The Properly Flown Missed

Far too often, missed approaches are neglected in both planning and execution.

By Wally Roberts

WHEN EXECUTING AN APPROACH in instrument meteorological conditions (IMC) a missed approach typically becomes necessary for one of two reasons: (1) the approach was properly flown but weather conditions would not support visual descent below the minimum instrument altitude, or (2) the pilot failed to keep the aircraft within acceptable lateral and vertical limits in the final approach segment to the extent that the only safe way to salvage the operation was to miss the approach.

Far too often, the pilot's lack of preparation for the missed approach causes it to be poorly flown, even though the approach might have been flown competently. This article will review both the operational and airspace aspects of missed approach procedures.

Mind and configuration

Whenever the surface weather observation indicates even the *slightest* prospect you'll still be IMC passing the FAF (or completing the procedure turn in a no-FAF IAP), the approach should be flown with the mindset that a missed approach will be more likely than a landing. This likelihood can vary from *slight* to *great*, depending on the reported weather—but, the key aspect is *the pilot's mental attitude is geared for the missed approach every bit as much as it is for a successful visual assessment and landing.*

It's as important to practice missed approaches from MDA or DH as it is to land out of a practice approach. Some airplanes are simple to transition from approach to missed approach configuration; others require well-timed changes in attitude, flap configuration, and power plant management.

The key is to transition the aircraft from either level or descending flight close to the ground into a configuration similar to takeoff. During takeoff, the airplane is already configured and trimmed for the initial climb. Not so, however, with most airplanes for transition from approach to missed approach configuration.

There have been a number of crashes in IMC approach conditions because the pilot couldn't cope with both the mental and mechanical requirements to smoothly, and with due deliberation, transition from approach to missed approach configuration. Landing gear retraction is usually the least critical configuration change, but it's often unnecessarily rushed by many pilots.

TERPs optimum missed

The TERPs edict to the procedures designer about missed approach procedures design states:

"The missed approach shall be initiated at the decision height in precision approaches and at a specified point in non-precision approaches. The missed approach procedure must be simple, specify an altitude, and whenever practical, a clearance limit.

"The missed approach altitude specified in the procedure shall be sufficient to permit holding or en route flight. All alternate missed approach procedures which are to be used must be specified in the procedure. (Note: Only the primary missed approach procedure shall be included on the published chart.)"

Note the requirement for the missed approach procedure to be simple. The foregoing TERPs language is followed by:

"Wherever practical, the missed approach course should be a continuation of the final approach course. Turns are permitted, but should be minimized in the interest of safety and simplicity. When a turn of no more than 15 degrees is made, the missed approach is considered straight, and the straight missed approach area applies."

The context of the requirements for the missed approach to be "simple," and wherever "practical" a continuation of the final approach course implies airspace considerations take precedence over these ideals. Where significant terrain is a factor, it obviously takes precedence over the ideal. Further, at many locations, ATC airspace management issues also take precedence over a "simple," straight-ahead missed approach.

The remaining generic element of TERPs missed approach requirements states:

"The missed approach point specified in the procedure may be the point of intersection of an electronic glidepath with a decision height, a navigation facility, a fix, or a specified distance from the final approach fix. The specified distance may not be more than the distance from the final approach fix to the usable landing surface."

Not the whole truth

The last sentence of the foregoing, although true most of the time, isn't the whole truth. Where the IAP is predicated on an "on airport" NDB or VOR

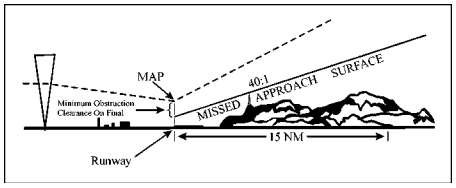

***Figure 1**. TERPs standard missed approach surface.*

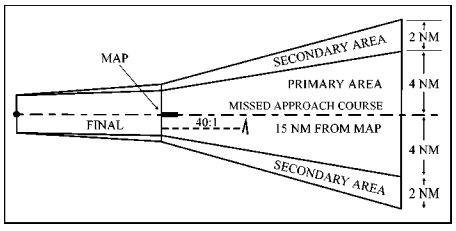

***Figure 2**. Representative TERPs straight-ahead missed approach area.*

facility, and there is no FAF, the facility is always the MAP even though it may be well beyond the runway. Further, on-airport NDB or VOR IAPs with an FAF may still have the MAP beyond the runway threshold at the on-airport navaid (except on-airport VOR/DME IAPs which will have a DME fix for the MAP). This all adds to the care and planning that must go into flying on-airport-navaid IAPs.

The 40-to-1 obstacle surface

Figure 1 (page 10) shows a representative application of the TERPs missed approach surface. A 40:1 surface represents a gradient of 152 feet/nm. Unlike IFR departure climb gradients, the missed approach surface has no buffer, because it's an obstacle identification surface (OIS), not a performance surface. A conservative rule is for the pilot to provide an additive similar to what the FAA provides for climb gradients on departure procedures, or 48 feet per mile. Therefore, a climb gradient of 200 feet per mile should be everyone's *minimum* missed approach climb performance requirement.

At some airports, the missed approach area is 40:1 clear, thus there may be no critical climb requirement whatsoever, at least from an obstacle clearance standpoint. At any mountain area airport, however, it's safe to assume a minimum, sustained climb gradient of 200 feet per mile is always required. Always keep in mind this gradient is only valid at DH or MDA, and at the MAP.

At mountain-bowl airports with high HAT/HAA MDAs or DHs, and/or MAPs well prior to the runway, descent below MDA/DH and/or beyond the MAP is proceeding into undefined performance requirements in the event a missed approach becomes necessary subsequent to the instrument phase of the final approach segment.

Typical protected airspace

All present missed approach segments expand from the width of the final approach segment to the width of a Victor airway in 15 flight-path miles. Figure 2 (page 10) shows the ideal—the simple, straight-ahead missed approach segment.

Figure 3 (below) shows a typical non-precision turning missed approach area for a turn of greater than 90 degrees. Where a turn of less than 90 degrees is required, protection is provided for the turn starting one mile prior to the MAP. If the FAF fix error is greater than one mile, turn protection is provided prior to the MAP in an amount equal to the FAF fix error. These machinations are to protect for timing errors only, not deliberate early turns.

Timing considerations

Whether or not a missed approach requires a turn, the missed approach surface can be violated by sloppy timing. Accurate timing is a must not only to have some idea of where the runway is, but to ensure turning and/or missed approach surface protection. On a straight-in ILS, of course, the DH point is always a very accurate MAP. DME MAPs are the next best thing and should be used instead of timing wherever feasible. GPS IAPs always have accurate, fix-defined MAPs.

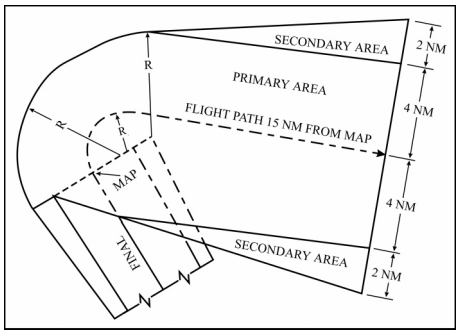

***Figure 3**. Airspace required when more than a 90-degree turn is required for the missed approach procedure. The "R" radius protects only for variances in turning performance, not for straight-ahead flight.*

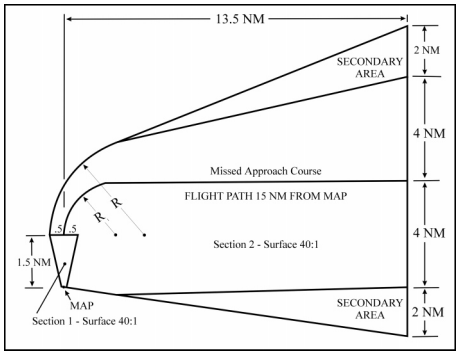

***Figure 4**. TERPs ILS turning missed approach airspace. Note the narrow Section 1, which extends 1.5 miles from the MAP (DH point).*

ILS missed approach airspace

Figure 4 (below left) shows typical missed approach airspace for an ILS IAP's turning missed approach procedure. Note the narrow Section 1, which extends 1.5 miles from the MAP (DH point). This same narrow area is provided for straight-ahead ILS missed approach procedures. Recall the TERPs citation at the beginning of this article, that a course change of up to 15 degrees is considered a straight-ahead missed approach. This bears watching in ILS approaches, because any course change of up to 15 degrees must be respected as the missed approach begins, in order to ensure containment within the narrow Section 1 of the ILS missed approach procedure.

At Manchester, NH (Figure 5 page 12), when executing the ILS Runway 35 missed approach at 200 feet HAT, you are well-advised to be easing the airplane to a heading of 340 degrees as soon as you have established the aircraft in its proper missed approach configuration and attitude. Then, tracking of the MHT R-340 should be started as soon as workload permits. In single-pilot operations, it might be wise to have the No. 2 VOR tuned to the MHT VOR with the R-340 set prior to starting the ILS final approach.

Climb before turning

Most ILS turning missed approach procedures specify an altitude at which to commence the turn. If they don't, but a turn is specified (greater than 15 degrees), climb to 400 feet above the airport elevation before turning. That is what Section 1 as shown in Figure 4 is

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all about. The principle is the same as turning after an IFR takeoff.

Straight-ahead/turning missed

Many turning missed approach procedures specify an altitude to climb straight-ahead to before turning. If the specified altitude is higher than 400 feet HAA, this is known as a combination straight-ahead/turning missed approach.

Where a turning altitude is specified considerably higher than 400 feet, but no point is specified at which the turn is to be made, then it's okay to turn once the specified altitude is achieved provided, of course, you don't turn prior to the MAP. Some airplanes may be climbing at barely a 40:1, where others might be climbing at gradients many times steeper than a 40:1. Thus, the combination straight-ahead/turning missed approach procedure must protect for a turn as early as one mile prior to the MAP (timing error allowance) to straight ahead for an airplane climbing at only 152 feet per mile.

If, however, the combination straight-ahead/turning missed approach procedure specifies the turn will be made at a fix, then that point becomes the turning point for all aircraft, regardless of altitude.

Really low-altitude climb-in-hold

Figure 6 is the ILS missed approach for KGCN. It seems simple enough—just climb to 10,000 feet direct to the GCN VOR and hold. But, take a close look. The VOR is just over 1.5 miles from the precision MAP. Not only do you have the less-than-15-degrees non-turning-but-offset ILS missed approach Section 1, you had better be prepared to enter the climb-in-hold just as you catch your breath and are perhaps just 500 feet, or so, above the ground. These low-level missed approach holding pattern entries exist at several airports.

Slow to react

An FAA Flight Standards person recently told me the FAA observes far too many pilots failing to start the turn on a turning missed approach on a timely basis. If no altitude is specified for the turn, you're expected to turn immediately in the miss from a non-precision IAP, and at 400 feet HAA, in an ILS miss.

Take another look at Figure 3. That "R" radius protects only for variances in turning performance, not for straight-ahead flight. ("R" is from Table 5 of TERPs, and varies with approach category.) Turning "immediately" means to commence the turn as soon as you're confident the aircraft is configured properly, in missed approach attitude, and a sustained positive rate of climb is underway.

Missing early in the final segment

Most pilots know to continue along

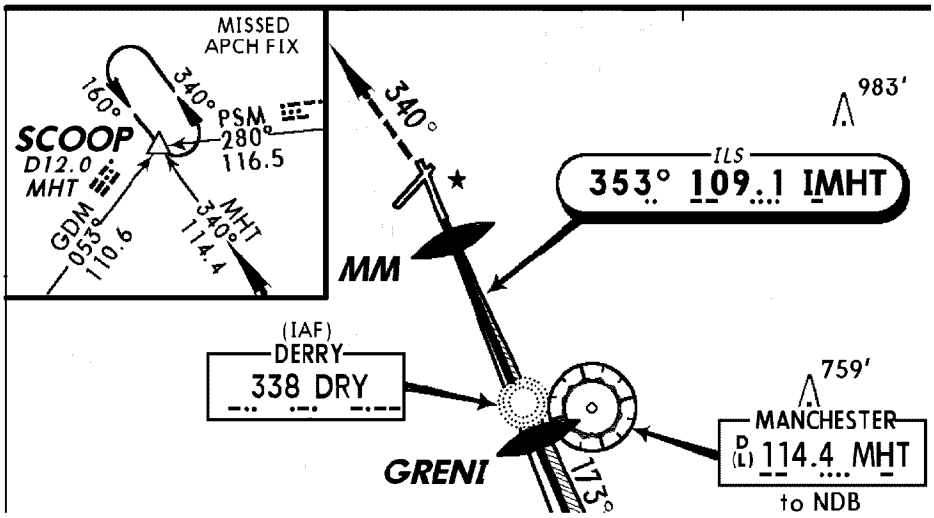

***Figure 5**. The missed approach on this ILS uses a "less-than-15-degree" turn.*

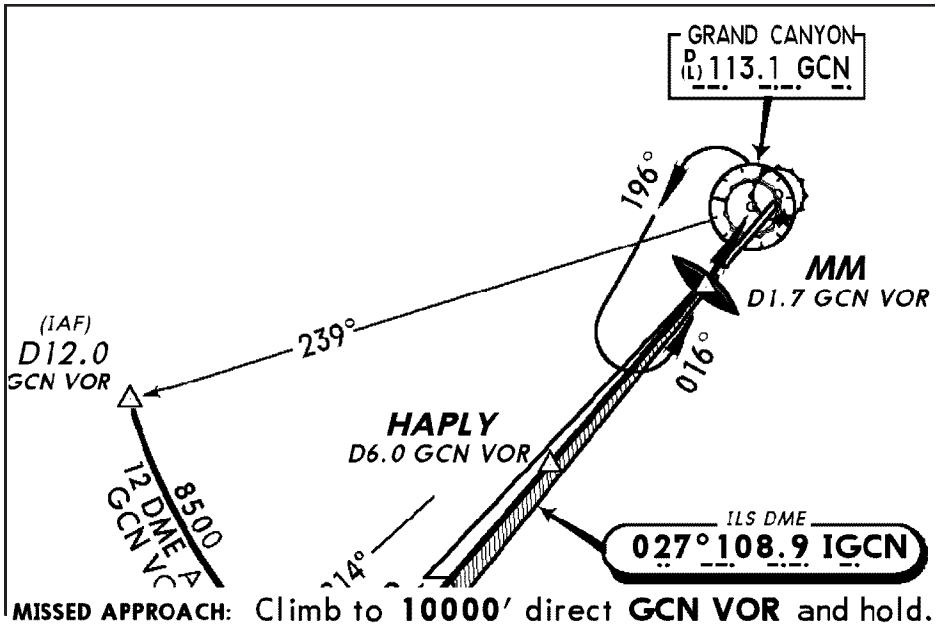

***Figure 6**. This missed approach requires entry into the hold just after gear-up.*

the approach path to the MAP in the event a decision is made to miss well prior to the MAP. Some pilots have the mistaken impression, however, the climb shouldn't begin until the MAP in such circumstances. Not so. Once you decide to miss, you climb! Flying level inside a cloud just a few hundred feet above the ground does nothing to enhance either safety or the operational task at hand.

Electing a higher category

Some pilots elect to operate Category A and B aircraft at Category C or D minimums when circling, in order to gain additional circling protected airspace. The same can be applied to turning missed approaches in the sense that more airspace is provided when the higher approach categories are authorized in the IAP. But, you can't take this for granted. Figure 7 is the Medford, OR ILS Runway 14 missed approach and minima section. Note straight-in minimums vary by approach category, because of terrain west of the airport.

Future missed approach

Once GPS becomes a full stand-alone system for all phases of IFR operations, there will be inevitable pressure to reduce the width of the GPS low-altitude route from the present Victor airway's 2-4-4-2 nm width. GPS airways are apt to be about one-half those values, thus GPS missed approaches will follow suit by expanding to less generous widths than used in present GPS IAPs. Further, in mountainous areas GPS missed approach segments will likely be closer to lots of laterally higher terrain, thus "minding the store" will become ever more critical in the future.

Many IAPs at mountain bowl airports have minimums limited not by obstacles along the intermediate or final approach segments, rather by obstacles along the missed approach 40:1 OIS. Although the 40:1 is a traditional international standard of long standing, the FAA is chomping to relax this standard in the U.S. by placing climb gradients on any missed approach procedure where lower minimums can be the result. Stayed tuned.

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MISSED APPROACH: Cat **A**, climb to **2000′** Cat **B**, climb to **2200′** Cat **C**, climb to **2300′** Cat **D**, climb to **2600′**. Then climbing **RIGHT** turn to **6000′** direct **OED VOR** and hold **NORTHWEST**, **RIGHT** turns, **153°** inbound.

	STRAIGHT-IN LANDING RWY 14					CIRCLE-TO-LAND	
	ILS DA(H) A:**1510′** *(200′)* C:**1714′** *(404′)* B:**1631′** *(321′)* D:**1854′** *(544′)*		LOC (GS out) MDA(H) A:**1640′** *(330′)* C,D:**1960′** *(650′)* B:**1800′** *(490′)*			Max Kts	MDA(H)
	FULL	RAIL or ALS out		RAIL out	ALS out		
A B	RVR 24 or 1/2	RVR 50 or 1	RVR 24 or 1/2	RVR 40 or 3/4	RVR 50 or 1	90 120	**2000′** *(669′)*-1
C	RVR 50 or 1	1 1/2	RVR 60 or 1 1/4	1 3/4		140	**2000′** *(669′)*-1 3/4
D	1 1/2	2	1 1/2	2		165	**2140′** *(809′)*-2 1/2

***Figure 7**. The ILS straight-in minimums affected by rising terrain in turning area of missed approach airspace.*