

# When It's Time To Reverse Course

*There continues to be confusion about course reversals, even within the many factions of the FAA.*

**By Wally Roberts**

THE TERPS HANDBOOK STATES that “a procedure turn shall be specified when it is necessary to reverse direction to establish the aircraft on an intermediate or final approach course, except as specified in paragraph 234e.” Except for the obtuse reference to “paragraph 234e” it seems simple enough, right?

## TERPs context

Well, it really isn't all that simple. What is easy, though, is to take a short statement like the above out of TERPs and, in the process, take it way out of context. This is done not only by pilots and instructors who are seeking the ultimate clarification about all the nuances of instrument approach procedures (IAPs), but also by the FAA staff who are charged with getting bits and pieces of this stuff into the AIM.

The TERPs Handbook is something like the ultimate French cookbook. You can read it and read it, but unless you've been through the complete chef's course and have done a fair amount of cooking, much of it loses both context and real meaning. The “chefs” in this context are the procedures specialists who draw up IAPs, not the pilots who fly the system. If the procedures specialist puts the IAP together correctly, then it should be intuitive and simple for the competent instrument pilot to fly. Let's tear apart the brief excerpt from above, which is extracted from TERPs, Paragraph 234, “Initial Approach Segment Based on a Procedure Turn.” By reading the title, we gain the understanding that a procedure turn (PT) is a form of an initial approach segment. The context of Paragraph 234 would make this obvious as well—it's within the section pertaining to all initial approach segments.

Let me add some context [in brackets] to the operative language before we dissect it further: “a procedure turn

shall be specified [by the procedures specialist who designs an IAP] when it is necessary to reverse direction [the feeder route or airway doesn't line up properly with the rest of the IAP] to establish the aircraft on an intermediate or final approach course [alignment limitations differ greatly, depending on whether the procedure turn fix is the intermediate or final approach fix], except as specified in paragraph 234e. [the sole exception is a course-reversal holding pattern in place of the PT].”

## Three types of course reversal fixes

1. Where the PT is predicated on the intermediate fix (IF), any terminal route that leads to the IF will have “NoPT” designated if it requires no more than a 120-degree course change to track the intermediate segment (lead radials are required for a course change of more than 90 degrees), and the terminal route altitude permits straight-in descent within intermediate segment descent gradient limits.

2. Where the PT fix is predicated on the final approach fix (FAF), any feeder route that feeds to that fix always requires a course reversal. There is an option, but it's for the procedures specialist during design of the IAP: if the intermediate course is aligned within 30 degrees of the final approach course,

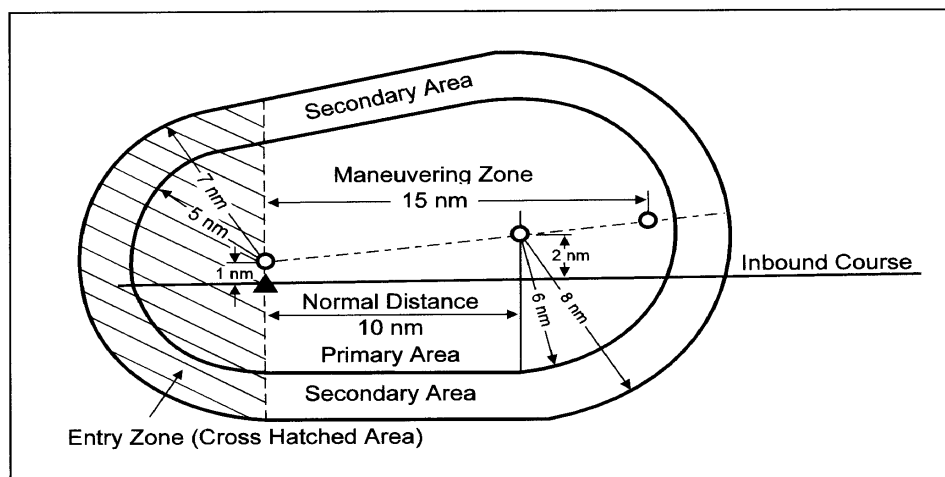
and the FAF is an NDB or VOR, then NoPT is authorized. The final approach segment must be at least minimum length specified elsewhere in TERPs, in order to have an adequate distance to make the final approach alignment and descent. The 30-degree course change limit is reduced to 15 degrees for GPS/RNAV IAPs.

3. Where the primary navigation facility (NDB or VOR) is located on the airport (within one mile of the runway for straight-in minimums and within one mile of the airport for circling only minimums), and there's no FAF, there will always be a PT, which will be predicated on the nav facility.

If any feeder route doesn't have “NoPT” and there's a course reversal specified in the IAP, the course reversal is required. This requirement is the subject of a lot of debate and heartburn, usually because of less-than-optimum IAP design at some locations, but more on this later. Where the feeder route leads to the FAF or on-airport/no-FAF nav facility, a feeder route can never be “NoPT.”

## Course-reversal holding pattern

Where the procedures specialist needs a course reversal, but doesn't have the airspace wiggle room (either nearby higher terrain or ATC facility airspace



**Figure 1.** TERPs procedure turn protected airspace.

limitations), the Paragraph 234e exception is applied: a standard holding pattern is applied to the course-reversal fix. If the course reversal fix is also the FAF, the minimum holding altitude must be no higher than 300 feet above the FAF altitude (which is really the intermediate segment's minimum altitude). This is because non-DME holding patterns are one-minute patterns in the IAP altitude stratum, and 300 feet per mile is the maximum descent gradient permitted in the intermediate segment (deference was given to the 60-knot airplane).

If the course-reversal holding pattern is predicated on the IF, then the minimum holding altitude can be no higher above the FAF crossing altitude, plus 300 feet per mile, for each mile of length of the intermediate segment.

You can see that there's a lot of puzzle solving and fitting required in the design of an IAP. Just this course-reversal design consideration alone can be quite complex.

The course-reversal holding pattern is always printed in **bold** and is shown in the both the plan and profile views of the approach chart. If there's a pattern there that isn't in bold, and isn't in the profile view, it's not a course-reversal holding pattern. Usually, it's there for the end of missed approach. Sometimes, it's there at mountain-bowl airports to lose altitude before doing the PT, because the feeder altitude is too high for PT descent limitations.

The maximum speed for course-reversal holding patterns is always 200 knots for jets and 175 knots for props, unless a different speed is shown on the IAP.

### IAP without course-reversal

There are many IAPs without either a PT or course-reversal holding pattern. This is the optimum design for an IAP that doesn't have any traffic flow from the "wrong" direction. In this case, all terminal routes must meet NoPT criteria, both as to alignment and descent gradient limitations.

The terminal routes won't be marked NoPT on an IAP that doesn't have a course reversal. A point often overlooked is that there's no airspace pro-

tected for a PT or course-reversal holding pattern in such an IAP. If you request a PT from ATC in such an IAP, you'll probably get approval, based on traffic. It could kill you at a mountain-bowl airport. The controller is generally not responsible for knowing the limitations of an IAP; that's your responsibility.

### Procedure turn airspace

Figure 1 (page 10) shows the airspace set aside for a PT. These are the dimensions for the almost-universal 10-mile PT. There's an occasional 5-mile PT in IAPs that have only Category A minimums.

Note that the primary protected airspace goes out for 15 miles. This provides for fix and timing errors where there's no DME, and for late reversal maneuvers. Also, "one size fits all," in that no additional protected airspace is provided for high density altitudes, unlike holding patterns, which expand with increasing altitude. The secondary areas are to be treated like a soft shoulder adjacent to a highway when you're doing 70 mph.

### Conservative flight technique

AIM Paragraph 5-4-8 "Procedure Turn," covers the waterfront about course-reversals from the FAA's perspective. There's some good information in there, and also some bum or misleading info.

For you jet jocks, 250 knots is way too fast to enter a PT. At high density altitudes, you can run out of airspace real fast, particularly when the wind is on your tail

outbound (not an unusual event considering you're more often than not setting up for a final approach into the wind). Since 200 knots is the maximum for a jet course-reversal holding pattern, why not standardize on the same maximum speed for a PT?

### Fly centerline

Although the method of course reversal in a standard PT is at the pilot's discretion, conservative application of technique to the procedure dictates that you fly outbound on course until doing the actual reversal maneuver. This protects you from the adverse effects of unknown crosswind components and minimizes the impact of inaccurate bearings or radials when at a considerable distance from the nav facility. Figure 2 (below) is from TERPs, and gives the procedures specialist guidance on how to treat a significant obstacle in the PT entry zone. An interesting aside is that the plan view shows the outbound track on course, AIM permissive language notwithstanding.

### Teardrop precautions

There are situations where, for instance, flying a dead reckoning "teardrop" in a standard PT maneuvering *(continued on next page)*

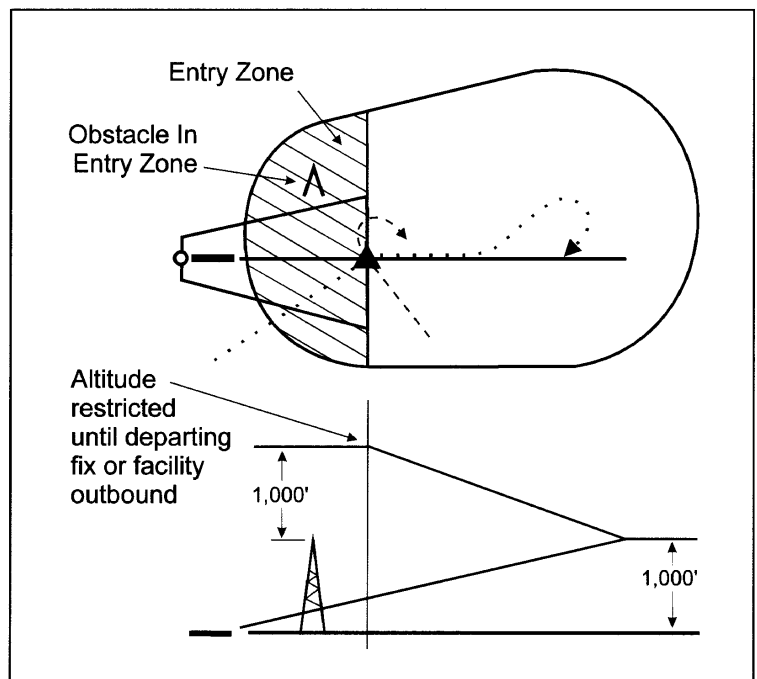


Figure 2. TERPs procedure turn entry obstacle option.

## When It's Time

(Continued from page 11)

area could buy you a dirt sandwich at a mountain bowl locale during a blustery winter storm.

### Paragraph 234e and the AIM PT

As I said earlier, the reference to TERPs, Paragraph 234e in this article's featured TERPs excerpt is what provides the procedures specialist with the option to conserve airspace by designing into the IAP a course-reversal holding pattern instead of PT (By the way, this is the standard issue for the new standalone GPS IAPs). Following is Paragraph 234e:

*Elimination of Procedure Turn. A procedure turn is NOT required when an approach can be made direct from a specified intermediate fix to the final approach fix. A procedure turn NEED NOT be established when an approach can be made from a properly aligned holding pattern. See paragraph 291. In this case, the holding pattern shall be established over a final or intermediate approach fix and the following conditions apply:*

(1) *If the holding pattern is established over the final approach fix, the minimum holding altitude shall be not more than 300 feet above the altitude specified for crossing the final approach fix inbound.*

(2) *If the holding pattern is established over the intermediate fix, the minimum holding altitude shall permit descent to the final approach fix altitude within the descent gradient tolerances prescribed for the intermediate segment. See paragraph 243d. (emphasis added.)*

Having read that, let's go back to the AIM 5-4-8 stuff, in particular Paragraph 4, the first sentence:

*"A procedure turn need not be established when an approach can be made from a properly aligned holding pattern. In such cases, the holding pattern is established over an intermediate fix or a final approach fix."*

Looks sort of like it was lifted right out of Paragraph 234e, doesn't it? This

is language for the procedures specialist, not the pilot. Because pilots tend to hang on every terse word in the AIM, it isn't surprising that many pilots read something different into this language because of the lack of context and training that the procedures specialist possesses. I know for certain that many pilots think the AIM language provides them with discretion that was never intended for the pilot by the framers of the TERPs criteria.

### Entry zone obstacles

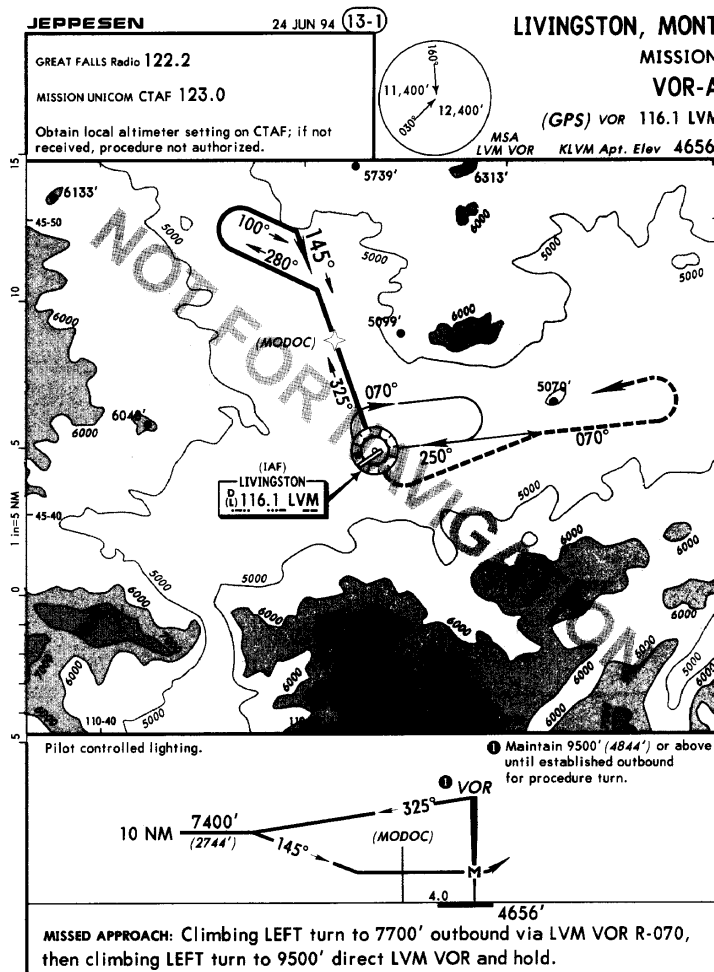
Referring to Figure 2 again, note that the procedures specialist can exclude a significant obstacle provided the pilot is instructed by note to maintain the entry altitude until established outbound. Figure 3 (below) is Livingston, MT VOR-A IAP, which has such a note.

### Descending before the PT

Figure 4 (page 13) is the Helena, MT VOR-A IAP, where the mountain bowl requires some altitude loss in a holding pattern before doing the PT. This is an unusual application reserved for difficult mountain bowl airports.

### Summary and differences

Of course, a radar vector to final negates all of this course-reversal stuff. But, we're seeing more and more IAPs in mountain areas where there's skimpy-to-nil ATC radar. What about just bypassing the course reversal where it appears intuitively okay to go straight in, yet there isn't an NoPT on the terminal route? At a recent industry/FAA meeting, the consensus amongst many industry and FAA staffers was to do



REPRODUCED WITH PERMISSION © JEPPESEN SANDERSON, INC., 1996. ALL RIGHTS RESERVED

**Figure 3.** This procedure has an altitude restriction until established outbound for the procedure turn..

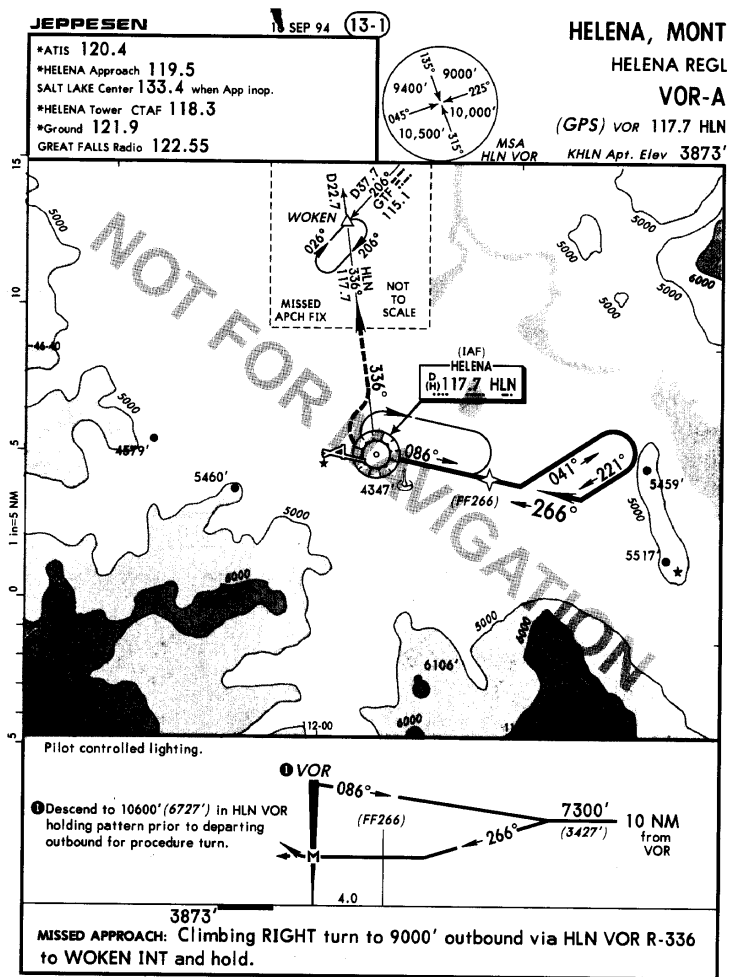
what you feel is right. I can't accept that for a couple of reasons: (1) the TERPs authors were trying to make it as simple as possible, to keep pilots from having to make inferences during a critical phase of flight. If all IAPs were created with equal care, it would be less confusing. (2) The FAA Chief Counsel issued a letter of legal interpretation on November 28, 1994, which makes it quite clear that the pilot has no such options (see letter below.) I'll leave it to you as to whether you feel bound by that letter.

## Contact the FAA

Finally, wherever you find an IAP that on its face appears to have poorly thought out design from your experienced perspective as an instrument pilot, I urge you to let the new national FAA office that designs all IAPs know:

National Flight Procedures Office  
Aviation System Standards  
Federal Aviation Administration  
P.O. Box 25082  
Oklahoma City, OK 73125  
Phone: 405-954-3027

*Wally Roberts is a retired airline captain, former chairman of the ALPA TERPs Committee, and an active CFII in San Clemente, CA. His e-mail: [terps@terps.com](mailto:terps@terps.com) Wally's web site: <http://www.terps.com/terps/>*



REPRODUCED WITH PERMISSION © JEPPESEN SANDERSON, INC., 1996. ALL RIGHTS RESERVED

**Figure 4.** "Mountain bowl" requires holding pattern to lose altitude to meet descent-gradient limitations of procedure turn.

## FAA Letter Regarding the Use of Instrument Approach Procedures

The following is from an FAA letter of legal interpretation regarding the use of a standard instrument approach procedures (SIAP) in a non-radar environment. The final two paragraphs pertain to course reversals.

"First you ask whether an arriving aircraft must begin the SIAP at a published initial approach fix (IAF). A pilot must begin a SIAP at the IAF as defined in Part 97. Descent gradients, communication, and obstruction clearance, as set forth in the U.S. Standard for Terminal Instrument Procedures (TERPs), cannot be assured if the entire procedure is not flown.

"You also ask whether a distance

measuring equipment (DME) are initial approach segment can be substituted for a published IAF along any portion of the published arc. A DME arc cannot be substituted for a published IAF along a portion of the published arc. If a feeder route to an IAF is part of the published approach procedure, it is considered a mandatory part of the approach.

"Finally, you ask whether a course reversal segment is optional 'when one of the conditions of FAR section 91.175 (j) is not present.' Section 91.175 (j) states that in the case of a radar vector to a final approach course or fix, a timed approach from a holding fix, or an approach for which the procedures speci-

fies 'no procedure turn,' no pilot may make a procedure turn unless cleared to do so by ATC.

"Section 97.3 (p) defines a procedure turn, in part, as a maneuver prescribed when it is necessary to reverse direction to establish the aircraft on a intermediate or final approach course. A SIAP may or may not prescribe a procedure turn and based on the application of certain criteria contained in the TERPs. However, if a SIAP does contain a procedure turn and ATC had cleared a pilot to execute the SIAP, the pilot must make the procedure turn when one of the conditions of Section 91.175 (j) is not present."