Stan/Eval Newsletter

CIVIL AIR PATROL
UNITED STATES AIR FORCE AUXILIARY
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Maxwell AFB, AL 36112

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Canyon turn (Maj M. Banner, FLWG)


Pilot's view of low-level flight within a narrow, confined canyon

Pilots involved in mountain flying should maintain heightened situational awareness to avoid accidental flight into a narrow canyon because of the risk of a fatal controlled flight into terrain (CFIT) mishap on the canyon walls. If by error a pilot flies into a narrow canyon, how should he/she turn around to exit the canyon, a turn critical for survival? Many pilots erroneously believe a chandelle is used for reversing course and flying out of a confined canyon. A chandelle, not to be confused with the so-called "canyon escape turn", is a performance maneuver included in the *Commercial Pilot Airman Certification Standards*. It is a maximum performance 180 degree climbing turn starting at maneuvering speed (V_A) with engine power increased to the recommended setting, flaps up, a bank angle of 30 degrees and ending in a nose-high pitch attitude at slightly greater than one G stall speed (V_S). A chandelle is ***not*** stated in the *Airplane Flying Handbook* (FAA – H – 8083 – 3C) and *Pilot's Handbook of Aeronautical Knowledge* (FAA – H – 8083 – 25C) as a maneuver for exiting from a narrow, closed-off box canyon. Additionally, mountain flying experts do not recommend using a chandelle to escape from a canyon. Also, maneuvers like a Hammerhead, bank angle greater than 45 degrees, and half-turn spin should be avoided. The idea is that if you are surprised by having to escape a canyon, this is no time to use a maneuver that you are not proficient in. A simple slow climbing turn is easy and preferable.

Turn radius

So, how should pilots safely turn 180 degrees around to exit from a confined canyon? Two salient concepts should be understood: (1) *Turn radius (R) is directly proportional to airspeed (V) squared (*$R \propto V^2$) (assuming a constant bank angle and no-wind conditions) and (2) *R is inversely proportional to bank angle* ($R \propto 1$ / bank angle). Basically, by decreasing V and increasing bank angle, R decreases, and vice versa.

Accordingly, to minimize R for a canyon turn V should be as low as possible, while sufficiently greater than one G V_S. Three possible values for V have been posited (Transportation Safety Board of Canada, Aviation Investigation Report, A11PO106, Aerodynamic stall and collision with terrain): (1) not less than maximum endurance speed, which is stall speed in the landing configuration (V_{SO}) times 1.2 for single-engine fixed gear airplanes and V_{SO} times 1.3 for single-engine or multi-engine retractable airplanes; (2) 1.83 times V_S; and (3) best rate of climb airspeed (V_Y). Another source recommends slowing to "flap extension speed" (*AOPA Pilot*, 2018, February). For example, the maximum flap extended speed for a Cessna 172 S with 10 to 30 degrees of flaps is 85 KIAS.

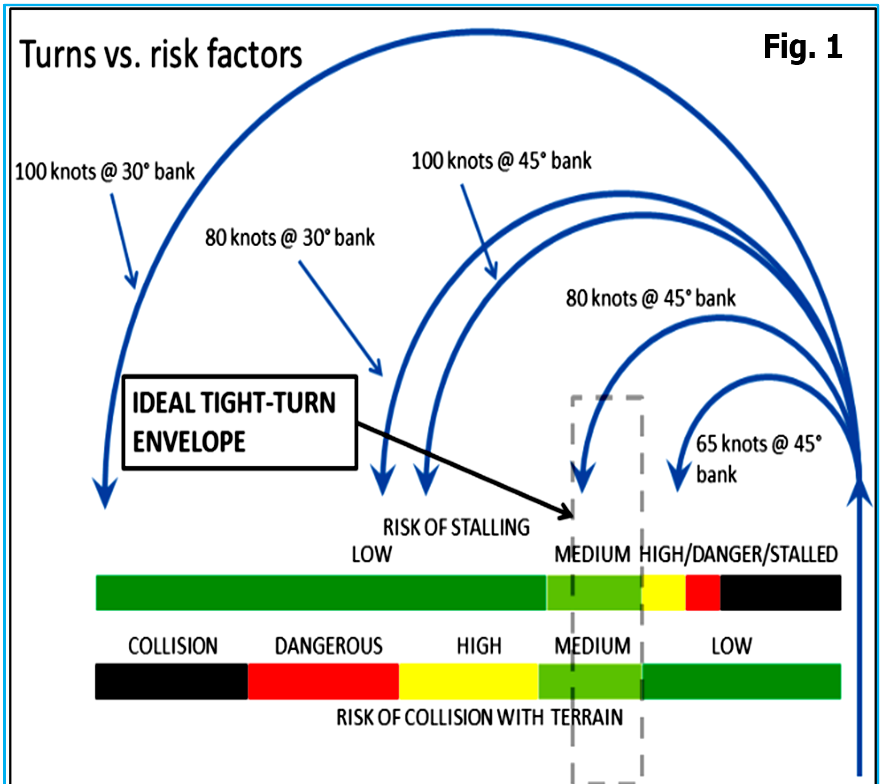
What bank angle should be employed? Employing a bank angle of 45 degrees is recommended (*AOPA Pilot*, 2018, February), while another source recommends more than 30 degrees and up to a steep 60-degree bank angle for a 180-degree canyon turn (Transportation Safety Board of Canada, Aviation Investigation Report, A11PO106).

Airspeed and bank angle – risk factors

Figure 1 depicts how R is affected by using various combinations of V and bank angles and, in turn, the total lateral distance to turn 180 degrees to exit from a narrow box canyon (data on the figure apply to flying a Cessna 152 or Cessna 172). Moving from the left to the right sides of the figure, as V is decreased and bank angle is increased, R decreases.

The figure also shows by turning too tightly, the risk of an accelerated stall increases and by turning too widely, the risk of colliding with terrain increases.

These risks can be mitigated by flying within the "*Ideal Tight-Turn Envelope* " as depicted on the figure, which in this example is V of 80 KIAS combined with a bank angle of 45 degrees.



Source: Transportation Safety Board of Canada, Aviation Investigation Report A11PO106

Pilots should be mindful that constant-altitude turns at increased bank angles predispose to increased wing loading and, in turn, increased accelerated stall speeds. For example, for a Cessna 182 T, one G V_S is 50 KIAS (bank angle zero degrees, flap setting zero degrees). For a constant altitude turn at a bank angle of 45 degrees (flap setting zero degrees), wing loading increases leading to an accelerated stall speed of 59 KIAS. Although decreased V and increased bank angle are desirable for decreasing R, care must be taken to ensure V is not too low precipitating an accelerated stall.

Flap setting

Deploying flaps (prior to commencing a canyon turn) is recommended as it allows for a lower airspeed. For example, one source states to deploy “lift flaps”, about 20 degrees, or half the full flap value (*AOPA Pilot*, 2018, February). For a Cessna 172 S model used by the Civil Air Patrol, 10 degrees of flaps (first notch) are recommended, while for Cessna 182 T and 206 models no more than 20 degrees (second notch) are recommended for a 180-degree canyon escape turn.

By deploying partial flaps, stall speed decreases for many airplanes. For example, for a Cessna 182 T flying at a constant altitude turn and banking 45 degrees, with the most rearward center of gravity (CG) and flaps “UP” (zero degrees) the stall speed is 59 KIAS and with flaps set at 20 degrees, stall speed decreases to 54 KIAS. Decreasing stall speed promotes a margin of safety.

Determining turn radius

Equation for determining R:

$$R = \frac{V^2}{11.26 \ \text{X} \ \text{Tangent of bank angle}}$$

(11.26 is a conversion constant, from the *Pilots Handbook of Aeronautical Knowledge)*

(Note that if we only consider banks of 45 degrees, the equation is greatly simplified since the tangent of 45 is one.)

Consider the following scenario; while flying a Civil Air Patrol Cessna 182 T, you are on a mission in a mountainous area searching for a downed airplane. V is 100 KIAS, and the pilot has erroneously flown into a narrow canyon whose walls are 2,500 feet across. Turning 180 degrees to exit the canyon, V is maintained at 100 KIAS, bank angle is 30 degrees to the left, and flaps are set to 10 degrees. (See Figure 1, first curve on the left.)

The R to exit from the canyon is

$$R = \frac{100^2}{11.26 \ \text{X} \ \text{Tangent of bank angle } 30°}$$

$$R = \frac{10{,}000}{11.26 \ \text{X} \ 0.577} = \frac{10{,}000}{6.50} = 1{,}538.5 \text{ ft}$$

1,538.5 feet, which means 3,077 feet is the total turning distance required to turn 180 degrees to exit from the canyon. Unfortunately, the canyon’s walls are too narrow to accommodate the turn, predisposing to a fatal CFIT accident.

A different V and bank angle strategy is needed to safely egress from the canyon. Accordingly, V can be decreased to 80 KIAS (V_Y for a C182T and well above V_S) and bank angle can be increased to 45 degrees with flaps set to 10 degrees. (See Figure 1, second curve on the right.)

The new R is:

$$R = \frac{80^2}{11.26 \text{ X Tangent of bank angle } 45°}$$

$$R = \frac{6{,}400}{11.26 \text{ X } 1.0} = \frac{6{,}400}{11.26} = 568.4 \text{ ft}$$

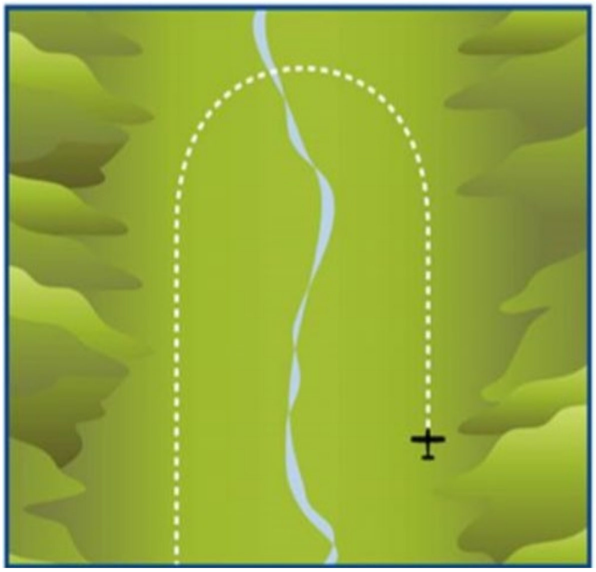
The new R of 568.4 feet means that 1,137 feet is the total turning distance required to completely turn 180 degrees to safely exit the tightly confined canyon, well within the canyon's walls.

Civil Air Patrol guidelines

"Canyon flying" is a topic included in CAPF 70-5A (Section 6, CAP Mountain Flying Endorsement), the evaluation form used for the Form 5 checkride. Provided on the Civil Air Patrol website is the topic "*Mountain Flying Training*", which includes a comprehensive slide presentation on mountain flying. From this source the following guidelines are recommended for flying a 180-degree canyon escape turn: *Maintain V at V_A, bank at 60 degrees, set flaps at 10 to 20 degrees and add power as needed to ensure the airplane is flying well above V_S.* For example, applying these parameters to a Cessna 182 T, V_A is 110 KIAS at maximum weight and the tangent of a 60-degree bank angle is 1.73. Under these conditions R is determined as 621 feet, and thus 1,242 feet would be the total distance required to turn 180 degrees to exit a canyon. In contrast, by flying at 80 KIAS while banking 45 degrees and flaps set at 10 degrees, 105 feet less are required to complete the same turn (1,242 feet - 1,137 feet = 105 feet) (see above). Accordingly, some pilots may prefer flying a canyon escape turn at 80 KIAS and bank at 45 degrees for two reasons: first, they may be more comfortable flying a less aggressive turn than flying at 110 KIAS while banking 60 degrees; and second, the total turning distance needed for the canyon escape turn is 105 feet less. By doing a gentle climb, they can also increase the margins of safety assuming the canyon walls widen as you climb.

Aircraft positioning

Prior to executing a canyon escape turn, the effects of positioning the airplane within the confined canyon walls should also be considered. Poor positioning of the airplane in the middle of the canyon valley requires a steeper bank angle. For this situation, there may be insufficient room to turn 180 degrees to exit the canyon, leading to a fatal CFIT accident on the canyon wall (Fig. 2 A). A safer strategy is to position the airplane to one side of the canyon valley, enabling the maximum room available between the canyon walls for the 180-degree turn (Fig. 2 B). Additionally, if possible, always turn into the wind to promote reducing ground speed. Good mountain flying practice is to always fly the upwind side of a canyon so this should take care of itself. Flying the downwind side risks turbulence and downdrafts. Never fly in the middle.



Safety
When considering a precarious 180-degree turn to exit from a narrow closed-in canyon, an important risk management control (best / safest course of action) to remember is: use an appropriately low V, with a safety margin to avoid a stall, combined with a safe bank angle that does not lead to excessive wing loading and an accelerated stall and set flaps to the first position (approximately 10 degrees). A slight climbing turn is also recommended for two reasons. First, this promotes a decrease in airspeed (assuming throttle is unchanged) leading to decreased R. Second, as R is decreased more lateral clearance from the canyon walls may be provided.

Lastly, there appears to be no singular canyon turn procedure applicable to all aircraft types. Pilots should consider conducting their own tests in a specific aircraft type to determine the best V, bank angle, flap and power settings for determining/minimizing R. An appropriate canyon turn procedure should be customized for each aircraft type. If not, performance will be degraded, and safety margins will be reduced.

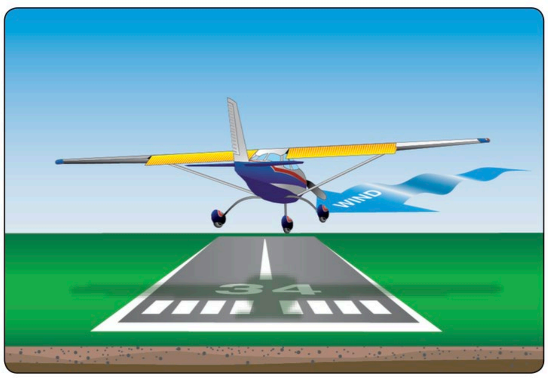
Safely Land in Crosswind Conditions (Maj L. Mateos, CAWG)
It seems like this is the time of year when we encounter stronger winds and winds that are not always aligned with the runway. Sometimes they are gusting from moderate to strong, and we may get some extra landing practice that literally keeps us on our toes. On a recent instructional flight, we even had the tower calling out wind direction and magnitude with every landing clearance. Apparently, they are only required to do this when there is a tailwind. However, our local tower tends to do this when winds are strong, gusty and/or changing in some significant way from the current ATIS recording. More on this below.

Some review of CAP rules
As we know, CAPR 70-1 applies the demonstrated crosswind performance from the aircraft POH (at least 0.2 Vso) or 15 kts for AFAM missions (whichever is less) as a limitation on crosswind landings. This is based on the reported winds, including gusts for the landing runway. Each pilot

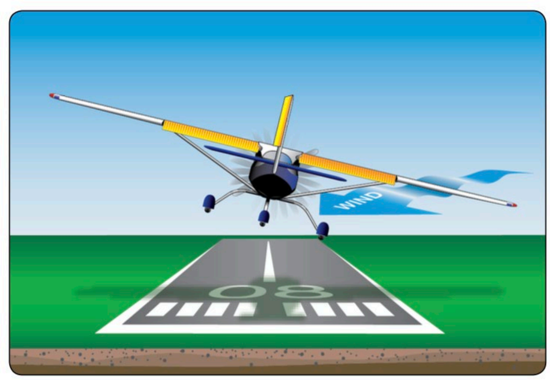
should also have their own personal minimum for crosswind operations based on training, experience, and current proficiency. In a non-CAP plane, you might be able to land with greater than 15 kts of crosswind, but have you practiced doing so recently? Don't forget, a personal minimum is not intended to be relaxed in the middle of a flight but on the ground, based on personal assessment of training, experience, and current proficiency. Even if we follow the rules, we may find ourselves facing a more than the demonstrated cross wind limit landing if mother nature forgot to read the TAF.

What does a crosswind approach look like in the air?

The Airplane Flying Handbook chapter 9 on crosswind landings is straightforward and worth a review from time to time. After listening to the ATIS (or AWOS/ASOS or looking at the windsock) and determining that the winds are within your personal minimum and CAP limitations, turning downwind and then base, it's time to set up your base to final turn so that your track is aligned with the runway centerline. Two methods are described: a crabbing final and a sideslipping final. When crabbing into the wind to keep your track aligned with the runway, you will need to straighten out as you transition to a landing attitude in order to align the wheels with the runway and avoid side load.



You don't want to transition too early, or you will drift off the runway centerline. When sideslipping to the final, you are banking into the wind and using sufficient opposite rudder to stop the turn and align the longitudinal axis with the runway centerline. As you transition to a landing attitude, be prepared to relax the opposite rudder and apply rudder into the wind as necessary to stay aligned on your roll out while keeping ailerons into the wind. You should land on the upwind wheel before the downwind wheel as needed in stronger crosswinds, and both before the nose wheel. Many will use a combination by crabbing down to short final and then transitioning to a wing low opposite rudder on touchdown.

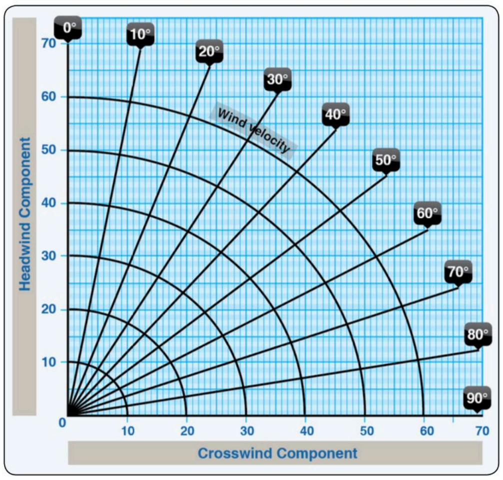


What about gusty winds?

When you add turbulence and gusty winds, using a power-on approach for more positive control, adding half the gust factor to the final approach speed, and perhaps using a reduced flap setting are also appropriate. With the additional power, don't forget that you will use more runway than with power at idle. As you make your final approach, you may have the latest reported wind from the tower and one or more windsocks near the runway that can give you an indication of up-to-the-minute wind direction and magnitude. At my airport there are two windsocks—one at the approach end and one at the opposite end of the runway which are often pointed in different directions—so I use the closer one as indicative of winds in the touchdown zone.

Mea culpa

The most important thing you should be thinking about when approaching to land is how to do it safely, right? (Or maybe how to do it safely if you don't end up going around.) In a recent instructional flight, we listened to the ATIS and the winds, while strong and gusty and not aligned with the runway, were still within CAP limitations. On downwind, the tower called out "wind 240@20G22, cleared to land RWY 31". So, if we do some quick math, the wind is 70 degrees off runway heading which is nearly 100% crosswind. At 20G22, that is well over the CAP limit. On the other hand, the near windsock (just past the numbers on the approach end) was indicating a 20–30-degree crosswind. Some quick math on 30 degrees off runway heading results in a crosswind component of half the total wind, 10-11 kts which is well within the CAP limit. The pilot landed safely. However, we were later reminded that CAP aircraft are very visible in the community and given the tower's report which is recorded, there could be questions brought up about the safety of the operation and our aeronautical decision making. Upon further contemplation and discussion, we decided that if we had a report from the tower indicating crosswinds would be exceeding our limit on landing, we should abort the landing and either circle until conditions improved or proceed to an alternate runway or airport, assuming there is one within reach with winds within CAP limitations.



Some final tips

While you should be diligent in obtaining forecasts and current conditions prior to your flight, those forecasts are just estimates and the conditions you encounter may be quite different. Take the opportunity to practice your crosswind landings. Invite an instructor along if that helps you reassess your personal minimum and polish your approach. Don't forget to have a plan B in the event you find conditions over the CAP limit.

Propeller Safety (1st Lt D. McCoy, DEWG)

I had flown our flying club Cessna 150 to York PA to visit my cousin, who had just given birth to her daughter two months before. It was a great visit and that evening my uncle and my cousin's husband took me back to the airport to fly back to Wilmington. I pre-flighted the airplane, said goodbye to my family standing 20 yards away and got into the cockpit. After running through the checklist, I started the engine.

I had the taxi light on, and I was finishing the checklist before taxiing out and was looking down at the checklist when I heard a knock on the windshield.

I looked up, horrified to see my cousin's husband standing in the corner where the left wing and strut met the fuselage. I froze, instantly telling him to move away, motioning towards the wing.

He backed up diagonally from where he was towards the 10:00 position and the outer arc of the propeller. (All of this happened in a matter of 5 seconds.) He was wearing a hoodie with a pass-through pocket on the front of the sweatshirt and had his hands in the pockets as it was wintertime. As he backed up, the propeller caught his sweatshirt right between his hands and tore his pocket. Fortunately, he had the presence of mind to back straight up. By that point in time, I had shut the engine down and gotten out, just baffled with what had just happened… and more importantly thankfully that what could have happened, didn't!

The reality is the noise of the propeller, especially at night, can be disorienting and people forget it's there, even if you tell them. I don't think I mentioned to them not to ever approach the airplane when it's running. I was a very young pilot at the time and never thought that people had to be told about the dangers of approaching a running aircraft. At the time, I thought it to be common sense.

From the outside, you can look at this and say you should have instantly shut off the engine… you wouldn't be wrong. My instant reaction was to tell him to move. A lot can happen fast, and these aren't things we train for.

Today, moving (or not moving) around airplanes safely and always staying out of the prop arc, is something we preach regularly to ALL that are in proximity to the aircraft. Especially cadets prior to Orientation flights. Teach them always to give the prop a wide berth. Nothing gets left to assumption.

Articles for the National Stan Eval Newsletter

These articles have been written to present ideas, techniques, and concepts of interest to CAP aircrews rather than provide any direction. The articles in this newsletter should in no way be considered CAP policy. We are always looking for brief articles of interest for CAP aircrews to include in this newsletter. CAP has many very experienced pilots and aircrew who have useful techniques, experiences, and tips to share.

Please send your contribution to stephen.hertz@vawg.cap.gov. You can view past issues here.