Rod Machado's Instrument Pilot's Survival Manual

Third Edition

An Advanced Book for The Serious Instrument Pilot

CONTENTS

INTRODUCTION

This book was born of the motivation to *provide IFR pilots with answers to questions they most frequently ask.* These are questions no single IFR publication has ever attempted to address. I'm referring to questions like:

How do I know whether those clouds have thunderstorms in them?

What do I have to do to avoid icing conditions? How can I tell if there is icing present?

What is the most efficient way to scan my instruments?

Is there a precise way to determine in-flight visibility at Decision Altitude?

What are some of the problems I'll face flying GPS approaches?

What is the best way to acquire confidence when flying instruments?

How are instrument approaches built to accommodate pilot performance?

These questions and many, many more are what this book is all about. And that is why this book is called *Rod Machado's Instrument Pilot's Survival Manual*.

With so many wonderful books available on instrument flying, my strategy has been to avoid duplicating what has been adequately covered in other publications. Therefore, the reader will not find anything about VOR navigation, basic IFR regulations, or information on how to pass a written test in this book. Questions on those topics generally, do not rob pilots of sleep, and deprive them of peace of mind as they attempt to ponder the apparent imponderables of the IFR world.

This is a book to be used in learning how to think differently in the cockpit, a book to be used in acquiring the IFR decision making skills of a professional pilot. This book attempts to establish connections and relationships that often take many, many years, and thousands of hours of flight experience, to identify. These relationships offer a pilot greater cockpit confidence and more effective decision making ability. *It's a text for both students and professionals.* This book is a supplement to all of the other excellent IFR texts available.

I've used both NACO and Jeppesen charts in this book. I have made it a point to compare and contrast differences and similarities between the two brands where appropriate. The principles applied to these charts apply to instrument charts throughout the United States. At the end of some chapters I've included what I call *Postflight Briefings*. These are supplementary sections of advanced knowledge that are well worth the time and effort to study.

This book is designed to be practical and fun to read. The most precious legacy each of us can leave to the other is our experience. Many years of in-flight experience have been gathered in the form of Aviation Safety Reporting System (ASRS) excerpts. These are the stories of pilots who have made mistakes, some humorous, some quite serious. These experiences convey important ideas that mere moralizing could hardly hope to duplicate.

I love to laugh! I hope, this book makes you laugh and learn, too. This is what learning should be, a fun and enjoyable experience.

extract information from it, return to the attitude indicator and make a correction in attitude, if necessary. This is called the *radial* scan because the visual scanning track is from the attitude indicator out to the primary instrument, then back to the attitude indicator. Radial scanning was originally based on a set of analog instruments that circled around the attitude indicator, making what appeared to be spokes radiating from the attitude indicator to all the primary instruments, as shown in Figure 19.

The attitude indicator is marked *start* because this is where all attitude changes begin. It's very important that you understand how the radial scan is accomplished. Your eyes should move from the attitude indicator to a primary instrument, observe its reading or detect its movement, then return to the attitude indicator and make an attitude adjustment necessary to stabilize the primary instrument (Figure 19).

Figure 19. The instrument scan begins with the attitude indicator then moves to the primary instruments.

As we've previously learned, readily identifying the primary instruments for a given flight condition is challenging for many new instrument pilots. On a PFD there are always going to be *three* primary instruments for any condition of flight: one for *pitch*, one for *bank* and one for *power*. As we did with our analog instruments, we'll stick the words shown in Figure 20 under each instrument on the panel (use the sticky strip portion of a PostIt since this is easy to remove and won't gum up the PFD's screen).

Figure 20. The primary instruments can be more easily identified by placing the names of the maneuver that they perform near that instrument on the PFD.

Figure 20 shows which instruments may be primary for specific conditions of flight. For instance, in straight and level flight you should look at the PFD and find those instruments listed as *straight* and *level*. The HSI's heading indicator is primary for bank, or, going straight, the altimeter tape is primary for pitch (remaining *level* in this instance) and the manifold pressure gauge (or tachometer) is primary for power.

In constant airspeed climbs or descents, the airspeed tape is always the primary pitch instrument. In a turn, the turn trend line is always primary for bank. The primary instruments for a climbing turn would be airspeed for pitch, the turn trend line for bank and manifold pressure for power. The primary instruments for a level turn would be the altimeter for pitch, turn trend line for bank and manifold pressure for power.

In a *straight climb* or *descent*, at a specific *rate*, the VSI is primary for pitch and the heading indicator is primary for bank. If a specific airspeed is necessary for the constant rate descent (and it most often is on ILS approaches), then the airspeed tape will be primary for power.

Figure 21. The scan above shows the primary instruments for straight and level flight.

Let's examine the scan for straight and level flight more closely (Figure 21). You would immediately radial scan the altimeter tape by observing it, then return to the attitude indicator. If the altimeter tape was moving, a small pitch change would be made on the attitude indicator to neutralize and then correct this movement. The heading indicator should be radial scanned next, by observing it and returning to the attitude indicator. If the heading indicator was turning, or was not on the desired heading, a small correction in bank would be applied to the attitude indicator. Use a five degree bank correction on the attitude indicator to return to a heading that's not off by more than 20 degrees. It's important to stop a straying parameter, then correct it.

The manifold pressure gauge should be radial scanned last. Look at the instruments and make any final adjustment in the setting, then immediately return to the attitude indicator.

After radial scanning all three primary instruments, alternately radial scan the altimeter tape and heading indicator, making small corrections on the attitude indicator to stabilize these instruments.

Figure 22 shows the proper instrument scan for a *descending left hand standard rate turn* at a constant airspeed of 125 knots. The primary instruments for this condition are airspeed for pitch, turn trend line for bank, and manifold pressure for power. The power is reduced as an 18 degree (or the bank necessary for a standard rate turn)

Figure 22. The scan above shows the primary instruments for a descending left turn at 125 knots.

Postflight Briefing 9#1

The Skew-T/Log-P Diagram

If someone asked you whether or not you've checked the *skew-T/Log-P* diagram before your flight, you'd probably say it wasn't necessary since you're not licensed to work on your radio's circuit boards. Of course, this diagram has absolutely nothing to do with circuit analysis, but it does have everything to do with understanding the convective potential of the atmosphere. The skew-T/Log-P diagram is one of the most powerful forecasting and analysis tools available to meteorologists and it's extremely useful to instrument pilots, too.

Before we begin, let me be clear that my objective isn't to turn you into a meteorologist. This takes years of concentrated study and practice, to say nothing about learning to use the sling psychrometer (a nunchuk-like weapon meteorologists use to defend themselves when their forecasts go bad). Neither should becoming a meteorologist be your objective as a pilot who is simply interested in piloting an airplane safely. That said, it's desirable that you have a reasonable understanding about how meteorologists develop their forecasts, primarily because this gives you greater confidence in the weather reports you'll read. That's why we're going to take an in-depth look at one of the most useful weather observing and forecasting tools available to the meteorologist and the IFR pilot, too. This tool is known as the *skew-T/Log-P diagram*.

The skew-T/Log-P diagram (Figure 13) is a vertical snapshot of the atmosphere from the surface to approximately 53,000 feet. Temperature, moisture, wind direction and speed data are collected by radiosonde soundings taken twice daily at 00Z and 12Z and plotted on the skew-T/Log-P chart form. The diagram allows you to assess the stability at different layers of the atmosphere and estimate the type and degree of weather present. To understand how to read this diagram, you'll need to know something about all those little lines you see on the chart. That's where we'll begin.

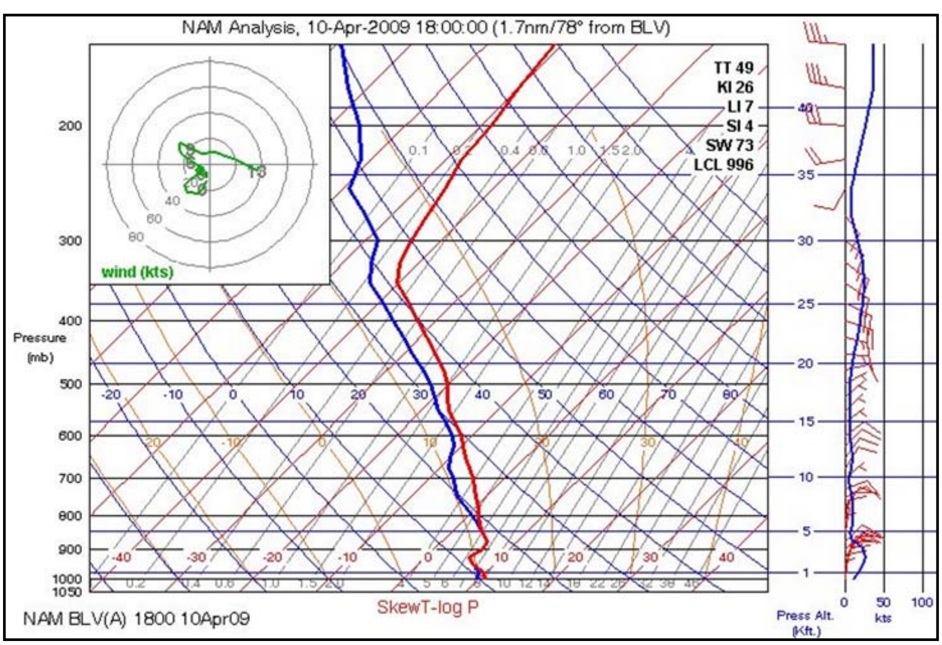


Figure 13. The skew-T/Log-P diagram provides a visual representation of the radiosonde soundings taken twice daily.

Let's assume a dry, unsaturated parcel of air rises and cools as it follows the dry adiabat (Figure 30, position A). The LCL is the point where the dry adiabat crosses the saturated mixing ratio line that runs through the dewpoint (Figure 30, position B). The parcel (assumed saturated) continues to rise on its own as its ascent path follows or parallels the nearest moist adiabat (Figure 30, position C). The black line in Figure 30 identifies the moist adiabatic cooling path of this rising parcel. In this instance, the LCL is also known as the *level of free convection* (LFC) since the air parcel now rises on its own, thus indicating unstable air.

In Chapter 9, page 9-9 of this manual, we discussed one way to measure the instability of the air. We call this measure the *lifted index* (LI). As you recall, we calculate the LI by taking a parcel of air near the surface and lifting it to 18,000 feet (approximately the 500mb level) and taking the difference between its starting and ending temperatures. As you can see from Figure 30, the difference between -22 degrees C and -10 degrees C gives us a lifted index of -12. This value certainly indicates that the lifted parcel is positively buoyant and will continue to rise, thus indicating a degree of instability. The LI, however, is calculated for only one level in the atmosphere and doesn't represent the potential for convection through all levels in this atmospheric sounding. For that, we need another means of estimating instability called CAPE.

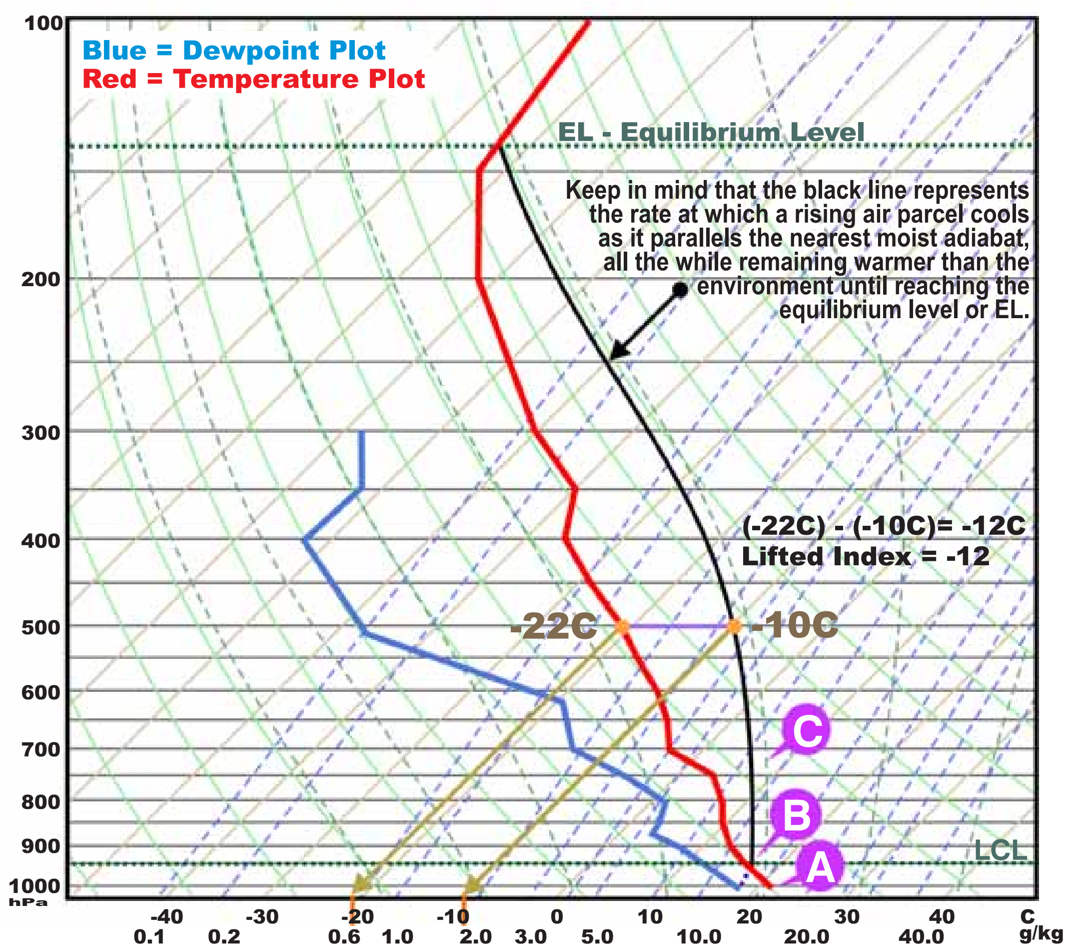


Figure 30. The lifted index is determined by assuming that a parcel of air is lifted from the surface to the 500mb level (18,000 feet MSL) and cools along the moist adiabat. The temperature difference between parcels is noted, which provides a coarse assessment of atmospheric stability.

Figure 31 shows an area colored in orange which represents the difference between the ascent path of a parcel of air as it cools along the moist adiabatic lapse rate and the environmental temperature sounding. The orange area is essentially the summation of all the differences in temperature between these two lapse rates beginning at the LFC (where the air parcel rises on its own) and the EL or *equilibrium level* (where the air parcel, once again, takes on the same temperature of the environment). The size of this area is known as CAPE (convective available potential energy) and is a measure of joules of energy per kilogram of air. The important point to understand here is that the larger the CAPE value (the area in orange in our diagram), the more potential energy (think "latent heat") trapped in the air. Ultimately, the numerical value of CAPE is another means of measuring how potentially unstable the air might become if it's lifted.

Of course, you (and a billion other people) may not be all that good at estimating the area between the environmental lapse rate and the moist adiabat. Fortunately, when you look at the skew-T/Log-P diagram, you'll see that the weather service specialist has already calculated the CAPE value for you. It is usually found on the upper right side of the diagram. The larger the CAPE value, the greater the potential for convective storm activity.

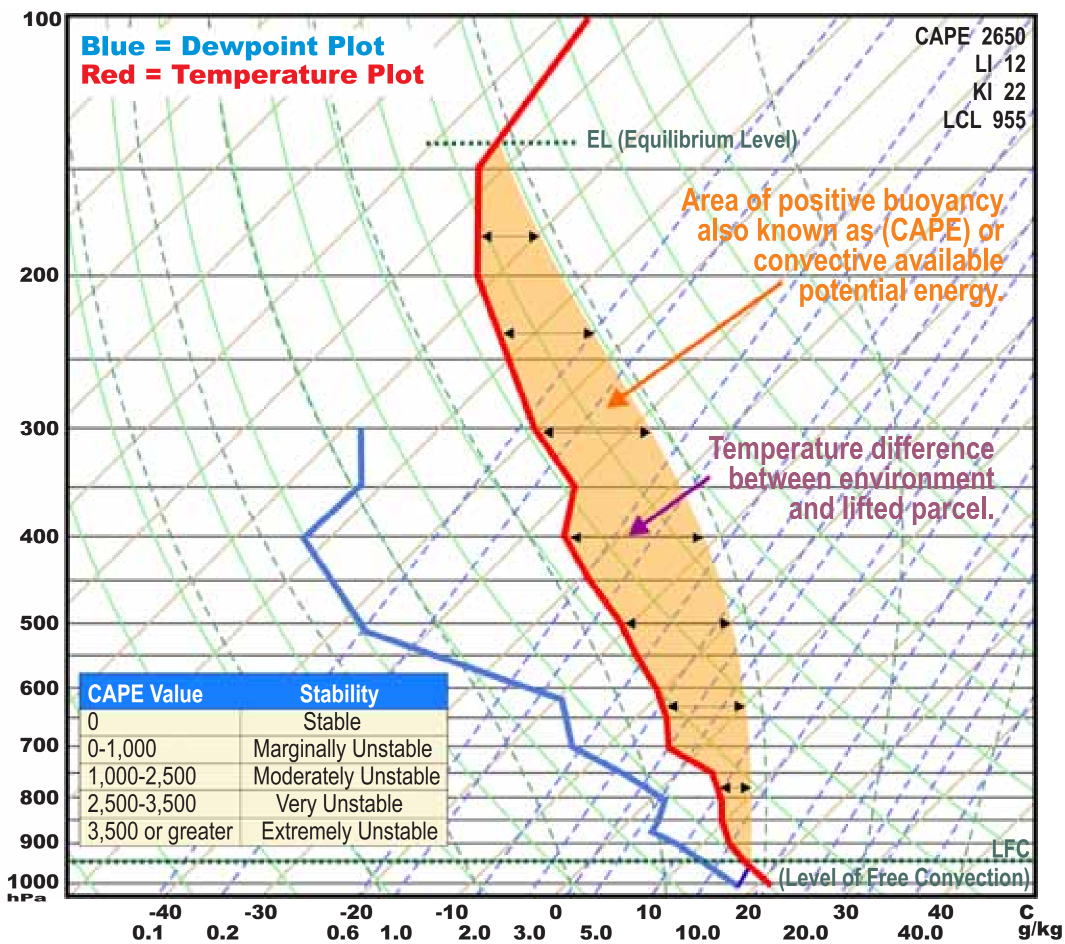


Figure 31. The CAPE value is the orange area above, measured between the LFC , the EL, the moist adiabat nearest where saturation occurred and the environmental lapse rate, and calculated in Joules/kilogram of air. CAPE provides a good assessment of updraft potential in convective clouds.

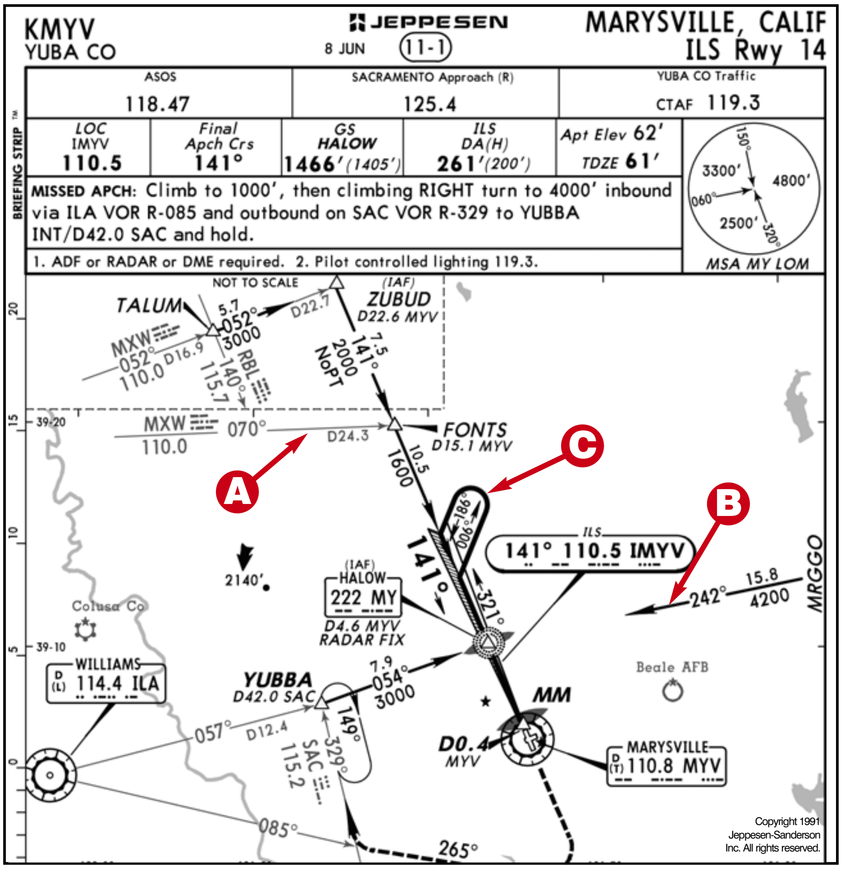


Figure 16A. Comparison of line thickness in Jeppesen's chart with the NACO chart below.

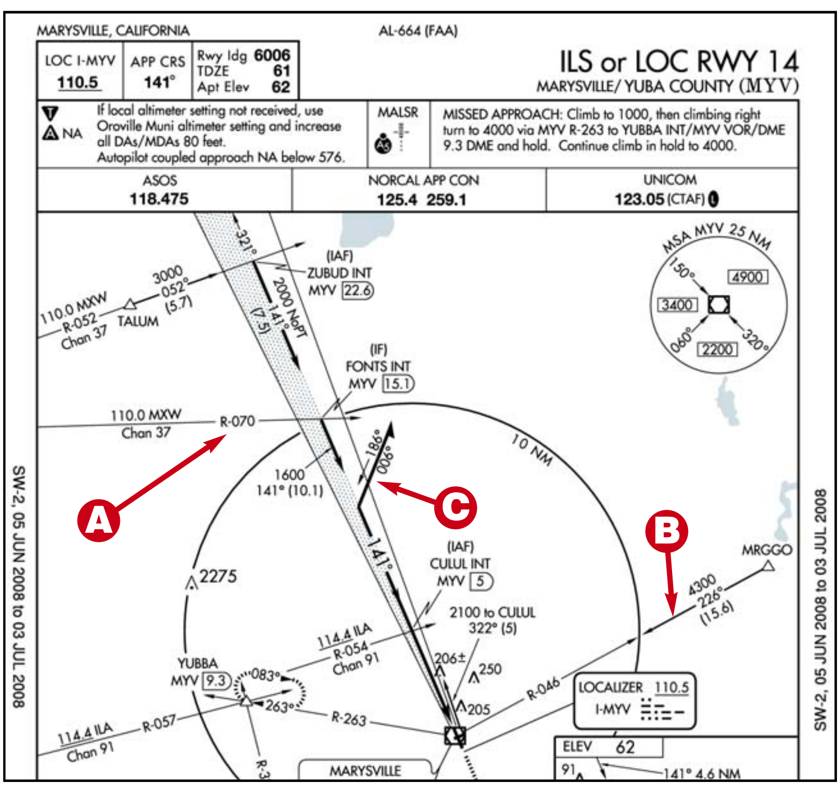


Figure 16B. Comparison of line thickness in NACO chart with the Jeppesen chart above.

separating medium from minimum thickness on NACO charts, a specific line can be identified as a feeder route because altitude, direction and distance will always be listed. The route from MRGGO intersection along the 242 degree bearing to HALOW LOM lists the three criteria for non-radar flyability.

Deciphering Feeder Routes

Government authorities use metal strips to band certain birds. The strips are inscribed *Notify Fish and Wildlife Service, Washington, D.C.* Previously, the strips read, *Wash. Biol. Surv.* This was an abbreviation for *Washington Biological Survey*. The strips were changed after a Vancouver farmer complained to the United States Government. He wrote: "Dear Sirs: I shot one of your crows a few days ago and followed the instructions attached to it. I washed it, boiled it and served it. Worst thing I ever ate! You folks shouldn't be trying to fool people with things like this..." It seems that the government, however unintentionally, is still fooling people, especially those in the aviation community.

For instance, if you're shooting the ILS Rwy 29R approach into Stockton,

(Figure 17), you might be in for a surprise similar to what the Vancouver farmer experienced. Suppose you received a clearance for the approach while over the Manteca VOR. Assume that radar service is not available. What would be the correct procedure to follow? Sorry, but canceling IFR is not one of the options. There doesn't appear to be a routing from the VOR to the approach procedure track. At least, there is no medium thick line to indicate a route that's flyable without a radar assist. A closer inspection of the Manteca VOR indicates that all three criteria required for a feeder route are listed underneath the frequency box. Although not easily identified, the altitude, direction and distance to JOTLY is clearly depicted. This is an acceptable feeder route onto the approach course, even though a medium thick line is not shown.

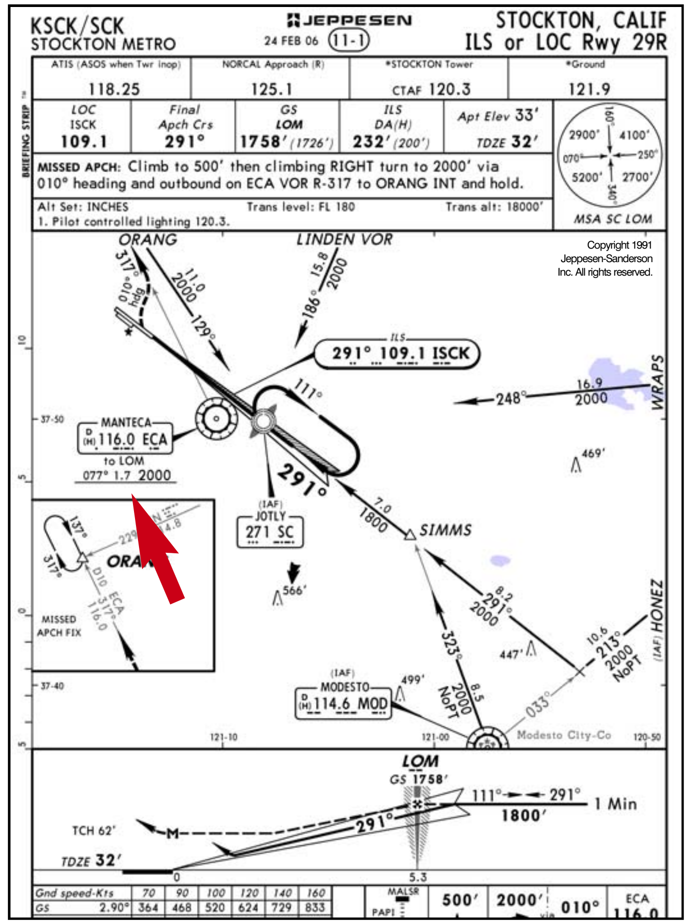


Figure 17. The feeder route from Manteca VOR to the approach procedure track is shown below the VOR box.

Sometimes chart logistics make it impossible to place a line that would be readable, so the information gets re-routed and the feeder route criteria are listed under the navaid in question. Clearly, a medium thick line, drawn from the VOR to the LOM, would not be visually apparent. NACO charts, however, may show something different. Figure 18 reveals a very small, medium-thick line routing from the Manteca VOR with the altitude, direction and distance listed. If you look closely you can see it right next to the ink molecules that make up the VOR. Jeppesen apparently considered it too much of a strain on your eyes to draw it the same way.

It's often easy to be visually deceived. A gambler at a racetrack once bet on a horse named "Boy George." This horse came in last. Unfortunately, it wasn't a horse, it was a

He Who Laughs Last

Several years ago, at a Southern California airport, a controller and an airline pilot had a tense encounter. It seems that just after the airline pilot rotated for takeoff, the controller mentioned that the pilot took a little too long on the runway and created an aircraft spacing problem. The pilot wasn't in any mood to hear this and said, "Hey buddy, if you think you can do it any better, why don't you come up here and fly this thing?" The controller didn't respond immediately. About 10 seconds elapsed then the controller issued the pilot a new clearance. The pilot said, "Hey, I can't accept this clearance, it will take me to the airport I just departed from. What's the matter with you guys?" The controller replied, "Well, what do you expect? If you want me to fly that thing you're going to have to bring it back."

Author

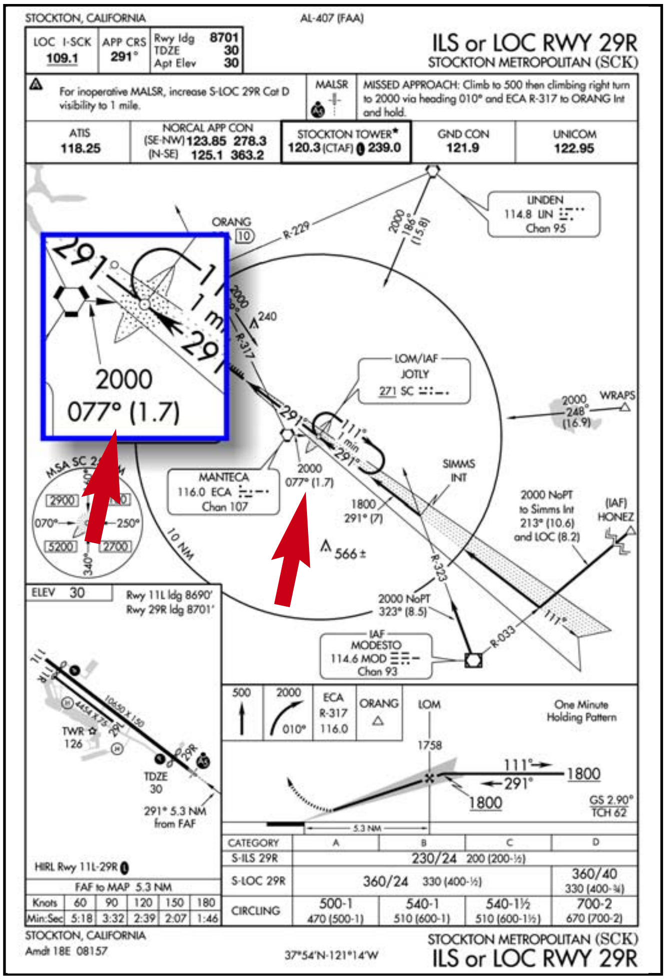


Figure 18. NACO chart variation in feeder route depiction from over Manteca VOR as compared to Figure 17.

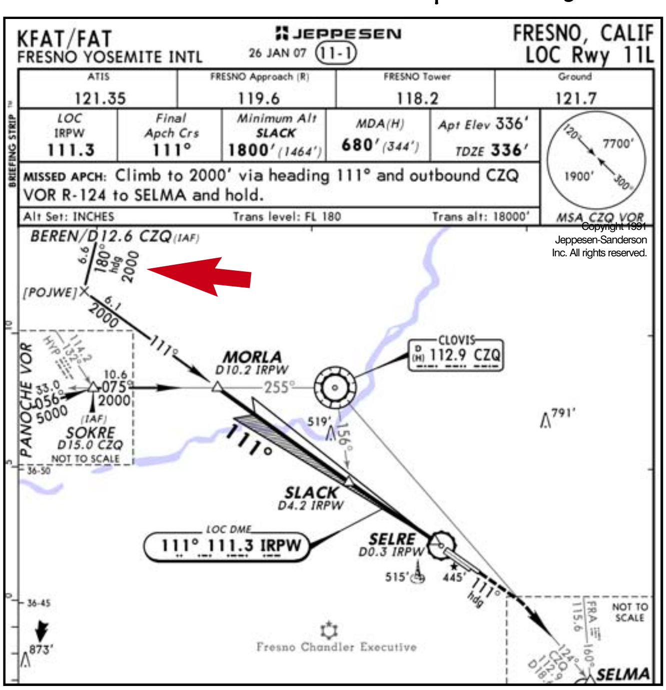


Figure 19. Dead reckoning route shown from BEREN to the localizer.

cow dressed up like a horse! Approach charts can fool you in a similar way. If you are confused about the routing for an approach clearance, look at the navaid box nearest your position. Feeder routes may be listed without being accompanied by darker, medium-thick lines. If that doesn't clear up the confusion, it's time to swallow your pride and ask. *If you don't know, don't go.* When it comes to interpreting an approach plate, there are no safe assumptions.

Direction Without Correction—Dead Reckoning Routes

In addition to altitude, direction and distance, feeder routes always imply the means of navigation to be used to get on the approach structure. Normally, this will be via VOR or NDB navigation. On occasion, no electronic means of navigation is used. That's right, nothing! It's possible to have a feeder route that has no means of electronic navigation. This is one case where you don't have to worry about your instructor saying, "Hey, center that needle." Instead, your instructor will say, "Hey, keep that heading constant." Here's why.

Figure 19 shows the Fresno LOC Rwy 11L approach. If you're located at BEREN intersection and cleared for the approach, you would fly a 180 degree heading as shown by the letters "hdg" next to the route direction. Essentially, you are flying via dead reckoning. I've always thought this was a really unfortunate choice of terms, but it's part of our aviation heritage, I reckon. Other than radar vectors, this is the only time it's legal to fly IFR without some navigable signal to follow. A heading of 180 degrees is flown until intercepting the localizer. Should any attempt be made to correct for wind? No, wind correction is neither required to use the glideslope when descending to the circling MDA at Van Nuys. The “LOC GS out NA” statement is Jeppesen’s method of saying that you are required to use the glideslope while descending to MDA on this approach, despite its culminating in an MDA as opposed to a DA.

Figure 18C shows the NACO version of this chart. It states, “APPROACH NOT AUTHORIZED WHEN GLIDE SLOPE NOT USED” in the minimums section. The reason the glideslope must be used for this procedure, and others similar to it, is to keep the airplane above the dangerous obstructions depicted along the approach procedure track. I really can’t speak for other pilots, but I would certainly feel a little discomfort if I looked out my window while in the clouds and caught a glimpse of a mountain goat! All the more reason to respect glideslope information. When ILS procedures list localizer minimums, and don’t show (GS out) restrictions, pilots experiencing glideslope failure can descend to the MDA and complete the approach as a nonprecision procedure. This is a good reason to always start timing when over the FAF on an ILS.

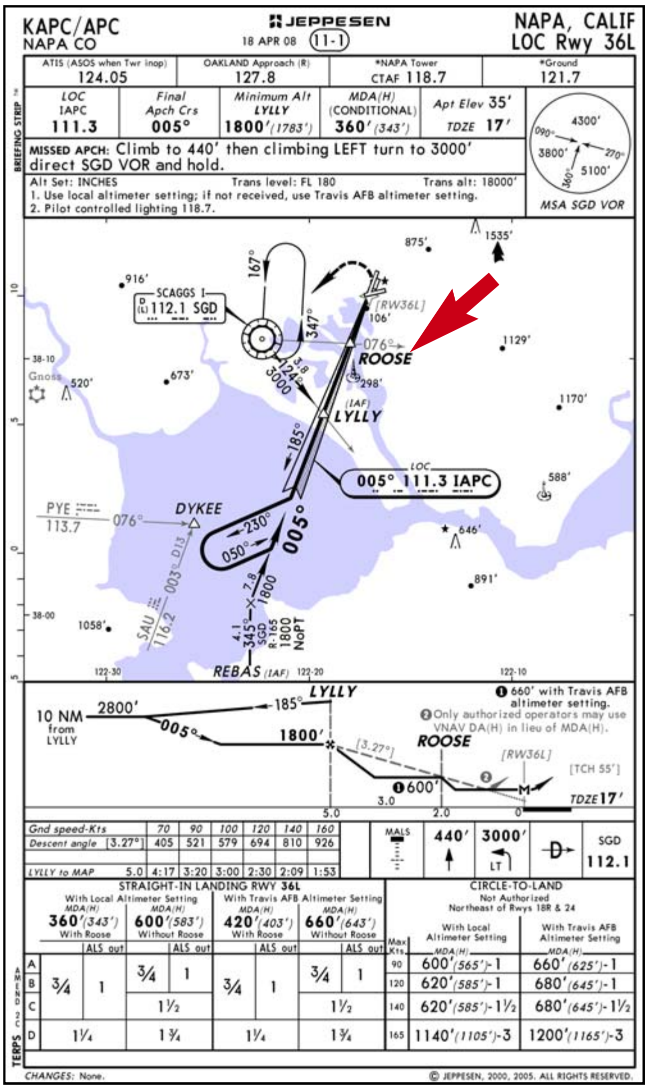


Figure 19A. ROOSE intersection is a stepdown fix inside the final approach fix.

Stepdown Fixes

A stepdown fix is found between the FAF and the MAP. It’s associated with nonprecision approaches and serves a double purpose. First, a final approach segment can have excessive length. Yes, you can have too much of a good thing. FAA requirements state that when the final approach segment exceeds six miles, the MDA must be increased by five feet for each one-tenth of a mile over six miles. The intent is to protect you from flying long segment lengths at very low altitudes. Errors in timing, navigation reception and weather related phenomena could present unusual hazards at low altitudes. The longer you’re exposed, the greater your risk.

Second, when obstructions are present along the final approach segment, a stepdown fix may be established inside the final approach fix, allowing a lower minimum for the procedure. These stepdown fixes will be established when at least an additional 100 foot descent can be achieved. Figure 19A shows the LOC Rwy 36L approach at Napa, California. ROOSE intersection is a stepdown fix inside the FAF. An altitude of 600 feet would be maintained until reaching ROOSE, then a descent to 360 feet could be made with a local altimeter setting. If you had only a single VOR, you could legally identify the stepdown fix by tuning the 076 VOR cross radial from Scaggs VOR, identifying ROOSE, then returning to the localizer. Things would get busy on this approach while changing frequencies to identify the stepdown fix. In fact, your hands would be moving so fast it would be like watching a Bruce Lee whop-and-chop karate movie. Figure 19B shows the NACO version of the same approach chart.

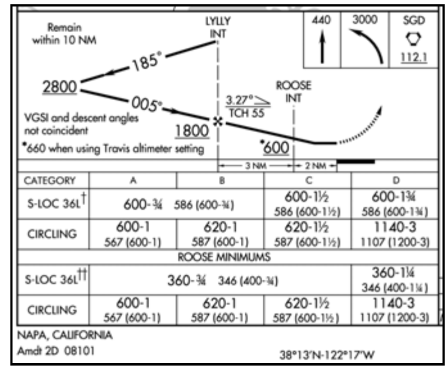


Figure 19B. The NACO version of Figure 19A.

There are times when additional equipment is required to identify a stepdown fix. Figure 20A shows the Ontario ILS 26L approach. The stepdown fix at BAKES requires DME to make the ID. This is a case where the plan view clearly shows the absence of a VOR radial identifying BAKES. The profile shows that BAKES is identified by the 3.8 DME off the localizer. It should (I hope) be clear that without DME, you can't identify the 3.8 DME fix. Figure 20B shows how the same stepdown fix minimum is listed on the NACO chart. Figure 20C shows how an outer marker and an altimeter setting can both be criteria for identifying and using a stepdown fix.

When instrument procedures are flight checked by the FAA, the procedure specialist carefully considers pilot workload. A decision is made on the practicality of identifying a stepdown fix requiring a frequency change while using a single radio. Where pilot workload is too intense to do this safely, a requirement for additional equipment will be listed. Figure 20D shows that either dual VORs or DME are required to identify

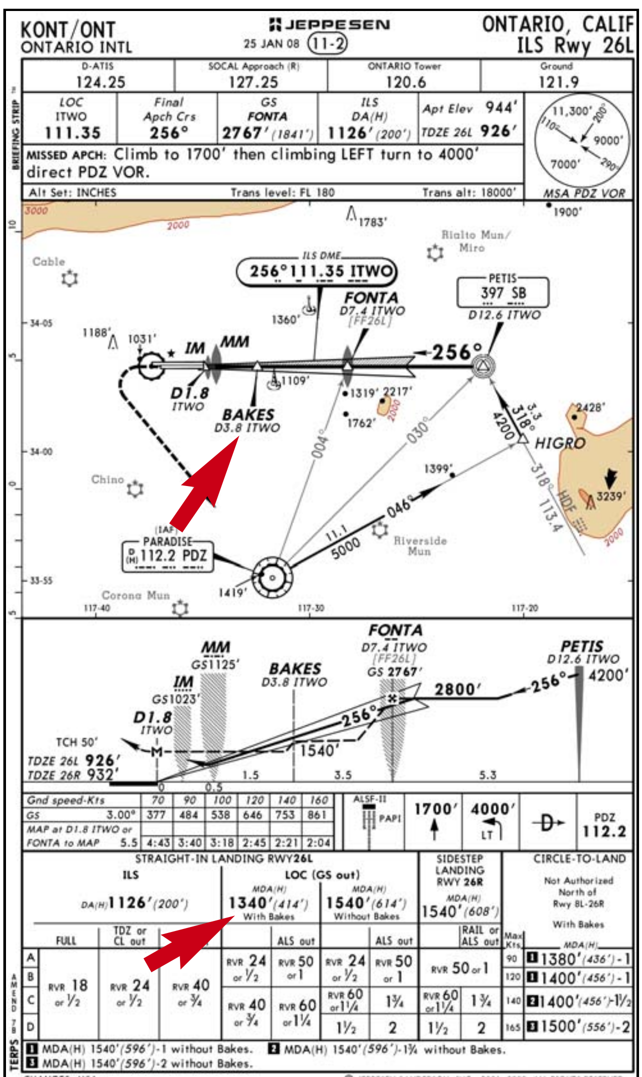


Figure 20A. The stepdown fix at BAKES requires DME to make the identification.

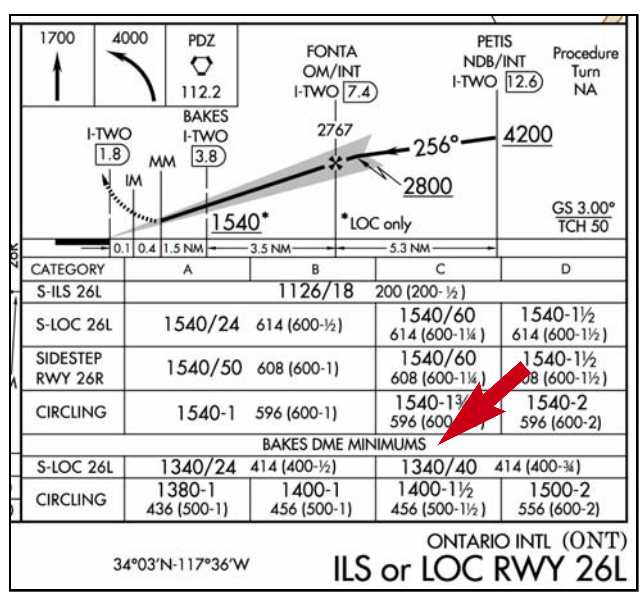


Figure 20B. The NACO version of the stepdown fix minimums in Figure 20A.

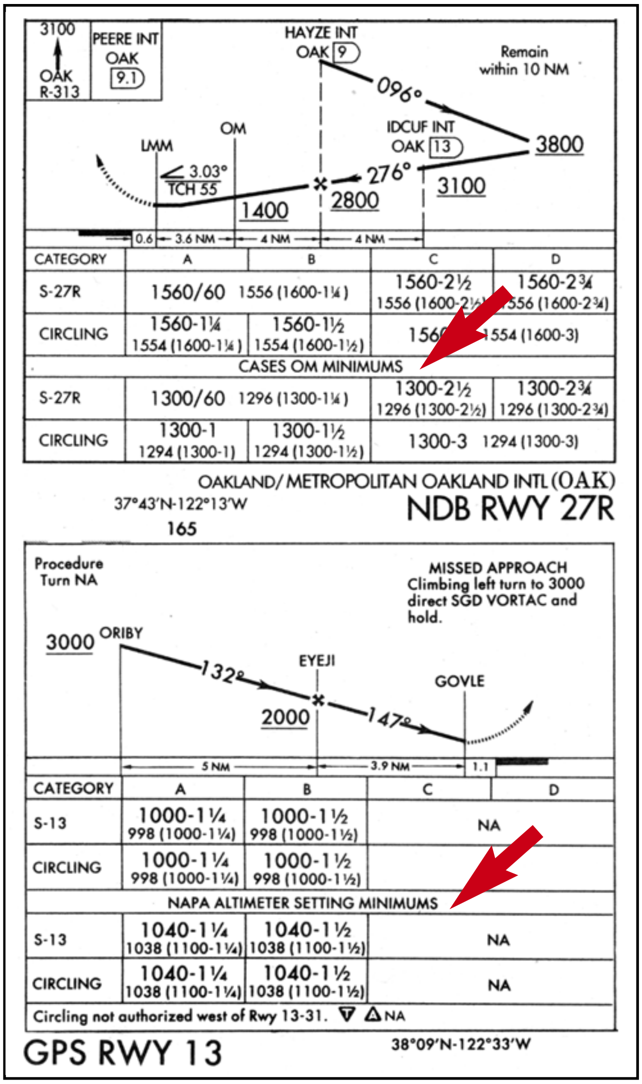


Figure 20C. The outer marker and/or altimeter setting can both be criteria for stepdown fixes.

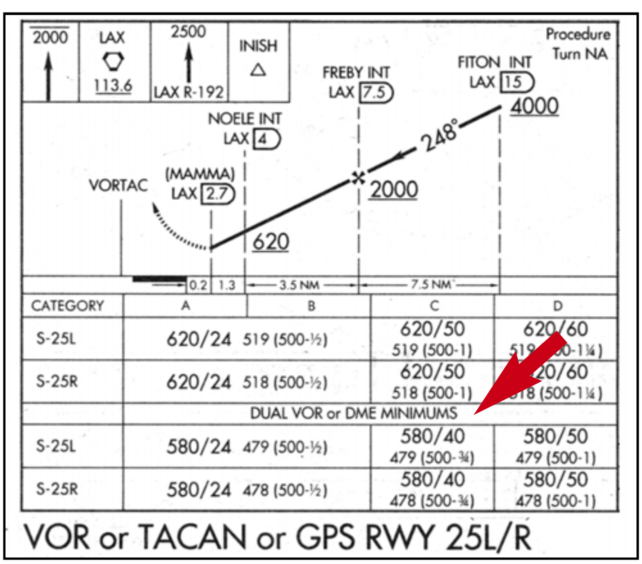


Figure 20D. Dual VORs or DME is required to identify NOELE intersection.

NOELE intersection (the only fix between the FAF and the MAP). If you see the words "DUAL VOR MINIMUMS" (or "LOC/VOR MINIMA") on NACO charts, then dual receiving equipment is required to identify that stepdown fix. Jeppesen will normally make this point clear with a note in the briefing strip.

When approaches are constructed, they are normally limited to only one stepdown fix inside the Final Approach Fix. The reason for this limitation is pilot workload. However, there are always exceptions to the rule. The Elko, Nevada LDA DME Rwy 23 approach, Figure 20E, shows three stepdown fixes inside the FAF. This procedure had to be approved by the Great Kahoona in Washington before it was charted. Fortunately, DME makes defining the intersections on this approach easy and

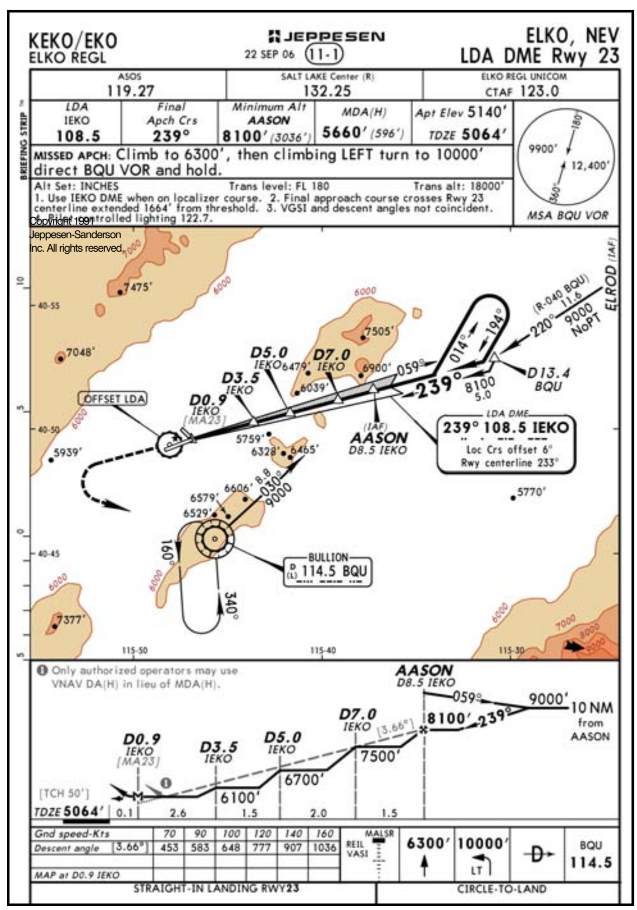


Figure 20E. Three stepdown fixes are shown inside the FAF at Elko.

Turning Inbound

When a holding pattern type procedure turn is shown, *it must be flown as charted*. No variations are allowed. This is *not* an area where you will be rewarded for innovation and creativity. *Au contraire*. Do your own thing and the FAA may enable you to be ground bound for a while, or at least invite you in for a little luncheon where you are the main course.

Standard entries should be made to the pattern for course reversal. When a procedure turn other than a holding pattern or teardrop course reversal is shown, you may fly any variation of the turn you want, as long as it's done in the maneuvering zone (Figure 5). Do not make the 45/180 reversal on the side opposite the maneuvering zone. You could easily run out of obstacle-protected airspace.

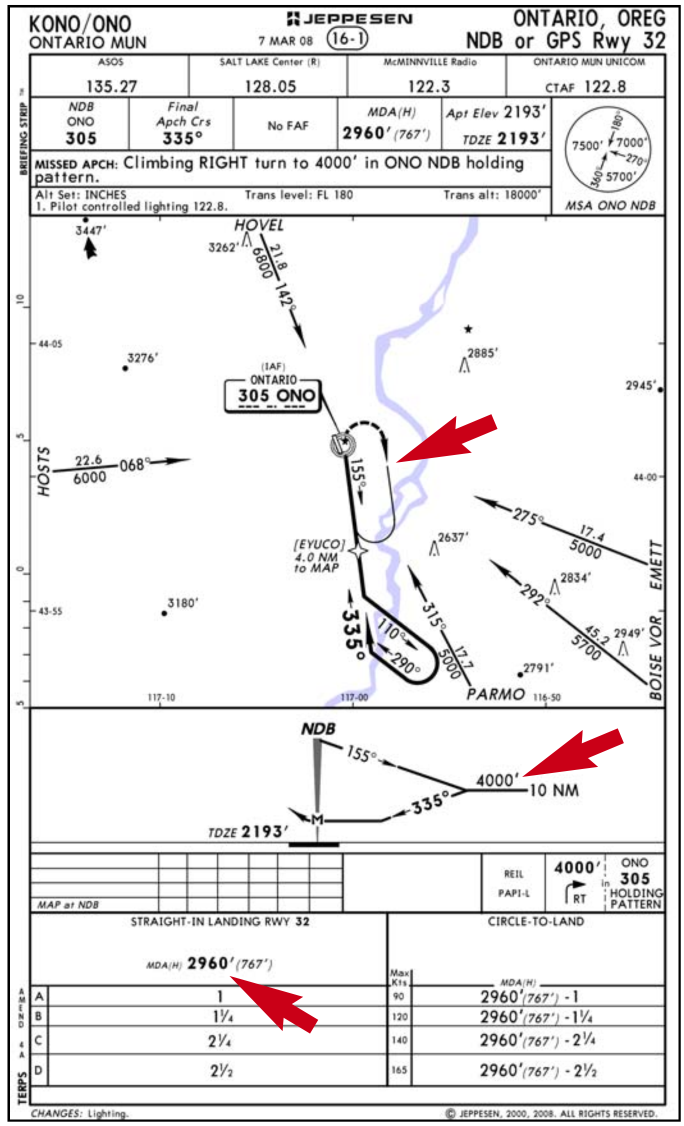


Figure 4 (Repeat). You can descend to 4,000 feet when outbound on the procedure turn.

It makes a lot of sense to fly what is published. What's published is guaranteed to work if you follow the directions. Besides, the act of flying is 99% discipline and 1% creativity. *Talking* about flying, on the other hand, is the other way around. If you have a compelling need to be creative, take an art class. That's why I enrolled in a Pablo Picasso correspondence art course. Unfortunately, I didn't do that well sketching people. I kept putting the eyes (all three of them) on the same side of the face.

While outbound on the procedure turn at Ontario (Figure 4), you can descend to a minimum of 4,000 feet. When inbound, you can descend to the minimum altitude shown in the profile or minimums section. The Ontario NDB or GPS Rwy 32 approach is peculiar in that it doesn't have a final approach fix. Therefore, the final approach starts when you are established inbound on the 335 bearing. At this point a descent to the MDA can be made.

Missed Approach Holding Patterns

It's easy to become confused about the purpose of the thin line holding pattern shown on the Ontario NDB or GPS Rwy 32 approach, in Figure 4. Thin line holding patterns are used for the missed approach. They are not part of the procedure turn. An aircraft making a missed approach at the NDB would simply climb in the NDB holding pattern, as published.

Chapter 14 - Procedure Turn Secrets

Many years ago, when a missed approach holding pattern was established on the procedure turn course, the FAA would place the following note on the IFR chart: "Approach from holding pattern not authorized, procedure turn required." This legend has disappeared from many IFR charts.

The FAA assumes that pilots holding at the NDB after a missed approach would execute the complete procedure turn if cleared for another approach. In the case of Ontario, while it's not illegal to start an approach from the missed approach holding pattern, doing so may require excessively steep descent rates to arrive at the MDA prior to the MAP. Therefore, it's best to fly a complete procedure turn when cleared for the approach from the missed approach holding pattern.

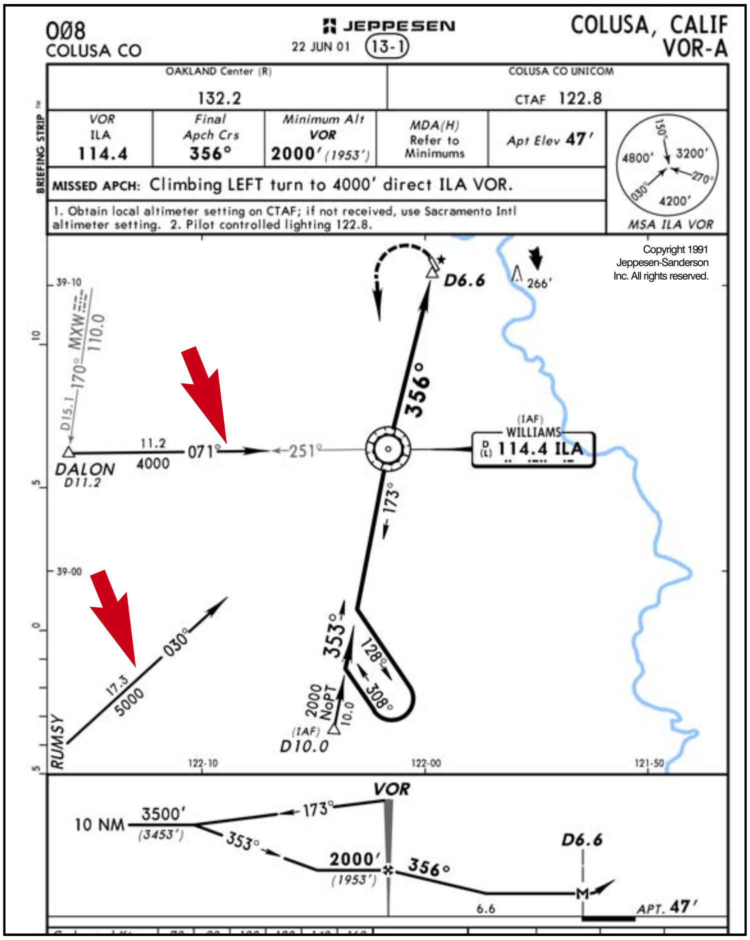


Figure 7. Feeder routes from RUMSY and DALON require that procedure turns be made.

Why Is It Required?

Often, it's not at all clear why a procedure turn is necessary, even though one is depicted. Since I've told you what the criteria are, you can turn figuring out why there is a PT for a given approach into a fun new hangar game. You might even use it to win a few candy bar bets, since you now know much more about procedure turns than most instrument pilots.

The VOR-A for Colusa, California (Figure 7) shows a feeder route from RUMSY intersection, located at the bottom left hand side of the plan view. This routing requires a procedure turn. However, it appears that it would be so much easier to turn straight in from over the VOR and descend to the MDA. I see a Hershey Bar here. Why is there a PT? Because turning straight in from the VOR would mean a descent profile similar to that used by the Space Shuttle. The minimum altitude from RUMSY to the VOR is 5,000 feet. The profile shows 2,000 feet for crossing the VOR inbound. This is a 3,000 foot drop! Your eardrums would probably pop out quicker than Champagne corks on New Year's Eve. The Williams VOR serves as both a final approach fix and as an initial approach fix. When the procedure turn is started over the VOR, Williams is acting as an initial approach fix. If the approach were allowed from RUMSY without a procedure turn, a 34 degree turn would be required to align the airplane with the final approach segment. This, too, flunks the FAA wholesomeness test. (See *Postflight Briefing #14-1* on Page 14-16 for additional procedure turn information.)

Trying to descend from 5,000 feet over Williams VOR to an airport elevation of 47 feet would probably cause you to land so fast that all three tires would be reduced to a puff of smoke. Controllers would get whiplash watching you land. Then they'd have to send a recovery team out to look for those eardrums.

Figure 8 shows the San Luis Obispo VOR-A approach. A feeder route from FRAMS intersection doesn't require a procedure turn. Notice the difference between the inbound course to the VOR and the final approach segment. It's 28 degrees. And there is no difference between the minimum altitude along the inbound routing and the FAF crossing altitude at the VOR. Both these minimum altitudes are 2,800 feet. Neither an additional descent nor a turn of more than 30 degrees is required to align the aircraft with the final approach segment. No PT. I'll have the Hershey Bar with almonds, please.

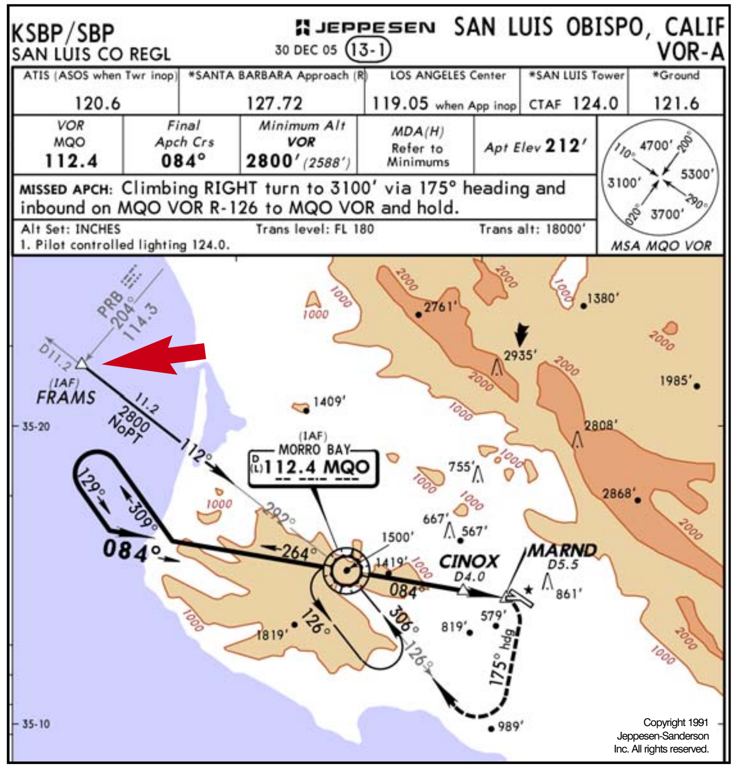
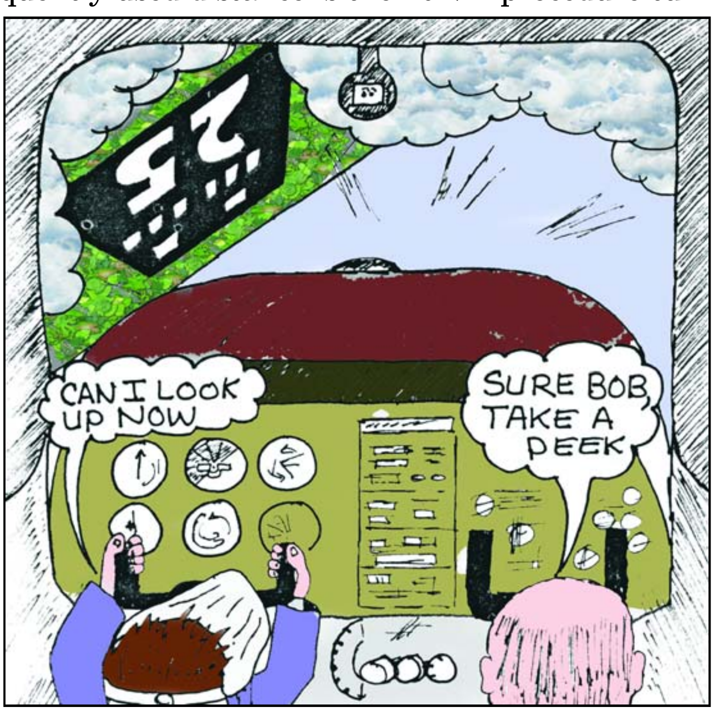


Figure 8. The feeder route from FRAMS intersection doesn't require that a procedure turn be made.

Procedure Turn Distances

Procedure turn distance limits are predicated upon the amount of altitude to be lost before turning inbound. Procedure turn distances vary from 5 to 15 miles. The most frequently used distance is the 10NM procedure turn, as shown in Figure 9. A 3,000 foot procedure turn altitude is shown, followed by a 2,700 foot glideslope intercept altitude. Once established inbound on the localizer, you may leave 3,000 for 2,700 feet.



You are not required to fly the entire distance shown in the profile when completing the procedure turn. You should remain within the depicted distance shown in the profile (10 NM in Figure 9), and turn when you are ready. In smaller airplanes, pilots sometimes fly procedure turns at 90 knots IAS. Assuming no wind, the aircraft is covering 1.5 nautical miles per minute. Traveling outbound for four minutes would put the aircraft six miles from USTIK (see Figure 9). This keeps the

Postflight Briefing 14#1

The Procedure Turn Entry Zone

As we've previously discussed, you may begin your descent to the outbound procedure turn altitude when crossing the fix from which the procedure turn begins (the PT fix). There are occasions, however, where altitude restrictions are placed on this descent. The ILS approach to Jackson Hole, Wyoming shows such a restriction with an *at or above* (minimum) altitude symbol (Figure 16, position A). When an *at or above* altitude symbol is shown next to the PT fix (QUIRT in this instance), then you must maintain this altitude (14,100 feet) until you're established outbound on the procedure turn. Then and only then may you descend to the published procedure turn altitude (13,100 feet in the case of Jackson Hole as shown in Figure 16, position B).

For instance, let's assume you're inbound to QUIRT from the northwest as shown in Figure 17. When crossing QUIRT and beginning your right turn to intercept the PT course outbound, you would normally begin your descent to 13,100 feet. Since an *at or above* altitude symbol is present next to the PT fix in the chart's profile view, you must remain at 14,100 feet until you're established outbound on the PT course. The reason for this restriction is the presence of obstacles/terrain in the entry zone (the green area in Figure 17). Older NACO charts show this restriction with a note in the chart profile view (Figure 16, position C). Jeppesen charts also identify this restriction with a note in the profile view. The absence of a chart note or an at or above symbol in the profile view means that the descent to the procedure turn altitude can begin immediately upon crossing the PT fix, regardless of the flight's direction.

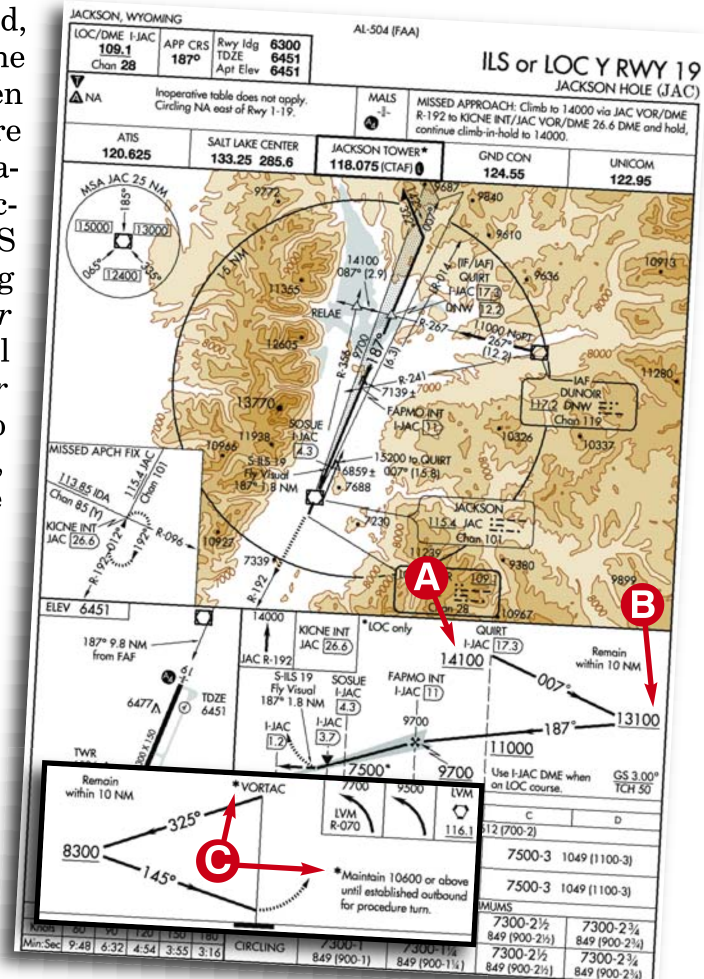


Figure 16. The "at or above" symbol in the profile view next to the PT fix indicates that 14,100 feet must be maintained until established on the outbound PT course. Older NACO charts (or current Jeppesen charts) identify this restriction with a chart note.

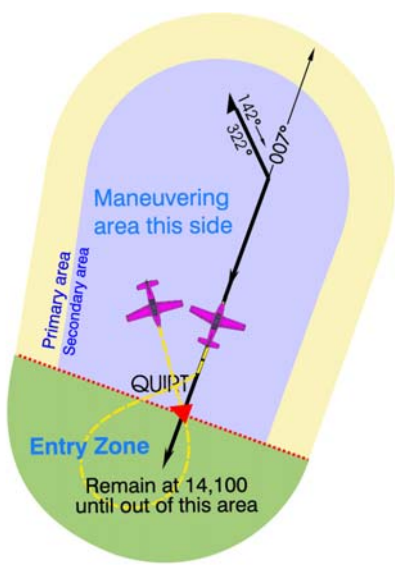


Figure 17. The PT entry zone (green area) for the ILS at Jackson Hole, Wyoming.

U.S. approach lighting systems have them. It serves several purposes. First, the decision bar (Figure 5) creates a reference to the horizon that's useful when making a visual transition from instruments. While the threshold lights may be off in the distance, the decision bar is closer to the airplane. It acts to help you keep your airplane's wings level during a low visibility landing (Figure 6).

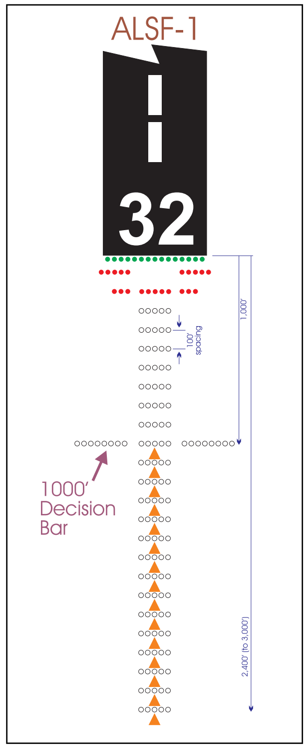


Figure 5. The 1,000 foot decision bar.

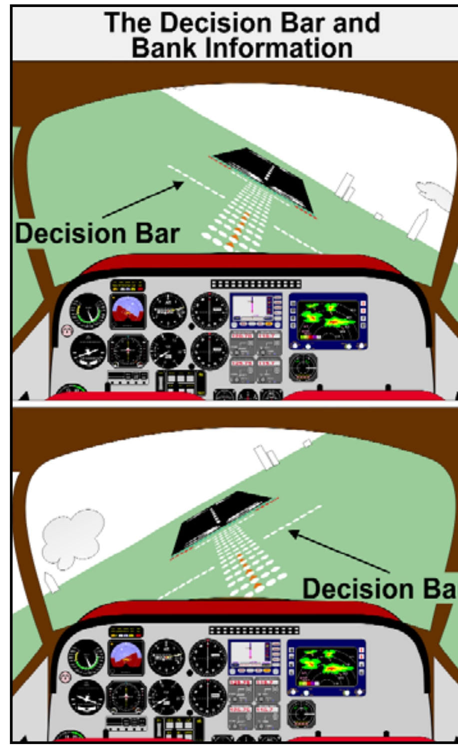


Figure 6. The decision bar as it appears from the cockpit.

When the aircraft is on the glideslope at Decision Altitude, the decision bar will usually be seen going underneath the cowling, as shown in Figure 7. This may at first appear quite contradictory. If the decision bar is located 1,000 feet from the threshold and Decision Altitude is located near the middle marker (.4 to .7 NM from the threshold), how can the decision bar appear to be going underneath the cowling? The answer lies in your observation angle. While looking in a forward and downward angle from this height, based on the average arrangement of aircraft cowling, panel and pilot sitting height, it will appear that the decision bar is just disappearing below the dashboard, as shown in Figure 8.

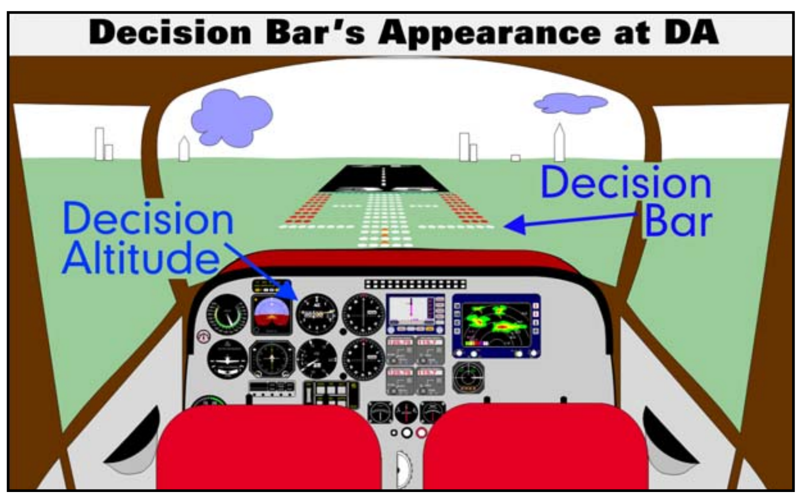


Figure 7. The decision bar appears just over the nose when the airplane approaches Decision Altitude.

Second, the position of the decision bar explains why sequenced flashing lights, found on some approaches, stop at the decision bar. These balls of light, flashing twice per second, could be a real distraction during the transition from Decision Altitude to touchdown. Fortunately, the sequenced flashers end at the decision bar. At DA, these strobes disappear underneath the cowling and are no longer a distraction. Prior to Decision Altitude, the sequenced flashing lights help point you in the direction of the runway (Figure 9).

This explains why some pilots ask controllers to turn off the flashers when they have spotted the runway prior to Decision Altitude. The professional jargon to use in asking

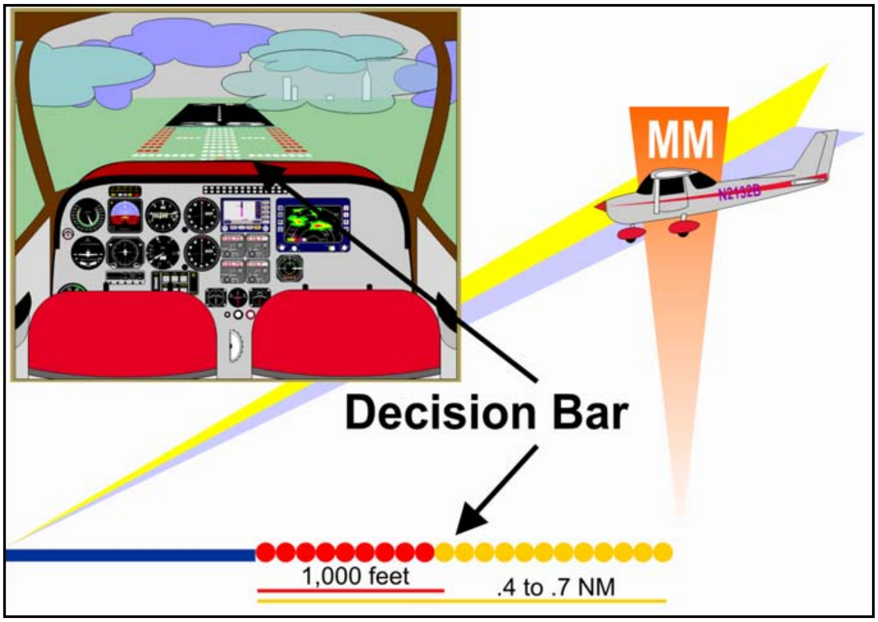


Figure 8. At or near DA, the decision bar is usually visible over the panel.

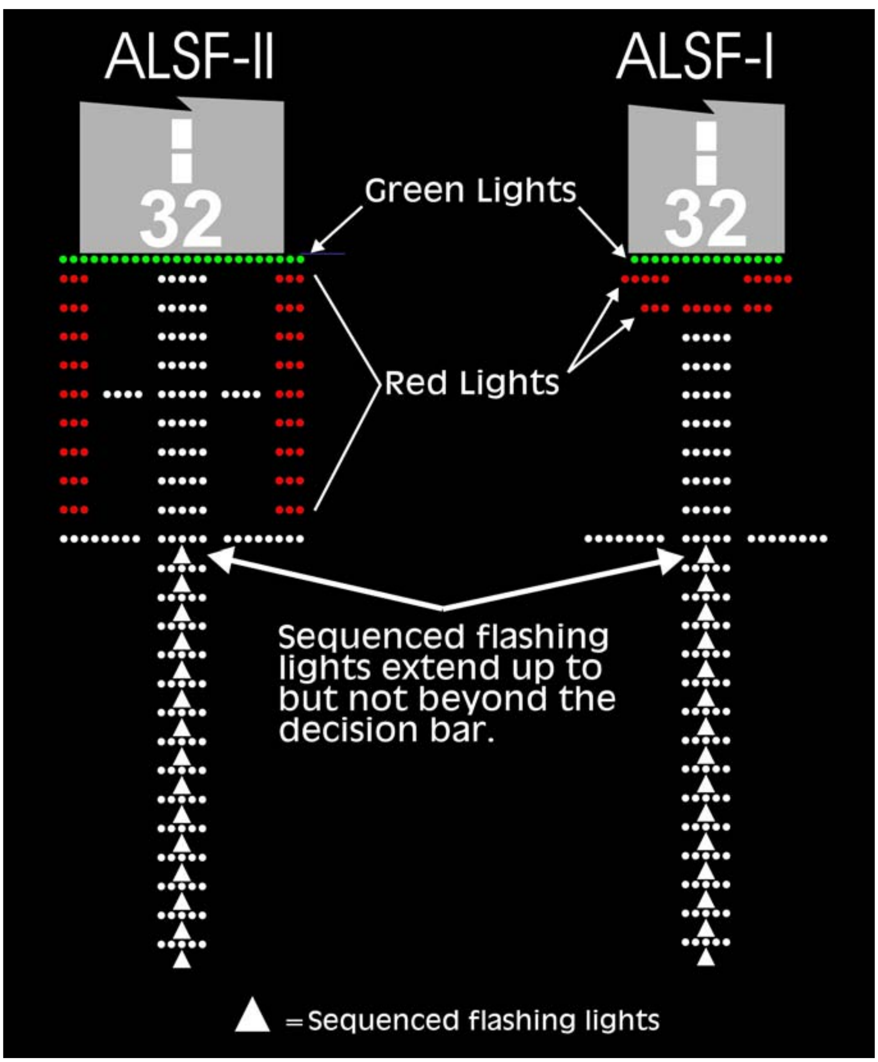


Figure 9. Sequenced flashing lights don't go beyond the decision bar.

the controller to turn off the sequenced flashers is, "Kill the rabbit." I had one gentleman in a seminar, several years ago, who thought it was actually, "Kill the parrot." I had to inform him that he was killing the wrong thing. He said, "Oh, maybe that explains why they never turned it off." He couldn't honestly say no birds were harmed in the making of his approaches, though all his approaches were *fur* sure.

Third, the decision bar is a valuable aid in helping pilots gauge in-flight visibility. If the aircraft is at the middle marker, and the runway threshold cannot be seen, you should look for the decision bar. If the middle marker is .6 miles (3,600 feet) from the runway threshold, and the

IFR Wisdom

A young student pilot
from Lyme,

Whose negligence
seemed just a crime

Took off one fine day

In the most careless way

Said, "I'm lost but I'm
making good time."

Ellis S. Nelson

decision bar is visible, then the visibility from the cockpit is 2,600 feet (Figure 10). If the approach minimum calls for a half mile visibility (2,640 feet), the minimum visibility requirement for landing is met (I'll give you the 40 feet).

Similarly, if the middle marker is .5 miles (3,000 feet) from the threshold, and the decision bar is spotted but nothing is visible inside the decision bar, the estimated in-flight visibility is approximately 2,000 feet. Based on this estimate, the approach minimum of a half mile visibility (2,640 feet) would not be met.

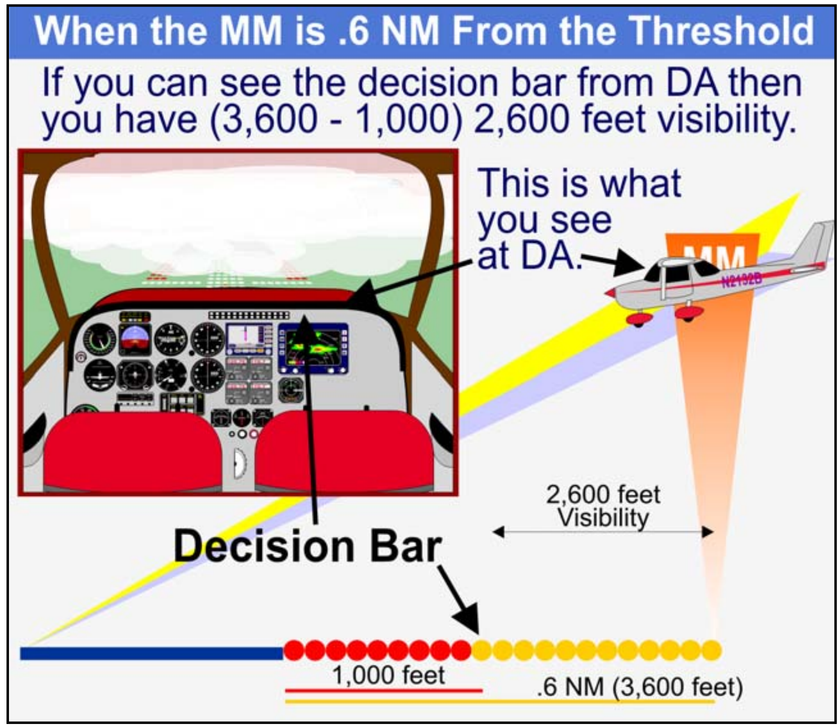


Figure 10. Determining in-flight visibility at Decision Altitude.

A word of caution is appropriate here. FAR 91.175 C2 specifically requires that, to descend below DA or the MDA, the flight visibility can't be less than that prescribed in the approach procedure being used. Another regulation in the same section, FAR 91.175 D, specifically states that no pilot may land an airplane if the flight visibility is less than that specified in the procedure. Having the required visibility at Decision Altitude is no guarantee that it won't change as you approach the runway. A lot can happen in the seven tenths (or less) of a nautical mile from the ILS missed approach point to touchdown. If, upon reaching the runway, the flight visibility has decreased below that required, then a missed approach must be made.

Always be prepared for a change in visibility when approaching the runway. The most likely cause for such a change in visibility is variable cloud density near the touchdown zone. This is one reason why professional pilots pay special attention to varying Runway Visual Range (RVR) values. This usually indicates that visibilities near the runway could be much different from those found at Decision Altitude.

You can make a more refined estimate of in-flight visibility by using the distance between the individual approach light bars. Figure 11 shows two of the basic approach light structures available in the U.S. The ALSF type has light bars, separated by 100 feet, along the lighting system. The MALS and similar approach lighting systems have light bars separated by 200 feet. The number of lighting bars you can see beyond the decision bar will help you more accurately estimate the in-flight visibility. If you're at the middle marker and are using an ALSF system and can see three light bars past the decision bar, you have an additional 300 feet of visibility.

At this point you may be wondering, "Do I have enough synaptic connections to handle estimating in-flight visibility at 90 knots in bad weather?" Unless you took too many fizzies in the 60's, the answer is a qualified, "Yes."

in Figure 36. The magenta line/arrow from GMN to DERBB in the Active Flight Plan window indicates that GMN to DERBB is the active leg of this flight plan. By returning to the moving map display, you'll see your new route to San Jose (Figure 37). (Note: I sometimes switch from Nav Page #1 to Nav Page #2 because the latter allows me to show you a more complete picture of the flight planned route in these examples.)

Figure 36. DERBB intersection has now been added between GMN and AVE VOR's.

Figure 37. On Nav Page #2, you can see your new routing to San Jose airport.

Now that you understand Leg and OBS Modes, flight plans and how to edit them, you're ready to fly any of the instrument approaches, STARs or DPs stored in your GPS's database. This is what you've been waiting for, and it's exciting. Remember, not all GPS units are alike. They do, however, have many similarities, and you'll find that knowing how the Garmin 530W works will help you better understand how other GPS units work. I can't emphasize enough how important it is for you to study your GPS owner's manual to learn all the details peculiar to your personal unit. It's also very helpful to download the GPS PC simulator that many manufacturers make available for their products. This allows you to learn your GPS at home in your Spiderman pajamas (if that's how you dress at home, and what pilot doesn't?).

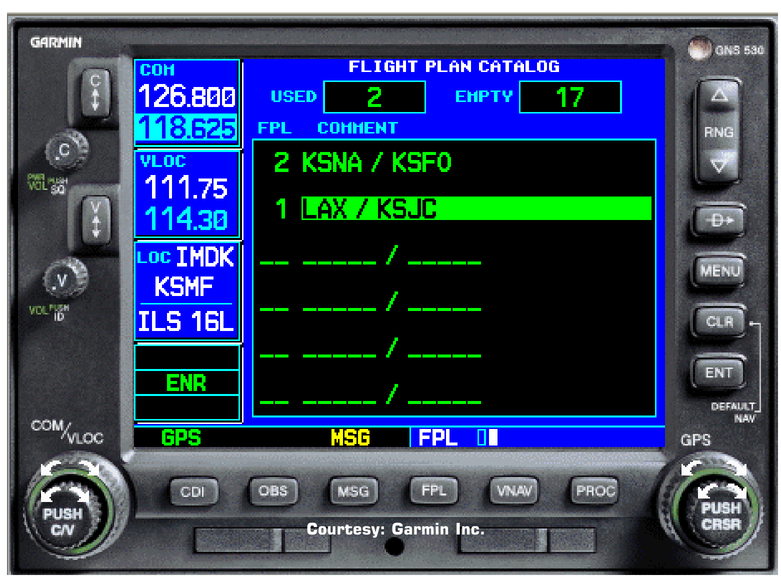


Figure 38. When returning from San Jose to the Southern California area, push FPL and twist the pull-turn knob once to open the "Flight Plan Catalog." Highlight your previous routing and press MENU.

GPS Approaches

Let's assume that you landed at San Jose and have, once again, claimed it for Spain. You are now ready to return to the Southern

Chapter 20 - The GPS Machine

California area. You've obtained your IFR flight plan and think you're having a major heart attack because the route you filed for is the exact same one you received. Surely something must be wrong here. After defibrillating yourself, you should query ATC several times just to make sure they aren't playing some sort of cruel joke on you. Quick, get someone to pinch you because it's your lucky day.

Since you have your original flight plan stored in the 530W, bring it into view by pushing FPL, rotating the pull-turn knob once to show the Flight Plan Catalog window, then highlighting the LAX-KSJC flight plan (Figure 38). Then push the MENU button and highlight *Invert & Activate FPL?* as shown in Figure 39. Finally, push the ENT button, which inverts and activates your return route as shown in Figure 40. The one small addition you'll add to your return route is from LAX VOR to SLI VOR. Add this route section (as you've learned how to do) to the end of your flight plan as shown in Figure 41.

Let's assume you've flown the installed route, have just entered the Los Angeles area (Figure 42). You now decide that you're going to land at Long Beach airport just so you

Figure 39. When the "Page Menu" opens, highlight "Invert & Activate FPL?" Press ENT which inverts and activates your return route.

Figure 40. Your original flight plan from LAX VOR to San Jose airport has been inverted and the KSJC-HENCE leg activated.

Figure 41. The SLI VOR has been added to the end of your routing past LAX VOR.

Figure 42. The routing above on Nav Page #2 indicates that you're enroute to LAX VOR.

can see how long their beach really is (I've seen the tiny sandbox they call a beach, which is why it should be called *Not So Long Beach*).

After looking at the approach charts for Long Beach, you elect to fly the RNAV (GPS) Z RWY 30 approach (Figure 43). It appears that SLI VOR (the end point of your flight plan) is a fix that takes you to an IAF (OYSUP intersection), therefore your present flight planned route allows you to transition onto the approach structure (It makes no sense to select a route to a fix where there's no feeder route by which you can transition onto the approach structure, right?)

At this point, you should consider loading the RNAV (GPS) Z RWY 30 approach into your GPS. Before doing this, it's important to understand that instrument approaches, as well as DPs and STARs are in stored in your GPS's database. If you wanted to fly an actual instrument approach that isn't in your GPS's database, then you should get out of aviation because this wouldn't be legal. In other words, it's not legal to create your own waypoints to fly a *home-made* instrument approach in IMC. Nor is it legal to fly the routing shown on an approach chart in IMC if that approach isn't loaded or activated. The main reason for this is that by loading/activating and flying an approach that's in your database, your GPS will automatically change its CDI sensitivity to match the protected area provided for the approach. By making up your own approach, CDI scaling won't take place, and this places you and your passengers at greater risk of terrain or obstacle collision. Therefore, to fly an instrument procedure with your GPS, you must select the specific procedure

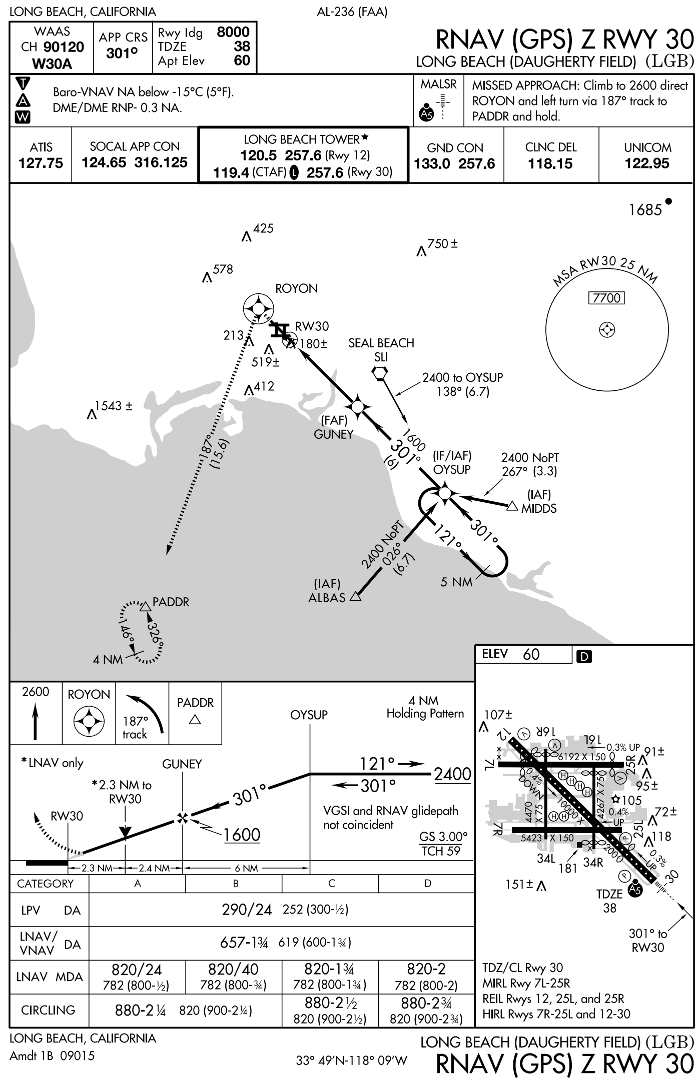


Figure 43. The RNAV (GPS) Z Rwy 30 approach to KLGB.

Figure 44. To load an instrument approach into your GPS, press PROC to open the "Procedures" window. Then highlight "Select Approach?" and press ENT.

you need (i.e., instrument approach, DP or STAR) from the appropriate GPS menu then make it your *active flight plan* at the appropriate time.

Let's load the RNAV approach into your flight plan by pushing PROC (for Procedure) and highlighting and entering (ENT) the *Select Approach?* option (Figure 44). When the next window opens, move the cursor to the *Approach* box and rotate the small pull-turn knob to select the RNAV 30 approach (Figure 45). By pressing ENT again, you are given the option of choosing how you want to transition onto the approach structure (Figure 46). In the case of Long Beach, there are three IAFs, one VOR and the Vector transition from which to choose. More on the *Vector* transition shortly. For now you should choose SLI as your transition, since this is where the flight plan takes you. Press ENT and select SLI as your transition using the small pull-turn knob (Figure 46). Now press ENT again and select either *Load?* or *Activate?* (Figure 47). Load the approach by selecting *Load?*, which will add the approach onto the end of your flight plan while keeping the rest of your flight plan intact as shown in Figure 48.

Figure 45. When the "Approach" box opens, move the cursor to RNAV 30 (GPS) and press ENT to select this approach.

Figure 46. After pressing ENT, you are given the choice of approach transition. Scroll down to SLI and choose this option by pressing ENT.

Figure 47. Select "Load" or "Activate" then press ENT. You should select "Load" here.

Figure 48. By "loading" the approach, its routing was appended to the end of your flight plan.