

Departing IFR Safely

It's in your best interest to adhere to takeoff minimums and to follow the departure procedure.

By Wally Roberts

HAVE YOU EVER HAD NAGGING doubts about doing the right thing during an IMC takeoff and departure to the MEA? If you have, join the club. IFR departures and takeoff minimums are one of the most misunderstood procedural areas of serious IFR flying.

At most airports in the United States, there simply aren't many significant obstacles to worry about once you have 500 or 1,000 feet of altitude in your pocket on departure. There are big exceptions, of course, where there are big mountains. And, how "big" a mountain is, depends a lot upon both the sustained climb performance of your aircraft and its ability to perform ably at high MEAs.

When obstacles are evaluated

The first consideration for departing an airport under IFR is to determine whether that airport has at least one public standard instrument approach procedure (SIAP). If it does, then the FAA is obligated to evaluate the airport for departure obstacles and either authorize or deny an IFR takeoff for each runway at the airport. If the airport doesn't have at least one SIAP then, as far as the FAA is concerned, the airport isn't authorized for an IFR departure. This doesn't make it illegal for a non-commercial flight to operate on an IFR flight plan out of such an airport. It does mean, however, that the pilot is strictly on his/her own to depart under instrument conditions and safely reach the MEA at such an airport. Also, an ATC clearance must be obtained prior to entering controlled airspace, preferably before takeoff.

For the purposes of our discussion, we'll assume our departure airport has at least one SIAP.

Takeoff minimums

There are two fundamental considerations for every IFR departure: whether the runway is authorized for an IFR takeoff, and the proper procedure to fly from liftoff on an IFR-authorized runway until reaching the MEA of the appropriate en route airway or route.

Takeoff minimums for commercial operators are established in FAR 91.175 (f). This regulation states that the "standard" minimums apply only if takeoff minimums aren't specified in FAR 97 for that airport. Those of you who don't fly commercially might wonder about all this emphasis on takeoff minimums, since you aren't bound by them. There's a good reason: If the runway is "NA" (not authorized) for takeoff minimums, it probably means there's a brick wall not too far off the end of the runway. This is important to someone who really doesn't know the lay of the land. If the runway has IFR takeoff minimums, but has complex minimums in FAR 97, the brick wall might not be off the runway end, but along the departure route.

Three areas evaluated

Chapter 12 of Terps contains the criteria for IFR departure procedures. The FAA procedures specialist is required to evalu-

ate three zones for departure obstacles. The slope used for this evaluation is the same as that used for missed approach procedures: 40 to 1. This works out to 152 feet of altitude gain per nautical mile. An additional 48 feet is added for each mile of flight path for a minimum climb gradient of 200 feet per mile.

Straight-ahead climb

Zone 1 of the departure area assumes a straight-ahead climb for two miles after lift-off. It also assumes you can climb to at least 400 feet agl by the time you reach the departure end of the runway. Zone 2 is evaluated for up to a 90-degree turn after reaching 400 feet, and Zone 3 is evaluated for turns of more than 90 degrees after reaching 400 feet. Zones 2 and 3 are evaluated at a 40:1 slope up to the MEA.

If no obstacles penetrate the 40:1 slope for any of the three zones, no IFR departure

(continued on next page)

TAKE-OFF			FOR FILING AS ALTERNATE Authorized Only When Twr Operating			
All Rwys			Precision	Non-Precision		
Adequate Vis Ref	STD					
1 & 2 Eng	1/4	1	600-2	800-2		
3 & 4 Eng		1/2				

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Figure 1. Takeoff minimums for commercial operators: lower-than-standard (1/4-mile) and standard (1/2 or 1 mile). The 40:1 slope is clear in all directions. No departure instructions or procedures required. After climbing straight-ahead to 400 feet agl, you can proceed in the most expeditious manner to the filed route.

TAKE-OFF & IFR DEPARTURE PROCEDURE			FOR FILING AS ALTERNATE			
All Rwys						
Adequate Vis Ref	STD					
1 & 2 Eng	1/4	1	NA			
3 & 4 Eng		1/2				

IFR DEPARTURE PROCEDURE: Climb direct to MXW VOR.

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Figure 2. At this airport, the 40:1 slope is clear provided that you proceed direct to the MXW VOR after climbing straight-ahead to 400 feet agl.

INSTRUCTION

Departing IFR...

(continued from page 5)

procedure is published (see Figure 1). At these locations, you're free to proceed in the most expeditious manner to your filed route, assuming no ATC restriction to the contrary. However, it's essential to remain on runway heading until reaching 400 feet above the departure end of the runway. This is a fundamental condition of all departure procedures. Always climb to 400 feet before making any turn, whether there's no departure procedure, a specified IFR departure procedure, a SID, or a radar vectored departure. This is a minimum altitude (Figure 2). If an IFR departure procedure or SID specifies a turn above 400 feet, or at a specified fix, that instruction takes precedence over the "400-foot rule."

Although Terps criteria require the FAA procedures specialists to evaluate the 40:1 slope in all directions, this evaluation sometimes stops short of the MEA in mountainous areas. If an airport is surrounded by high terrain, but doesn't have IFR takeoff minimums or departure restrictions, depart via a published airway. An example is Riverton, WY (Figure 3).

Early turn

What about turning below 400 feet, where no turning altitude or fix is specified? There is one rare exception: when the IFR departure procedure or SID states, "Turn as soon as practicable." In this situation, there will be at least a mandatory 400-foot ceiling and one mile visibility takeoff minimum for that runway. This "early turn" option is used when insurmountable obstacles exist off the departure end of the runway, within the departure criteria turning area. The mandatory minimum of 400/1 is established to provide a visual capability to see and avoid obstacles of less than 400 feet that could exist in the direction of an early turn. There is also an occasional situation where a mandatory ceiling and visibility takeoff minimum is established by the FAA procedures specialist due to a judgment call about the need to see and visually avoid a close-in obstacle without an early turn.

Turn to avoid

When the airport isn't free of obstacles in either Zone 2 or 3, the takeoff minimums are annotated with instructions as simple as, for example, "Turn left, proceed on course." This example means the entire sector that could be entered with a right turn

should be avoided below the MEA. However, more typical than such a simple restriction will be a complete IFR departure procedure, where significant terrain features penetrate the obstacle clearance identification zones for the airport.

A complete "route description" IFR departure procedure often won't be 40:1 clear, although it should avoid the more significant terrain between the airport and the MEA. Wherever a climb gradient of

more than 200 feet per mile is specified, two sets of takeoff minimums are usually specified. Typically, "standard" will be authorized if the climb gradient can be maintained, and a "higher than standard" ceiling and visibility minimum will be specified for aircraft that cannot meet the specified climb gradient because of performance limitations (Figures 4 & 5).

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TAKE-OFF				FOR FILING AS ALTERNATE		
All Rwys				Authorized Only With Approved Weather Service		
Adequate Vis Ref		STD		VOR Rwy 10 VOR Rwy 28	ILS Rwy 28 LOC Rwy 28	
1 & 2 Eng	1/4	1		800-2	NA	
3 & 4 Eng		1/2				
A						
B						
C						
D						

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Figure 3. Riverton, WY has standard takeoff minimums and no IFR departure procedure. To avoid high terrain southwest of the airport, depart via one of the airways.

TAKE-OFF & IFR DEPARTURE PROCEDURE				FOR FILING AS ALTERNATE				
Rwy 33		Rwy 15		Authorized Only When Ukiah FSS Operating				
With Min climb of 350'/NM to 4000'				LOC Rwy 15	RNAV-B	VOR-A		
1 & 2 Eng	300-1		NA		A	1200-2	1900-2	2800-2
3 & 4 Eng					B			
					C	1200-3	1900-3	2800-3
					D			

IFR DEPARTURE PROCEDURE: Climb to 4000' via 350° heading then climbing left turn to 6000' direct ENI VOR.

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Figure 4. Runway 33 has takeoff minimums of 300/1, and a minimum climb requirement of 350 feet/nm to 4,000 feet msl. This is an exception to the general rule of two sets of minimums for climb gradient departure procedures. Runway 15 is "NA" for IFR departures.

TAKE-OFF & IFR DEPARTURE PROCEDURE							FOR FILING AS ALTERNATE				
Rwys 28L, 28R			Rwys 10L, 10R				Authorized Only When Class D Airspace Effective				
With Min climb of 220'/NM to 900'			With Min climb of 360'/NM to 1100'				ILS Rwy 10R		LOC Rwy 10R	NDB Rwy 10R	LOC DME Rwy 28L
Adequate Vis Ref	STD	Other	Adequate Vis Ref	STD	Other						
1 & 2 Eng	RVR 16 or 1/4	RVR 50 or 1	600	1/4	1	1100	A	700-2	800-2	1100-3	1500-2
3 & 4 Eng		RVR 24 or 1/2	-2	1/2	1/2	-2	B				
							C	900-3	900-3		1500-3
							D				

IFR DEPARTURE PROCEDURE: Rwys 10L/R climbing left turn, heading 295°, rwys 28L/R climbing right turn, heading 330°. All aircraft continue climb via the SNS VOR R-260 to SNS VOR.

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Figure 5. Commercial lower-than-standard and standard with climb gradient (Runways 10L&R: 360ft/nm to 1,100 feet msl; Runways 28L&R: 220ft/nm to 900 feet msl), and higher-than-standard without climb gradient. The east takeoff climb gradient applies only to 1,100 feet msl, since a turn away from terrain is part of the IFR departure procedure. The SID for this airport climbs directly over high terrain to the east, with a 405 ft/nm climb gradient for almost 4,000 feet; a subtle trap for the unwary.

INSTRUCTION

Obstacle close-in

If the "higher than standard" ceiling value is less than 500 feet, the obstacle(s) that penetrates the 40:1 slope is/are fairly close to the airport, and can usually be avoided visually (during daylight) if the aircraft cannot maintain the standard climb gradient. If the ceiling minimum is high, the obstacle is usually beyond the distance specified in the associated visibility minimum. If you can't maintain the specified climb gradient, and you aren't familiar with the area topography, circle the airport visually on departure and cross the departure end of the runway at or above the ceiling specified in the takeoff minimum (Figures 6 & 7). This will ensure the departure route is clear for a marginal performance aircraft. When departing a controlled airport, this option must be coordinated with ATC. At an uncontrolled airport, ATC usually isn't concerned about your use of the visual/circle climb option.

When SID is used

The busier controlled airports have SIDs, in addition to any IFR departure procedure. SIDs are established for traffic flow, and are almost always used by ATC for departure routing. At an airport with high terrain, the SID will usually have a climb gradient steeper than the IFR departure procedure. Unless otherwise stated in the SID, the takeoff minimums associated with the IFR departure procedure apply to the SID.

When two sets of takeoff minimums are listed with the IFR departure procedure, the higher minimums cannot be used with the SID, because the climb gradient for the SID is an ATC clearance that is mandatory for all operators. The climb gradient in the SID can be for either vertical traffic separation, terrain, or both. Don't accept the SID unless you're certain you can comply with its climb gradient.

NOS depiction

While I have used Jeppesen charts for the illustrations, NOS charts incorporate the same information in a separate listing. When the airport has standard takeoff minimums for all runways and the 40:1 slope is clear in all directions, NOS doesn't have a listing, and standard minimums/40:1 clear is assumed for all runways. When there are exceptions to the standard takeoff minimums and/or an IFR departure procedure, the NOS approach chart will list a white

"T" on an inverted black triangle, indicating the "IFR Takeoff Minimums and Departure Procedures" listing should be consulted. In our examples, only the airports in Figure 1 & 3 would not have the "T" listed.

Another difference between Jepp and NOS is that Jepp publishes lower-than-standard takeoff minimums for commercial operators, which must be authorized in the operator's operations specifications (ops specs). The commercial lower-than-standard minimums can be as low as RVR 600 on CAT III runways. Even though Jepp publishes lower-than-standard takeoff minimums, the possible permutations and combinations require that the commuter or airline crew be Philadelphia lawyers when applying ops specs to many major airport runways.

Although the non-commercial operator isn't legally bound by takeoff minimums, when ceiling and visibility minimums are

listed, either due to a mandatory requirement or a lack of climb performance, a prudent pilot will adhere to the restrictions. A margin above the specified climb gradient should be maintained for the vagaries of winds aloft, aircraft performance, etc. Also, climb performance declines rapidly in a normally-aspirated engine during a climb from a high density-altitude airport.

Any specified climb gradient must be made good over the ground, so it directly relates to groundspeed. When a specified climb gradient ends at an altitude below the IFR departure procedure's final altitude, a 200 feet per nautical mile climb must still be maintained until leveling off.

Wally Roberts is a retired airline captain, former chairman of the ALPA Terps Committee, and an active CFII in San Clemente, CA.

TAKE-OFF					
Rwys 29, 30L, 30R			Rwys 11, 12L, 12R		
Adequate Vis Ref		STD	With Min climb of 330'/NM to 3200'		Other
Adequate Vis Ref		STD	Adequate Vis Ref	STD	
1 & 2 Eng	RVR 16 or 1/4	RVR 50 or 1	1/4	1	2800-2
3 & 4 Eng		RVR 24 or 1/2		1/2	
IFR DEPARTURE PROCEDURE					
Rwys 11, 12L & 12R: climbing right turn. All aircraft climb direct OAK VOR, then proceed on course.					

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Figure 6. Lower-than-standard and standard takeoff on Runways 29, 30L&R. Lower-than standard takeoff with climb gradient, and higher-than-standard without climb gradient for takeoff on Runways 11, 12L&R. Note the high ceiling requirement for aircraft unable to climb 330 ft/nm to 3,200 feet msl. The poor performer would be well advised to depart on Runway 29, 30L or R, if possible, when the ceiling is below 2,800 feet.

TAKE-OFF & IFR DEPARTURE PROCEDURE					FOR FILING AS ALTERNATE	
Rwys 25, 30, 34			Rwys 7, 12, 16		Authorized Only When Bishop Altimeter Setting Available	
With Min climb of 350'/NM to 9000'		Other				
Adequate Vis Ref	STD				VOR DME-B	VOR-A
1 & 2 Eng	1/4	1	NA		A	1800-3
3 & 4 Eng		1/2			4000-2	
				C	3300-3	
				D		
IFR DEPARTURE PROCEDURE: Rwys 25 & 30 turn right, rwy 34 turn left; climb northwestbound to 13000' via BIH R-322 to NICOL INT.						

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Figure 7. Lower-than-standard and standard with climb gradient, and very higher-than-standard without climb gradient. Runways 7, 12, 16 (northeast through southeast) are "NA." Careful consideration must be given to normally-aspirated engine performance limitations. If performance is a problem, don't depart when the ceiling is less than 4,000 feet, or perhaps go VFR during the day. Someone who isn't familiar with the terrain in the vicinity of this airport, and who must visually circle-climb, shouldn't depart at night.

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Departing & Turning

A correction about the turning rule during IFR departures.

We want to make a correction to Wally Roberts' article "Departing IFR Safely," and "IFR Quiz" question #8, both in May IFRR. We made an unintentional misstatement about the "turning rule" for instrument takeoffs and departures. Where a turn is required, and there is no specified turning point or fix, the turn should be made when departing 400 feet agl. There is no requirement to make the turn over the departure end of the runway. The TERPs departure criteria assume that the worst performing aircraft will cross the departure end of the runway at only 35 feet agl, and not be at 400 feet until two miles beyond the departure end of the runway, when no climb gradient is specified.

On the other hand, a good performing light airplane might be at 400 feet agl, well before the far end of the runway. So, when there's no specified turning point or fix, the criteria not only protect for the airplane that crosses the departure end at only 35 feet, the criteria also provide protected airspace for a turn that occurs as early as 2,000 feet from the beginning of the runway, provided the airplane is at least 400 feet agl when starting the turn. (This keeps the folks in those high control towers happy.) What constitutes the "agl" reference point for the turn is technically the elevation of the runway at the departure (far) end, although in practice the airport elevation is normally sufficient. Throw your brickbats at the Editor (not Wally Roberts), and his souped up word processor for the confusion on this one.—Ed.

<----- EDITOR'S CORRECTION

Editor's Correction of editing error made in May, 1995 article: "Departing IFR Safely"