# Lessons Learned from Transitioning to Gliders

by

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**Abstract**

Learning to fly gliders has been a dream of mine since a very young age. Ever since I can remember, I have been gazing up into the sky and watching the airplanes soar high above this earth. My deep love and passion for aviation stems from multiple generations of pilots in my immediate family. Having loved ones so involved in aviation often made me think about some of the less appealing statistics of our industry. In 2015, the National Transportation Safety Board published a notice stating that over 40% of all fatal accidents in the general aviation category of flying can be attributed to the pilot's lack of control of their airplane (NTSB, 2015). This alarming statistic is what motivated me to explore ways to reduce the overall percentage of these "loss of control" accidents. This thesis takes the form of an easy-to-read manual to help certificated pilots of powered aircraft transition into gliders.

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# CHAPTER I – INTRODUCTION

Learning to fly gliders has been a life-long dream of mine. Ever since I can remember, I have been starring up into the sky and watching the airplanes cruise high above this earth. My first true aviation experience that hooked me was flying with my dad, for fun, on a beautiful fall morning back in late 2003. I loved everything about flying: the absolute freedom you feel, the fact that we were defying gravity, and the great time I was having with my family.

A few years later, I had the spectacular opportunity to complete my aviation merit badge through my scout troop with the help of the local EAA chapter. That Young Eagles flight in a beautiful Beechcraft Bonanza is one I will never forget. The pilot let me "fly" the airplane under his watchful eye and that is what sparked my interest in becoming a pilot. Over the years, I have become fascinated with gliders due to their simple powerless design. I was amazed at how far and how high a glider could travel using nothing but different weather phenomenon.

Recently, I have been quite troubled by the accident rate within the relatively small general aviation community. In 2015, The National Transportation Security Board (NTSB) stated that "over 40 percent of fixed wing GA fatal accidents occurred because pilots lost control of their airplanes." This alarming percentage has seemed on the high side, and I have many times pondered what could be done to reduce the number of accidents caused by the pilot outright losing control of their plane. As pilot's, we are always taught that the most important thing is to "aviate" or fly the airplane before doing anything else. The NTSB does publish some helpful reminders on how the GA pilot community could reduce this number like; flying with a certified flight instructor more

often than once every two years, which is the minimum legally required, becoming more familiar with stall/spin awareness, managing distractions, and maintaining situational awareness and they called on schools, clubs and manufacturers to create “educational initiatives” to help educate pilots further on the best principles and practices to avoid loss of control. Many pilots could use a nice refresher lesson on how to use the elevator, ailerons, and rudder to avoid situations where the planes angle of attack gets dangerously close to the critical angle of attack.

Becoming a glider pilot is something I truly enjoyed and will bring great benefits, especially a deeper understanding of why and how one can lose control of an airplane and the steps that should always be taken to avoid a situation like that. I am hooked on flying gliders, especially the tranquility of soaring. Glider pilots seem to have more respect for the natural forces of flight and can command their aircraft to do what they want using the ailerons, rudder and elevator controls. We remember that in early 2009 Captain “Sully” Sullenberger successfully landed his U.S. Airways Airliner into the Hudson river because he lost power to both engines, which is an extremely rare event. He was a rated glider pilot and when asked if he thought it had helped him, Sullenberger stated: “the glide was comfortable. Once we had established our plan, once we knew our only viable option was to land in the river, we knew we could make the landing.” He did mention that his gliding days were a long time ago, but I think his experience stayed with him all these years.

This creative project was decided on to serve as an example of what it can take and what the transition process from powered airplanes into gliders looks like. It is important to remember that this was written to be understood by already certificated pilots not only at the private pilot level but also the commercial pilot level. The

decision was made to focus on subject areas not normally taught to powered pilots and to give specific examples of what training flights will most likely resemble if the flight training is conducted under FAR Part 61. Part 61 of the federal aviation regulations refers to a set of rules that must be adhered to during any flight training and is often considered more flexible in nature compared to an FAR Part 141 school. Part 141 schools have a specific training syllabi, for each rating, that is approved by the Federal Aviation Administration (FAA) and must be followed closely.

## CHAPTER II – HISTORY

Gliders were designed many years before powered aircraft development even started. It was the extensive research and development of gliders that would lead the Wright brothers to complete their historic powered flight in 1903. Initial testing of wing designs dates back all the way into the 15th century. Early on, Leonardo da Vinci, Galileo Galileo, Christian Huygens, and Isaac Newton began researching the relationship between resistance and the surface area of different objects (Crouch, 2016). Early studies of a dynamic reaction between a surface and the surrounding air would serve as a basis for further examination.

Initially, researchers looked to the sky for clues to what might be behind this phenomenon of producing lift. Naturally, they studied birds and other flying creatures to see how they were able to soar high above our earth. Early believers and dreamers would try to replicate the surface and movements of birds or other flying creatures by employing different "flapping" mechanisms to try and mimic a bird's wings (Crouch, 2016). Leonardo da Vinci was an avid dreamer who created plans for these bird mimicking devices that we know as an ornithopter. According to Abbott and Kailey, the greatest flaw with the ornithopter was the strength-to-weight ratio of birds compared to that of humans. Humans do not have the sheer power required to operate these wings successfully. Da Vinci's work also included blueprints for projectiles, parachutes, and even a basic helicopter; however, his manuscripts were not made public until over 300 hundred years after his death (Abbott & Kailey, 2002). This slowed down early innovations that could have altered the course of aviation history.

George Cayley, an Englishman and aeronautical pioneer, discovered and published on the effects of the size and shape of an airfoil on the amount of lift it could produce (Crouch, 2016). He keenly observed birds and theorized that a cambered wing would produce more lift than a flat wing. Throughout his lifetime, he made numerous presentations at aeronautical societies to share his ideas about successful wing designs.

During the late 1800s, a new pioneer named Otto Lilienthal began testing different shapes of wings on gliders. Lilienthal was a German-born mechanical engineer and inventor who, with the help of his brother Gustav, translated much of the data surrounding airfoils into practical knowledge. Throughout his lifetime, Otto Lilienthal piloted over 2000 successful glides on a make shift hill that he had assembled (Abbott & Kailey, 2002). He became known as the "Father of Flight" and the "Glider King" due to successfully controlling a heavier-than-air aircraft during so many of his glides (FAA, 2013). Sadly, even after so many successful flights, Lilienthal perished in his final glider flight in 1896, but his work would forever change the face of the emerging aviation industry (Crouch, 2016).

Many historians give Lilienthal credit for inspiring and providing the supporting research to the Wright brothers, who would complete their historic first powered flight in 1903. Although aviation history is riddled with missed opportunities and dreams that did not become reality, it is truly incredible to see how far we have come in just over a century of human flight.

## CHAPTER III – FLIGHT OPERATIONS

Remembering a pilot's primary training is incredibly important since gliders really are not much different to operate when compared to a powered aircraft. Gliders are simpler in design, and the flights stay relatively close to the glider-port. Proper pre-flight planning is valuable for a safe flight. According to the FAA, learning to fly gliders is relatively easy but learning how to soar, which is the ability to gain altitude and travel farter without mechanically-produced power, is much more difficult. Of course, due to its difficulty, when one learns to soar, one feels very accomplished. It is important to remember that proper ground handling of the aircraft can help mitigate risks and avoid ground accidents.

### Pre – Flight

Many gliders are stored in long enclosed trailers, which require the wings to be taken off, folded back due to space constraints, and reassembled on the glider before the glider can become airworthy. Although this sounds like a simple task, setting up a glider requires some meticulous assembly because it has to be completed using the specific aircraft's pilot operating handbook, which is basically like an owner's manual for aircraft. Fortunately for some, a local soaring club might have its own part of the airfield with hangars, allowing members simply to push the airplane in without any disassembly and reassembly required. This also gives members faster access to the gliders. This was the case for the local glider club I used, and it made for a great experience, because it allowed me to spend more time focusing on other training tasks.

Any time a glider is going to be left unattended for any period of time, it should be secured properly (FAA, 2013). This includes latching the front and back canopies and

raising the upwind wing to prevent the glider from accidental movement. If the glider will be unattended for long periods of time, it is recommended that he or she find a permanent tie-down area and secure the aircraft correctly using ropes, straps, or chains. Any covers, such as those for the canopy and pitot tube, should be attached before leaving as well.

Most gliders are either pushed by hand or by some vehicle towing them, utilizing a shortened tow line. Although, if the glider only needs to be moved a short distance, then it makes more sense to push it by hand. When moving a glider or any vehicle on the airfield, one should have plenty of space. If there is any doubt, then one should just wait for someone to "walk the wing." When some one is "walking the wing" they follow the tip of the wing to make sure there is no risk of collision while the glider is moving. Also, the FAA makes a great point about the length of tow line if utilizing a vehicle to tow a glider. To ensure the length of the shortened tow line is still more than the length of one wing, or half the wing span. This length of tow line would prevent the glider from hitting the vehicle in the event that the glider pivots. Two more things to watch for when carefully ground towing a glider is to ensure the slack in the tow line is removed slowly and to not tow faster than a brisk walking pace.

A thorough pre-flight inspection is required and should be accomplished prior to every glider flight. According to Tom Knauff (2016), roughly half of the total emergency situations that could be encountered during launching could have been solved by properly assembling the glider, conducting proper preflight checks, and going through the appropriate before takeoff checklist. Many people will complete pre-flights, or walk around, checks by memory since they usually start and stop at one spot on an aircraft. If

one is unsure, it is always a good idea to utilize an approved checklist to complete this task. Most of the important items he or she is looking for during the pre-flight checks are the same as a powered aircraft. He or she should make sure that nothing looks out of place. Some examples of things to look for during the pre-flight checks include: damaged areas, excessive worn/tore skin, and that the flight controls are free and correct.

**Flight**

Early glider flights were often accomplished by moving the aircraft to the top of a hill and launching it down the hill. We have come a long way since the days of Otto Lilienthal and his homemade hill flying. It did not take long for people to start using long tow lines and cars to pull gliders into the air (FAA, 2013). This form of getting the glider into the sky is more commonly called "ground" launching and utilizes either a car or winch to accelerate a glider. It then becomes the responsibility of the glider pilot to pitch the aircraft upward at a very high angle of attack to get the most altitude for a given distance. The popularity of ground launching never really caught on in the United States, but it is still very widely used abroad, especially in Europe. Interestingly enough, many glider pilots argue that winch launching is the best thing for a club. Anyone can be taught how to safely operate a winch quicker than using a tow plane because it could take time to get qualified pilots required to fly the plane (Daniels, 2016). Another downside to using a tow plane is the expensive nature of operating a high-performance aircraft and its limited availability. Winches can launch anywhere between 10 to 30 gliders per hour compared to a tow plane's ability to launch roughly five per hour, depending on the tow altitude (Daniels, 2016).

However, in the United States, most glider operations still use a tow plane and rope to tow the glider up and then release them at a certain altitude. Using a tow plane versus ground launching gives a glider pilot a lot more flexibility. Pilots can decide which direction and how high they want to go, while ground launching limits pilots based on the runway direction and length of the tow rope.

In preparation for a normal take off, the procedures are quite similar to powered aircraft. A few major differences are the hand signals used by glider pilots to communicate with the wing runner and tow pilot. The main signals that powered pilots never use are for opening the tow hook release, closing the tow hook release, and having the wing runner lift and level your wings. The wing runner will signal the glider pilot to pull the yellow knob to open the tow hook release by holding his or her hand straight up like one would to give a high five. To signal the glider pilot to close the tow hook release mechanism, the wing runner would signal this by holding up a closed fist. Finally, to get the wing runner to lift the wing laying on the ground and check the area for any traffic, the pilot would give a simple thumb up sign. These are the most common hand signals used by glider pilots.

With the wings level, the slack out of the tow line, and the area clear, one is ready to radio the tow pilot and begin the takeoff roll. All the primary flight controls (elevator, aileron, and rudder) will function almost exactly like in a powered aircraft. As the tow plane accelerates, the glider will reach its take off speed rather soon, and the glider pilot should “rotate” just enough to get the glider off the ground as the tow plane continues to accelerate to its lift off speed (FAA, 2013). Glider pilots should use the rudder to keep the aircraft centered behind the tow plane just like they do to hold the runway center line

when flying a powered airplane. It is important for the glider pilots to stay right behind the tow plane for the duration of the tow and to correct for a crosswind like they would in any other airplane. If the glider is doing excessive movements, it become incredibly hard to properly control the tow plane, which would lead to a dangerous situation. Remember too that the flight controls tend to feel very sluggish at low air speeds and full deflections on the controls might be needed when slow.

If any issues arise during the take off roll and before the glider reaches a height of roughly 200 feet (can be higher or lower depending on the weather/wind conditions) then it is recommended to release the glider from the tow plane and land straight ahead on the remaining runway. If at or over 200 feet above ground level it is advised to turn around and land right back on the runway you just departed from.

During the tow phase, the glider pilots needs to keep the tow rope level and follow right behind the tow plane. Shallow bank angles will be required to keep the line tight and follow the tow plane during turns. If the glider-in-tow over banks, the tow line will start to get slack. If this condition is not fixed expeditiously, then the jerking force of the slacked line going under tension again can lead to the tow rope breaking (FAA, 2013). Upon reaching the agreed-upon altitude, the glider pilot visually clears the area to his right and pulls the big yellow release knob. After releasing from the tow line, the glider will bank to the right while the tow plane banks and descends to the left. This helps with any miscommunication and always ensures adequate separation between the two aircraft.

During this phase of flight, the glider is free to maneuver and position itself however the pilot likes while maintaining situational awareness. The student's instructor

will demonstrate the different maneuvers required under 14 Code of Federal Regulations (CFR) Part §61.87 (see Appendix C – Applicable Federal Aviation Regulations and Endorsements) for student pilots to fly solo. Controlling the glider is no different from what powered pilots are used to. The only difference are that the controls do feel a little lighter and it is much quieter.

During the landing or approach phase is when things start to seem different. One of the most important things to remember when coming in to land is that you can not "go around." There is only enough altitude and speed to set up one approach, and this is why it is imperative to make sure it is comfortable and precise. If the glider is too high and fast on final approach, then it might not be able to stop in time. If it is too low or slow on final approach, then it might have to land short of the runway. Both these situations need to be avoided when setting up the glider to land. The pattern entry, legs, and radio calls are all the same as powered aircraft. It is recommended that, "prior to entering the downwind leg and accomplishing the landing checklist, concentrate on judging the approach angle, distance from the landing area and staying clear of other aircraft while monitoring approach speed, as recommended by the POH" (FAA, 2103). This might sound like a lot to keep track of, but powered pilots already do this for every landing. It is also recommended, similar to powered aircraft, that the maximum bank angle be limited to 30 degrees when flying in the local traffic pattern.

The normal operations involved in flying gliders are quite similar to operating powered aircraft, with only a few differences. Adapting and learning are what pilots are taught early on in their career, and transitioning into a glider is something any pilot can do with some hard work and dedication.

**Aero-Towing**

In the United States, using a tow plane to launch gliders is the most common practice due to the flexibility in what it can offer. The tow is not altitude or direction limited like ground launching. Tow pilots are required by the FAA to posses at least a powered single-engine private pilot certificate along with a few more requirements in FAR Part 61.69 (see Appendix C).

For a powered pilot to get towing privileges, he or she must hold at least a private pilot certificate with the appropriate category rating, have logged a minimum of 100 hours of Pilot in Command (PIC) time in the same category of aircraft being used for towing, have a logbook endorsement from a flight instructor certifying he or she has received the proper ground and flight training, and have a logbook endorsement from a current tow pilot stating that hey have practiced at least three flights either towing or being towed in the last 12 months (FAA, 2013). Tow pilots and other ground crew should make daily and routine inspections of all the tow equipment to ensure its functionality. A standard pre-flight check of the tow plane should be made every day to verify the airworthiness of the tow plane (FAA, 2014).

There are two main types of tow hooks used in the United States, which are the *Schweizer* and the *Tost* tow hook (FAA, 2013). The actual mechanisms are relatively different but the use remains the same. The wing runner and tow pilot both inspect the tow hook and lines to verify that they are opening and closing correctly, free of any dirt, and that the tow line condition is acceptable. The following operational checks for tow hooks are recommended by the FAA:

- Attach the tow line to the tow hook and apply tension on the line in the direction of tow;
- With tension on the tow line, have another person pull the yellow release control in the tow plane cockpit and check for proper release of the tow line;
- If the tow line does not properly release, restrict the tow plane from towing duties until repairs can be made;
- Reattach the tow line and apply a moderate tug in the direction of tow;
- Inspect the release assembly to ensure it has remained completely closed;
- If the release assembly has opened, even partially, restrict the tow plane form towing duties and repair the tow assembly (FAA, 2013).

Proper operation of the tow hook is critical to the safety of a flight. While a tow pilot is verifying the functionality of the tow hook, they should also be inspecting the tow rings (at each end of the line) and the tow line itself. It is imperative that the right tow hook is used with the correct tow ring to avoid any malfunctions of the towing setup.

Inspecting the tow line and rings is similar to the tow hook inspection. One needs to make sure that the line and rings are free of mud or dirt and have no worn areas. The glider and tow pilot should visually inspect the entire length of the tow line for any abnormal conditions because they are mutually responsible for this condition inspection (FAA, 2013).

A thorough before take-off briefing is a must for tow and glider pilots. They need to go over exactly what will happen in case of different emergencies and have an abort plan ready. This is also a good time to verify the ground signals to be used and the tow

pilot understands that once the wing runner has leveled the gliders wings they are about to give the take off signal. The take off signal the tow pilot is looking for is the wing runner to do a circular motion with their arm and the glider pilot to "wiggle" the rudder back and forth. There should never be any confusion on the field due to a lack of communication. If someone is ever unsure about anything, he or she must ask for clarification.

The takeoff from inside the tow plane is rather routine and should be performed like a normal takeoff. However, due to the extra weight in tow, it will take the plane longer to accelerate and leave the ground. However, all the appropriate speeds will remain the same. Some different gliders, especially the high performance aircraft, have different max tow speed requirements and the glider pilot must make the tow pilot aware of these speed restrictions (FAA, 2013). If the glider pilot did not specify which direction to tow, then it is up to the tow pilot to decide on the direction. After the glider releases the tow plane will visually clear the area immediately to its left and begin a left turn to avoid contact with the glider. It is now up to the tow pilot to return to the field and pick up the next glider.

Prior to becoming a tow pilot, he or she needs to get the required instruction, get to know the glider pilots, and understand the limitations of his or her aircraft. There are multiple emergencies that could be encountered while being towed and proper mitigation techniques are needed to counter any adverse affects. Roughly half of the "take off emergencies can usually be attributed to improper assembly, improper preflight inspection, or improperly conducted pre-takeoff checklist" (Knauff, 2016, p 37). This is why bystanders should speak up if they ever notice any unsafe operations.

## CHAPTER IV – WEATHER

Weather is a subject area that is important for everyone in the aviation industry to thoroughly understand. Glider pilots face a multitude of decisions they must make during every preflight and flight. Pilots need to make sure the weather conditions are safe to fly in and that they feel comfortable taking off in. Glider pilots usually refer to rising air as "lift", which should not be confused with the lift the airfoil creates (FAA, 2013). Powered pilots know that weather production is dependent on many factors, but a large contributor is the uneven amount of solar radiation the ground receives on a daily or seasonal basis, which creates an uneven heating of the surface (Lester, 2013).

Many of the same variables that affect powered aircraft will have an affect on gliders. These variables are; temperature, density, and pressure. Temperature is the measure of the average kinetic energy of an object, density is the amount of mass molecules in a specified volume, and pressure is the force per a defined unite of area (FAA, 2013). These variables greatly affect the amount of rising air or thermals that can be found in a given region. When the ground under an air mass is much warmer, it will start to radiate heat into the air right above it causing the warmer air to rise and circulate in the atmosphere (Lester, 2013). These areas of rising air are called thermals, and they provide the basis for soaring lift.

No two thermals will ever be identical, and many are not even concentric. Typical thermals seem to be around 500 to 1000 feet wide horizontally and can have rising air for many hundreds and even thousands of feet (FAA, 2013). An unstable atmosphere is when there is abundant convective air action, providing for great soaring conditions. However, it should also be noted that these conditions are conducive to the creation of

thunderstorms. This becomes especially true when there is ample moisture in the air (Lester, 2013). Another popular method of gaining lift is through ridge soaring. This is when a glider pilot follows the ridge of a mountain range back and forth on the up-wind side where there is rising air.

Glider pilots need to have a general idea of what the weather will be like for the next few hours before launching. Gliders also tend to be unforgiving when taking off and landing in crosswind conditions, due to the long wings and proximity to the ground. Smart personal minimums in regards to weather must be created by the student and further developed by an authorized instructor (FAA, 2008). Proper pre-flight planning is the best way to ensure a glider pilot only flies in weather they feel comfortable in.

## CHAPTER V – TRANSITION REGULATIONS

Transitioning into gliders is not very difficult, but it does still require time and effort. Glider pilots are not required by FAR 61.23 (Appendix C) to have or maintain a medical certificate. Gliders pilots go through a self-diagnosing process where they ensure their own fitness to fly. Also pilots transitioning from another category of aircraft are not required to take any additional written tests for adding a glider category to their certificate.

For a private pilot to transition to a glider, they would need to be in compliance with §61.107 (Appendix C) and §61.109 (Appendix C). FAR part §61.107 states what the glider trainee is required to have been taught by their instructor and §61.109 are the minimum experience requirements. According to FAR §61.109, if a private pilot has less than 40 hours of pilot time in heavier-than-air aircraft, they must:

- receive and log 10 hours of flight time in a glider going over the subject areas outlined in §61.107;
- have 20 flights in a glider covering topics outlined in §61.107; and
- have 2 hours of solo flight in gliders reviewing topic areas from §61.107

(Federal Aviation Regulations, 2017).

If the pilot has more than 40 hours of flight time in heavier-than-air aircraft, they would need:

- to receive and log 3 hours of flight training on the areas listed in §61.107;
- 10 solo flights in a glider reviewing the areas in §61.107;

- three instructional flights in a glider in preparation for the practical test, and these flights must have been made within the preceding two calendar months (Federal Aviation Regulations, 2017).

A private pilot may act as the Pilot in Command of the tow plane if they meet the previously discussed requirements set forth in §61.69.

For a commercial pilot to transition into gliders they would need to be in compliance with §61.127 (Appendix C) and §61.129 (Appendix C). FAR part §61.127 states what the commercial glider trainee's required instruction, and §61.129 are the minimum experience requirements. According to FAR §61.129 the glider pilot applicant must have the following:

- logged 25 hours of flight time as the pilot of a glider and that flight time must include at least 100 flights in a glider as the pilot in command;
- three hours of flight training with an instructor or 10 training flights in a glider covering the subject areas listed in §61.127;
- two hours of solo flight that include at least 10 solo flights reviewing the subject areas from §61.127 (Federal Aviation Regulations, 2017).

If the applicant has more than 200 hours of flight time as the pilot in heavier-than-air aircraft and at least 20 flights as the Pilot in Command of a glider, they would need the following:

- three hours of glider flight training or 10 training flights with a flight instructor covering the subject areas listed in §61.127;
- five solo flights in a glider on the subject areas listed in §61.127 (Federal Aviation Regulations, 2017).

These requirements for private and commercial glider add on certificates might seem complicated, but they are rather straight forward and easy to follow. It is important to understand which set of rules and requirements apply to the transitioning pilot.

## CHAPTER VI – Reflection

Learning to fly gliders has been a lifelong dream of mine ever since I found out about my family's long history in gliding. Since the early 1900s, every generation of my family have had at least one glider pilot, and I wanted to continue this tradition. I knew this project would not be the easiest, but it would be one that has a great personal significance. I was slightly over zealous during the thesis proposal phase and had to leave a few things out. However, I added in the personal journal entries describing the actual flight experiences I went through leading up to my first solo flight.

One of the areas I did not cover extensively was all the complications of glider flight training. The local glider port has an absolutely perfect facility to train the next generation of general aviation and glider pilots. Like everything in aviation, it is more complicated than it looks, and of course, the safety of each and every flight is the top priority. Some of the most common setbacks I faced during my training were dealing with the weather and the scheduling of aircraft and instructors.

The local glider airport only operates on weekends and does not have a full time staff to support it. The main employees are volunteer club members who are tow pilots or flight instructors. There is nothing wrong with this, and I prefer the laid back culture more than a strict and rigid training program. It does cause some scheduling delays if there is not a tow pilot or a flight instructor available to fly with the glider student pilot. I often drove there only to find out there was not enough fuel in the tow plane, no tow pilot, no glider, or no glider flight instructor available. One can see how if a student glider pilot wants to get training done, there really needs be a minimum of three or four qualified people out there to operate everything in a safe manner.

The weather has a large impact on the aviation industry. There were many weekends, especially over the summer and into fall, where it would storm all weekend and would force the glider port to cease operations. Even if it had stormed or rained heavily during the week, they would not operate due to the sensitive nature of a grass runway when it was wet. There is only one grass runway at the glider port, and if they allowed operation on it while it was wet, then it could cause long lasting damage.

Other times I would arrive to find that all of the gliders where out soaring. I was told that there were incredible thermals going on at the time, and that is why none of the training gliders were back at the field yet. None of the previously-mentioned issues upset me in any way, because I understood the laid-back nature of flying gliders. I could still learn valuable information by helping the club operate on the ground. It was really convenient when I started showing up later in the afternoon once the thermals had died down. Anyone who really wanted to go soaring had landed or decided not to get towed up again, due to the lack of lifting air. This turned out to be the absolute best time for student glider pilots like myself to show up and already have all the resources out and ready to use. The training glider, tow plane and pilot, and a flight instructor would be waiting on anyone who did not care that there was no lift. These individuals are student pilots or a few folks trying to get landing current again. This allowed us student pilots a few hours of really great training time before the sun set. If I could have figured out one thing sooner, it would have been to show up later in the day when everything a student pilot needs to do a successful training flight is ready to go.

The experience I had while completing this project taught me a great deal, not just about gliders but also about myself. I had a great time learning to fly gliders and look

forward to continuing this hobby for as long as I can. There is something so incredibly peaceful about flying gliders, and it actually makes for a good stress reliever.

**Safety**

While transitioning into gliders gave me many different views on aviation related safety topics, it also reinforced going back to the basics and manually hand flying the aircraft correctly. This brings back up the NTSB statistic that in 2015 "over 40 percent of fixed wing GA fatal accidents occurred because pilots lost control of their airplanes" (NTSB, 2015). Could it be that learning to fly gliders could help solve this issue of pilots losing control of their airplanes? Personally, I really do believe that pilots never stop learning, and any extra positive learning experiences we can have in the air promotes the safety of the pilot. I would argue that learning to fly gliders would improve the NTSB's statistics by having powered pilots "relearn" how to properly and safely operate an airplane with no engine.

However, I found out that the glider flying community seems to still suffer from some of the same issues and problems that powered aircraft pilots face. During a recent study the Soaring Society Foundation published an article claiming that 40% of the fatal glider accidents are contributed to "loss of control" as well (Carlson, 2016). I found this to be interesting, especially since it is the exact same percentage of accidents in both gliders and General Aviation powered aircraft that are attributed to the pilot losing control of the aircraft.

One of the biggest things I took away from this experience is the situational awareness required to be a glider pilot. One is constantly cross-checking the airspeed with descent rates and distances to various fields, which a lot of powered pilots are

initially taught but do not do on a regular basis anymore. Flying gliders forces the pilot to get more in “tune” with his or her natural surroundings and to be able to properly manage the aircraft’s potential and kinetic energies.

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## Appendices

# Appendix A – Glossary

**AGL:** Above ground level. The actual height the aircraft is above the ground directly under it.

**Ailerons:** The hinged portion of the trailing edge of the outer wing used to bank or roll around the longitudinal axis.

**Air Density:** The mass of air per unit of volume.

**Airfoil:** The surfaces of a glider that produce lift.

**Angle of Attack:** The angle formed between the relative wind and the chord line of the wing.

**Best glide speed:** The airspeed that results in the least amount of altitude loss over a given distance. This speed is determined from the performance polar. The manufacturer publishes the best glide airspeed for specified weights and the resulting glide ratio.

**Chord line:** An imaginary straight line drawn from the leading edge of airfoil to the trailing edge.

**Critical angle of attack:** Angle of attack, typically around 18°, beyond which a stall occurs. The critical angle of attack can be exceeded at any airspeed and at any nose attitude.

**Cross-country:** In soaring, any flight out of gliding range of the takeoff field.

**Drag:** The force that resists the movement of the glider through the air.

**Elevator:** Attached to the back of the horizontal stabilizer, it controls movement around the lateral axis.

**Flaps:** Hinged portion of the trailing edge between the ailerons and the fuselage. In some gliders, ailerons and flaps are interconnected to produce full-span flaperons. In either case, flaps change the lift and drag on the wing.

**General Aviation:** All civilian flying except scheduled passenger airline service.

**Glider:** A heavier-than-air aircraft that is supported in flight by the dynamic reaction of the air against its lifting surfaces, and whose free flight does not depend on an engine.

**Glide Ratio:** The number of feet a glider travels horizontally in still air for every foot of altitude lost.

**Ground speed:** The horizontal speed of the aircraft relative to the ground.

**Instrument meteorological conditions (IMC):** Meteorological conditions expressed in terms of visibility, distance from clouds, and ceilings less than the minimum for visual meteorological conditions. Gliders rarely fly in IMC due to instrumentation and air traffic control requirements.

**Lateral axis:** An imaginary straight line drawn perpendicularly across the fuselage through the center of gravity. Pitch movement occurs around the lateral axis, and is controlled by the elevator.

**Lift:** Produced by the dynamic effects of the airstream acting on the wing, lift opposes the downward force of weight.

**Longitudinal axis:** An imaginary straight line running through the fuselage from the nose to tail. Roll or bank movement occurs around the longitudinal axis, and is controlled by the ailerons.

**Pitch attitude:** The angle of the longitudinal axis relative to the horizon. Pitch attitude serves as a visual reference for the pilot to maintain or change airspeed.

**Rudder:** Attached to the back of the vertical stabilizer, the rudder controls movement about the vertical axis.

**Sailplane:** A glider used for traveling long distances and remaining aloft for extended periods of time.

**Self-launching glider:** A glider equipped with an engine, allowing it to be launched under its own power. When the engine is shut down, a self-launching glider displays the same characteristics as a non-powered glider.

**Slip:** A descent with one wing lowered and the glider's longitudinal axis at an angle to the flight path. A slip is used to steepen the approach path without increasing the airspeed, or to make the glider move sideways through the air, in order to counteract the drift resulting from a cross wind.

**Spin:** An aggravated stall that results in the glider descending in a helical, or corkscrew, path.

**Spoilers:** Devices on the tops of the wings to disturb (spoil) part of the airflow over the wing. The resulting decrease in lift creates a higher sink rate and allows for a steeper approach.

**Stall:** A condition that occurs when the critical angle of attack is reached and exceeded. Airflow begins to separate from the top of the wing, leading to a loss of lift. A stall can occur at any pitch or airspeed.

**Thermal:** A buoyant plume or bubble of rising air.

**Towhook:** A mechanism allowing the attachment and release of towrope on the glider or tow plane. On gliders, it is located near the nose or directly ahead of the main wheel. Two types of towhooks commonly used in gliders are manufactured by Tost and Schweizer.

**Tow Line:** The 200-foot rope that attaches to the front of the glider using the towhook and attached to the back of the tow plane.

**Variometer:** Sensitive rate of climb or descent indicator that measures static pressure between the static ports and an external capacity. Variometers can be mechanical or electric and can be compensated to eliminate unrealistic indications of lift and sink due to rapid speed changes.

**Visual meteorological conditions (VMC):** Meteorological conditions expressed in terms of visibility, distance from clouds, and ceiling equal to or better than a specified minimum. VMC represents the minimum conditions for safe flight using visual reference for navigation and traffic separation. Ceilings and visibility below VMC conditions constitutes instrument meteorological conditions.

**Wake turbulence:** The turbulence created by an aircraft moving through the air usually found behind and under the flight path of the aircraft.

**Washout:** Slight twist built in towards the wing tips, designed to improve the stall characteristics of the wing.

**Wing Runner:** The person in charge of ensuring the safety of the take off roll by lifting the gliders downwind wing and visually scanning the area for any hazards before signaling the tow plane to begin its takeoff roll.

# Appendix B – Journal Entries from Actual Flight Lessons

## Table of Contents

## Glider Flight 1

The first flight in a totally different kind of aircraft is always an exciting experience. You can only spend so much time studying the internal workings of the aircraft and how the operations are different from what you are used to. We are fortunate to have a top notch flight school here at Middle Tennessee State University and they have sets of standard operating procedure for almost every aspect of a flight. Glider flights seem to be fairly different in that they only happened when the weather is beautiful and everything is working as it should which creates a very "laid back" atmosphere. Of course like everything in aviation the main focus is the overall safety of each and every flight.

According to the FAA's *Glider Flying Handbook,* they mention that there are "many factors [that] need to be considered when choosing the right school, such as location, type of certification, part or full-time training and cost" (FAA, 2013). The Eagleville Soaring Club was exactly what I wanted in a flight training school. They had great aircraft, instructors and a convenient location in Eagleville, Tennessee.

My first flight experience in gliders was just what I had expected. The weather was a perfect visual meteorological conditions day, the people were incredibly friendly, and the whole atmosphere at the local glider port was almost festive. I arrived quite early for my scheduled flight, which I like to do just incase I need to do any last minute work. I was warmly welcomed by all of the members at the club, especially since many of the club's members still remembered my late grandfather who was an avid aviator and loved flying his glider around Middle Tennessee and in Europe. I loved the feel at the club, and I could tell this genuinely was a great group of ladies and gentleman who were passionate

about soaring. I was instantly put to work by organizing the club's resources for a full day of glider flying. Everything had to be set up in an efficient and safe manner to let as many of us members take flight that day.

After meeting with one of the flight instructors, I gave him a full account of where I stand in my flying career and what I was hoping to accomplish through learning how to fly gliders. For the next few minutes, we discussed the various requirements put in place by the FAA, in regards to obtaining a commercial Glider certificate. Since I already held a commercial pilot certificate rated for powered airplanes, the transition would not be nearly as strenuous as I had initially thought, and it would be considered an "add-on" category for my commercial certificate.

After reviewing some paperwork and log books, we moved out towards one of the club's two, Alexander Schleicher Segelflugzeugbau ASK 21 gliders. The ASK 21 is a modern, 17-meter wing span, two-seat trainer glider that is still being built in Germany today. It is easy to see why the ASK 21 became an instructor's favorite due to its docile but still higher performance capabilities and flight characteristics. After doing a thorough pre-flight check to ensure the airplane was safe to operate, we connected the tow hook to the glider and used a golf cart to pull the plane down to the staging area. The staging area is where we met up with the tow pilot who would be flying the powered airplane that would tow us into the sky before releasing the towhook. We discussed the different emergency scenarios and made sure the tow pilot understood exactly what our plane was to avoid any miscommunication or confusion.

Now came the time I had been so excited for the last few days. The instructor helped me into the front seat of the glider and proceeded to show and explain to me what

the different controls did since I already knew what all the flight instruments were telling me from my powered flying experience. Everything seemed to be simpler in the front seat of the glider because there were fewer buttons, gauges and instruments. All that was in the front seat of the glider were the absolute basics required to make a safe flight.

The only difference that I was not used to was the left hand operated spoilers, or speed/dive brakes. According to the FAA, spoilers are "devices on the tops of the wings to disturb (spoil) part of the airflow over the wing. The resulting decrease in lift creates a higher sink rate and allows for a steeper approach" (FAA, 2013). I had never used spoilers before and was very curious as to their operation and actual effectiveness.

Once seated in the glider and briefed on the operation of everything we ran through a published "before-takeoff" checklist that ensures a few very important items are ready for flight. Some of the important items checked is that the rear canopy is securely latched, that the flight controls are "free and correct" (making sure we will be able to control the plane using the given controls) and that we have discussed and considered any emergency procedures that we might experience during the aero-tow portion of the flight.

After completing the checklists and briefing the take off phase, we gave the thumbs up signal to the wing runner, and he proceeded to lift the wing off the ground while scanning the traffic pattern for any traffic or other hazards that could affect our safety. He then proceeded to give the tow pilot a good-to-go signal and we wiggled the vertical stabilizer to confirm our intentions of taking off. As the tow plane accelerated down the grass runway, we continuously made small control adjustments since the low speed handling characteristics of many planes are not really the best. Once we reached

about 30 knots, the glider, with its incredibly high aspect ratio wings, starts trying to lift itself off the ground. However, we had to wait on the tow plane to reach its takeoff speed of 65 knots, which is more than double the glider's takeoff speed. During this part of the takeoff phase, it is important to be very aware of your situation since you are travelling rather quickly for a glider at only a few feet over the ground. Keeping the glider flying coordinated is also important to stream line the fuselage and reduce drag. This is done rather simply by keeping the "yaw string" centered right down the top of the canopy using the rudder pedals, if needed.

Once the tow plane has reached its lift off speed, we followed right behind the tow plane to ensure that the rope between the two aircraft was always level horizontally. Tow pilots like when the tow line stays horizontal because it gives them the best controllability, and they can look into a mirror attached to visually check on the glider in tow. We did practice what is called "boxing the wake," which is when the glider maneuvers in different ways to show how much it can move and how to reposition behind the tow plane's wake turbulence. The FAA still requires this maneuver along with many others to be proficiently demonstrated to the examiner on both the private and commercial pilot check ride.

After following the tow plane up to our pre-determined release altitude of 3,000 feet above the ground, I reached down and pulled firmly on the big yellow knob, which released the tow hook. Immediately after releasing, we checked to make sure that there was no traffic and initiated a turn to the right, while the tow plane made a left turn and started a rapid descent to get the next glider connected and into the air. This is when the whole surrounding environment seems to change so drastically compared to what

I am used to. It goes from being rather noisy and everything vibrating to a smooth, calm, and quiet flight as we gently glided back towards the earth at a very slow rate. I had the controls and my instructor was verbally walking me through a few maneuvers that I am familiar with until we hit what I can only describe as a small bump or jolt of turbulence around 2,800 feet. The instructor quickly takes the controls to show me the phenomenon of thermals. This is where gliders absolutely shine and defy gravity by circling in a rising column of warm air. It still seems unreal to me that we actually were able to climb a couple hundred feet with no engine and just the force of mother nature.

After a few minutes of sheer amazement at the amount of altitude we had gained, the serenity was interrupted by a radio call saying we needed to help solve a time sensitive issue on the ground. We made a learning moment out of this and the instructor told me to watch how much our decent rate varied as we "pop" the spoilers out and back in while maintaining a constant speed. I was absolutely astonished at the difference. According to the Alexander Schleicher Segelflugzeugbau flight manual for the ASK 21, the glide ratio of the plane we were in goes from 33:1 down to roughly 6:1. If needed, we can put the plane into a slip and bring that ratio down to almost 1:1, which means that for every foot we go forward, we go down one foot as well. By utilizing both a slip and the spoilers at max deployment, we were able to get back to the ground in only a matter of a few minutes.

The landing was rather uneventful with everything being like in a powered airplane as far as speeds, decent rates and the level off or flair at the very end. The only difference that I kept thinking about in the back of my mind was the potential of a forced landing. As a powered airplane flight instructor we heavily teach the importance of

"go-arounds," which are exactly what they sound like. If for any reason the student or myself is not 100% happy with the approach to landing, we always have the option to apply full power again and climb back up. These of course are not possible in a glider, and at a certain point on the final approach one needs to be totally committed to making the landing. The only other slight difference between landing a powered plane and a glider is the different sight picture. The ASK 21 is a very narrow and low sitting aircraft, which improves its aerodynamic performance. Due to the low sitting nature, it seemed to me that we were way to low during the flair but my instructor assured me that being within a few feet of the ground is completely normal.

We used up a good bit of the 2,200-foot grass runway to demonstrate a few more ground handling characteristics of gliders and slowly used the brakes to come to a complete stop. Not a minute later, a few club members came to help me move the glider off the runway and back to the staging area, while my instructor handled the issue on the ground. We spent a few minutes talking about the flight and answering any questions that I might still have before getting ready for our second flight of the day.

## Glider Flight 2

Even after just one single glider flight under my belt, I felt way more comfortable getting in for the second one. It was interesting to see how even a short half-hour long flight taught me so many things about my self as a pilot. We tell ourselves that we are constantly looking for emergency places to land in case our powered aircraft losses power and becomes a very under performing glider in a sense. I could tell prior to this experience I was not doing this as much as I should when flying a powered airplane. One could say I was taking for granted the fact that our power plant was operating exactly how it should without any issues. It is always a good idea to brief any abnormal situations or emergencies that might arise on a flight before you are put in a situation where one would be unsure how to handle it.

To prepare for our second flight of the day, my instructor and I went over some of the more critical situations we could face, especially when being towed up into the air. Some of the scenarios we spoke through included what to do if the tow line broke at various heights, what to do if the tow plane lost power at various heights, and any other unsafe conditions that might arise. The so called “rope break” exercise takes a lot of mental strength to do properly since we as pilots are always told to never try to make a turn back to the runway until we are at least above 1,000 feet. If anything happened before that altitude, we are told to land more or less straight ahead. However, in a glider that altitude restriction comes down to less than 200 feet, which seems incredibly low. Although, due to the glider’s performance, it is not impossible to turn around and return back to the runway.

We climbed back into the glider in preparation for the second flight and ran through the standard checks we had done earlier in the day. Everything happened like it should, and we followed the tow plane into the air with out incident. To be honest I was fully expecting the instructor to release the rope at 150 feet to 200 feet and have me practice returning to the runway safely, but I guess he wanted to save that exercise for a later date. At 2,000 feet, I pulled the yellow knob again to release the glider, quickly scanned the area to the right before making the turn, and watched the tow plane dive back to the ground. Even after having experienced the noisy tow plane going away in the distance, one still has a calm feeling when all you can here is the wind rushing over the canopy.

During this flight, we did a few more maneuvers and spoke more in-depth about how the angle of attack and bank angles affected the series of flight maneuvers. This lead to a brief discussion of stalls and spins along with how to mitigate these risks while flying gliders. Since we only went up to 2,000 feet on the second flight, it was only about 20 minutes of flight time from take off to landing. Coming into land, we did everything like normal, executed a great approach, and landed with plenty of runway still in front of us. It was the end of the day since the sun was starting to set, and the remaining members and I towed the gliders up to the hangar and packed them in one by one with little room for error on either side of the wings. The tow plane was refueled and pushed into a hangar alongside the gliders and a few miscellaneous aircraft parts that I was told have been there since the inception of the gliding club around World War II. The first two flights were it for the day and I returned home to process all the new information I had acquired that day.

## Glider Flight 3

In preparation for my next flight, I had to do some research into the different factors that affect gliders the most, and I was not exactly surprised to find out that a large percentage of glider pilots do not have the required piloting knowledge to safely operate one (Knauff, 2016). This is not just for student glider pilots but also the ones who have passed all the required testing and were given the stamp of approval from a designated pilot examiner. This made me think of some questions for the next time I am flying with an instructor to see what they believe could be a contributing factor.

While moving everything around, we discussed a few key points and emphasized how we as pilots need to see and mitigate any excess risk. Asking for all the help one can is important especially as a student who is trying to learn to operate these aircraft in the safest manner possible. One of the things we can all do as club members is become "safety inspectors" and politely mention if you see anything that could create a dangerous situation. It is about being proactive and catching these potentially dangerous situations before they actually occur. Knauff mentions in his article titled "Preventing Launching Accidents" that the wing runner has a very important role in the safe launching of every flight (Knauff, 2016). Granted, everyone participating or even watching these events taking place should not hesitate to speak up if there is even the slightest concern.

Flight number 3 actually started later in the afternoon since this was one of the best times for students to practice multiple takeoffs and landings. This is because many of the licensed glider pilots want to go and "soar" for hours when the sun is still completely out and heating the ground, which creates lifting warm air for them to thermal in. After arriving at the glider airport and meeting with the instructor whom I would be

flying with that day, we set right to work moving gliders and the tow plane into position in order to prepare our multiple flights for the day. We conversed about the different scan techniques for spotting hazards, the importance of being at the proper speed when needed, and how the weather would help influence the decision to go glider flying.

Everything seemed to go smoothly as we followed the tow plane up to only 1,000 feet since we just wanted to get the repetition of pattern and landing practice in that day. I demonstrated a few different type of stalls and then joined the pattern to land. Using good judgment, I made the correct turns and slowly started to bring the spoilers out during final approach since I could tell we were still pretty high. The landing was just like the first two where it seemed like we were flaring too low, but that was just due to an unnatural sight picture. Many instructors of all types will spend a fairly long amount of time practicing landings since these are often considered one of the harder things to really get a proper grasp on.

## Glider Flight 4

Flight number four happened only a few minutes after landing from the previous flight. Since I was one of only two students left at the field that afternoon, we could just continue doing flights and practice the required maneuvers and landings. We quickly reset the equipment to take off again and ran all the appropriate before take off checks. This flight lesson we would plan on covering slow flight, stalls, level turns, climbs, and descents. In my mind, I am thinking “Ok this is when I figure out how to properly manage my airspeed and altitude,” which I believe is a leading cause of loss of control accidents within aviation.

Everything seemed normal as were rolling down the grass runway and slowly started to climb out behind the tow plane until we came to about 200 feet above the ground and had just started to get trees under us instead of open fields. Two hundred feet really does not look or seem high at all, especially for a powered pilot like myself. At that moment, I could see the tow rope keep going in front of us, but we stopped accelerating. I immediately lowered the nose to make sure we kept a safe airspeed and proceeded to look straight ahead, for a place to land. I could hear the instructor laughing in the back seat and thought to myself that he is crazy! He took the controls from me and did a complete 180 degree turn and pointed us right back at the runway. I sat there in amazement of how little altitude we had lost making this so called "impossible" turn back. Gliders have such great glide ratios that most instructors say that, anytime above 200 feet, one should simply turn around and make a normal landing even if you need to land with a slight tailwind.

Once we got on the ground we had a little conversation about this topic and how it is rather unlikely that a tow line would break that close to the ground. This made me think of what would happen if the rope broke immediately after liftoff, which I later found out would mean the glider pilot goes full out on the spoilers to get back on the ground as soon as possible and execute heavy breaking to hopefully stop before the end of the runway. Another interesting scenario that might be encountered soon after the takeoff roll is the tow plane losing its engine power and having to land straight ahead. Of course this could all happen within a matter of seconds so it is imperative that we pay very close attention during the ground roll. One of the things this glider club does is have the tow plane in this hypothetical case land straight ahead, on the left side of the wide runway so the glider will have plenty of space on the right side. They do this to help avoid a collision on the runway. This is when I decided to take a little break and converse with other members to see if they had any tips for me as a glider student.

While observing the other members, I noticed just how low to the ground a glider is when it is in trail of the tow plane. I spoke to a few seasoned glider pilots who specialize in flying cross country in their sail planes. I would have never guessed that one can take a glider on a long "cross country." Although, this does not actually mean across the country. It is more like taking a flight to a different airport within Tennessee. I was especially interested in something called ridge soaring, which is practiced a lot in East Tennessee due to the location and weather patterns around the Smoky Mountains. Ridge soaring is when a glider follows the ridge of a mountain range since usually there will be some form of rising air, which will allow the glider to continue following the ridge line. Ridge soaring is something I plan to learn, if I ever move to a place where it is possible.

## Glider Flight 5

Flight five started very similar to the last few by us resetting the aircraft to the staging area and jumping right in. After completing the required before takeoff safety checks, we briefed what we would be doing and how high to get towed. We agreed 2,000 feet is perfect to practice some slow flight and then practice a forward slip to landing. A forward slip to landing requires the pilot to cross control the airplane by inserting aileron to one side (usually deflected into the wind) and apply opposite rudder with your feet using the rudder pedals.

During this takeoff we spoke about the various ways to reduce the likelihood of the tow rope breaking. Some of the most contributing factors to broken ropes are, weak spots (knots), excessive maneuvering behind the tow plane, and excessive slack in the line. The tow line has one pre determined knot in the rope which creates a weak point. One might think why anyone would purposely make their tow rope weaker, but this knot actually provides a safety factor of sorts because we will always know the very first place the rope will snap. This allows us to decide where along the rope it should break first if it is going to break. Almost always the knot is at the very end of the tow line closest to the glider, so if it did break, there would not be a 200-foot rope hanging down from the front of the glider. Of course it makes sense that excessive maneuvering behind the tow plane puts stress on everything in the situation and can easily cause a weak tow line to break. The last way a tow line commonly breaks is when the glider pilot flies their aircraft in a way that creates a lot of slack in the line behind the tow plane. This creates a heavy jerking motion when the slack is all taken out again, which really stretches the line.

After releasing from the tow plane, we slowed the glider down into slow flight and made sure to fly around coordinated. The instructor also had me perform a series of turns to different magnetic headings to ensure I fully grasped the concept of slow flight. It seems like one is barely traveling during the slow fight maneuver, especially when the airplane is pointed directly into the wind as it slows your groundspeed down even more. Slow flight is important to master because the glider will underperform and will become sluggish on the controls. This is how a lot of the loss of control accidents happen. Pilots getting too slow, too low, and trying to continue flying the airplane results in way too many accidents.

While we were practicing slow flight the winds actually started to pick up and shifted to an angle at the runway. This meant we could practice a crab, which is simply when you point the aircraft into the wind at different angles to continue flying straight across the ground even if the nose of the aircraft is pointed to the right or left of this ground track. On short final, I transitioned from the crab approach to a slip and continued the landing uneventfully.

## Glider Flight 6

During this lesson, we focused on some weather related issues that one might experience as a glider pilot. A few of the big weather issues that seemed to get people in unplanned situations are inadvertently flying into instrument meteorological conditions, flying into heavy sinking air, disappearing thermals, and night time flights. None of these issues are immediately problematic, but as a pilot one needs to understand how to avoid them if encountered in order to return home.

Flying into IMC happens everyday by certified pilots who are specifically trained and have a capable instrument set up in their powered aircraft. However, in a glider with just a few of the most basic instruments this can become very problematic. Of course the easiest and safest way to avoid IMC is to do thorough preflight planning and have an idea of what the weather and clouds are doing in your area. If a glider pilot does find themselves in a cloud, they need to make sure to only do smooth control inputs and scan their instruments very closely to get back out.

I will group heavy sinking air with disappearing thermals because they have similar outcomes for a glider pilot. We already talked about how the thermals are the areas of rising air that glider pilots use to gain precious altitude. There are also areas of sinking air which would push the glider back towards the ground at a faster than normal rate. Luckily, usually these areas of rising and sinking air tend to not be very wide at all, and you can increase your airspeed to get through them quicker if that is what you wanted. This is important to remember if there seems to be widespread areas of sinking air since your gliders performance will not be as great as it normally is, and one would want to stay fairly close to the airport to avoid having to land out. Glider pilots call it

“landing out” when a glider does not have enough altitude to return back to their intended destination, which is usually the airport they took off from.

Apparently, having to land elsewhere seems to be fairly common for glider pilots, which seemed a little odd to me. Either way, after landing in some random field, the glider pilot would call for someone with a trailer to pick up the plane and pilot and return them back to the original airport. I distinctly remember my late grandfather telling me a story where he was flying over his farm and all of a sudden the thermals started to disappear and a strong wind started to blow against his direction of travel. He decided the smartest and safest thing to do is just to land on one of his fields and walk back to the house for dinner.

On this flight we flew a normal pattern and approach all while considering the proper procedures if one needed to land not back at an airport. First of all, there is much thought that goes into making the decision to land out and deciding where the best options are.

## Glider Flight 7

Before getting ready for this next flight my instructor had two of us come into the hangar office and take a pre-solo written examination. I only missed one question on this test which is fine since it just needs to be corrected and explained by the flight instructor. Then, we went over all of the required items in the FAR Part 61.87 in regards to student pilots to ensure that I was in compliance with all the FAA requirements just incase I did solo soon.

We then reset the glider, attached the tow line to the plane, and hopped into the glider in order to complete another flight. This time we really did not discuss what we would be doing so I figured it would become another "normal" landing practice. Everything seemed normal until we hit 200 feet when I got that feeling of not accelerating anymore and the tow plane continuing on without us. This time, I was able to react much quicker and banked the glider over to turn around completely and made an excellent landing back on the runway. Since it was a simulated rope break we were technically landing on the correct runway just in the wrong direction, so we had a slight tailwind. Although, it was nothing that I could not manage with the spoilers. We rolled done the runway as far as we can almost making it back to the initial staging area. After jumping out to spin the glider back around, my instructor looked at me and told me to check and make sure the back seatbelt was fastened and the canopy was correctly locked. This initially seemed odd because that was his seat and his job to make sure it was closed correctly. It was not until he did not get in the back seat that it finally clicked in my mind. I was about to solo a glider after just a few instructional flights!

## Glider Flight 8

Finally, my time had come to put all this hard work and studying to use as I would be the only person in the glider. There would be no one in the back seat to ask a quick question or for help. I could use the radio or even my cell phone if I really needed help. Either way, it still made me a little nervous since this meant that there would be no one to take over the controls and land the glider if anything happened.

Lucky for me, it was an absolutely beautiful day in all of middle Tennessee, and I knew my instructor had prepared me very well for this occasion. I kept thinking about my first solo flight in a powered airplane almost four years ago and how much it meant to me. I know it would have made my grandfather incredibly happy and proud to see me complete my life long dreams just as he had so many years before me. Just thinking about this brought a big smile to my face, as I knew he was looking down at me and smiling as well.

Once I got settled back into the front seat of the glider, I immediately ran through the before takeoff checklist just like I had done seven times before this flight. I gave the thumbs up signal to my instructor who would also be the wing runner in this case. He leveled the wings for me and made sure to visually clear the area before signaling me back that I was good to go. I checked the flight controls one last time to make sure they were free and correct before letting the tow pilot know that I was in position to take off. As the tow plane started pulling me, I could tell everything was happening just a little faster due to the reduction in weight. I pulled back on the stick to start flying, and to my surprise leaped off the ground. Throughout this situation, I had to keep telling my self to do smooth control inputs because the reduction in weight caused the plane to be much

more responsive. Once I started doing that, it became just like every other flight. I followed the tow plane to 1,000 feet and pulled the yellow knob to release the tow hook. The feeling of absolute freedom was amazing. There I was with no engine and no noise. Just myself and the breath-taking natural world. Looking around I started to notice different birds who were also soaring since they actively look for thermals just like gliders do.

I decided to give a thermal a try since I was the only one in the area and had plenty of altitude still. After just a few turns in a weak thermal (only gaining maybe 100 feet), I decided to head towards the glider port again and plan my landing. I entered downwind in the traffic pattern while making position radio calls in case anyone was listening. I was a little high and fast on my final approach, which meant I needed to use the spoilers to get down faster. I brought the spoilers to full deployment and pointed the nose of the glider at the beginning of the runway. Once I started leveling off during the landing round out, I could really notice the affects of having less weight in the glider. I held the plane off the ground for quite some time before it slowly settled into the soft grass, and I slowed down to the side of the runway.

I was meet by fellow club members and my instructor who congratulated me and asked how it went. I told them that it was such an incredible experience and thanked everyone for their help. After putting the gliders and tow planes back into the hangar, I was invited to come into the office for some traditional after-solo celebrations. Including getting my shirt tail cut as a symbol of my new found freedom of flying gliders by myself.

# Appendix C- Applicable Aviation Regulations and Endorsements

The following regulations and endorsements are only a few of the many regulations and endorsements that a glider pilot should know. These were selected to explain the necessary training required to transition from powered aircraft to gliders:

- § 61.23 Medical certificates: Requirement and duration
    - (b)*Operations not requiring a medical certificate.*
        - A person is not required to hold a medical certificate –
            - (3) When exercising the privileges of a pilot certificate with a glider category rating or balloon class rating in a glider or a balloon, as appropriate.
- §61.31 Type rating requirements, additional training, and authorization requirements.
    - (j) Additional training required for operating a glider. (1) No person may act as pilot in command of a glider—
        - Using ground-tow procedures, unless that person has satisfactorily accomplished ground and flight training on ground-tow procedures and operations, and has received an endorsement from an authorized instructor who certifies in that pilot's logbook that the pilot has been found proficient in ground-tow procedures and operations;
        - (ii) Using aerotow procedures, unless that person has satisfactorily accomplished ground and flight training on aerotow procedures and operations, and has received an endorsement from an

- authorized instructor who certifies in that pilot's logbook that the pilot has been found proficient in aerotow procedures and operations; or
- (iii) Using self-launch procedures, unless that person has satisfactorily accomplished ground and flight training on self-launch procedures and operations, and has received an endorsement from an authorized instructor who certifies in that pilot's logbook that the pilot has been found proficient in self-launch procedures and operations.

(2) The holder of a glider rating issued prior to August 4, 1997, is considered to be in compliance with the training and logbook endorsement requirements of this paragraph for the specific operating privilege for which the holder is already qualified.

§61.69 Glider and unpowered ultralight vehicle towing: Experience and training requirements.

- (a) No person may act as pilot in command for towing a glider or unpowered ultralight vehicle unless that person—
  - (1) Holds a private, commercial or airline transport pilot certificate with a category rating for powered aircraft;
  - (2) Has logged at least 100 hours of pilot-in-command time in the aircraft category, class and type, if required, that the pilot is using to tow a glider or unpowered ultralight vehicle;

- (3) Has a logbook endorsement from an authorized instructor who certifies that the person has received ground and flight training in gliders or unpowered ultralight vehicles and is proficient in—
    - The techniques and procedures essential to the safe towing of gliders or unpowered ultralight vehicles, including airspeed limitations;
    - Emergency procedures;
    - Signals used; and
    - Maximum angles of bank.
- (4) Except as provided in paragraph (b) of this section, has logged at least three flights as the sole manipulator of the controls of an aircraft while towing a glider or unpowered ultralight vehicle, or has simulated towing flight procedures in an aircraft while accompanied by a pilot who meets the requirements of paragraphs (c) and (d) of this section.
- (5) Except as provided in paragraph (b) of this section, has received a logbook endorsement from the pilot, described in paragraph (a)(4) of this section, certifying that the person has accomplished at least 3 flights in an aircraft while towing a glider or unpowered ultralight vehicle, or while simulating towing flight procedures; and
- (6) Within 24 calendar months before the flight has—
    - (i) Made at least three actual or simulated tows of a glider or unpowered ultralight vehicle while accompanied by a qualified pilot who meets the requirements of this section; or

- (ii) Made at least three flights as pilot in command of a glider or unpowered ultralight vehicle towed by an aircraft.

- (b) Any person who, before May 17, 1967, has made and logged 10 or more flights as pilot in command of an aircraft towing a glider or unpowered ultralight vehicle in accordance with a certificate of waiver need not comply with paragraphs (a)(4) and (a)(5) of this section.
- (c) The pilot, described in paragraph (a)(4) of this section, who endorses the logbook of a person seeking towing privileges must have—
    - (1) Met the requirements of this section prior to endorsing the logbook of the person seeking towing privileges; and
    - (2) Logged at least 10 flights as pilot in command of an aircraft while towing a glider or unpowered ultralight vehicle.
- (d) If the pilot described in paragraph (a)(4) of this section holds only a private pilot certificate, then that pilot must have—
    - (1) Logged at least 100 hours of pilot-in-command time in airplanes, or 200 hours of pilot-in-command time in a combination of powered and other-than-powered aircraft; and
    - (2) Performed and logged at least three flights within the 12 calendar months preceding the month that pilot accompanies or endorses the logbook of a person seeking towing privileges—
        - (i) In an aircraft while towing a glider or unpowered ultralight vehicle accompanied by another pilot who meets the requirements of this section; or

- (ii) As pilot in command of a glider or unpowered ultralight vehicle being towed by another aircraft

§61.87 Solo requirements for student pilots

- (i) Maneuvers and procedures for pre-solo flight training in a glider. A student pilot who is receiving training for a glider rating or privileges must receive and log flight training for the following maneuvers and procedures:
    - Proper flight preparation procedures, including preflight planning, preparation, aircraft systems, and, if appropriate, powerplant operations;
    - (2) Taxiing or surface operations, including runups, if applicable
    - (3) Launches, including normal and crosswind;
    - (4) Straight and level flight, and turns in both directions, if applicable;
    - (5) Airport traffic patterns, including entry procedures;
    - (6) Collision avoidance, windshear avoidance, and wake turbulence avoidance;
    - (7) Descents with and without turns using high and low drag configurations;
    - (8) Flight at various airspeeds;
    - (9) Emergency procedures and equipment malfunctions;
    - (10) Ground reference maneuvers, if applicable;
    - (11) Inspection of towline rigging and review of signals and release procedures, if applicable;
    - (12) Aerotow, ground tow, or self-launch procedures;
    - (13) Procedures for disassembly and assembly of the glider

- (14) Stall entry, stall, and stall recovery;
- (15) Straight glides, turns, and spirals;
- (16) Landings, including normal and crosswind;
- (17) Slips to a landing;
- (18) Procedures and techniques for thermalling; and
- (19) Emergency operations, including towline break procedures.

§61.93 Solo cross-country flight requirements

- (j) Maneuvers and procedures for cross-country flight training in a glider. A student pilot who is receiving training for cross-country flight in a glider must receive and log flight training in the following maneuvers and procedures:
  - (1) Use of aeronautical charts for VFR navigation using pilotage and dead reckoning with the aid of a magnetic compass;
  - (2) Use of aircraft performance charts pertaining to cross-country flight;
  - (3) Procurement and analysis of aeronautical weather reports and forecasts, including recognition of critical weather situations and estimating visibility while in flight;
  - (4) Emergency procedures;
  - (5) Traffic pattern procedures that include area departure, area arrival, entry into the traffic pattern, and approach;
  - (6) Procedures and operating practices for collision avoidance, wake turbulence precautions, and windshear avoidance;

- (7) Recognition, avoidance, and operational restrictions of hazardous terrain features in the geographical area where the cross-country flight will be flown;
- (8) Procedures for operating the instruments and equipment installed in the aircraft to be flown, including recognition and use of the proper operational procedures and indications;
- (9) Landings accomplished without the use of the altimeter from at least 2,000 feet above the surface; and
- (10) Recognition of weather and upper air conditions favorable for cross-country soaring, ascending and descending flight, and altitude control.

§61.107 Flight proficiency.

- General. A person who applies for a private pilot certificate must receive and log ground and flight training from an authorized instructor on the areas of operation of this section that apply to the aircraft category and class rating sought.
  - (6) For a glider category rating:
    - (i) Preflight preparation;
    - (ii) Preflight procedures;
    - (iii) Airport and gliderport operations;
    - (iv) Launches and landings;
    - (v) Performance speeds;
    - (vi) Soaring techniques;
    - (vii) Performance maneuvers;
    - (viii) Navigation;

- (ix) Slow flight and stalls;
- (x) Emergency operations; and
- (xi) Postflight procedures.

§61.109 Aeronautical experience.

- (f) For a glider category rating.
  - (1) If the applicant for a private pilot certificate with a glider category rating has not logged at least 40 hours of flight time as a pilot in a heavier-than-air aircraft, the applicant must log at least 10 hours of flight time in a glider in the areas of operation listed in §61.107(b)(6) of this part, and that flight time must include at least—
    - (i) 20 flights in a glider in the areas of operations listed in §61.107(b)(6) of this part, including at least 3 training flights with an authorized instructor in a glider in preparation for the practical test that must have been performed within the preceding 2 calendar months from the month of the test; and
    - (ii) 2 hours of solo flight time in a glider in the areas of operation listed in §61.107(b)(6) of this part, with not less than 10 launches and landings being performed.
  - (2) If the applicant has logged at least 40 hours of flight time in a heavier-than-air aircraft, the applicant must log at least 3 hours of flight time in a glider in the areas of operation listed in §61.107(b)(6) of this part, and that flight time must include at least—

- 10 solo flights in a glider in the areas of operation listed in §61.107(b)(6) of this part; and
- (ii) 3 training flights with an authorized instructor in a glider in preparation for the practical test that must have been performed within the preceding 2 calendar months from the month of the test.

§61.127 Flight proficiency.

- General. A person who applies for a commercial pilot certificate must receive and log ground and flight training from an authorized instructor on the areas of operation of this section that apply to the aircraft category and class rating sought.
  - (6) For a glider category rating:
    - (i) Preflight preparation;
    - (ii) Preflight procedures;
    - (iii) Airport and gliderport operations;
    - (iv) Launches and landings;
    - (v) Performance speeds;
    - (vi) Soaring techniques;
    - (vii) Performance maneuvers;
    - (viii) Navigation;
    - (ix) Slow flight and stalls;
    - (x) Emergency operations; and
    - (xi) Postflight procedures.

§61.129 Aeronautical experience.

- (f) For a glider rating. A person who applies for a commercial pilot certificate with a glider category rating must log at least—
  - (1) 25 hours of flight time as a pilot in a glider and that flight time must include at least 100 flights in a glider as pilot in command, including at least—
    - (i) Three hours of flight training in a glider with an authorized instructor or 10 training flights in a glider with an authorized instructor on the areas of operation listed in §61.127(b)(6) of this part, including at least 3 training flights in a glider with an authorized instructor in preparation for the practical test within the preceding 2 calendar months from the month of the test; and
    - (ii) 2 hours of solo flight that include not less than 10 solo flights in a glider on the areas of operation listed in §61.127(b)(6) of this part; or
  - (2) 200 hours of flight time as a pilot in heavier-than-air aircraft and at least 20 flights in a glider as pilot in command, including at least—
    - (i) Three hours of flight training in a glider or 10 training flights in a glider with an authorized instructor on the areas of operation listed in §61.127(b)(6) of this part including at least 3 training flights in a glider with an authorized instructor in preparation for the practical test within the preceding 2 calendar months from the month of the test; and

- (ii) 5 solo flights in a glider on the areas of operation listed in §61.127(b)(6) of this part.

**Endorsements**

The following endorsements are from AC No: 61-65F written by John Duncan of the FAA.

**1. Prerequisites for practical test: Title 14 of the Code of Federal Regulations (14 CFR) part 61, § 61.39(a)(6)(i) and (ii).**

I certify that (First name, MI, Last name) has received and logged training time within 2 calendar-months preceding the month of application in preparation for the practical test and he/she is prepared for the required practical test for the issuance of (applicable) certificate.

/s/ [date] J. J. Jones 987654321CFI Exp. 12-31-19

**3. Presolo aeronautical knowledge: § 61.87(b).**

I certify that (First name, MI, Last name) has satisfactorily completed the presolo knowledge exam of § 61.87(b) for the (make and model aircraft).

/s/ [date] J. J. Jones 987654321CFI Exp. 12-31-19

**4. Presolo flight training: § 61.87(c).**

I certify that (First name, MI, Last name) has received the required presolo training in a (make and model aircraft). I have determined he/she has demonstrated the proficiency of § 61.87(d) and is proficient to make solo flights in that make and model aircraft.

/s/ [date] J. J. Jones 987654321CFI Exp. 12-31-19

**7. Solo flight (each additional 90-day period): § 61.87(p).**

I certify that (First name, MI, Last name) has received the required training to qualify for solo flying. I have determined he/she meets the applicable requirements of § 61.87(p) and is proficient to make solo flights in (make and model).

/s/ [date] J. J. Jones 987654321CFI Exp. 12-31-19

**PRIVATE PILOT ENDORSEMENT**

**33. Flight proficiency/practical test: §§ 61.103(f), 61.107(b), and 61.109.**

I certify that (First name, MI, Last name) has received the required training in accordance with §§ 61.107 and 61.109. I have determined he/she is prepared for the (name of) practical test.

/s/ [date] J. J. Jones 987654321CFI Exp. 12-31-19

**COMMERCIAL PILOT ENDORSEMENT**

**35. Flight proficiency/practical test: §§ 61.123(e), 61.127, and 61.129.**

I certify that (First name, MI, Last name) has received the required training of §§ 61.127 and 61.129. I have determined he/she is prepared for the (name of) practical test.

/s/ [date] J. J. Jones 987654321CFI Exp. 12-31-19

**ADDITIONAL ENDORSEMENTS**

**70. To act as PIC of an aircraft in solo operations when the pilot does not hold an appropriate category/class rating: § 61.31(d)(2).**

I certify that (First name, MI, Last name) has received the training as required by § 61.31(d)(2) to serve as a PIC in a (specific category and class of aircraft). I have determined that he/she is prepared to serve as PIC in that (make and model) aircraft. Limitations: (optional).

/s/ [date] J. J. Jones 987654321CFI Exp. 12-31-19

**77. Launch procedures for operating a glider: § 61.31(j).**

I certify that (First name, MI, Last name), (grade of pilot certificate), (certificate number), has received the required training in a (list the glider make and model) for (list the launch procedure). I have determined that he/she is proficient in (list the launch procedure).

/s/ [date] J. J. Jones 987654321CFI Exp. 12-31-19