INSTRUMENT READINGS™

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OBSTACLE DEPARTURE PROCEDURES

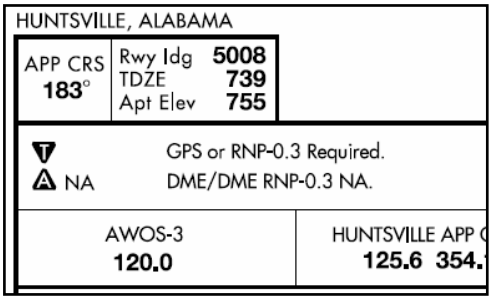
Part 2

When departing on an IFR flight plan, many times you will find that you are departing into a low overcast or into conditions of rain and mist resulting in very poor visibility. Avoidance of terrain and obstacles becomes an issue of paramount importance. Such departures can be executed safely if you pay careful attention to departure procedures (DP) and takeoff minimums. But as often as not, pilots will ignore published minimums and procedures, and their departures range from just heading off into the muck willy nilly and turning onto course as soon as reaching controlled airspace, or trying to roll their own departure procedure, such as flying an approach procedure backwards.

In the last installment of *Instrument Readings*, we explored the subject of making sure your clearance matches your departure procedure. This time, we will look more closely at the published takeoff minimums and departures, so that they can be understood and used more safely.

Instrument approach procedures, along with their transition routes, if any, and Standard Terminal Arrival Routes (STARs), where they exist, provide structured and safe means for an aircraft to transition from the enroute structure to the terminal environment and approaching the airport for landing. A lot of complex criteria, policies, engineering surveys, and flight checks go into their making to ensure safety under a variety of conditions. The flip side of that is Departure Procedures (DP), which provide a structured and safe means for an aircraft to depart an airport and transition into the enroute environment.

FAR Part 91 gives the standard minimum conditions for an IFR departure. For a single-engine or twin-engine airplane, the visibility must be at least one mile, and must be at least one-half mile for airplanes with more than two more engines. Even though the rule is stated in Part 91, it does not apply to Part 91 operations. That is to say, it is not mandatory. Furthermore, the standard minimum conditions do not always apply. If an approach procedure chart has the black triangle with white "T" inside, that means that alternate takeoff minimums have been established for that airport. The alternate minimums are published in Section C of the FAA NACO Terminal Procedures Publication (TPP) booklets, organized by city name.



Before delving into the details, let's consider an example. Suppose you are departing Madison County Executive Airport (KMDQ), and the conditions reported by the AWOS are overcast 400, visibility 3. You wisely consult Section C of the TPP (Terminal Procedures Publication, the approach plate booklet), and look under Huntsville, AL. You see that MDQ has published alternate minima and obstacle departure procedures, and that the prevailing conditions satisfy the takeoff minima.

MADISON COUNTY EXECUTIVE
TAKE-OFF MINIMUMS: **Rwy 36,** 200-1½ or std. with a min. climb of 260' per NM to 1100.
DEPARTURE PROCEDURE: **Rwy 18,** climbing left turn heading 360° to 1500 before turning on course. **Rwy 36,** climb runway heading to 1500 before turning on course.
NOTE: **Rwy 36,** tree line 6250' from departure end of runway, on centerline, 75' AGL/934' MSL.

Should you depart? Suppose you had to return to the field immediately after takeoff, after entering the low clouds. How would you get back? You would hope to fly one of the instrument approach procedures back to the airport. So let's look at them, there are two. The lowest MDA is 565 feet above the runway, and the ceiling is at 400 feet. You can't get back.

CATEGORY	A	B	C	D
CIRCLING	1320-1	565 (600-1)	1320-1½ 565 (600-1½)	1340-2 585 (600-2)

CATEGORY	A	B	C	D
LNAV MDA	1400-1	661 (700-1)	1400-1¾ 661 (700-1¾)	1400-2 661 (700-2)
CIRCLING	1400-1	645 (700-1)	1400-1¾ 645 (700-1¾)	1400-2 645 (700-2)

The point is that there is more to consider about a departure than just the takeoff minima and departure procedures. Sometimes you just have to wait for conditions to improve, or choose another day to go. Set some personal minima; mine include not departing unless I can return to the field. Some pilots of twins might choose to depart MDQ under the given conditions, and if one engine becomes inoperative, limp over to HSV and use the ILS to get down. That's fine, just have some criteria that fit your equipment and personal risk acceptance. And have Plan B.

Back to the details. I do not intend to duplicate all the material written in the AIM or the FAA *Instrument Procedures Handbook* (IPH) on the subject of ODPs. There is a lot of valuable information there, and I recommend that you read AIM 5-2-6 and IPH Chapter 2 before proceeding. A lot of what follows will assume that you have read those references.

All instrument departure procedures, and missed approach procedures, assume that you can make good a climb gradient of at least 200 feet per nautical mile (fpnm). That is 200 feet per minute at 60 knots, 300 feet per minute at 90 knots, and 400 fpm at 120 knots. If your airplane can't make at least 200 fpnm, given its gross weight and the density altitude, don't attempt a takeoff into instrument conditions. On a hot day at high altitude, with a lot of fuel, passengers, and baggage, you might not be able to make this puny climb gradient. Consult the POH and add a hefty margin. But don't use POH numbers based on Best Rate Of Climb airspeed if you will need to climb at a higher airspeed for engine cooling. In some locations, you may have to maintain the required gradient for many thousands of feet of climb, so engine cooling can be a significant concern. This is serious business, and it is not good enough to *think* you can make the required gradient, or that you will just try it and see if you can. You must *know* that you can make it before departing. If you are not absolutely sure, don't try it.

Let's learn how to interpret the takeoff minima and departure procedures, and examine why they are like they are.

First, consider Courtland, AL (9A4). You will find two IAPs (Instrument Approach Procedures) but no Takeoff Minima or ODPs. Courtland is not even listed in TPP Section C, and there is no black triangle with a T in it on the IAP charts. This means that the obstacle evaluation found no penetrations of the 40:1 slope (152 fpnm) Obstacle Clearance Surface (OCS) [formerly known as the Obstacle Identification Surface (OIS)] and diverse departures may be performed, and that standard takeoff minima apply. The minimum visibility is ½ mile for our singles and twins, with no ceiling requirement, and you may depart any runway, cross the departure end of the runway (DER) at 35 ft AGL or higher, climb at a minimum of 200 fpnm to 400 ft AGL or greater, then turn in any direction, maintaining the 200 fpnm or greater climb to the altitude specified in your clearance.

Next consider Fayetteville, TN (KFYM). No nonstandard minima are given, nor is a departure procedure specified. There is no black triangle with a T on the IAPs. But there is a list of obstacles near the departure paths of both runways. An obstacle list is provided when there are close-in obstacles that penetrate the OCS, but aren't more than 200 ft above DER. This means that the obstacles are within one nautical mile of the DER. You are supposed to visually detect and avoid these obstacles as you depart. (Remember that as you depart with zero ceiling and one-half mile visibility.) After successfully avoiding the close-in obstacles and reaching 400 ft, you can continue with a diverse departure. These lists of obstacles can be quite long; for example, see Marietta, GA.

FAYETTEVILLE MUNI
NOTE: **Rwy 2**, trees 820' from departure end of runway, 520' left of centerline, 70' AGL/1052' MSL. Trees 2430' from departure end of runway, 25' right of centerline, 78' AGL/1050' MSL. **Rwy 20**, trees 875' from departure end of runway, 420' left of centerline, 65' AGL/996' MSL. Trees 1370' from departure end of runway, 60' right of centerline, 65' AGL/1014' MSL. Trees 1720' from departure end of runway, 300' left of centerline, 60' AGL/1008' MSL. Trees 2070' from departure end of runway, 200' left of centerline, 70' AGL/1029' MSL.

Decatur, AL (KDCU) has nonstandard minima but no ODP. For runway 18, you can depart with 300 ft ceiling and one mile visibility using standard diverse departure procedures, including the minimum 200 fpnm climb gradient. The presence of the ceiling and visibility requirement means that there is an obstacle (or obstacles) that must be avoided visually. We are not told where the obstacle(s) is, but we know it is more than 1 nm from DER, since there is no obstacle list. Actually, we know that it is more than 3 nm from DER, for reasons I will explain later. At this airport and runway, the takeoff minima give us an alternate way to avoid obstacles. Notice that we can depart under standard takeoff minima if we can make good a climb gradient of 380 fpnm to 800 ft MSL. At 75 knots initial climb speed, 380 fpnm requires a climb rate of 475 feet per minute. The TouchDown Zone Elevation (TDZE) for Rwy 36 (DER for rwy 18) at DCU is 592 ft MSL; 800 MSL is only 208 ft above DER, so we don't have to maintain the higher climb rate very long.

PRYOR FIELD REGIONAL
TAKE-OFF MINIMUMS: **Rwy 18**, 300-1 or std. with a min. climb of 380' per NM to 800.

At DCU, the nonstandard minima apply only to runway 18; runway 36 has standard minima with diverse departure. Aha! A clue! Whatever the obstacles are that affect departures from rwy 18, they do not affect rwy 36. This means that there were no penetrations of the OCS from rwy 36. One can conclude that the obstacles are south of the runway center and more than 3 nm from rwy 18 DER. So if you were taking off from rwy 18 due to wind, but your planned course takes you to the north, you should have no problem turning north after reaching 400 AGL.

Let's revisit Madison County Executive. Refer to the takeoff minima and ODP, shown again here for convenience, particularly the note about the tree line. In the earlier example at

MADISON COUNTY EXECUTIVE
TAKE-OFF MINIMUMS: **Rwy 36**, 200-1½ or std. with a min. climb of 260' per NM to 1100.
DEPARTURE PROCEDURE: **Rwy 18**, climbing left turn heading 360° to 1500 before turning on course. **Rwy 36**, climb runway heading to 1500 before turning on course.
NOTE: **Rwy 36**, tree line 6250' from departure end of runway, on centerline, 75' AGL/934' MSL.

Fayetteville, there were several obstacles identified within one nm. Now in the MDQ case we see obstacles identified more than a mile away. A couple of points need to be made here. First, the tree line is shown as 75'AGL/934MSL. The AGL number is relative to the ground elevation at the tree line, not the runway. The tree line is 216 ft above DER of rwy 36 (threshold elevation of rwy 18 is 718 ft MSL). So the obstacles are more than 200 ft above DER, a climb gradient of more than 200 fpnm[*] is required; in this case it is required to publish the locations and elevations of obstacles within 3 nm, as well as a ceiling and visibility to allow seeing and avoiding the obstacle while flying the minimum climb gradient, and standard minima with a climb gradient to avoid the obstacle, and possibly a route to avoid the obstacle.

What if the obstacles are more than three miles from DER? They will not be identified. Otherwise, everything is as described for MDQ.

So far, we haven't examined a Departure Procedure, so let's look at the MDQ ODP. Assume we can make the specified climb gradient of 260 fpmn. For runway 36, we cross DER at or above 35 AGL, climb runway heading at 260 fpnm or greater until 1100 MSL, then runway heading at 200 fpnm or greater to 1500 MSL, then turn to the course specified in your clearance and climb at 200 fpnm or greater to the clearance altitude. If we can't make the greater-than-standard climb gradient, we have to rely on the 200 ft ceiling requirement and 1½ mile visibility to allow us to see and avoid obstacles. The only obstacle identified is the tree line, and the top of the treeline is actually 216 ft above DER. So the tips of the trees may be hidden in the 200 AGL cloud.

Let me interject a note about that treeline at night. Nighttime is in many ways like solid IMC as regards visual obstacle avoidance. You might see a lighted tower, but not a treeline, and remember all those NOTAMs about unlighted towers. Even when departing on a VFR flight at night, following an ODP can help you depart safely. Another trick to increase obstacle clearance, at night or in IMC, is to use short-field takeoff procedures. This does two things: it reduces how far down the runway you are at liftoff, and you climb at the best angle airspeed (for the flap configuration), which is your best climb gradient. Just be sure to explain it to passengers beforehand.

Back to the MDQ ODP. Departing runway 18, you cross the DER at 35 AGL or higher, climb runway heading to 400 AGL at 200 fpnm or better, then make a climbing left turn to heading 360 and 1500 MSL at 200 fpnm or better, then turn to the heading specified in your clearance and maintain the climb rate to your clearance altitude. Looking at the sectional, I see obstacles south of the field (towers on Monte Sano) that would require about 365 fpnm for avoidance. These are avoided by the specified route, namely the climbing left turn away from the obstacles. From the ODP completion altitude of 1500 MSL, assuming that you are abeam the DER, you could turn south and clear the towers using a climb gradient of 216 fpnm, still greater than standard. My numbers came off the sectional; they are not extremely accurate, and a more accurate analysis might show that a standard 200 fpnm climb gradient would clear the towers, as is suggested by the procedure. But clearly, there is not a lot of margin for a departure to the south from Rwy 18.

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[*] The published minima show a required climb gradient of 260 fpnm. Here is how that comes about: The treeline is 1.03 nm from DER and is 216 ft above it. TERPS requires an obstacle clearance of 24% of the climb gradient, and we can calculate the required CG by 216/(0.76*1.03) = 263. That's pretty close; the TERPSter used slightly different numbers or rounded off the result.

Why didn't the procedure designer give an alternate set of minima with a higher climb gradient? I don't really know, but there are two things that might have contributed. One, the specified departure route off 18 is not onerous, it is pretty much just a normal climb to downwind. Second, there are noise concerns south and west of MDQ. Noise abatement considerations can be a factor in departure procedures, and the specified route avoids the sensitive areas. The departure route does double duty, contributing to noise abatement and obstacle avoidance.

Some departure routes are long and complex, winding you around mountains and up valleys. I will show some examples in the next installment of *Instrument Readings*.

Before we close out this issue, I want to mention one fairly new element of some ODPs, and that is the Visual Climb Over Airport (VCOA) procedure. A VCOA has you circle over the airport to gain altitude before proceeding into obstacle country. More on this in the next issue, but in the meantime, you might look at the ODP for Andrews-Murphy, NC (KRHP).

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