TwoTenDegrees

Users

Manual

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Introduction

This Calculator tool was developed to help pilots understand the physics and factors for a decision to go straight ahead or return to the runway after a power failure on a single engine aircraft during takeoff. It is specifically designed to complement the training approach of the "Bolon Method". The "Bolon Method" developed by Dr. George Bolon, is scenario-based training that will give pilots their best chance to safely return to the runway after a power failure during takeoff.

"Bolon Method"

The purpose of the "Bolon Method" is to save lives by helping the pilot make good decisions what, where, and how to respond after power failure on takeoff. The central notion is to assist pilots in making the best decision after power failure, and where to put the aircraft down in a location to minimize the likelihood of injury to the passengers and pilot.   Any result that avoids property damage is coincidental and is not a focus of the "Bolon Method". The "Bolon Method" is comprised of simulator training of the "Bolon Method", development of an appropriate pre-flight **Pilot Brief**, classroom training aided by this software tool, and instruction of the "Bolon Method" with your CFI above 3000 feet AGL.

As with most scenario-based training, simulator training of the method is necessary to develop competence and confidence in the pilot's ability to execute the "Bolon Method". It is strongly recommended to have a CFI to assist you during your simulator training.

A crucial element of the "Bolon Method" is to include in your pre-takeoff **Pilot Brief** the essential elements of the actions you would take in case of a power failure. These include climb speed (Vbg), minimum and maximum altitudes to turn back, glide speed, direction of turn, and target heading after the turn. If the **Pilot Brief** does not include the actions taken in case of power failure on takeoff, no attempt should be made to return to the runway/field; land straight ahead +/- 30 degrees Vbg until the wheels/skin squeaks.

“Bolon Method” Summary

1) On the ground, and in concert with the pre-flight planning, use this Calculator to establish the minimum and maximum altitudes a return to the runway/field is possible; as well as, the turn direction and heading after the turn all at Vbg.
2) In the aircraft and before take-off, brief your plan in case of power failure; as well as, where you should look straight ahead for a place to put the aircraft down.
3) Minimize your takeoff roll to get airborne as soon as possible.
4) Climb out at the airspeed in the **Pilot Brief**. V best glide is recommended for most aircraft as the pilot does not have to think about what airspeed to fly after a power failure.
5) If a power failure has occurred, do not exceed your planned time to delay your decision to turn back. If you exceed your planned time for any reason, go straight ahead +/-30 degrees at Vbg and look for a suitable site to land the aircraft.
6) If the decision warrants a turn back to the runway, execute a 210 degree instrument turn at the briefed bank angle and V best glide speed. Resist the urge to look outside the aircraft until the planned heading has been accomplished. Maintaining V best glide is crucial **(until the wheels/skin squeaks).**
7) After completing the 210 degrees turn, look at the runway, and if necessary, increase your turn up to a maximum of 30 degrees while maintaining the Vbg.
8) Glide wings level at V best glide speed until you need to turn back to align with the runway. Do not add flaps or drop the landing gear as this will severely reduce your glide ratio. Resist the urge to pull back on the yoke. Slowing the aircraft will reduce your glide ratio. Maintaining V best glide is crucial **(until the wheels/skin squeaks).**
9) Once aligned with the runway fly the aircraft at Vbg until the “wheels squeak”. It is not advisable to try to lower the landing gear as an unlocked landing gear could be more problematic than landing wheels up.
10) Execute your normal evacuation procedures once the aircraft has come to a stop.

Using The Calculator Tool

Disclaimer

When you open the Calculator, you should see the disclaimer button on the top left-hand corner highlighted. The first step is to read and understand the disclaimer for TwoTenDegrees (210 degrees). After you have read, understood and shall comply; **Check the box in the lower left-hand corner to confirm you agree with all of the disclaimer and that you are not a ROBOT**. You cannot proceed with setting up your case analysis until the disclaimer is confirmed.

Please note that many inputs may be overwritten by the user. This is a bit of a double-edged sword. While you have broad flexibility to define your test case, at the same time you can input unreasonable values to be evaluated. Remember the old adage, “Garbage In” equals “Garbage Out”.

Aircraft Data Inputs

Once you have agreed, check the disclaimer, you then can select the "Aircraft" via the box in the upper left-hand corner. Then you will be able to start to configure your aircraft options.

You may select your aircraft from any of the preloaded options or enter your own. The performance parameters in the preloaded options are general values for that aircraft. Your actual aircraft may have different performance parameters. Then verify that you have entered all of your parameters.

Vs1

This is the Max Gross Weight stall speed of your aircraft in the clean configuration. This is very important since the "Bolon Method" capitalizes on the fact that your best glide ratio requires zero flaps. The Calculator is predicated that retractable gear aircraft are in the wheels up configuration.

Vx

This is the air speed at MGW for maximum angle of climb for your aircraft. When you climb at this airspeed you are increasing your altitude at the maximum rate relative to rate you are flying away from the end of the runway. Climbing closer to this airspeed will reduce the distance you will have to glide back to the runway.

Vy

This is the airspeed at MGW where you are maximizing your altitude with time. While it is true that you are getting to a higher altitude sooner, you are also flying beyond the runway faster. Climbing at this speed will result in a longer path to glide back to the runway than climbing at Vx.

Vy Climb Rate

This is rate your aircraft climbs at MGW at Vy airspeed. It is not used directly in the Calculator and is more of a reference relative to the actual climb rate of your aircraft.

V Best Glide

This is the indicated airspeed of your aircraft in KIAS where it achieves the largest glide ratio. It is based on a set of reference conditions set forth in your AFM or POH. The Calculator assumes you fly the scenario close to this reference condition. Typically, V best glide airspeed is between Vx and Vy for most aircraft. The “Bolon Method” recommends that for your aircraft climb out at V best glide airspeed as this will reduce the workload should the pilot be faced with an unexpected engine failure during takeoff.

TakeOff Roll

This is the distance down the runway you expect is required to take off. The minimum value should be the value at MGW in your AFM or POH to clear a 50’ obstacle at the current airport conditions. However, it is recommended to increase this estimate if you like most pilots normally use a rolling takeoff instead of a short field take off technique. You may elect to cross-check your assumptions on takeoff distance by using various instruments and their apps.

Best Glide Ratio

This value is the distance your aircraft will fly forward relative to the altitude it will lose. Usually, this will be found in your AFM or POH, but on some older aircraft this can be tough to find. Again, the airspeed and value for this are based on a typical configuration for your aircraft at MGW; generally, your actual value and the published value will be close. For retractable aircraft, this value is for the wheels up configuration. The glide ratio usually at any airspeed is substantially lower for the wheels down configuration.

Additional Data Fields for Aircraft with Best Glide Airspeeds greater than Vy

Generally, with fixed undercarriage aircraft, you will find your best choice of airspeed (IAS) to glide back after power failure is V best glide. And V best glide is almost always between Vx and Vy. So, it follows that a good decision for these aircraft is to reduce load on the pilot, and climb out and glide back at V best glide. This is consistent with the “Bolon Method” for dealing with a power failure on climb out. Further, under normal conditions the Calculator assumes the pilot is attempting to glide back at V best glide. and all calculations are done with that assumption.

Some aircraft are unique in that V best glide is higher than Vy. These aircraft typically have retractable undercarriages, low drag wing profiles and high power. This is represented by the Beechcraft family of Bonanzas. With these aircraft, V best glide is likely not your optimum way to return to the runway. If V best glide for your aircraft is higher than Vy, the Calculator has the option of a user defining Glide Back speed. All subsequent aerodynamic calculations for the glide back, use the user defined glide back speed (IAS).

Choosing a different speed to glide back other than V best glide requires that the wings level glide ratio be updated. The Calculator uses an approach which only requires the Wing Aspect Ratio of your aircraft in addition to the other aircraft parameters already defined. The result is presented in the “Aircraft” tab.

How to use the Alternate Glide Speed Function

To use this option, you must fill in the **Wing Aspect Ratio, Alternate Glide Speed,** and **check the “Use alternate values” box** in the Calculator. Once you have done all three, the Calculator will use these values in the glide back calculations.

Wing Aspect Ratio

In aeronautics, the aspect ratio of a wing is *the ratio of its span to its mean dynamic chord. It is equal to the square of the wingspan divided* by the wing area. This value is published for most certified aircraft, but you may choode to estimate it for an experimental aircraft. Typical value is around 6 for most aircraft.

Alternate Glide Speed

This is the IAS that you would like the Calculator to use for the Glide Back after Power Failure. Generally, you will find the best choice for this value is near Vy. Values less than Vy may increase the risk of an accelerated stall in the turn back to the runway.

Airport Data Inputs

Bring up the airport data options by clicking on the “Airport” box in the upper left-hand corner.

For your convenience, this Calculator can search for current weather conditions and data for many US airports. You just need to enter the airport identifier starting with “K” in the provided input field, and then hit the “search” button. Once the fields below have been populated, you can choose the runway you expect to use. For airports with parallel runways, it is recommended to choose the shorter runway in case that is where ATC directs you. In case your airport data is not available, or you elect, you can populate all the fields manually.

Field Elevation

This is the elevation of your airport in feet MSL.

Runway Length

This is the length of your runway in feet not including any extensions or overrun areas. Short runway lengths will make it very difficult to return to the runway. How short is too short depends on a lot of factors including density altitude and best glide ratio of the aircraft, etc. This will become evident when you run the calculations for your case.

Runway Heading

This is the **magnetic heading** of your runway. In most cases you can use the runway number for this, but double check your runway data to be sure.

True Heading

This is the **true-north heading** of your runway. The program uses this to orient the 3D flight path in Google Earth KML files.

Use Right Pattern?

The default setting in the program is to use a left pattern for the calculations. However, the user can direct the program to do the calculations using a right pattern turn by checking the “Right Pattern” box.

Wind Heading

This is the magnetic heading of the wind at your airport. If a Metar can be downloaded, this field is populated with that information. However, if you want to simulate a different set of conditions, you can overwrite this field with your information.

Wind Speed

This field contains the wind speed at your airport in knots. You can accept the value the Calculator pulled from the Metar, or you can put in values you choose.

Density Altitude

This is the density altitude at your airport in feet. You can accept the value the Calculator pulled from the Metar, or you can put in the value you choose.

KML Information

Google Earth can use a KML file format to plot data from a flight path. To see your predicted flight path in Google Earth, the Calculator needs to have the latitude and longitude of the start and end of the runway you are simulating.

Scenario Inputs

Bring up the scenario inputs table by clicking on “Scenario” in the upper left-hand corner.

This group of fields are where you tell the Calculator how you intend to fly a possible return to the runway after power failure. The Calculator gives you a lot of latitude in choosing the parameters. The reason for this is so you can immediately see the impact of bad choices. For example, if you intend to give yourself 15 seconds to try to re-establish power, put that value in the “pilot’s reaction time” so that you can see the impact of that decision.

Climb Indicated Air Speed KIAS

This is the speed you tell the Calculator you are going to climb out from the runway. The “Bolon Method” recommends you choose Best Glide Speed generally between Vx and Vy for this value, but feel free to examine the effects of this for all choices. Higher climb speeds usually lower the chances you will return to the runway.

Actual Climb Rate

This is the actual climb rate you expect your aircraft to achieve at takeoff and maybe the one most important value you the user will input into the Calculator. This may be referenced in your AFM or POH, but you should be very careful about what value you choose. Many factors affect the value of your climb rate. It’s best to gather actual data for you in your aircraft at a reference density altitude and weight. Sources for gathering actual data on the climb rate include recorded data from various digital instruments as well as GPS based programs on smartphones and tablets. Many pilots are surprised to find that they do not achieve AFM or POH performance values.

Power Loss Altitude

This is used as a reference to generate several performance values for a hypothetical power failure at that altitude. Those performance values can be used to refine your other choices for your scenario.

Pilot Reaction Time

This is the time in seconds between the power failure and the actual pilot taking action to turn back to the runway. If the pilot has been properly trained and briefed for a possible power failure, then the reaction time can be quite short. However, if the pilot is caught by surprise by a power failure, then it can take a longer time to make the decision to turn. In that case, the aircraft has likely gotten too far from the runway to make a turn back possible. The reaction time also includes the time the pilot takes to try to reestablish full power in a sputtering engine. We recommend not wasting time attempting to restart the engine. If that process takes several seconds, most likely the safest choice is to go forward, +/- 30 degrees at Vbg and look for a suitable place to land the aircraft.

Primary Turn

This is the turn in degrees that the pilot shall make as the first action to return to the Runway/Airport, while maintaining Vbg. Obviously, this turn must be more than 180 degrees due to the radius of the turn, but less than 270 degrees which would put the aircraft on a path perpendicular to the runway. In practical terms, a turn less than 210 degrees will not allow the aircraft to get headed to a point over the runway centerline or the Airport. Also, a turn of more than 240 degrees will not create a flight path significantly shorter than a 240 degree turn. The “Bolon Method” targets a 210 degree instrument turn, and must be included in the **Pilot Brief**. And if, looking at the aircraft’s course toward the runway after the 210 degree turn is complete, then the pilot may choose to turn up to 30 more degrees.

Primary Turn Bank Angle

Also included in the **Pilot Brief** is the bank angle chosen from the Calculator to execute the primary turn. The choice of bank angle is a compromise between two competing outcomes. If the bank angle is too high, then the risk of an accelerated stall is a concern. The outcome of an accelerated stall could result in a deadly spin close to the ground with no possibility to recover. If the bank angle is too shallow, then the radius of the turn and the corresponding altitude loss becomes very large. The outcome could be that there is not enough altitude for the aircraft to return to the Runway or Airport Field. In many cases, use of the Calculator gives us a bank angle which gives the pilot a reasonable safety factor to avoid an accelerated stall and at the same time minimize the radius of the turn to allow a return to the Runway/Field. For most initial training aircraft, 35 degrees seems to be optimal.

Turn Back Bank Angle

Once the pilot has completed the primary turn, the aircraft is gliding wings level at V best glide. But regardless of how the pilot has chosen to return to the runway, a final turn to align to the runway is necessary. The factors involved in deciding what bank angle to make the final turn are the same as with the Primary Turn Bank Angle. Certainly, the turn back bank angle should be no larger than the primary turn bank angle. However, if the angle is too shallow, the pilot may overshoot the centerline. Precious altitude can be lost trying to correct this error. The “Bolon Method” recommends the bank angle range be equal to the primary turn bank angle, to 15 degrees less than the primary turn bank angle.

Running and interpreting the results of the calculations

Once all the required fields in the “Aircraft”, “Airport”, and “Scenario” tabs have been filled, you may now proceed with the calculations for your case by clicking the **“Calculate!”** button in the lower left-center of the main screen. If the values you have chosen for your case are incompatible with the flight path calculations, you will see a warning message. Usually, the issue is caused by incompatible entries in the “Scenario” fields. Try changing those field entries and then click the **“Calculate!”** button. If the warning disappears, you can proceed with the examination of your results.

“Application” functions

The options under the **“Application”** tab in the upper left-hand corner of the screen include **“New Flight”, “Open Flight”, “Save Flight”,** and **“Exit”.** Choosing **“New Flight”** gives you a clean parameter file to define a new case. **“Save Flight”** is a very powerful tool that allows the user to save an important case you may want to recall later. All the aircraft and airport parameters are saved in that file. **“Open Flight”** allows the user to import a file you previously saved. This can be extremely useful if you are using an aircraft not in the preloaded list, or you are using an airport that does not have published parameters that can be uploaded by the Calculator. All these parameters will be stored in your saved file. These files are saved in *.json file format. Lastly, you can exit the application by clicking on the **“Exit”** button.

Export KML File

This program will generate a 3D path for your case in the form of a file in KML format. The flight path for your case can be viewed in Google Earth or similar software. Generate the 3D file by clicking the “Export KML File” button on the lower right-hand corner of the screen. Next, rename and save the file to a directory of your choice. If you have Google Earth loaded on your computer, viewing the file is as simple as double-clicking the KML file from the directory it is saved.

Elevation view of the flight path

An elevation view of your flight path is on the main screen. The Y axis is elevation in feet AGL of your airport. The X axis is the distance in feet from the beginning of the runway you chose. The runway coordinates are shown in **Blue** on the X axis. The no wind path of the aircraft is shown in **Green lines** and data points. The wind compensated path of the aircraft is shown in **Red lines** and data points. The highest value for the wind and no wind plots is the power failure altitude you selected in the scenario. And the curves beyond that show how altitude is lost as you glide back to the runway. The curves for the glide back path terminate at the theoretical altitude you would intersect the runway centerline on your glide back. You will note that with certain variable choices, the path dips below 0 feet AGL even though you appear to be over the runway. You can interpret this as the condition where your aircraft impacted the ground to the side of the runway before you were able to get over the centerline. Many times, if you increase the primary turn angle or a combination of other variables, you may be able to return to the runway.

Understanding the Calculations

The flight path calculations are run both with and without the effects of the wind. This is because the “Bolon Method” wants the pilot to understand the impact of the wind on the flight path if the wind condition changes at the time of takeoff. Generally, the information you want to include in your **Pilot Brief** should be the “no wind” information. Relying on the wind for a successful return to the runway is a risk that should be considered carefully.

Climb Out – Distance Off the End of the Runway

This tells the pilot how far past the runway the aircraft is at the time of the hypothetical power failure. The purpose is to raise awareness of the fact that in most cases the aircraft is significantly past the end of the runway. A positive value means the aircraft is beyond the end of the runway. Negative values are possible and means you are still over the runway.

Climb Out – Accent/Decent Ratio

This is a comparison of the angle of climb before power failure to the angle of decent during the glide back to the runway. A ratio less than 1.0 means the ability to return to the runway is less likely the higher the aircraft is at the time of power failure. For example, an aircraft that can successfully return to the runway at 500 feet AGL may not be able to return to the runway from 1500 feet if the accent/decent ratio is less than 1.00.

An accent/decent ratio greater than 1.0 means the ability for a return to the runway is more likely the higher the aircraft is at the time of power failure. This is an advantage that exists for higher powered aircraft like the Bonanza. Aircraft in this category will likely have a minimum altitude needed to return to the runway, but no maximum altitude. However, be aware that high density altitude at the airport can eliminate this advantage.

Primary Turn – Altitude at the End of the turn

This is the altitude of the aircraft in feet AGL after the primary turn is completed. Its significance is two-fold. First, it gives the pilot an image of how little altitude is available to complete the glide back. Second, it highlights how much altitude is lost during the primary turn.

Primary Turn – Distance from the End of the Runway at the End of the Turn

This is the distance in feet that the aircraft is from the end of the runway at the end of the primary turn. The result is intended to give awareness as to where the aircraft is located at the end of the primary turn.

Primary Turn – Angle of the Turn

This value is just confirmation of the angle of the primary turn chosen in the Scenario.

Primary Turn – Time in Turn

This is a calculation of how long it will take to complete the primary turn in seconds. Typical results are in the range of 15-25 seconds, and you will note this is not a very long time. However, if you ever experience this in a real emergency, it will probably feel like an eternity.

Primary Turn - Calculated Optimum Turn Angle

If we take the objective of the turn as minimizing the distance of the flight path, we can calculate the turn angle that would best accomplish this. Generally, for hypothetical power failures at low altitude, we would expect the calculation to be nearer to 240 degrees. However, for hypothetical power failures at higher altitude, we would expect the calculation to be nearer to 210 degrees. Since we cannot predict the altitude of power failure, the “Bolon Method” recommends a primary turn of 210 degrees, and then increasing the turn angle up to 30 degrees if required by visual assessment of the pilot.

Glide Back – Altitude Over the Runway Centerline

This is the altitude over the runway centerline in feet AGL the aircraft is calculated to be, assuming all the turn and glides are executed as described in the case setup. One factor that could negatively impact this is the pilot pulling back on the yoke and not maintaining V best glide. Flying the aircraft at V best glide all the way to the runway or surface is an important element to the “Bolon Method”.

Glide Back – Touchdown Point Relative to Runway End

This is a calculation of how far from the runway end in feet that the aircraft will touchdown. A positive number means you have made it to the runway during the glide back. A negative number means the aircraft touched down short of the runway end. In that case a determination should be made if that touchdown point is on the field. The key objective of the “Bolon Method”” is to save lives, so a touchdown not on the runway, but on the airport property is acceptable. There may be damage to the aircraft, but the Pilot’s objective is for the occupants of the aircraft to exit uninjured.

Glide back – Touchdown Relative to the Side of the Runway

This calculation indicates where the aircraft will touch down relative to the centerline of the runway. Often at low altitude power failure, the aircraft will be able to get to the endpoint of the runway but fail to get back to the centerline of the runway. In this case, you may find that adding a few degrees to the primary turn will get the aircraft back to the centerline. Please note that if the runway in your case is 60 feet wide (centerline +/- 30 feet), and the calculation reports the aircraft touched down 30 feet off the centerline, in fact the aircraft has touched down on the runway. Just not on the centerline.

Glide Back – Time in Glide Back

This is a calculation of the time in seconds the aircraft was gliding back after the primary turn until the "wheels squeaked". The purpose is to give the user a perspective on how much time this segment takes.

Glide Back – Total Time Since Power Loss

This is a calculation of the total time that has elapsed from the power failure to the wheels touching down. Most cases will be under a minute, so it is not a lot of time. Note that regardless of whether the pilot chooses to go straight ahead or turn back to the runway, it is still less than 1 minute before the aircraft touches down.

Glide Back – Minimum Runway Length at Minimum Altitude

It turns out that the minimum runway length to return to the runway usually occurs when the aircraft reaches the minimum altitude to return to that runway. This means, that if the airport runway length is shorter than this minimum, there is no SAFE way to return to the runway pavement.

Glide Back – Minimum Altitude to Return to the Runway

This is one of the most important results from the calculation. Independent of the hypothetical power failure point, this result gives us the minimum altitude that a return to the runway can be successful. This is the lower limit after power failure where a return to the runway should be considered. It should be included in the **Pilot Brief** before the flight. Please note that if no minimum altitude can be calculated, a return to the runway is not possible at any time and should not be attempted – Land Straight Ahead at Vbg +/- 30 degrees.

Glide Back – Maximum Altitude to Return to the Runway

This is the other important result from the calculation. This result gives us the maximum altitude that a return to the runway can be successful, and should be included in the **"Pilot Brief"** as well. Combined with the minimum altitude calculation, this establishes the range of power loss altitudes where a return to the runway can be successful. Please note that for aircraft with an accent/decent ratio greater than 1.00, no maximum altitude to return to the runway may exist. But this assumes the aircraft continues to climb at the same angle during the climb out.

Glide Back – Altitude Drop during Glide Back

This calculation determines the altitude that is lost from the end of the primary turn until the aircraft lands. The intent is to give the user a better understanding of the loss of altitude during this phase of flight.

Glide Back – Touchdown Point

There are three possibilities where the aircraft will touch down in any hypothetical case analysis. The value of this calculation is either **"Runway", "On Field", or "Off Airport"**. **"Runway"** means that the aircraft was able to touchdown on the paved surface and within 30 feet of the runway centerline. **"On Field"** means that the aircraft touched down within 200 feet of the runway centerline and 200 feet from the end of the runway. In general, this will mean that the aircraft will have touched down somewhere on the airport grounds. Damage to the aircraft could be possible, if not likely, but our goal always is for the occupants of the aircraft to walk away uninjured.

Other Results

This group of results are not influenced by the direction and speed of the wind. They apply the same even if the wind data changes.

Altitude of Power Loss

This is nothing more than a restatement of the hypothetical power loss altitude that the user decided in the **"Scenario"** tab.

Time to Power Loss

This is the calculated time in seconds from take off to power loss altitude. It is meant as a frame of reference to compare the other segments of time in the scenario.

True Airspeed in Climb

This a reference value in knots for the aircraft's true air speed under the conditions stated in the scenario.

Radius of the Primary Turn

This is the calculated radius of the primary turn in feet. The purpose is to help the user visualize the relative distances for each segment of the turn back to the runway.

Radius of the Turn Back to the Runway

This is the calculated radius in feet for the turn back to the runway. The purpose is to help the user visualize the relative distances for each segment of the turn back to land on the runway.

Stall speed of the Alignment Turn

This is the calculated stall speed in knots for the aircraft during the final turn back to the runway.   The basis for this calculation is the clean configuration of the aircraft. Zero flaps and gear up (if applicable) at MGW.

Load Factor in Primary Turn

This is the calculated load factor for the primary turn. The calculation is based on the primary turn bank angle the user entered in the **"Scenario"**.

Glide ratio in the Primary Turn

This is a calculation of the glide ratio in the primary turn. The glide ratio in a turn at V best glide is slightly reduced due to the higher load factor in the turn.

Stall speed in the Primary Turn

This is the calculated stall speed of the aircraft in the primary turn back to the runway. It is important to note the difference between the stall speed in the turn relative to the airspeed in the turn.   If these two values are very close, a small error by the pilot could result in an accelerated Stall/Spin.

Primary Turn – Glide/Stall Speed Ratio

This calculation divides the indicated air speed in the primary turn by the stall speed in the primary turn. The result is a number which gives the user a feel for the safety factor to avoid an accelerated stall in the turn. To give this context, we remember in our training as pilots that Vref is 1.3 times configuration stall speed. The ratio of 1.3 being chosen is a discussion of aviation safety that is too long to be included here. This ratio is affected by the choice of bank angle in turns. The higher the bank angle the closer the ratio gets to 1.0. And below 1.0, the aircraft will enter an accelerated stall followed by an unrecoverable spin to the ground. In any case, the user is free to select a bank angle in the "Scenario" that will result in a glide/stall ratio that the user is comfortable with. The "Bolon Method" favors a 35 degree bank angle for aircraft similar to a Cessna 172.

Glide Back – Glide/Stall Speed Ratio

This calculation divides the indicated air speed in the turn back to the runway by the stall speed in the turn back to the runway. The result is a number which gives the user a feel for the safety factor to avoid an accelerated stall in the turn. Again, to give this context, we remember in our training as pilots that Vref is 1.3 times stall speed. The ratio of 1.3 being chosen is a discussion of aviation safety that is too long to be included here. This ratio is driven by the choice of bank angle in the turn. The higher the bank angle the closer the ratio gets to 1.0. And below 1.0, the aircraft will enter an accelerated stall followed by an unrecoverable spin to the ground. In any case, the user is free to select a bank angle in the **“Scenario”** that will result in a glide/stall ratio that the user is comfortable with.

Altitude Drop in the Primary Turn

This is the calculated loss of altitude in the primary turn. It is calculated to give the user an understanding of the magnitude of altitude loss during a 210 to 240 degree turn back to the runway. You will note; how significant this altitude loss is, and why a turn back to the runway must be carefully considered.

Vref

This Vref calculation in this calculation tool is the stall speed of the aircraft in the clean configuration times 1.3 the configuration Stall Speed at MGW. Therefore, this is 1.3 x Vs1. The classical calculation of Vref is 1.3 times aircraft stall speed in the landing configuration (1.3 x Vs). Students of this calculation will know that this value is also affected by the weight of the aircraft relative to gross weight. The calculations in this software assume the aircraft is at worst case, maximum gross weight.

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