Low Visibility Operations

Assessing visibility during low visibility approaches is fraught with operational and regulatory ambiguities.

By Wally Roberts

I TOUCHED BRIEFLY ON THE evolution of runway visual range (more commonly known as "RVR") in my article about approach light systems ("Lights, Camera, Action!" August *IFRR*). This article discusses low-visibility operations and the differences between visibility and RVR, both from the regulatory and operational viewpoints.

Because some readers make their living by flying under "for-hire" rules, I'll cover the distinctions between the regulatory aspects of RVR for both private and commercial instrument operations. Although RVR regulatory concepts vary somewhat between commercial and not-for-hire instrument operations, the operational requirements during instrument approach and landing are pretty much the same for all instrument pilots. It's also important to understand that runway visibility value (RVV), although mentioned in the AIM, is an obsolete concept in this country.

The regulations

The cornerstone regulation for visibility minimums is in FAR 91.175, "Takeoff and landing under IFR." The last major change to this regulation (previously FAR 91.116) occurred in 1981.

Before May, 1981, the required visual references for operating below MDA or DH were loose, and had become increasingly so from years of sharp-shooting and liberal interpretations by both the aviation community and FAA operational staffs. The 1981 change did away with descending below MDA or DH based on the sighting of "Farmer Jones' barn," etc. and instead required without exception that either approach lights or one of nine runway-specific visual aids be in sight.

FAR 91.175(c) contains the regulatory imperatives about visibility requirements for the visual segment of an IAP, from the pilot's visual assessment at MDA/DH, until touchdown on the runway occurs. The entirety of FAR 91.175 is the Approach Category I rule, Category I being defined as any precision IAP with a DH of 200 feet (HAT), or higher, and all straight-in and circling non-precision IAPs.

The regulation sets forth two requirements about visibility for descent below MDA/DH:

"No pilot may operate an aircraft, except a military aircraft of the United States, at any airport below the authorized MDA or continue an approach below the authorized DH unless...(t)he *flight* visibility is not less than the visibility prescribed in the standard instrument approach being used..." [91.175(c)(2)] (emphasis added.)

It's indisputable that the pilot must continuously find the required flight visibility to exist from MDA or DH until the landing roll-out begins.

"No pilot operating an aircraft, except a military aircraft of the United States, may land that aircraft when the *flight* visibility is less than the visibility prescribed in the standard instrument approach procedure being used." [(91.175(d)] (emphasis added.)

Flight visibility is defined in FAR 1 as, "...the average forward horizontal distance, from the cockpit of an aircraft in flight, at which prominent unlighted objects may be seen and identified by day and prominent lighted objects may be seen and identified by night."

That definition is straight forward and gives further definition to FAR 91.175(c)(2) and (d). It's indisputable that the pilot must continuously find the required flight visibility to exist from MDA or DH until the landing roll-out begins. What isn't so clear, however, is how the pilot makes this assessment.

Assessing visibility

There are various, somewhat objective methods of measuring flight visibility using the geometry of the approach light/runway threshold environment on an ILS approach. These schemes are based on the aircraft's position in space vis-à-vis the runway or approach lights based on an evaluation of altitude on the electronic glideslope vs. runway elevation. Actually, these methods attempt to measure slant-range visibility and equate it to the "average forward horizontal distance." On a non-precision straight-in IAP without either a charted visual descent point (VDP) or VASI/PAPI, the task is difficult, if not effectively impossible, especially during low-visibility conditions.

It's been my experience that none of the so-called geometric evaluation schemes hold up under actual low-visibility operations, not even on ILS approaches. What are the prevailing methods used overwhelmingly by those who fly in instrument weather conditions on an ongoing basis? The answer varies greatly upon whether it's a precision, non-precision straight-in, or circling approach:

• Precision. The vast majority of IMC approaches are flown to full ILS runways. When weather is at or near minimums the pilot or flight crew make a quick visual assessment approaching DH. If the ALS bars are distinctly visible, the approach is continued using both electronic guidance and visual sighting, until a significant portion of the runway comes into view. This point where the runway comes into view is the second and final decision height, although no one in industry or the FAA will admit to it when pressed. (Descent based only on sighting of sequenced flashers without seeing ALS bars isn't safe and most likely not legal. Also, keep in mind the ALS doesn't provide any vertical guidance.) If the ILS runway doesn't have approach lights, then the prudent pilot runs with sighting at least the runway threshold before descending below DH.

• Non-precision straight-in. The regulation permits descent below MDA based only on sighting of approach lights, when the runway has them. The regulation further permits descending to only 100 feet HAT, using only approach lights. The prudent pilot never descends below MDA until both the runway threshold and a significant portion of the runway is clearly visible. At night (especially at unfamiliar airports), descent below MDA should be made only to runways with either VASI or PAPI, and where these vertical-guidance lighting aids are clearly visible.

• Circling approach**.** If the final approach is fairly well lined up with the runway, but there are only circling minimums published, the final segment descent gradient probably exceeds straight-in descent criteria. Nonetheless, the descent below MDA and landing are usually done straight-in to the favored runway. The real circling approach involves circuiting a significant portion of the airport to line up and land on a runway not associated with the IAP. The prudent pilot runs with sighting most of the airport before departing the electronic guidance for what is a demanding, low-level VFR-type operation in less than VFR conditions. Circling has its own sets of hazards of visually avoiding nearby terrain and obstacles, which I discussed in "Circling and the Visual Segment" (January *IFRR*).

RVR instead of visibility

RVR is defined in FAR Part 1 as, "...runway visual range as measured in the touchdown zone area." Note the definition doesn't use the word "visibility." The FAA official position is that RVR is *not* visibility[1]. RVR is the measurement of the distance at which the pilot is likely to be able to see the high intensity runway lights (HIRLs) once the aircraft has touched down on the runway surface in the runway's touchdown zone. A 1977 FAA advisory circular[2] about RVR sets forth the components of the RVR system:

"a. A full RVR system consists of the following:

(1) Transmissometer projector and related items.

(2) Transmissometer receiver (detector) and related items.

(3) Analogue recorder.

(4) Signal data converter and related items.

(5) Remote digital or remote display programmer.

"b. The transmissometer projector and receiver are mounted on towers either 250 or 500 feet apart. A known intensity of light is emitted from the projector and is measured by the receiver. Any obscuring matter such as rain, snow, dust, fog, haze, or smoke reduces the light intensity arriving at the receiver. The resultant intensity measurement is then converted to an RVR value by the signal data converter. These values are displayed by readout equipment in the associated air traffic facility and updated approximately once every minute for controller issuance to pilots."

A basic understanding of RVR is essential in order to avoid its pitfalls, yet take advantage of its good aspects.

There are new RVR systems being installed today that are digital and much faster than the analog system described in the 1977 advisory circular. Nonetheless, the concepts remain the same.

It's important for pilots to be exposed to the characteristics of the RVR system. A basic understanding of RVR is essential in order to avoid its pitfalls, yet take advantage of its good aspects. Obviously, if the lights are cranked up, RVR increases, everything else being equal. The converse, of course, is true.

What "everything else" is in this context are the obscuring atmospheric conditions and whether it's daytime or nighttime. Although the above system description fails to mention it, the ambient lighting conditions "behind" the HIRLs are considered in the RVR computation. This makes sense because bright lights stand out more at night in a given set of atmospheric conditions. HIRLs are a prerequisite for the installation of an RVR system. The runway must also have all-weather markings.

The FAA asserts that RVR has a 3-to-6-fold advantage over reported prevailing visibility. The maximum advantage usually occurs at night. What this means is the prevailing visibility can be—and often is—well below minimums when RVR is above minimums. Sometimes this difference is the result of the prevailing visibility measurement being made a couple of miles away from the approach end of the RVR runway in non-homogeneous weather conditions. In other situations, the prevailing visibility can indeed be very low, yet RVR makes the touchdown zone's high-intensity runway edge lighting adequately visible for safe control of the landing aircraft.

Although RVR relates to high-intensity lights, the FAA authorizes its use with medium intensity approach light systems at some locations. The pilot should understand this, and be prepared for a higher likelihood of a missed approach where RVR is at minimums and the ALS has medium intensity light bulbs. This is especially profound at some "Super CAT I" runways (HIRLs, TDZ and CL lights) where RVR 1800 is authorized with MALSR.

RVR is *the* minimum

Those of you who make the study of IAP charts an art form will note that NOS doesn't publish a statute-mile visibility value along side RVR (what is shown along side on the NOS charts are military minimums). This is the correct legal description of the minimum as set forth on the FAR 97 IAP source document. Jeppesen elects to include a statute-mile visibility value, which they extract from the table of "comparable values of RVR and ground visibility" contained in FAR 91.175(h). The table doesn't have any application, however,

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except when RVR isn't reported—in which case the comparable visibility value must be used in place of the published RVR minimum.

RVR can only be authorized for straight-in minimums and only where the visibility minimum, if published, would be 1-1/4 statute mile or less. In other words, you'll never see a published RVR value greater than 6,000 feet.

In homogeneous weather conditions, RVR loses its advantage over reported prevailing visibility at some point around 1-1/4 to 1-1/2 miles. In unusual, non-homogeneous conditions, it's possible to have a fairly high prevailing visibility and an RVR reading below minimums. This usually is a valid condition, such as ground fog covering the approach end of the runway or localized blowing snow.

When RVR is controlling

For commercial operations RVR is clearly the controlling minimum when it's shown both on the IAP chart and reported by ATC or some other official weather reporting source. This is the result of clear language in all commercial operators' FAA-issued operations specifications, which bind the operator to reported RVR for both takeoff and landing under IFR.

What about the not-for-hire instrument pilot? Well, there obviously aren't any operations specifications to bind use of RVR. Further, reported weather doesn't bind the not-for-hire pilot. The not-for-hire pilot has no visibility requirement for takeoff strictly from a legal standpoint (safety issues notwithstanding). For IFR approach and landing, it's clear the not-for-hire pilot must find at least the minimum visibility in the IAP both at MDA/DH and continuously thereafter to landing. The skillful not-for-hire pilot can overcome the legal presumption that either the reported RVR or visibility is accurate.

Assessing RVR for the FARs

How does the pilot make the flight-visibility assessments required by FAR 91.175(c)(2) and (d) from MDA/DH to touchdown when RVR is the published and reported minimum? As I pointed out earlier about how the prudent pilot assesses visibility, no one at the FAA cares when the reported RVR is at or above minimums. The regulation clearly requires the pilot to assess flight visibility in such circumstances, although the FAA's expert air carrier operations staffs assert that RVR isn't visibility (with which I agree).

The issue becomes one of the viability of the regulation itself, when applied to RVR operations. Note that FAR 91.189, "Category II and III operations: General operating rules," which is the Category II and III rules that apply to all (commercial and not-for-hire) CAT II and III operations, do not place a flight visibility assessment requirement, per se, on the pilot. Yet, CAT II minimums can be almost as high as the lowest CAT I minimums. The problem doesn't lie with FAR 91.189, rather with FAR 91.175(c)(2) and (d) when RVR is used.

This convoluted aspect of FAR 91.175(c)(2) and (d) can work to the not-for-hire pilot's advantage, though—at least from a legal standpoint. The FAA Chief Counsel issued a letter of legal interpretation, dated March 10, 1986, in which it states:

"The question arises as to whether descent below the DH or MDA can be made when the runway visual range (RVR) is reported at less than the published minimum RVR for the approach but the flight visibility is greater than that minimum.

"The flight visibility is controlling. If the flight visibility exceeds the published minimum for the approach, then the pilot may proceed as long as the other requirements of paragraph 91.116(c) are met regardless of the reported RVR. The National Transportation Safety Board (NTSB) has upheld this interpretation in several enforcement cases. However, the pilot's judgment of flight visibility is not necessarily conclusive if there is a question as to the actual flight visibility conditions at the time of the approach. Reported visibility and other evidence of record may be considered by the Federal Aviation Administration and the NTSB in determining the actual flight visibility."

This was written only for not-for-hire IFR operations and it flies in the face of the view of RVR held by the expert operations staffs at the FAA. Nonetheless, it's the legal precedence of standing and argues for maintaining the ambiguities contained in FAR 91.175(c)(2) and (d) for sake of below-RVR-minimums landings by not-for-hire pilots. The safety issues are another matter. Also, a careful reading of the letter suggests that the reported prevailing visibility better be above minimums in order for the not-for-hire pilot to successfully challenge a below-minimums RVR report.

Commercial "look-see"

Under limited conditions, FAR 121 and 135 commercial operators are permitted to continue an IAP if the reported visibility or RVR goes below minimums after the aircraft has passed the FAF on final approach[3]. This is an operational "expediency" the carriers have lobbied for over the years based on the rationale the flight is "almost home," so the pilot should be able to "take a look." The logic is fundamentally flawed, especially when RVR is the controlling minimum. You can be virtually certain that when RVR drops below minimums, the "seeing conditions" have deteriorated. The wary commercial flight crew will use this provision with great caution. It's use should be considered (if at all) only on an ILS with no noted restrictions and which the crew knows to be rock-solid, both as to glideslope and localizer guidance, to well below DH.

The FAA's RVV

The current AIM (October, 1996) has several references to RVV (runway visibility value), which is discussed in Section 7-1-10 on the automated weather observing system (AWOS). RVV historically involved placing a certified observer at the approach end of the runway who would report the visibility along the runway to the control tower. This represented an improvement over prevailing visibility, especially at large airports where the prevailing visibility might be observed a couple of miles away from the runway in use. This manual observing system, however, has long been just a bit of aviation nostalgia.

The FAA folks who included the "new" RVV in the AIM failed to check with the FAA folks who design and certify IAPs and charted minimums. There are no plans to use any automated RVV capability of AWOS in IAP minimums. The next AIM *should* be corrected to properly reflect FAA policy.

International RVR

RVR is measured differently in other parts of the world than set forth in this article—in some countries it's more like RVV, although it's called RVR. Most all-weather operations experts will agree that the FAA's definition and measurement of RVR is the best way. Issues of both politics and dollars dictate different methodologies in other parts of the world. One thing is fairly universal throughout the world, however: where RVR is published and reported, it's controlling for the IAP—the United States' not-for-hire legal interpretation being the exception.

Wally Roberts is a retired airline captain, former chairman of the ALPA TERPs Committee and an active CFII in San Clemente, CA. His email: terps@terps.com Wally's web site: http://www.terps.com/terps

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[1]FAA Order 8400.10 (Air Transportation Operations Inspector's Handbook), uses the phrase "seeing conditions" 44 times when discussing in-flight visibility conditions for air carrier IFR and VFR operations. On the other hand, "flight visibility" is used only once, which demonstrates the discrepancy between the view of FAA operations and legal staffs.
In addition to "seeing conditions" vs. "flight visibility," Order 8400.10 discusses RVR in detail, of which the following is a significant excerpt:
"To properly apply operating minimums it is important to understand RVR. The following is a list of statements which describe what RVR is:
(a) RVR is an instrumentally derived value.
(b) RVR is currently measured by transmissometers located approximately 400 ft from runway centerline.
(c) RVR is related to the transmissivity (degree of opaqueness) of the atmosphere.
(d) RVR is an approximation of the distance a pilot should see when an aircraft is on, or slightly above, the portion of the runway associated with the report.
(e) RVR is calibrated by reference to runway lights and/or the contrast of objects.
(f) RVR is a value which varies with runway light setting.
(g) RVR is a value which only has meaning for the portions of the runway associated with the RVR report (TDZ, MID, or Rollout).
(3) The following describes what RVR is not:
(a) RVR is not a measure of meteorological visibility.
(b) RVR is not a measure of surface visibility or tower visibility.
(c) RVR is not a measure of seeing conditions on taxiways, ramps, or aprons.
(d) RVR is not a measure of seeing conditions at or near MDA or DH.
(e) In the U.S., RVR is not measured or reported by a human observer.
(f) RVR IS NOT 'VISIBILITY.'
FYI: RVR is a value which can be five to six times greater than ground or tower visibility at night and two to three times greater during daytime."

[2]AC 97-1A - "Runway Visual Range (RVR)," dated 9/28/77.

[3]FARs 121.651(c) and 135.225(c)