.

Fly Nav-1. On intercept of Sarasota's Localizer for Runway 14, turn left and track inbound at 136°. You are about 13 NM from the field.

Begin descent to 2000 ft.

Drop one notch of flaps and slow to 75 kts.

Retune the Nav-2 receiver to 115.2 MHz., Sarasota's VOR, Ident SRQ.

Set VOR-2 OBS to 315°.

Monitor the DME along with the other flight instruments—there is no OM.

Maintain 2000 ft. until intercept of the glide slope, shortly before arrival at FRUGL intersection.

FRUGL intersection is 6.3 NM from SRQ VOR. It is the FAF for the ILS approach to Runway 14.

Reduce power and descend down the glide slope upon intercept.

Stay on the glide slope and localizer until you reach your DH of 224 ft. Don't look away from the gauges until very shortly before reaching the DH, about one-half mile from the runway.

DH is 224 ft. Don't descend below that point if the runway is not in sight. You will reach the DH near the Middle Marker, amber light on the panel, alternating dots and dashes sounding from the speaker.

Sarasota's Runway 14 TDZE, Touch Down Zone Elevation, is 24 ft., 200 ft. below you at the DH. It should be an easy coast in from there if you've stayed on top of the needles.

Pat yourself on the back for a good flight.

Flight time: About 22 minutes.

* * *
Kissimmee, Florida to Melbourne, Florida

Kissimmee Municipal airport, Fla. to Melbourne Int'l airport, Fla. with an ILS approach to Runway 9R. Click the image to access the complete flight-information package.

An ILS approach doesn't get much simpler than this one. The flight originates at Kissimmee Municipal airport, Fla., KISM, with a destination of Melbourne Int'l airport, Fla., KMLB. The ILS approach is to Runway 9R. Click on the image above to download the flight-information package, ism-mlb.zip.

The zip-file includes the IFR chart, the approach plate for ILS Rwy 9R at Melbourne, and this text description of the flight.

We proceed southeast from Kissimmee and intercept Melbourne's Localizer 21 NM from the field providing a nice long straight-in ILS approach to Runway 9R. The previous flights will make this seem very easy. Except that it's time for a real-world cross wind.

By now you should have downloaded and installed the virtual E6-B computer, and placed an icon on the desktop. This marvelous utility calculates Wind Correction Angle—WCA, and Ground Speeds in a matter of seconds. You should use it for every flight where a
wind is present. Then you will know in advance what action is necessary to counteract the effects of the wind.

As usual, do nothing until you have gone through the step-by-step details of the flight with this text and your charts. Only by doing this will you both understand the purpose of each step, but you will visualize them in your mind, a critical part of instrument flight.

- Set the flight simulator weather conditions to 400 ft overcast, cloud tops at 10,000 ft., and one-mile visibility. Set the wind at 150° at 15 kts.
- Move the aircraft to Kissimmee's Runway 15, airport KISM, and retract the flaps to 0°.
- Tune the Nav-1 receiver to the Melbourne VOR, 110.0 MHz., ident MLB.
- Set the VOR-1 OBS to 089°.
- Tune the Nav-2 receiver to the Vero Beach VOR, 117.3 MHz., Ident VRB. Fly the first leg with Nav-2.
- Set the VOR-2 OBS to 129°.
- Turn Nav-2 Ident on, and leave it on, to recognize when that VOR becomes "active," which will be about 3000 ft. MSL.
- Switch the DME to Nav-2. This will monitor the distance to VRB VOR.
- Takeoff from Runway 15, climbing out left to 135°
- Fly Nav-2. Intercept VRB's 129° radial when the VOR gauge becomes "active,"—hear ident and OFF flag no longer visible.
- ATC has cleared you to 5000 ft. Climb at 90 kts., then cruise at 110 kts. after reaching your assigned altitude.
- The Virtual E6-B calculates 3°R WCA for this cross wind and heading at 110 kts. TAS. The wind is almost directly on the aircraft nose during this first leg, slowing the ground speed to 96 kts.
- At about DME 42 the VOR-1 needle should be nearly centered.
- Near the intercept point of the 089° radial to MLB retune Nav-1 receiver to Melbourne's Localizer, 108.3 MHz., Ident I-MLB.
- Set the VOR-1 OBS to 090° as a reminder of the runway heading.
- Fly Nav-1. Turn left and intercept Melbourne's Localizer for Runway 9R.
- Inbound track is 090° but roll out on 097° heading to compensate for the cross wind
- You are about 17 NM from the FAF.
- Begin descent to 2100 ft.
- Maintain 110 kts. until instructed otherwise.
- Change Nav-2 to the Melbourne VOR, 110.0 MHz., ident MLB.
- Set the VOR-2 OBS to 089°.
- Drop one notch of flaps at DME 13 and slow to 75 kts.
- The Virtual E6-B calculates 10°R WCA for this cross wind and heading at 75 kts. TAS.
- The ground speed will be 66 kts. on final. Use the rule of thumb of five times ground speed for rate of descent on the glide slope, which is 330 fpm, a shallower rate of descent than you are accustomed to. Be attentive to this rate of descent
while coming down the glide slope. Less power reduction will be needed than for a no-wind approach.

- The FAF, Outer Marker, is at 7.8 NM on the DME.
- Maintain 2100 ft. until intercept of the glide slope.
- Use this level-flight part of the approach to stabilize the air speed and WCA before reaching the FAF.
- Reduce power and descend down the glide slope upon intercept.
- Stay on the glide slope and localizer until you reach your DH of 233 ft. Don't look away from the gauges until very shortly before reaching the DH, about one-half mile from the runway.
- DH is 233 ft. Don't descend below that point if the runway is not in sight. You will reach the DH near the Middle Marker, amber light on the panel, alternating dots and dashes sounding from the speaker.
- Remember, your WCA is 10°R. Therefore you must look slightly left to spot the runway since you are crabbing down on the approach.
- Melbourne's Runway 9R TDZE, Touch Down Zone Elevation, is 33 ft., 200 ft. below you at the DH. It should be an easy coast in from there if you've stayed on top of the needles.
- Flight time: About 35 minutes.

Here's what you'd have seen had the flight to Melbourne been VFR.
Dade County Training Facility to Miami, Florida

Dade County Training Facility to Miami Int'l airport, Fla. with an ILS approach to Runway 9R. Click the image to access the complete flight-information package.

This flight originates at the Dade County Training Facility, KTNT, 32 NM west of Miami Int'l airport, Fla., KMIA. The ILS approach is to Runway 9R. Click on the image above to download the flight-information package, tnt-mia.zip. The zip-file includes the IFR chart, the approach plate for ILS Rwy 9R at Miami, and this text description of the flight.

Here you will be introduced to the "Might is Right" rule.

You fly this ILS approach into Miami Int'l, intermingled with the big iron and their 160 kts approach speed, over twice that of your C182 Nav Trainer. The controller has asked you to maintain 110 kts. until glide slope intercept, a routine type of request at many very-busy airports. You're not obligated to comply, but if you don't the controller may ask you to do a "left 360 for spacing, and report over Atlanta for additional advisories before returning to the final approach course."

You see, the 767 and 747 drivers can get a little testy when asked to line up over Mexico for their turn inbound behind you while you lollygog in at 75 kts. from 20+ NM out.
As usual, do nothing until you have gone through the step-by-step details of the flight with this text and your charts. Only by doing this will you both understand the purpose of each step, but you will visualize them in your mind, a critical part of instrument flight.

- Set the flight simulator weather conditions to 400 ft overcast, cloud tops at 10,000 ft., and one-mile visibility. The wind is calm.
- Move the aircraft to Dade County's Runway 9, airport KTNT, and retract the flaps to 0°.
- Tune the Nav-1 receiver to the Homestead VOR, 108.2 MHz., ident HST.
- Set the VOR-1 OBS to 133°.
- Tune the Nav-2 receiver to the Virginia Key VOR, 117.1 MHz., Ident VKZ.
- Set the VOR-2 OBS to 096°.
- Turn on Nav-1 Ident, and leave it on, to recognize when that VOR becomes "active," which will be about 1500 ft. MSL.
- Fly Nav-1. Takeoff from Runway 9 with a right turn-out to 133°.
- Intercept Homestead's 133° radial when the VOR gauge becomes "active,"—hear ident and OFF flag no longer visible.
- ATC has cleared you to 5000 ft. Climb at 90 kts., then cruise at 110 kts. after reaching your assigned altitude.
- Fly Nav-2. When VOR-2 centers turn left to track VZK's 096° radial.
- Change Nav-1 to Miami's Runway 9R Localizer, 110.9 MHz., Ident I-BUL.
- Set the VOR-1 OBS to 090° as a reminder of the runway heading.
- Switch the DME to Nav-2.
- Fly Nav-1. When VOR-1 centers turn left to 090° to track the Localizer to Miami's Runway 9R.
- You are about 15 NM from the FAF.
- Begin descent to 3000 ft.
- Maintain 110 kts. and 3000 ft. until glide slope intercept.
- Change Nav-2 to the Dolphin VOR, 113.9 MHz., ident DHP.
- The VOR-2 indications are unimportant. The only interest here is the DME distance to that VOR, so it must be tuned in.
- Drop one notch of flaps at the glide slope intercept and slow to 75 kts.
- Reduce power and stay on the glide slope while bleeding off speed.
- Stay on the glide slope and localizer until you reach your DH of 209 ft. Don't look away from the gauges until very shortly before reaching the DH, about one-half mile from the runway.
- DH is 209 ft. Don't descend below that point if the runway is not in sight. You will reach the DH near the Middle Marker, amber light on the panel, alternating dots and dashes sounding from the speaker.
- Miami's Runway 9R TDZE, Touch Down Zone Elevation, is 9 ft., 200 ft. below you at the DH. It should be an easy coast in from there if you've stayed on top of the needles.
- Flight time: About 24 minutes.

* * *
The DME arc

The next flight introduces the DME arc. A DME arc is a flight path that is flown at a constant distance from a VOR station. In the extreme case, it would be a 360° circle around the VOR. For a 16 NM DME arc the radius of the circle would be 16 NM centered on the VOR. The illustration below shows the 16 NM DME arc from Ormond Beach VOR, OMN, entering from the north to the Runway 7L ILS approach at Daytona Beach, Florida.

A DME-arc approach saves time. The time-consuming procedure turn is eliminated along with the frustration of flying away from the airport to set up the approach.

Daytona Beach International has two DME arc approaches. This is the north-entry 16 NM DME arc.

The pertinent information is written along the DME arc on the approach plate: 16 NM arc from OMN, no procedure turn required (or allowed), fly the route at 1600 ft. altitude. The entry point is BARBS intersection.

The aircraft enters the DME arc at BARBS intersection on V267 and continues around the arc until LR–224, the 224° Lead Radial, which Leads you into the ILS. At LR–224 the pilot turns sharply to the left and intercepts the localizer.
To fly a DME arc perfectly accurately the pilot must concentrate solely on the DME, constantly making small heading corrections towards the VOR. This is neither practical nor safe. Other gauges on the panel demand attention and pre-landing duties are usually calling at this time, also.

Flying straight-line segments is the key to mastering the DME arc.

The BARBS intersection is on OMN 271°. The Lead Radial is 224°—47° around the arc. We will fly "20° straight-line segments," that is, we will change heading by 20° increments to remain "on the arc."

Upon entering the arc, include the DME in your instrument scan. When the DME increases by 0.1 mi, turn left (in this case) by 20° and be alert again for the next shift of the DME to 16.1 NM and make the next 20° change in heading to the left, and so forth until reaching the 224° Lead Radial. Then make a normal, left turn to intercept the localizer.

* * *

Larkin airport, Palatka, Florida to Daytona Beach, Florida

Larkin airport, Palatka, Fla. to Daytona Beach Int'l airport, Fla. with an ILS approach to Runway 7L. Click the image to access the complete flight-information package.
This flight originates at Larkin airport in Palatka, Florida, 28J, with a destination of Daytona Beach Int'l airport, Fla., KDAB. The ILS approach is to Runway 7L. Click on the image above to download the flight-information package, kayl-dab.zip. The zip-file includes the IFR chart, the approach plate for ILS Rwy 7L at Daytona Beach, and this text description of the flight.

We proceed east from Larkin to V267, then southbound to the BARBS intersection, and then follow a 16 NM DME arc around OMN to the ILS to Daytona Beach's Runway 7L.

As usual, do nothing until you have gone through the step-by-step details of the flight with this text and your charts.

- Set the flight simulator weather conditions to 400 ft overcast, cloud tops at 10,000 ft., and one-mile visibility. The wind is calm.
- Move the aircraft to Larkin's Runway 9, airport 28J, and retract the flaps to 0°.
- Tune the Nav-1 receiver to the Craig VOR, 114.5 MHz., ident CRG.
- Set the VOR-1 OBS to 178°.
- Tune the Nav-2 receiver to the Ormond Beach VOR, 112.6 MHz., Ident OMN.
- Set the VOR-2 OBS to 135°. Fly the first leg with Nav-2.
- Turn on Nav-2 Ident, and leave it on, to recognize when that VOR becomes "active," which will be about 1500 ft. MSL.
- Fly Nav-2. Takeoff from Runway 9 and fly due east, 090°, anticipating intercept of the 135° radial to OMN.
- ATC has cleared you to 5000 ft. Climb at 90 kts., then cruise at 110 kts. after reaching your assigned altitude.
- Intercept OMN's 135° radial after the VOR gauge becomes "active,"—hear ident and OFF flag no longer visible.
- When VOR-2 centers turn right, intercept, and track OMN's 135° radial south-east bound.
- Fly Nav-1. About 6 NM later, when VOR-1 centers, turn right, intercept, and track CRG's 178° radial south bound.
- Switch the DME to Nav-1.
- Set the VOR-2 OBS to 271° to identify BARBS intersection.
- At DME 48, ROYES intersection, begin descent to 1600 ft.
- Maintain 110 kts. TAS.
- Switch the DME to Nav-2.
- Fly Nav-2. When VOR-2 centers at BARBS, note the DME reading.
- If the DME is less than 16.0 NM, turn right 10 to 30° to enter the DME arc, depending on the distance from the desired arc.
- If the DME is more than 16.0 NM, turn left to 10 to 30° to enter the DME arc, depending on the distance from the desired arc.
- Change the VOR-2 OBS to 224°, the LR-224 radial from OMN.
- Maintain the heading determined above until the DME moves to 16.0 NM. Then return to original 180° heading.
- Change VOR-1 to 109.7 MHz., Runway 7L Localizer, Ident I-DAB.
- Change VOR-1 OBS to 068° as a reminder of the runway heading.
• When the DME shows 16.1 NM turn left 20° and maintain the new heading until the DME again moves to 16.1 NM.
• If the DME keeps increasing, cut another 10° to the left and proceed as before.
• Repeat this procedure around the arc until VOR-2 centers, at LR-224°.
• Fly Nav-1. Turn left to 090° and intercept the localizer to Runway 7L.
• Drop one notch of flaps and slow to 75 kts.
• Intercept the glide slope and descend normally.
• Stay on the glide slope and localizer until you reach your DH of 232 ft. Don't look away from the gauges until very shortly before reaching the DH, about one-half mile from the runway. Don't descend below that point if the runway is not in sight. You will reach the DH near the Middle Marker.
• Daytona Beach's Runway 7L TDZE is 32 ft.
• Flight time: A busy 37 minutes.

* * *

The P-40 was America's foremost fighter in service when WW-II began. P-40s engaged Japanese aircraft during the attack on Pearl Harbor and also were flown in China early in 1942 by the famed Flying Tigers. Courtesy Air Force Museum, wp-afb, Dayton, Ohio.

It was raining like the dickens. I had just taxied in to Ithaca's Tompkins County airport, in New York, on my way back home from Florida, with a detour tomorrow to Albany to pick up a package for The Boss. The rain and low weather hadn't messed up my plans, this was my scheduled stopover for the night anyway.

The receptionist and I were waiting for the line-boy to bring the numbers in for my refuel so I could settle the bill, catch a taxi into town, and get to my motel. The line-boy would need a canoe to make it in with this downpour. It was pitch black outside except for the nearby blue taxiway lights and the reflections off the tarmac from the rain-weakened floodlights.
The telephone rang. The receptionist answered it, said a few words, then turned to me. "Did you just fly in from Florida in a C182 Nav Trainer?" she asked.

"Yes," I said, puzzled.

"Lucky," she responded, with a glance out the window at the weather, and handed me the phone.

"Glad I caught you." It was Counter. "The Boss didn't have your motel info so I would have missed you if you weren't at the airport."

I glanced at the weather, too, thinking only of my nice warm motel. "Glad that didn't happen, I answered."

"I need a lift to Elmira in the morning. Want to get over to the Hammondsport, to the Glenn H. Curtiss Museum."

"Albany's the other direction from Elmira," I responded, drily. "And the weather's not looking good, either."

"Albany? Who wants to go to Albany? My father-in-law's brother was a Flying Tiger in World War II. Flew the P-40 Tomahawk. Glen Curtiss invented and built that plane, over 14,000 of them. I want to go see what it looks like and learn more about it. Twelve cylinder, 1400 HP engine pushed that baby along, I know that much."

"Great plane, great pilots you know," Counter went on. "They held back the Japanese planes from attacking the Burma road into China. The Flying Tigers had a thirty to one kill ratio over the Japanese. That ratio's never been equalled since. Just about won the war for us in China, shot down 300 Japanese aircraft. Our guys were there the summer before Pearl Harbor, in 1941."

"Sound's a worthwhile visit," I said.

"You know, Curtiss was a great pilot, too," Counter interrupted. "The government issued him Pilot's License #1. But back to the Tomahawk, I'd sure like to buy one of those P-40s for what Uncle Sam paid."

"How much was that?"

"$55,000 and change," Counter said with a laugh. "See you in the morning."

Ithaca, New York to Elmira, New York
Tompkins County airport, Ithaca, New York to Elmira/Corning Regional airport, Elmira, New York with an ILS approach to Runway 6. Click the image to access the complete flight-information package.

We're back in the north again. This flight originates at Tompkins County airport in Ithaca, New York, KITH, with a destination of the Elmira/Corning Regional airport, Elmira, New York, KELM. The ILS approach is to Runway 6. Click on the image above to download the flight-information package, ith-elm.zip. The zip-file includes the IFR chart, the approach plate for ILS Rwy 6 at Elmira, and this text description of the flight.

We proceed southwest from Ithaca to the Elmira VOR via V426, execute a tear-drop turn and return to intercept the localizer to Elmira's Runway 6.

As usual, do nothing until you have gone through the step-by-step details of the flight with this text and your charts.

- Set the flight simulator weather conditions to 1200 ft overcast, cloud tops at 10,000 ft., and one-mile visibility. The wind is calm.
- Move the aircraft to Ithaca's Runway 32, airport KITH, and retract the flaps to 0°.
- Tune the Nav-1 receiver to the Ithaca VOR, 111.8 MHz., ident ITH.
- Set the VOR-1 OBS to 236°.
- Tune the Nav-2 receiver to the Elmira VOR, 109.65 MHz., Ident ULW.
- Set the VOR-2 OBS to 235°.
• Switch the DME to Nav-1.
• Fly Nav-1. Takeoff from Runway 32 with a climbing left turn.
• Intercept and track V428, the 236° radial of ITH.
• ATC has cleared you to 4000 ft. Climb at 90 kts., then cruise at 110 kts. after reaching your assigned altitude.
• Fly Nav-2. At 11 DME, VILCU intersection, switch navigation to VOR-2.
• Track the 235° radial to the Elmira VOR, ident ULW.
• Switch the DME to Nav-2.
• Change Nav-1 to Elmira's Runway 6 Localizer, 109.1 MHz., ident I-UEK.
• NOTE: Runway 6 and 24 Localizers are both on 109.1 MHz., but have different idents because each is a front-course approach. If you ident the localizer too early you will hear I-ELM for Runway 24.
• Change VOR-1 OBS to 062° as a reminder of the runway heading.
• Don't chase the VOR-2 needle as you approach ULW, it will be very sensitive and may even drift off scale for a moment.
• At station passage of ULW, turn left to 220°.
• Reset VOR-2 OBS to 220° and track that radial outbound.
• Fly Nav-1. At 7 DME turn right to 040°.
• Descend to 3000 ft.
• Intercept the Runway 6 Localizer.
• After localizer intercept, drop one notch of flaps and slow to 75 kts.
• Intercept the glide slope and descend normally.
• Stay on the glide slope and localizer until you reach your DH of 1144 ft.
• Don't look away from the gauges until very shortly before reaching the DH, about one-half mile from the runway. Don't descend below that point if the runway is not in sight. You will reach the DH near the Middle Marker.
• Elmira's Runway 6 TDZE is 944 ft.
• Flight time: 34 minutes.

* * *
A reminder to the "young-uns" that flavorful, multi-course meals were once served in the "back cabin," and on real china, as seen in this DC-2. Note, too, the absence of over-size luggage in the overhead bins.

* * *

CAT II Approaches

For years, the ILS capability to land with a ceiling as low as 200 ft. and a visibility limited to one-half mile was satisfactory for airline schedule maintenance, if not without a few grumbles. When conditions lower than this extreme exist, it is rarely for long periods of time, i.e., morning fog that will later burn off, or during heavy thunderstorms when no one should be attempting a landing anyway, etc. Most passengers understand that delayed flights due to poor weather are beyond everyone's control.

But the rapidly increasing number of passengers and aircraft showed how much chaos could result if weather shuts down an entire region to air travel, even if briefly. So the FAA went the extra step and developed a working system to allow aircraft to land all the way down to zero ceiling and zero visibility.

As previously discussed, ILS landing conditions were segregated into three Categories, with CAT I being the existing minimums of 200 ft DH and one-half-mile visibility.
A CAT II capability allows landings with seeing conditions as low as a DH of 100 ft. above the TDZE, and 1200 ft. RVR, slightly less than a quarter-mile. In other words, CAT II cuts the CAT I minimums in half.

A pilot doesn't just jump into his favorite aircraft, though, and decide to shoot a CAT II approach because the weather has gone sour. The FAA issues a CAT II authorization after the pilot satisfies certification and currency requirements. In addition, a CAT II approach may only be flown in an aircraft meeting minimum equipment requirements and into fields with approved CAT II approaches.

The pilot must pass both an oral exam and a flight test to be certified. The flight test requires at least two ILS approaches to a DH of 100 ft, one to a full-stop landing and the other to include a missed-approach procedure. The CAT II approaches must be performed with an autopilot (over-simplification, but will do).

A CAT II authorization is only valid for six months, then another oral exam and flight test must be passed.

For a runway to be certified for a CAT II approach, an Inner Marker beacon, IM, is required in addition to the OM and MM beacons. The IM is located at the DH for a CAT II approach.

The minimum additional aircraft equipment requirements are a marker-beacon receiver capable of receiving the IM and a CAT II approved autopilot. At the IM a white light on the aircraft's instrument panel flashes and high-frequency dots sound from the loudspeaker.

**CAT II Approach Plates**

Five features distinguish a CAT II approach plate from a standard (CAT I) ILS approach plate. See the illustration below, from the CAT II ILS Rwy 9 approach Plate for Stewart Int'l airport in Newburgh, New York.
The approach plate is identified as CAT II adjacent to the Approach Title. The plate carries an aircrew and aircraft certification notice. Two "S-ILS 9" lines exist in the profile view, one for 150 DH, 1600 RVR, and the other for 100 DH, 1200 RVR.

a. For six months after the first issuance of a CAT II authorization, the pilot must adhere to the 150/16 limitation.

b. If the aircraft has no IM receiver (or it's inop), and the pilot relies on a barometric-pressure altimeter for DH, the pilot must adhere to the 150/16 limitation.

c. The 100/1200 CAT II approach is authorized when the pilot confirms completion of three CAT II ILS approaches to a landing under actual or simulated conditions with a 150-foot DH within six months of the date of original issuance (after the first six months).

4. Radio (Radar) Altimeter readings are shown on the approach plate for the 150 and 100 ft. DH points.

5. The TDZE, Touch-Down Zone Elevation appears on the profile view.
Radio (Radar) Altimeter

The radio altimeter, or terrain-clearance indicator, is an absolute altimeter; it indicates the actual altitude over terrain, however uneven. It operates by first sending a radio signal from the aircraft to the earth's surface. A receiver in the aircraft then picks up the reflection of the signal from the surface. The time it takes for the signal to travel to the earth and back is converted into absolute altitude which is displayed on a gauge.

The radio altimeter does not depend on barometric pressure settings. The C182 Nav Trainer does not have a radio altimeter, but most FS heavy aircraft have one on their panel.

The radio altimeter has several unique features:

- The altitude scale is non-linear. Notice that as much space on the dial is devoted to 0–100 ft. as is used for 1000–2500 ft. The low end of the scale, when near the ground, is where the greatest resolution is needed.
- Here the altitude bug is set at 92 ft. This corresponds to the 100 ft. DH, 1200 ft RVR CAT II minimums at Stewart Int'l airport in Newburgh, N.Y.
- The radio altimeter can be coupled to the autopilot. When coupled, the green indicator shows on the dial. The radio altimeter only arms when the autopilot is coupled to the localizer of an ILS approach.
- The green indicator light switches to red when descending below the altitude set by the bug.
- In a CAT I or CAT II approach, the aircraft is manually flown on to the runway from the DH point. The autopilot must be switched off to allow manual flying. The radio altimeter automatically switches off the autopilot when the aircraft has descended to the altitude set by the bug.
- Modern radio altimeters are digital with an audio call-out at the bug setting in addition to the above features.

Consider this CAT II approach. The DH is 100 ft., and with a TDZE of 20 ft., the DA (Decision Altitude) is 120 ft. If the terrain were absolutely flat, at the DA point, the Radio Altimeter would register 100 ft. above the ground. But at the DA here the terrain is 28 ft. MSL, 8 ft. above the TDZE, so the RA correctly shows that the aircraft is only 92 ft. above the terrain.

* * *

Monticello, New York to Newburgh, New York
Sullivan County airport, Monticello, New York to Stewart Int'l airport, Newburgh, New York with an ILS approach to Runway 9. Click the image to access the complete flight-information package.

The final flight in this section culminates in a CAT II ILS approach. This flight originates at Sullivan County airport, Monticello, New York, KMSV, with a destination of Stewart Int'l airport, Newburgh, New York, KSWF. The CAT II ILS approach is to Runway 9. Click on the image above to download the flight-information package, msv-swf.zip. The zip-file includes the IFR chart, the CAT II approach plate for ILS Rwy 9 at Stewart, and this text description of the flight.

This CAT II flight will use the autopilot.

You may wonder why Stewart Int'l airport, not near a major city, has an 11,818 ft. runway. Those living in the region will remember it as Stewart Air Force Base, an installation closed down for budget reasons.

We proceed south-bound from Monticello to the Huguenot VOR and turn east to intercept the localizer to Stewart's Runway 9, followed by the CAT II approach.

As usual, do nothing until you have gone through the step-by-step details of the flight with this text and your charts.
• Set the flight simulator weather conditions to 630 ft overcast, cloud tops at 10,000 ft., and one-quarter mile visibility. The wind is calm.
• Move the aircraft to Sullivan County's Runway 15, airport KMSV, and retract the flaps to 0°.
• Tune the Nav-1 receiver to Stewart's Runway 9 Localizer, 110.1 MHz., ident I-SWF.
• Set the VOR-1 OBS to 092° as a reminder of the runway heading.
• Tune the Nav-2 receiver to the Huguenot VOR, 116.1 MHz., Ident HUO.
• Set the VOR-2 OBS to 165°. Fly the first leg with Nav-2.
• Switch the DME to Nav-2.
• Fly Nav-2. Takeoff from Runway 15 with a right turn to 165° on climb-out.
• Pay close attention to VOR-2. The OFF flag will be showing because the aircraft is out of range of the HUO Omni until you gain sufficient altitude. Turn on and leave on the VOR-2 ident so that you will hear when this VOR becomes active. Check that the OFF flag is no longer visible before relying on this gauge.
• Intercept and track the 165° radial to Huguenot VOR.
• ATC has cleared you to 5000 ft. Climb at 90 kts., then cruise at 110 kts. after reaching your assigned altitude.
• At Huguenot VOR turn left to heading 080°.
• Change VOR-2 OBS to 080°.
• Begin descent to 2900 ft.
• Track HUO's 080° radial to the MANEE intersection, the intercept of Stewart's Runway 9 Localizer.
• Fly Nav-1. On localizer intercept, turn right to 092°.
• Turn On the autopilot and activate the Approach function–APR.
• Descend to 2400 ft.
• Monitor the flight instruments to be certain that the autopilot is accurately tracking the localizer.
• Drop one notch of flaps and slow to 75 kts.
• On glide slope intercept, reduce the RPMs to maintain 75 kts.
• Monitor Airspeed and all other flight gauges closely. Don't let anything wander.
• The DH is 582 ft., 100 ft. above the runway.
• Don't look away from the gauges until very shortly before reaching the DH, at the Inner Marker (series of high-speed dots from speaker.)
• At the DH, disconnect the autopilot (press "Z") and manually fly the aircraft to touchdown.
• Stewart's Runway 9 TDZE is 482 ft.
• Flight time: 28 minutes.