

## Learning to Launch a Power Harness

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You are standing there, holding a glider in take off position as you have many times before. But this is not familiar. The ground in front of you is flat, there is some awkward-feeling contraption in your mouth, and there is a large chainsaw idling very close behind you. You are at this moment trying very hard to recall why you thought this would be a good idea. You are about to try your first take-off with a powered harness.

A few lucky pilots have access to experienced power-harness pilots and instruction, but most of us do not. As one pilot said, too many launches are simply “full throttle, run and hope”. I am far from being an expert in launching or flying a powered harness - I took my first demo flight in Spring of last year and got my own unit at the beginning of Summer. But I have spent considerable time in discussion with more experienced pilots and tried out many of their ideas and approaches.

There comes a point for any hang gliding student that they finally understand the elements of a good launch. They may not yet be able to do it repeatedly, but they can generally tell what they did wrong if it was not good and what they did right if it was. They are also able to observe and knowledgeably critique the launches of others. I feel I have reached this point with flying my powered harness.

I was a Hang Gliding Instructor for several years and later an Advanced Instructor. What I am going to present is how I would go about teaching someone to fly a powered harness today, based on what I have learned till now. Most of these ideas are not original with me but came from more experienced pilots. I will talk about the ones that I have tried and found useful. And I will try to put them into a framework for an incremental approach to learning to fly a powered harness - one that will hopefully remove many of the pitfalls that can come to a new convert.

### Angle of Attack is Key

A successful take off with a power harness depends on precise control of the nose angle, especially in light winds or at altitudes above sea level. Too low and you will simply not fly no matter how far you run. If it is too high it will create excessive drag and you will never get the speed you need. Probably the worst situation is just *slightly* too high. While the wing is not yet loaded with your full weight the induced drag will be low enough that flying speed can be achieved (especially if there is any wind). But as soon as you become airborne the additional weight increases the *induced* drag, which will tend to slow the glider. A reduction of speed effectively increases the angle of attack and further increases the drag, and almost immediately you will be a couple of feet off the ground, at full power and in a near stall. You can also get into this predicament by trying to force the glider to fly before it is ready by pushing out during the run. Either way, you will be in “mush mode” with very poor control authority, which is likely to result in dropping a wing and doing a ground loop as you settle back to earth. This is where it can get expensive. The legs that keep the prop clear of the earth are designed to be sturdy as long as the force on them is pushing down and dragging back. But they are not strong in resisting a sideways force and will easily fold under when being dragged sideways during that ground loop. If the pilot has

not been quick enough to spit the throttle, the prop will not survive contacting the ground at full power.



### The Ideal Takeoff

We'll start by describing an ideal power harness takeoff. We will assume that the air is still, which is the most challenging situation. Wind would simply make things happen quicker and be less demanding of technique. The pilot remains upright throughout the run, allowing forward acceleration to be provided by the push of the engine. The pilot does not use his legs to accelerate but only to carry the weight of himself and the glider. Acceleration is smooth with a light touch on the control bar, allowing the glider to fly itself at its trim position. The pilot runs as long as necessary, taking strides of ever increasing length ("moon walking") until flight is achieved. During the last steps most of the pilot's weight will be carried by the glider. To an observer it will be difficult to tell exactly when the transition to flight was achieved - there will be no noticeable change in pitch angle, and the pilot will have stopped running only after the last steps no longer touch the ground. In zero wind the entire launch may have taken from 15 to 25 steps (or more).

Kevin Cosley of Washington state writes about his experiences using a stationary winch for beginning hang gliding instruction. The technique he describes applies equally well to launching a powered harness: "I used a stationary winch to instruct students for a couple years so they were getting their first ever airtime launching this way. I would have them stand and hold the glider at an appropriate attitude while I brought up some line tension. They would stand and resist and when they felt ready just start running. For the first flights I would not even bring up tension beyond what they were resisting, (they would still climb barely) so these were typically longish runs and low power.

"What I would tell them is that once the glider floated off their shoulders to just let it fly at trim. We let the glider lift us off the ground flying at trim speed but would pull in a little bit as we lifted off and climbed away from the ground. If the glider is trimmed right you can let it launch you without hardly touching the down tubes. If it's trimmed too slow, the nose pops up and you have a drag chute (and no control).

"For the running part I had them relax their legs like their arms were relaxed. The legs were not to add power - they were just to keep themselves under the glider... The key was to have a relaxed grip so you could feel the glider. As soon as

anyone resisted anything or tried to power the glider with their arms or legs the whole thing usually went to pot.”

Kevin brought up two key points that bear further discussion - remaining upright during the takeoff, and having a properly trimmed glider.

Failure to remain upright throughout the takeoff run is one of the main problems I am still working on. After 20 years of launching from a slope, my tendency is to move towards prone position as soon as I feel the glider lifting. With many launches, such as from a launch ramp, there is no reason to be upright past the end of the ramp, so I will be progressively leaning forward into the takeoff all the way through the run. But on a flat ground takeoff you do not have the hill dropping away from you to help achieve flying speed - you need to provide “running gear” up until the time you are firmly established in a climb. What can often make the difference between a successful take off and settling back to earth is those last one or two “moon walking” steps. If you are not upright you cannot take those steps!

Glider trim position: A powered launch is easier to do well if you allow the glider to achieve flight from the trim position - so you want to make sure this trim speed is fast enough for safety. If you are trimmed right at minimum sink (very close to mush/stall) then it would be advisable to move your hang point forward to where you have good roll response and control authority (without pulling in). Setting the trim speed higher will mean you have to run a tad faster, but when you do get airborne it will be at a safer airspeed and there will be less drag for the motor to overcome. Some pilots say they just move their hang point forward an inch or so whenever they are using their power harness. My personal preference is to find a single trim setting that works well for both free and powered flight.

### **A Way to Approach that First Takeoff**

What follows is an outline of the steps I would use to introduce an experienced hang glider pilot to launching a power harness. This discussion will assume the worst case of no appreciable wind. The stages of the takeoff would be the same with wind, but they would happen so much faster that it would be difficult to separate them. In practice I would recommend doing the pitch control practice in zero wind and then trying your first flat-ground takeoffs with a light and steady wind. If you can get someone to record your learning with a camcorder it is very valuable. It will show you what you were actually doing versus what you *thought* you were doing.

Pitch control practice - for this first step you do not need the power harness, only your glider, a regular harness (I pulled my old knee-hanger out of moth balls for this part), and a flat field. There should be little or no wind to get the most out of this part. You are going back to your first day on the training hill, learning to fly the glider on flat ground again. This was not as easy as I had expected it to be. In truly zero wind the control of the nose angle had to be very precise. Slightly low and the glider would not fly, just slightly high and there is significant drag from the glider that holds you back. It also requires some readjustment because you will need to have the nose a little bit higher on the flats than you are used to for launching on a slope. You should work on this stage of things until you can repeatedly achieve hands-free flight efficiently and smoothly. By “hands free” I do not mean not touching the control bar but only that you are not putting in any significant control forces. It

is important to have a harness on so that you can fly the glider against the tug of the hang strap.

When you have the glider flying smoothly at trim, spend some time imagining that you are in the power harness and able to advance the throttle to full power. Practice smoothly accelerating to as fast as you can run while the glider maintains its trim position. Visualize yourself running even faster than you are now (the harness is providing the power) and that you are becoming lighter and lighter on your feet until at some point they are no longer touching the ground.

I still take at least one or two brief runs with just the glider before I actually do a flat ground takeoff, although most of the time I don't use the knee-hanger any more. These runs are very useful in that they build confidence in having the nose angle set right and also provide good information about the day's conditions. They help to tell me just how smooth the air flow is and how fast I will have to run on this particular day. If I'm feeling a little rusty I put the knee-hanger back on and do more extended practice.

Hand Position - It really pains me to say this, so I'll get it over as fast as I can: I am finding that I prefer the "beer can grip" of the control bar for light wind powered harness takeoffs. For years I have been a vocal proponent of the "grape vine grip", which I feel gives far better glider control in a wide range of conditions. It is still the only method I consider using on a mountain launch, especially in soaring conditions. But for the light touch required during the potentially long runs of a no-wind powered take-off I am finding that the beer can grip seems to work better. I am still limiting myself to smooth and/or light wind takeoffs. When I feel confident enough to try more challenging takeoffs in stronger conditions I may find that I prefer to go back to the grape vine grip, but I have not reached that point yet so I do not have a firm opinion one way or another.

Adding Power - Once you feel like you have a good understanding and control of the pitch throughout the run it is time to move on to the power harness. You need not go directly to trying a takeoff, but can try some part throttle runs to get a feel for the harness pushing you. If you do not intend to fly at first then the only caution is to not use too much throttle - use just enough that the harness is not dragging you but also not pushing very hard. Your goal is to get a feel for running with the addition of power, controlling the mouth throttle, and flying the glider with the same light touch you were using earlier. On one of these runs, when everything is going smoothly - the glider is flying itself, the wings are level, and you are ready - advance to full throttle and keep on running! Concentrate on keeping your legs underneath you and letting the thrust accelerate you - at some point you will find your feet are no longer contacting the ground and you will have made your first power harness takeoff!

### Two Stages of a Takeoff

It may be apparent by now that there are two stages to a powered harness takeoff. The first is to get the glider stable and flying smoothly at trim position. You should be applying very little control pressure if you have indeed achieved this stage. If this is not happening (a wing is low or you are fighting the glider) then it is time to spit the throttle and figure out why before you go any further. Stage two is simply maintaining the equilibrium you have achieved in stage one while you smoothly accelerate with strides of increasing length.

Never try to begin stage two until you are sure you have been successful at stage one. It should be noted that these two stages may be very close together, especially if there is any wind. The entire takeoff in that case might only be 5 or 10 steps and it would be difficult for an observer to tell that it was not all just one event. But in terms of your mental checklist it should still be two stages, even if they are very close together.

### Into the Air

As soon as your legs have wind-milled into the air and you are flying, pull in the bar just a bit from trim to make sure you have adequate airspeed. Once you are confident you are safely climbing be sure to get into the normal prone flying position (or suprone position if you are flying the Doodlebug). It is easy to fly a power harness when upright without power - as in landing. But at full power you will be pushed forward so that your hands on the downtubes will be at (or even slightly behind) your shoulders. This is not a good position for either pitch or roll control. Also, with any of the prone harnesses you will have much better control of the thrust direction with your legs back in the harness. Once in the normal flying position you will most likely want to pull in the bar even more. Your glider's "best glide" position is defined by the maximum ratio of lift to drag. In any steady flight regime (climbing, gliding, level), the lift will always equal your total weight. That means your minimum total drag will occur at the best L/D position. Whatever thrust from the engine that is not being used to overcome drag will be available for climbing, and the glider's best L/D angle of attack will provide the best climb rate.

### **Aborting a Takeoff**

It is very useful to at least once or twice practice aborting a takeoff. This is to simply establish that it is *an option for every takeoff*. Unlike a mountain launch where your best bet is usually to continue once begun, significant sorrow and money can be saved by aborting a powered harness takeoff if things are not going exactly right. Trying to continue a launch once begun is a habit that can be hard to break. That is why it is very useful to have the experience of doing it. If it is something you have done before it becomes more of an option when you need it. To abort a takeoff do not just stop running! Between yourself, the glider and the harness you will have a lot of momentum. First let the throttle return to idle while you continue running, then the drag of the legs will help you to bleed off the momentum that both you and the glider have achieved. Learning to let go of the throttle can be one of the hardest parts - when things start to go wrong the general tendency is for everything to clench up, including our jaws! You might want to work up to this in stages, first aborting a takeoff while running at low speed, then do several more at increasing speeds.

### **Some Final Notes**

I am not recommending that your first take-off be in still air on flat ground. If you have a nice hill or mountain launch available that would be a very good way to become familiar with flying under power. And if you have a smooth breeze for your first flat-ground take-offs then they will be much less demanding. I would however, strongly recommend doing the pitch control practice in very light winds, you will learn more that way.

Throttle control: there are two schools of thought on this - one is immediately going to full

throttle as you begin your run, the other is to match throttle to speed - that is, the faster you are running the more throttle you apply. Both seem to work pretty well although right now my own preference is for the gradual approach because it seems to make the process flow more smoothly.

I'd like to update my own experiences since I wrote the article that appeared in the Oct '01 issue. At that time I had been flying my Mosquito NRG with the Airwave K4. I found roll control to be a real bear with the K4 under full power. If I got to more than about a 30 degree bank under full throttle it was nearly impossible for me to roll out of it without reducing the throttle, regardless of how much I pulled in the control bar. That glider is stiff in roll and a bit spirally unstable. The additional roll instability of powered climbing flight really made it a handful. Since then I bought an Airborne Sting XC2 175 which has proved much more suitable. With the Mosquito I am right in the middle of the glider's weight range (I was over the upper limit with the K4). As with any glider the Sting is harder to roll out of a turn with full power than with power off, but it is entirely manageable. I can confidently roll out of a 45 degree bank at full power. As an extra bonus this glider comes with a detachable keel so no modifications were required to add the power harness.

In the previous article I wrote about the Wisconsin pilot who said he "learned with his wallet", breaking a number of props while teaching himself. Since that article came out he had this to say: "Still love my Mosquito - over 100 flights so far and looking forward to years of fun ahead." So even if you have problems at first don't give up too quickly!

I have flown the Sting/NRG combination from my favorite mountain site several times. These days I take both harnesses to the mountain. If it is obviously soarable I use my standard harness. If it looks light and marginal I use the NRG to be sure I get all the airtime I want. I have soared for over an hour with the power off and did not find it to be very different from my regular harness. On one marginal day I did about half-a-dozen restarts to keep me up between cycles. I watched almost everyone else that day take off, fly for awhile, then go out to land. Sometimes it would start with just a pull or two, other times it took more effort, but it always started eventually.

One of my most memorable flights was on a day when the ceiling was at about 400 ft AGL. It was stable with little wind and my main goal was to get some light-wind takeoff practice. On my final flight of the day I decided to go exploring and it was great! I was in a little valley so it was like being in an aerial playpen - surrounded by ridges with a cloud ceiling. Staying right at the bottom of the cloud layer I flew all over the valley. There were plenty of fields available so losing power was not a worry. Here and there tendrils of clouds hung down and it was fun to fly around them, sort of like being in an upside down forest. And it was great to be able to enjoy the view from 400 feet up. At that altitude I have always been too busy setting up the landing approach to have much time to look around. It was a real treat to be able to relax and see the world from that close (and on a day that no other hang glider pilot was flying!)

**Safety Advisory:** There have been several reports of pilots snagging their harnesses on glider cables. A powered harness contains a frame with bars that run up both sides of the harness to the vicinity of the pilot's waist. On some harnesses these bars extend an inch or two past the last point of connection, or have throttles, etc on the end of them. Under rare, but possible, circumstances a rear flying wire or downtube can become caught between the

frame and harness, preventing roll control. Normal emergency procedures dictate pulling in whenever there is difficulty in trying to roll out of a turn - which only maintains the snag. To overcome this situation simply push out on the control bar and you will be free again. I believe most newer harnesses are designed to reduce or eliminate this possibility. Check your harness and glider combination carefully to see if it is a potential problem. If it is you can either find a way to prevent a cable from becoming trapped, or just fly with an awareness that this situation could develop. It does not normally occur during typical control motions.

*Richard Cobb has been flying hang gliders for over 20 years and was a USHGA Instructor for nearly 10 years. More information on flying with a powered harness may be found on his web page: <http://wind-drifter.com>*

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