Establishing Visibility Minimums

How the FAA determines the minimum visibility for an approach is part formula and history.

By Wally Roberts

EVERY INSTRUMENT APPROACH has a visual segment in which you must confirm that the airplane is either in a position to make a final approach for a visual landing, or that the airplane can be appropriately maneuvered for a landing using visual references.

In this article, I'll discuss how the FAA establishes visibility minimums for Category I instrument approaches, but won't discuss Category II and III approaches, since these two special categories of approach procedures have different flight crew qualifications and aircraft avionics requirements.

"Categories" of Category I

It's normal to think of a Category I approach as a standard "200 and 1/2" straight-in ILS procedure. While it's true that such an ILS is a Category I approach, so is an NDB approach with only circling minimums. There are three major subsets of Category I: precision straight-in, non-precision straight-in, and non-precision circling. Precision approaches are limited to straight-in procedures with an electronic glideslope (ILS, PAR or MLS), and employ a decision height/altitude (DH/DA), below which you must be in visual meteorological conditions (VMC) consistent with the visibility minimums for the approach. All other Category I approaches use the minimum descent altitude concept for continuing the approach under VMC.

Many of the operational concepts contained in the FAA's "U.S. Standard for Terminal Instrument Procedures" (TERPs) are a combination of science and politics, with a lot of undocumented historical precedence thrown in for good measure. Our aviation forefathers decided long ago that three miles visibility was the minimum for VFR flight, and that a visibility of one mile would be required for a standard instrument approach without any visual aids. It probably had a lot to do with the handling and cockpit visibility characteristics of the DC-3. Also, visibility minimums to this day are expressed in terms of "DC-3 miles," e.g., statute miles, whereas all other distances are in nautical miles.

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The standard visibility value of one mile historically assumed a standard minimum approach altitude of 300-400 feet above the field elevation. This evolved over the years to the last major revision to Terps, which occurred in 1976. Until that time, aircraft approach categories were based on both landing weight and approach speed.

The 1976 revision eliminated landing weight, making approach speed the only criterion for classifying aircraft into approach categories. Implicit in this 1976 revision, however, is the assumption that approach categories A and B are usually propeller airplanes, and C and D are usually jet airplanes. Further, it's assumed that category D jets are more difficult to approach and land during any straight-in non-precision approach, than are category C jets.

The political horse-trading that led to the 1976 revision also resulted in a recognition that both C and D swept-wing jet airplanes need to make a stabilized descent in the visual segment at approximately a 3-degree angle, whereas propeller airplanes can make steeper visual descents to landing. The result was to permit the standard one-mile visibility, provided the height above touchdown (HAT) for straight-in, and the height above airport (HAA) for circling did not exceed the following heights:

- Category A - 880 feet
- Category B - 740 feet
- Category C - 400 feet
- Category D - 341 feet

Above these standard MDAs and DHs, a sliding scale increases the basic visibility in increments to 1-1/4 for category A, 1-1/2 for B, and 3 miles for C and D. A complete breakdown of how HAT/HAA affects visibility minimums is contained in Terps Table 6 (see page 5). Also, Table 6A (not

(continued on next page)

HAT/HAA (ft.)	250-320	321-390	391-460	461-530	531-600	601-670	671-740	741-810	811-880	881-950	951 & above
CAT A	1 mi -									1¼ - - - - - - - -	
CAT B	1 mi -							1¼ - - - - - - - - - - - -			1½
HAT/HAA	250-400		401-500		501-600	do	do	do	do	do	do
CAT C	1 mi		1¼		1½	1¾	2	2¼	2½	2¾	3
HAT/HAA	250-341	342-426		427-511	512-600	do	do	do	do	do	do
CAT D	1 mi	1¼		1½	1¾	2	2¼	2½	2¾	3 - - - - - - - -	
HAT/HAA	250-320	321-390	391-460	461-530	531-600	do	do	do	do	do	do
CAT E	1 mi	1¼	1½	1¾	2	2¼	2½	2¾	3 - - - - - - - - - - - -		

Terps Table 6. Effect of HAT/HAA on Visibility Minimums. *The highest visibility for category A is 1-1/4 miles for an HAT/HAA above 880 feet; for category B, the highest visibility is 1-1/2 above 950 feet; for category C, the highest visibility is 3 miles above 950 feet; and the highest visibility for category D is 3 miles above 810 feet.*

Visibility. . .

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shown) of Terps requires an increase in the standard visibility minimum for approaches based on navaids that are a considerable distance from the airport. Finally, an ILS with a DH of 200 feet has a standard visibility of 3/4-mile. This is the only exception to the required one-mile visibility for standard straight-in minimums.

Approach lights

When a runway has approach lights, credit for these lights will usually reduce the basic straight-in visibility requirement by one-half mile. So, 1 mile becomes 1/2-mile, 2-1/4 miles becomes 1-3/4 miles, etc. There are some exceptions: (1) the standard ILS visibility of 3/4-mile can only be reduced to 1/2-mile. (2) NDB straight-in approaches for approach categories A, B, and C cannot be less than 3/4-mile, (3) All non-

When the FAA considers whether any credit for approach lights can reduce the visibility minimum below one mile (below 3/4-mile for a standard ILS), a portion of the visual segment is assessed for obstacles.

precision approaches for category D cannot be less than 1 mile, except for localizer procedures, which can be as low as 3/4-mile, and (4) some abbreviated approach light systems cannot have a visibility of less than 3/4-mile for any non-precision approach for categories A, B, and C.

Credit for approach lights, and the adjustment of minimums by the pilot when the lights go out, is a complex situation. On Jeppesen charts, it's taken care of quite nicely in the chart's minima format (see chart above right). Those pilots who use NOS charts must apply the inoperative components table, as modified by any notes on the approach chart. Both chart formats are lacking when an FDC notam suddenly raises either the DH or MDA to such an extent that Terps, Table 6 requires an increase in visibility.

Obstacles in visual segment

When the FAA considers whether any credit for approach lights can reduce the visibility minimum below one mile (below

STRAIGHT-IN LANDING RWY 16	ILS DA(H) 4427' (200')			LOC (GS out) MDA(H) 4560' (333')		CIRCLE-TO-LAND Not Authorized East of Rwy 17-35	
	FULL	TDZ or CL out	ALS out		ALS out	Max Kts	MDA(H)
A	RVR 18 or 1/2	RVR 24 or 1/2	RVR 40 or 3/4	RVR 24 or 1/2	RVR 50 or 1	90	4640'(413') - 1
B						120	4680'(453') - 1
C						140	4680'(453') - 1 1/2
D				RVR 40 or 3/4		165	4780'(553') - 2

Gnd speed-Kts	70	90	100	120	140	160
GS 3.00°	377	485	539	647	755	862
MAP at D2.2 IMOY ILS						

AMEND 6

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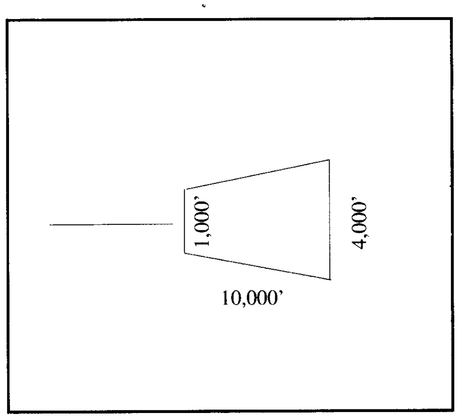
Jeppesen lists the change in visibility minmums for inoperative lights in the minima section.With NOS, you must refer to the "Inoperative Components or Visual Aids Table" in the front of each approach volume.

3/4-mile for a standard ILS), a portion of the visual segment is assessed for obstacles below the MDA or DH to touchdown. This visual segment is a trapezoid-shaped area that extends 10,000 feet from the runway threshold. If no obstacles penetrate a 34:1 surface within this area, credit for approach lights can reduce the visibility minimum to 1/2-mile. If obstacles penetrate a 34:1 surface, but not a 20:1 surface, the visibility minimum cannot be less than 3/4-mile.

If the 20:1 surface is penetrated, the visibility cannot be less than one mile, regardless of whether approach lights are present. In this latter case, there is no effective constraint on close-in obstacles in the visual segment. The visual segment trapezoid is 1,000 feet wide starting at 200 feet prior to the runway threshold, and expands to 4,000 feet in width at its limit of 10,200 feet prior to the runway threshold (see below). This section is the same whether the approach is an ILS, NDB, or any other type of approach.

Familiarity invaluable

The pilot isn't provided any information about obstacles below the DH or MDA. However, you can back into it with the following general rule: any time a runway has approach lights, but has a visibility minimum of one mile or greater, the visual segment could have significant close-in obstacles. In such cases, local familiarity and experience with the runway environment under day VFR is invaluable.



Trapezoid used to assess the visual segment of an approach for obstacles.

The only time you can be certain of obstacle protection through approach and landing during the visual segment is when there are approach lights, and the lowest visibility is less than one mile (preferably less than 3/4-mile), and you don't descend below MDA or DH until you're within the 10,000-foot long visual segment trapezoid. The minimum visibility can be forced up by an excessively high HAT of the MDA or DH, but you have no way to determine this.

Course alignment

Straight-in minimums won't be authorized unless the final approach course is aligned within 30 degrees of the runway centerline (15 degrees for GPS non-precision approaches), and the descent gradient for the final approach segment doesn't exceed 400 feet per mile to the touchdown zone elevation. If both of these criteria cannot be met, only circling minimums will be authorized.

Standard circling minimums are (HAA and visibility):

- Category A: 350/1
- Category B: 450/1
- Category C: 450/1-1/2
- Category D: 550/2

The standard obstacle clearance required for a circling MDA is 300 feet. So, anytime you find a circling MDA with an HAA substantially above these standard HAAs, you can rest assured there's at least one obstacle in the circling area almost within 300 feet of the MDA. There's no way to determine where such an obstacle or obstacles might

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be located, other than airport familiarity. Another caution about circling approaches: some sectors can be excluded entirely, and this is done with an easy to miss note, such as "Circling not authorized east of Runway 17-35."

When a final approach course is aligned within 30 degrees of a runway (15 degrees for GPS) and there are no straight-in minimums, the final approach segment descent gradient is excessive. In this situation, the 400-foot per mile final segment limit only has to be calculated to the circling MDA. You're on your own to compute the descent gradient for a straight-in landing out of such an approach (see chart on right).

RVR

When straight-in minimums are 1-1/4 miles or less, and the runway has high intensity runway lights (HIRL) and at least a touchdown zone transmissometer, runway visual range (RVR) will be authorized as a straight-in minimum in addition to prevail-

When RVR is reported, and the not-for-hire pilot elects to land when the reported RVR is below minimums, the pilot has a formidable task to prove that the reported RVR was inaccurate.

ing visibility. When RVR is reported, it is controlling for landing on that runway. Usually, the lowest Category I RVR is 2,400 feet, which is equivalent to 1/2-mile ground visibility (when RVR isn't reported). ILS approaches to runways with touchdown zone lights, HIRL, and centerline lights, are authorized an RVR of 1,800 feet. This is informally called "Super Category I," and is also equivalent to 1/2-mile ground visibility (when RVR isn't reported).

For those of you who aren't flying for hire, you aren't required to apply reported visibility to the visibility minimum on the approach procedure. But, you are required to determine that you have flight visibility equal to, or greater than, the specified visibility minimum when operating in the visual segment of the approach. You must also find the actual ground visibility to be equal to, or greater than, that visibility minimum during landing and roll-out. When RVR is reported, and the not-for-hire pilot elects to land when the reported RVR is below minimums, the pilot has a formidable task to prove that the RVR was inaccurate.

Hazards at unfamiliar airports

I hope I've provided some insights into the concepts behind approach minimums, and pointed out the potential alligators that can exist at unfamiliar airports. There's no substitute for knowing how the airport is laid out. The best way to do this is to make a day-VFR flight into any airport before attempting a serious IMC arrival. This is why the FAA requires airline crews to be qualified for every field regularly used.

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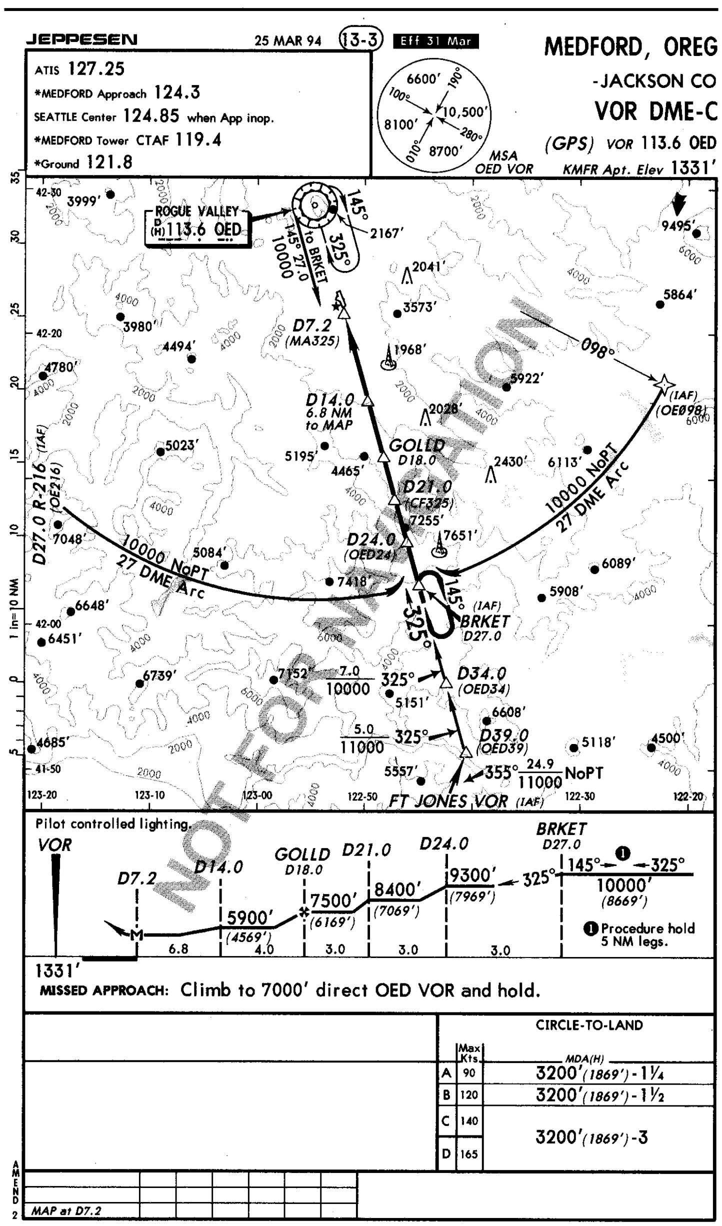

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The final approach course for this VOR/GPS procedure is aligned within 30 degrees of the runway, but doesn't have straight-in minimums, because the descent gradient on the final approach segment is excessive. In this situation, the 400-foot per mile final segment has been calculated only to the circling MDA. You're on your own to compute the descent gradient for a straight-in landing.