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TURBINE PILOT

TBM Technique: LANDING IN STYLE

Prop-strike prevention 101

BY THOMAS A. HORNE

ALL AIRPLANES HAVE THEIR QUIRKS and "gotchas"—traps for the unwary. The TBM series of turboprop singles has its modest share, but one in particular—the propeller arc's proximity to the ground—has drawn increasing attention lately. An effort has emerged to educate TBM pilots about the risk of a prop strike while landing. The exact number of prop strikes is unknown. Yarns and lore aside, some members of the TBM pilot community say insurers are taking note.

PHOTOGRAPHY BY MIKE FIZER

The setup begins with a few of the TBM's design essentials. Its Pratt & Whitney PT6A engine provides the power (700 shaft horsepower in earlier models; 850 shp in more recent versions) to give late-model TBMs max cruise speeds as high as 330 knots. The engine is installed at the end of a longish nose section, which gives TBMs such aggressive-looking—and, some would say, attractive—snouts.

Out on the tip of that snout is a huge four- or five-blade Hartzell propeller with a 7.5-foot diameter. This provides the thrust needed for the TBM's light-jet speeds. But that large-diameter propeller arc spins a mere 8.15 inches from the ground—assuming a properly inflated nosewheel strut. That's pretty close. So, a tight propeller-to-ground clearance endures as a TBM quirk.

A body of evidence indicates that some pilots fly faster, no matter the landing weight...the result can be wheelbarrowing in a nose-down attitude; excessive floating as airspeed is bled off; and, in the worst case, a prop strike.

So does a nearly horizontal stance. As it sits on the ramp, the airplane's pitch is a tiny 1.7 degrees nose-up. From the cockpit this gives a great view ahead, over that long nose. It should also serve as a reminder of just how low the prop arc rides.

By themselves, this collection of quirks is of little import. But add poor landing technique to the mix and you've got a recipe for trouble. Like all too many other pilots, some TBM drivers fly their final approaches too fast. Igor Lucas, an assistant manager and TBM instructor at Orlando's Simcom Aviation Training Center, says that there's a tendency to come down final at 90 knots, or faster. "That's way too fast," he says. "The goal is to approach the touchdown zone at a V_{REF} of 1.3 V_{SO} [1.3 times the stall speed in the landing configuration]. At lighter landing weights, for example, the TBM 930's proper approach speed can be 75 knots [at a 5,700-pound landing weight] or 77 knots [at a 6,000-pound landing weight]."

At max landing weight, V_{REF} is precisely 83 knots for the TBM 900/910/930/940 series, although it's most often rounded off to 85 knots. For the TBM 700 and 850 models, it's 80 to 85 knots. In the TBM 910, 930, and 940, pegging the primary flight display's angle of attack indicator at its white reference line is a quick way to accurately fly at 1.3 V_{SO}.

But for whatever reason, a body of evidence indicates that some pilots fly faster, no matter the landing weight. Perhaps they've gotten away with this in the past. Perhaps it's the "10 knots for the wife and kids" calculus that equates extra speed with safety. Maybe pilots like to see the runway over that longish nose. Maybe airspeeds hovering around 80 knots make pilots uncomfortable knowing that the airplane is designed for 300-knot-plus cruise speeds. Whatever the case, the result can be wheelbarrowing in a nose-down attitude; excessive floating as airspeed is bled off; and, in the worst case, a prop strike—with or without porpoising. It's worth emphasizing that this behavior isn't exclusive to TBM pilots. You can see pilots making high-speed, flare-free landings at any airport on any given day.

Higher approach speeds translate into lower angles of attack and a flat attitude over the threshold. "We see 2-degree pitch attitudes all the time," Lucas says. "And that's when a prop strike is very likely. A little bit of strut compression is all it would take. Think of that 1.7-degree ramp attitude. You need to fly at a pitch attitude of 4 to 7 degrees

CLOCKWISE FROM THE TOP, some views from Simcom's TBM 930 simulator: Taking off from Orlando Executive Aiport; descending to the Palm Beach International Airport; between layers above the Sierra Nevada; and on a high-speed ILS approach into Palm Beach International Airport.


LOC
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2460
-600
2300
2200
2100
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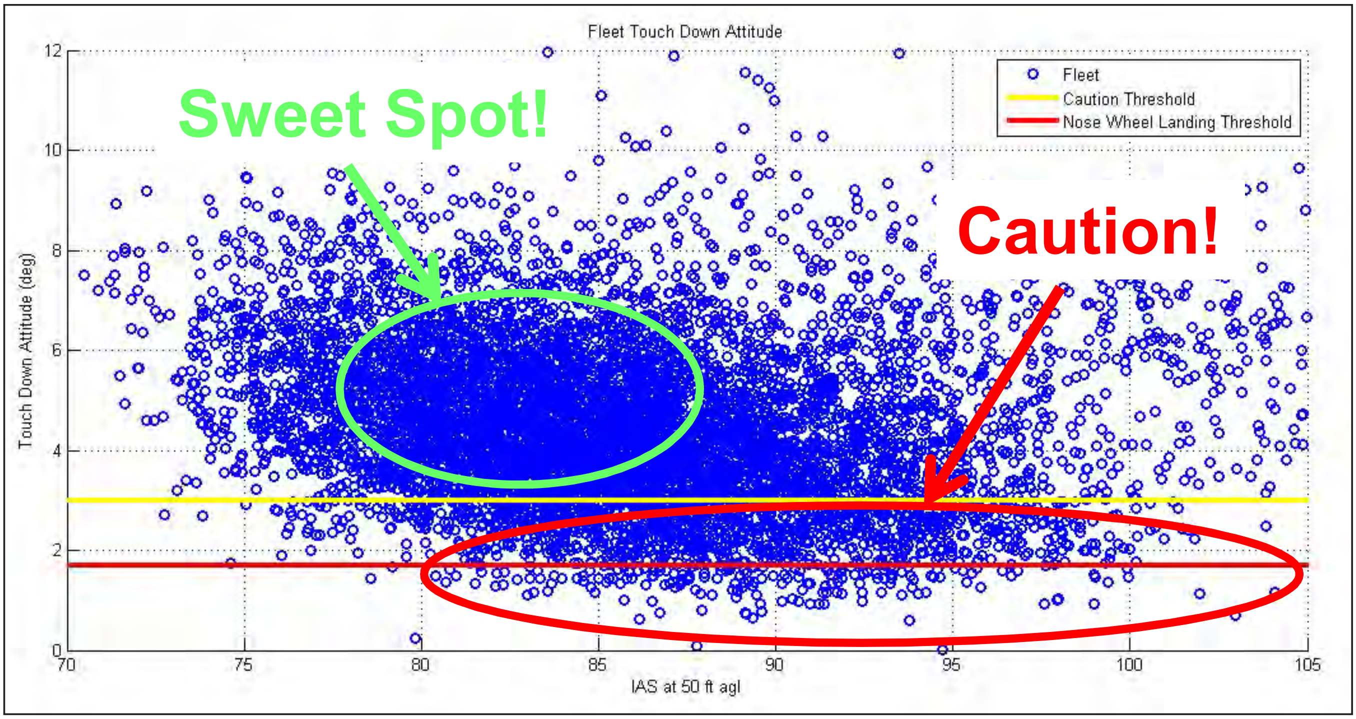
RA 2400
100°
AOA
BARO MIN 216FT
29.92IN
WILBA iaf → ZISUR faf
DIS 1.5NM
BRG 099°
LOC1
NAV1 IPBI 111.90
DME 9.2NM



DIERK REUTER'S GRAPH (above) shows ideal and risky combinations of touchdown pitch and airspeed values. The ideal touchdown attitude (opposite page) is four to seven degrees nose-up pitch, and airspeed at or slightly below 1.3 V_{SO}.

nose-up to have a good margin at touchdown, and certainly no lower than 3 degrees. That way you'll land main gear first."

John Warnk, Simcom's Orlando, Florida, training center manager, puts it this way: "You can't just fly to the runway and do a chop and drop." He says pilots must learn to land the main gear first, then slowly lower the nosewheel for its own landing. "It's more like an airliner landing," Warnk says. "You have to fly precise airspeeds for the approach and touchdown."

Dierk Reuter, a TBM 930 owner, became interested in the issue when he kept hearing anecdotal reports from flight instructors and prop-strike victims. A pilot's typical description of events leading up to the strike usually involved a "normal" approach disrupted by a wind gust. A self-professed "data guy," Reuter began recording several TBM pilots' landing performance on data cards installed in their multifunction displays. One dataset sampled 100 pilots' data cards for a one-year time frame. The cards logged landing performance parameters—airspeed and attitude on touchdown—in files that recorded 10,000 landings. These results were extrapolated to compare against estimates of landing performance among all TBMs in the fleet, assuming each pilot flew 150 hours per year. The assumption was that pilots in the entire TBM fleet have 70,000 landings per year.

Based on his findings, Reuter's analysis showed that 14 percent of his 100-pilot sample experienced touchdowns in the "caution" range, where landings were made at airspeeds in the 90-plus-knot range, and pitch attitudes were 3 degrees or less. Three percent of landings were flat-attitude arrivals with nosewheel touchdowns, where prop-strike potential is high. If this was representative of those 70,000 TBM landings, it meant there could have been a fleet annual total of 10,000 "caution" landings and 2,000 nosewheel touchdowns.

Reuter's next step was publicizing his findings at TBM Owners and Pilots Association conventions, and sharing his data with Daher. The intent is to use the landing performance findings in publicity and teaching campaigns.

Reuter and a fellow TBM owner, Phillip Bozek, used the landing data to create learning experiences incentivized in the form of spot-landing contests. The first contest in July 2020 had eight contestants and was held at Howell, Michigan's Livingston County Spencer J. Hardy Airport. The emphasis was on stabilized approaches and, of course, landing at the proper airspeed and attitude. Some contestants hired instructors to practice up, so this learning approach seems to show promise. Coming in at first place was TBM 850 owner Jason Robertson, who took home a distinctive, ornate trophy. "I landed right on the target zone—the beginning of the ILS touchdown bars—but I guess I forgot that the main gear are behind me, so they touched down four feet short," Robertson said. "But I was still the closest."

A second spot-landing contest is scheduled to take place at the Naples, Florida, Municipal Airport in February 2021. Another trophy—and, of course, commemorative T-shirts!—will await the most precise pilots.

Reuter continues to collect data and promote education. Most encouraging is that pilot scores are on an upward trend. A year ago, one new TBM pilot's landings had a 14-percent compliance score with target airspeeds and attitudes. Since then, he's been practicing. Now his scores are among the top four, and he qualified to land on the very short (2,119 feet), challenging Runway 10/28 at the Gustav III Airport in St. Jean, Saint Barthelemy Island in the Caribbean.

Simcom has incorporated a prop-strike awareness module in its TBM courses, using the data Reuter gathered. It's heavy on promoting stabilized approaches and strict landing profiles.

For example, on precision approaches at maximum gross weight, the steps begin with a power reduction to 35 percent torque, which yields approximately 150 KIAS. At two dots above the glideslope, extend the landing gear. At one dot above the glideslope, extend the flaps to the first, takeoff position. At glideslope intercept, reduce power to 22 percent torque, leave it there, and go to full flaps. The airplane will slow to the recommended 85 KIAS (with

THE TBM 930'S Garmin G3000 primary flight display includes a green circle on the airspeed tape, showing 1.3 V_{SO} for the airplane's specific weight and landing configuration. An angle of attack (AOA) indicator is below the airspeed tape. The white line extending from the AOA's scale also marks 1.3 V_{SO}. The airplane's yellow attitude indicator matches the pitch attitude set by the magenta flight director command bars. The simulator—technically, a Level 6 Aviation Training Device—doesn't move but its visual presentations (next page) are impressive.

> “You can’t just fly to the runway and do a chop and drop. You have to fly precise airspeeds for the approach and touchdown.”

an acceptable deviation of minus 5 knots/plus 10 knots) as it follows the glideslope to the runway. It’s important to trim for 85 KIAS so that you won’t be nose heavy and holding excessive back-pressure during the flare and touchdown. Additionally, at 50 feet agl, make sure that torque is at or slightly above 10 percent; this also prevents the airplane from becoming nose-heavy as the threshold nears. Right before touchdown, begin adding back-pressure for the flare. Going to flight idle should be delayed until immediately before touchdown—at which point you should be holding the nose at the 3-to-7-degree “sweet spot” pitch attitude.

Simcom also provides a “high-speed” approach procedure that uses the same torque setting but delays full flap extension until 1,000 feet agl. After that, the airplane slows to 85 KIAS (again, minus five/plus 10 knots) by 500 feet agl. At 50 feet agl, back pressure should be applied slowly, and then held at three to seven degrees nose-up for the touchdown.

It all boils down to this: Fly final at an appropriately slow airspeed, reach 1.3 V_{SO} on short final, and flare to hold the nose up for a full-stall touchdown. If this sounds anything at all like the approach and landing profile you’d perform for *any* high-performance single, you’re right. **AOPA**

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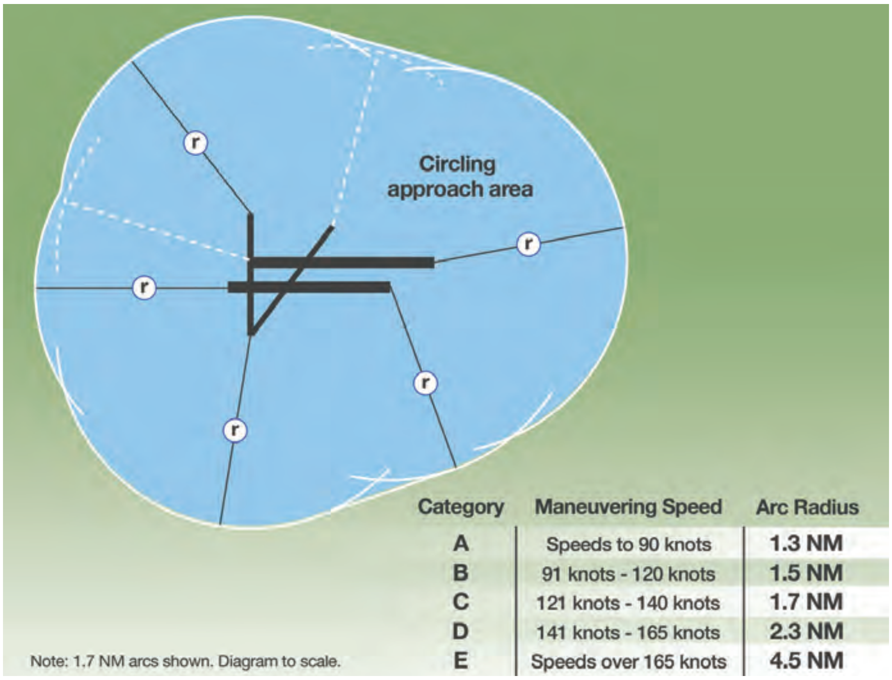
Say goodbye to a stabilized approach

Practice makes perfect, but every circling approach has its curveballs

BY THOMAS A. HORNE



Category	Maneuvering Speed	Arc Radius
A	Speeds to 90 knots	1.3 NM
B	91 knots - 120 knots	1.5 NM
C	121 knots - 140 knots	1.7 NM
D	141 knots - 165 knots	2.3 NM
E	Speeds over 165 knots	4.5 NM

CIRCLING APPROACH AIRSPACE is measured from the threshold of the runway. For airplanes in categories A and B, this gives you little room for maneuvering for a final approach. Steep banks may be needed to stay within circling airspace and it's easy to end up high and close-in on final. The temptation to dive for the runway can be strong, but this can leave you set up for an overrun. That's just one reason why airlines stay away from circling.

CHARLES FLOYD

WE'RE CONSTANTLY WARNED ABOUT the inherent risks involved in flying circling approaches, and for good reason. I had another reminder recently, after taking a Daher TBM 930 recurrent course at Simcom Aviation Training Center's Orlando location. As with any simulator-based training experience, there were loads of instrument approaches—many to minimums, others that ended in missed approaches—and some of them involved circle-to-land procedures. I also had plenty of practice flying stabilized approaches and precise touchdowns.

Simcom's simulators are well known for the quality of their visual displays. The simulator cab doesn't move, so when you're "flying" the simulator you don't get the rolling, pitching, yawing, and heaving that you'd experience in one of FlightSafety International's or CAE's full-motion simulators. That's one of the reasons why Simcom's simulators are classified as Level 6 Advanced Aviation Training Devices (AATDs), and not full-blown Level C or D simulators with full ranges of motion and credit for landings.

But what these simulators lack in motion is more than offset by their wraparound visual displays. When the scenery moves the body plays right along, and there's a definite psychosomatic sensation of movement. Another benefit is that the angle of view from the cockpit is so wide that it lets you see a runway from the downwind leg of a landing pattern. Breaking out on an instrument approach, the entire runway complex is spread out before you.

But back to circling approaches. Compared to ILS, LPV, and RNAV GPS approaches, they're the oddball relatives with cranky dispositions. The heavily advertised stabilized approach? Forget about it. You won't be landing straight-in to a runway. Instead, you'll have to level off at higher minimums than those of a precision approach. That means adding power, flying a slightly higher airspeed, and resetting trim for a new configuration. Of course, this all assumes that you've broken out of instrument conditions by the time you reach circling minimums.

Then there will be a turn to circle to your chosen runway. During the turn you'll have to remain within a prescribed circling radius defined by distance from the landing runway's threshold. In practical terms, this means you'll have to stay as close as 1.3 or 1.5 nm from the threshold (maybe a bit more if you're using expanded circling minimums) while you maneuver to a position that puts you on your chosen runway's extended centerline. That can be uncomfortably close. That's for approach category A and B airplanes, respectively—which represent most owner-flown single-pilot airplanes.

Imagine banking while turning to stay within those margins. You're slowed up but need to stay in a comparatively steep bank, one that puts you closer to stall speed. At the same time, you'll be scanning the terrain ahead for the runway. Your attention is divided between the panel, outside visual cues, and going no lower than the published circling altitude. It may be turbulent, adding to the distractions. It may be night. It may be an unfamiliar airport. And a landing—or missed approach—is coming up in seconds. You're on anything but a stabilized approach.

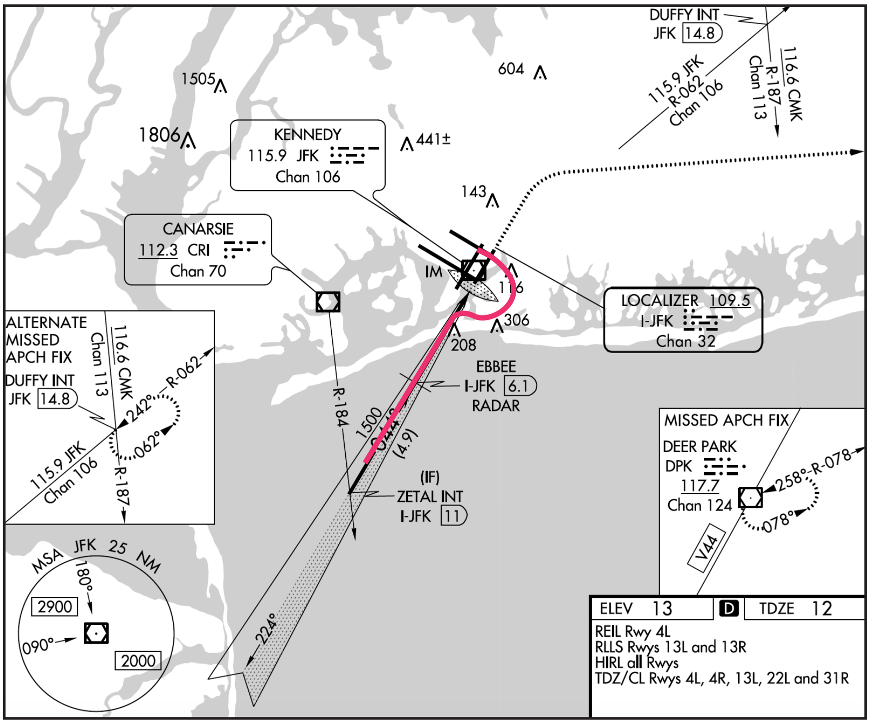
CIRCLING IN THE SIM

During my training at Simcom, I flew two circling approaches. Both were at night. One was at New York's John F. Kennedy International, where I was vectored for the ILS Runway 4R, with a circle to land on Runway 31R. This is an approach that's been approved for use in Simcom's simulators, as well as those at FlightSafety International and CAE.

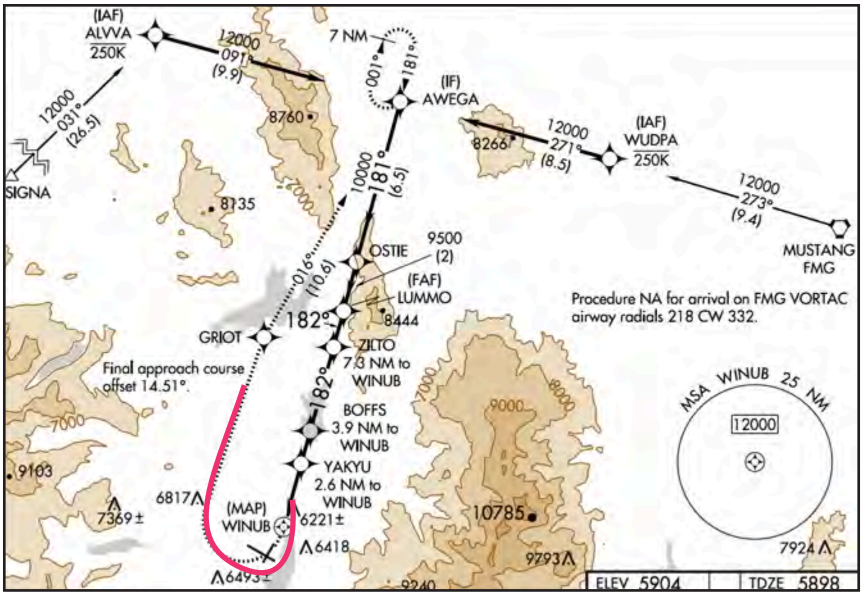
I broke out at 700 feet msl, so I was in the clear by the time I descended to the 640-foot circling minimum altitude. The visual display showed JFK and its runways, taxiways, terminals, and hangars in all their glory. It was a confusion of lights, but after sidestepping to the right I maneuvered to a heading that I figured would put me on a base leg for 31R. I could have used the TBM 930's autopilot to fly the leg, but decided to hand-fly. After 10 seconds or so, I still hadn't positively identified 31R—and this was in good visibility. I was flying at 120 knots, so time was of the essence.

Finally, I saw what looked like a horizontal illuminated structure—maybe the blast fence noted on the runway diagram—with runway alignment lights to its right. Next, it was quick—go to the landing flap setting, motor over to line up with the runway, slow to 85 knots, and fly to the threshold. To me, the risks on this particular approach were on the low side, even though it was night. The lights of the vast runway complex made it somewhat easy to locate the landing runway, there was adequate visibility, and the distance to the landing runway allowed a gradual turn onto the final approach.

The rules say that you can't descend from the minimum descent altitude until you're in a position to make a "normal" landing. I take that to mean that you're lined up on the extended runway centerline, and there was plenty of room to get there with a fairly shallow bank. Last but not least, this approach had an expanded circling radius, so instead of being held to earlier, 1.5-nm radius limits, I had 1.7 nm of room to work with. An expanded circling radius is identified on approach plates in the minimums information blocks at the bottom of the page. You'll see a white "C" embedded in a black box if there is expanded circling.



THE FLIGHT PATH (in red) shows a track for circling to JFK's Runway 31R out of the ILS approach to Runway 4L. With adequate visibility it can be easy to spot 31R.



CIRCLING TO TRUCKEE, California's Runway 29 out of the RNAV (GPS) approach to runway 20 can be tricky in low visibility. Terrain is nearby, and you're left at 1,216 feet agl (category A) or 1,316 feet agl (category B) for a very steep descent to the runway. The approach flown for this article ended in a missed approach (flight path in red).

Another circling approach was vastly different. It was Truckee-Tahoe's RNAV (GPS) Runway 20 approach with a circle to land on Runway 29. Truckee is in mountainous terrain, the approach path threads its way down a valley, and the minimums are higher. The expanded circling minimums are 7,120 feet (Category A) and 7,220 feet (Category B), which have you levelling off at 1,216 and 1,316 feet agl, respectively. There's not much room to circle, and not much time to descend to the runway, either. That means steeper banks, so risk goes up. And it was night.

There have been many accidents at Truckee-Tahoe, and this approach had me flying one specific accident scenario involving that circle to Runway 29. The accident pilot could have flown down Runway 20, crossed the airport, and then made a left pattern to land on Runway 29. Instead, after breaking out he circled to the left to make a modified right base to Runway 29.

Flying the approach in the simulator, it was easy to see that this move ratcheted up the stress—and risk. From the left seat, you can't easily see Runway 29, unless you dip the right wing. I did, and I could barely make out the runway. My first thought was that at 1,316 feet agl I was way too high to maneuver to a position from which I could make a normal landing. I thought of bending the airplane around, descending at the same time, and rolling out on final, but I figured that I'd land too long. I saw that fog covered the distant half of the runway. I'd be landing fast, into fog. Bad idea.

So I opted for a missed approach, hit the go-around button on the power lever, and the command bars popped up on the PFD to guide me through the procedure. Then it was a climbing right turn to 12,000 feet. For the accident pilot, things didn't turn out so well. He stated he lost visual contact, became disoriented, then realized he was in a 70- to 80-degree left bank. By the time he levelled the wings the ground was directly in front of the airplane. He slid to a stop; he and three passengers suffered minor injuries. The NTSB listed the pilot's failure to maintain control due to spatial disorientation as a probable cause of the accident, with dark night as a factor.

No matter where you fly them, circling approaches carry risks. Some approaches have more curveballs than others, but the general rules still apply: plan your circling maneuver ahead of time, stay on top of the airplane, don't go below MDA until on final, be ready for steeper-than-standard bank angles, count on higher-than-normal descent rates on final approach—and have the missed approach procedure briefed and ready for action. **AOPA**

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