PowerPlanes.com

Powered Hang Gliding Harness

OWNERS MANUAL

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Contents

Congratulations ! for having purchased a ***Powerplanes*** *flying machine!* We encourage you to read and follow carefully the operating instructions on service / maintenance before attempting assembly or use. Fly safely so you can enjoy many hours of great new air adventures over the next years !

Harness / Glider Usage

Remember - this harness should only be used with hang gliders that are certified for auxiliary power units. Consult your hang glider manufacturer or the German DHV for further information.

This harness should only be used by experienced intermediate to advanced hang glider pilots who hold a valid hang gliding licence rating for this level and obtain proper related instruction for auxiliary power units. Actual licence – and insurance requirements vary from country to country and it **is your personal responsibility** and "in your best interests" to fulfil these requirements. Do not allow inexperienced or unlicensed pilots to use this harness.

Warning

This harness is not an absolute dependable main power system. Consider that anyone who uses these kind of systems will "most certainly" – sooner or later have a total or partial engine or thrust failure.

Any kind of mechanical failure can cause the propulsion / engine system to stop at any time - without notice. Even a simple Bolt or other part which falls off can go through the propeller can destroy it immediately – instantly leaving the pilot with zero thrust, and big vibrations from unbalanced prop. In the event of an engine failure, flying without sufficient altitude to arrive safely at a landing area can be the cause of serious injury and death. Flying the RAVEN harness with inadequate experience or improper procedure can result in injury and death. Flying the RAVEN harness in the presence of strong gusty winds or turbulence may result in the loss of control, which may lead to injury and death. Do not fly in these conditions unless you realise and wish to personally assume these risks. It is your responsibility to choose your take off, landing and flying areas and flying altitudes with ample room for emergency in the event of a complete power loss. Engine/power failures almost always happen at the most inopportune times - so always be prepared. We do indicate some of the things to watch for and what needs to be serviced to reduce the certain risks of engine – or total thrust failure However, this by no means guarantees you will not encounter problems.

Transport & Handling

Be careful to take good care of your harness in transport to save unnecessary damage. Remember that because there is an engine and various controls attached, you must take care during transport and pack-up to handle it well. Pay also close attention not to damage the spark plug which exits the cylinder head and keep all lines tucked away where they can not get caught on other components when you set up or transport harness. Always put the harness down gently after carrying not to damage engine or frame components. Always transport your RAVEN harness with the zipper on the top-side and do not place any loads on top of it. Pay close attention not to damage end of drive shaft.

Setting up your RAVEN

The easiest way to set-up your RAVEN harness is as follows:

1) Open the harness Bag zipper. Unzip the harness leg section completely and check that all lines are clear of

Picture

2) Unfold the front half of the harness carefully paying attention to the start throttle mouthpiece, on off switch, parachute/handle and accelerator console.

Picture

3) Always idea to keep the mouth-piece accelerator tucked away in one of the harness camera containers so as not to step or pull on it accidentally.

Picture

4) Unclip the harness legs from the side bars and pull them up to rear position. Control the legs to be sure that no lines are wrapped around them so that they extend fully and freely. Attach / hook the two bungee cords into their slots at the side of the transmission axle – left leg on left side and right on right side.

Picture

5) Control once more all components on the underside of the harness to be sure all is in order as described above.

Now pick the harness up and gently roll it over onto its legs. Check front section and is unfolded properly and that the two side bars are touching the ground unobstructed.

Picture

6) Check both accelerator controls as follows; **Mouth accelerator** – Control that the mouth accelerator to be sure it operates freely and :

1) that the accelerator lever on the carburettor opens fully when lever is fully depressed.

2) that the accelerator lever returns to idle position **on the carburettor idle set screw** when you de-accelerate completely.

PICTURE of idle set screw etc.

7) Control that this is not obstructed in any way and make the same acceleration and de-acceleration as with the mouth control. Check again that the accelerator lever on the carburettor returns to idle position when you de-accelerate completely - see Fig 3.5.
Always leave fixed accelerator in idle position.

Picture

8) Check main suspension lines and carabiner to make sure all lines are free and clear. Leave quick connect end of fuel line in its protective sheath to keep it free of dirt until it is time to connect to fuel tank

Picture

9) Take propeller out of its protective sheath and remove the central locking pin. Control that the propeller is clean free of damage. A dirty or damaged propeller will have less thrust performance.
Check that propeller shaft is clean then slide the propeller hub onto end of drive shaft. Turn propeller by hand to line up holes for locking pin. Insert pin and safety ring / or retaining clip. If pin is difficult to insert then remove the pin and rotate the shaft a half turn and re-insert pin in this position.

After assembly check –

Do a once over complete check of your harness after assembly as follows:
Check.

- Harness leg support ropes, elastic cords and lines are free from obstructions and attached properly.
- Carabiner, suspension lines and fuel line in order
- Fuel line clean untangled and connected properly.
- Parachute container in order. Check parachute handle and make sure it is not dislodged – or blocked in any way.
- SPECIIAL NOTE: particularly after first flights be sure to check the two 5 mm hex head bolts which attach the exhaust collector to the cylinder head exhaust port. The gasket tends to squish with the heat and vibration of first hours of running, after that they tend to stay tight. Doing this is a safety factor – and will prevent any leaks, keeping things cleaner.
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Packing It Up

1) Make sure the engine has cooled off before packing up your RAVEN harness. This means cool enough that – you should be able to comfortably place your hand on the cylinder head.
2) Disconnect fuel line while holding it away from harness so that any drops exiting the connection do not land on the harness. Wrap the fuel line up so it does not get any dirt in the connection. A dirty connection can impede fuel flow – or cause a plugged filter resulting in engine failure.

3) Wipe off drive shaft end and place harness bag over top of the unit. Tuck the main harness lines and fuel line over the side of harness where they are visible to you.
3) Carefully roll the harness over onto its back.
4) Disconnect the leg bungee's and fold legs down into the clips making sure to keep the lines untangled.
5) Take front body section of harness and fold it over and into the rear section taking care for the accelerator console and parachute container handle. Take care to lay the main harness lines together with the front section. It is important to keep these lines tucked in tight to the harness so they can not get hooked on any objects during pack-up or transport.
6) Zip up rear section of harness closing all front section parts inside .
7) Pull harness bag over the front section and pull zipper closed – after one final check to be sure all lines are as they should be.

Harness and Pre-flight Preparation

Highly recommended and for obvious safety reasons, it is important initially to hang the harness from a tree, swing or whatever, and test all things you will have to do later in the air.

This includes closing and opening harness, *finding* and using all engine controls including start cord - if you intend to do in flight starts. There is nothing like preparation – and this will help prepare you and remove surprise's.

Definitely make sure you know your harness well before heading to the field . Don't just do this once – get comfortable with them! Following is a check list to make this easier for you.

CHECK:

- and adjust the main and secondary hang straps so the harness has 8-10 cm clearance between itself and the and control bar – with pilot hooked in!
- and adjust harness suspension lines for proper loading and comfort
- locate and note parachute container and emergency handle position
- parachute bridle line length and connection to carabiner is correct.
- and familiarise yourself completely with all engine controls, both accelerators, choke, prop brake, etc.
- close and zip-up harness leg section
- and familiarise yourself with the support legs and putting them into their respective side clip positions.
- and open / unzip harness leg section – REMEMBER! You have to unclip the support legs first! Failing to do this will inhibit proper opening of zipper and
- you may land with gear up!
- Propeller brake. Learn to apply and release this in flight. (always release before starting engine!
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Harness suspension system and adjustment

Your harness has a number of adjustments which you can use to fit to your own body size. Hook the harness in to a fixed hang point in to check and properly adjust your harness.

1) Shoulder lines can be adjusted by letting out or taking up slack in the buckles found on each side. Each time you adjust this you need to pull the velcro slightly apart to allow the adjustment to fully transfer to the shoulder section.

2) Shoulder back / plate can be adjusted by moving the knot in the 9 mm rope up to shorten or down to lengthen.

1) Leg section back / plate can be adjusted in the same way as shoulder back plate.
2) Engine unit support line can also be adjusted however it is important to adjust it in co-ordination with the leg support line so they have a similar tension.

3) Best way to adjust your Raven harness is to do it with a friend of similar size / height. Hang the harness from a fixed point in your garage (or tree..) and adjust the lines one by one. Use also a small chair to help support the pilots arms to be in a similar attitude as when under glider. In the end the pilots weight must be distributed evenly ie: each line tension is similar.
4) Everyone has their own idea of best flying position (heads up/down) and can easily adjust the harness following the above given instructions.
5) Be sure that when you do adjust your harness that it is to a comfortable position – usually so the top of the harness is near flat – sometimes even with a slight curve with head and foot section being slightly lower than the top middle section. Important is not to adjust shoulder straps too tightly as this tends to add a compression load to shoulders etc.

Before every flight

- Clean zipper with cotton cloth and apply silicone spray when necessary
- Control safety clips on legs and chest section to be clean functioning properly
- Check shoulder straps and buckle settings
- Check accelerator, choke and propeller brake controls are working properly
- Check fuel system and lines for any leakage
- Clean engine of any oil or fuel residue with a cotton rag.
- Check all nuts bolts wires, exhaust system etc / complete check of attached parts, be sure there are no cracks and all is secured properly.
- SPECIAIL NOTE: particularly after first flights be sure to check the two 5 mm hex head bolts which attach the exhaust collector to the cylinder head exhaust port. The gasket tends to squish with the heat and vibration of first hours of running, after that they tend to stay tight. Doing this is a safety factor – and will prevent any leaks, keeping things cleaner.
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Every 5th Flight

- Clean harness zipper and apply high quality silicon spray.
- Check reduction drive belt for tension and signs of wear
- Check the start cord for signs of wear
- Control that the fuel filter is clean and change if necessary.
- Check fuel lines for signs of wear or leakage
- Check for any loose bolts, nuts or fasteners.
- Check elastic cord for signs of wear.
- Clean and lubricate the end of drive shaft with oil spray

Every 20th flight

- Check Exhaust and silencer system for wear points or loose parts.
- Use silicon spray on harness leg connection / joints
- Check all suspension / support lines for signs of wear.

Every 50th flight

- check flexible connection of exhaust system and change if necessary
- check engine anti vibration rubbers for signs of cracking or wear and replace with original parts if necessary.
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Harness Repairs

All replacement parts must be originals produced by WINDS. Do not hesitate to replace any bent part, or "parts". Replace all recommended parts at scheduled maintenance intervals. Do not try to straighten bent tubes this immediately weakens the tube and can cause failure.

Washing your harness

Take care to use only mild soap with warm water if ever you should need to wash your harness. Rinse well with clean water immediately after washing. The materials used to make your RAVEN harness are very resistant however over-washing does not help.

Cleaning Engine

Any small fuel or exhaust leaks in time can leave residual oil stains on the cylinder head. Take care to keep engine clean using a cotton rag/cloth and solvent to dissolve and wipe off oil build-up

Engine

Before starting engine

Best is to have the harness on soft grassy ground with the two sidebars touching at the front. These bars tend to dig in and help to hold the harness from moving forward**.** It is still necessary to stabilize the harness at the front section applying pressure to keep the harness from moving when accelerating engine. Never start engine without the two side bars firmly fixed at ground level.

Initially – for obvious safety reasons, it is a good idea to start your engine *without propeller attached* ! Do pay attention however not to over-rev. your engine in this mode . Keep the engine down to no more than 6-7000 rpm without propeller attached.

Always check to make sure that both the throttle cables are in the idle position and working freely.

Failing to do this could be seriously dangerous for yourself, bystanders by losing control of a machine a lethally dangerous rotating propeller.

Propeller & personal safety

It is necessary to **exercise extreme caution** with any propeller driven craft and the propeller on the Raven harness is no exception. The most obvious danger is that of coming in physical contact with the moving propeller. Pay full attention as Propellers are under extremely high centrifugal force. Be sure that any bystanders are well clear – preferably well in front of you to avoid contact with propeller - or flying articles picked up in the turbulent thrust zone near the ground.

Preparations for Starting Engine

Fuel Mixture-Important !

Every two stroke engine needs oil to lubricate the cylinder, piston and all the various bearings and seals. Running your engine one unmixed fuel will cause serious engine failure due the lack of lubrication to all internal moving parts.
Be sure to carefully control each time you add or mix fuel for your Radne engine that you use only top quality 100% **Synthetic two stroke engine oil, mixed at a 3% to 4 % oil to fuel ratio.** Use minimum 95 - but better "98" octane fuel for best running and performance

OIL Type , Quality and Fuel Mixture

Oils, recommended oil for Radne engine is FULLY synthetic oil for two stroke engines.
You should not to use Marine two stroke oils because of the additives which they contain. Marine environments are very corrosive - therefore special additives are used to combat the corrosion etc. Trouble is these additives are not the best thing as they tend to coat the parts to heavily and leave more residue throughout entire engine.
Tips "Shopping for oil" Best oils are definitely pure synthetic (not semi synthetic) without additives like anti-smoke, anti corrosion etc. A good Synthetic oil already burns clean and lubricates well. Read the labels carefully and choose a reputable company.
High quality oil also tends to separate less from the gas itself over time. Low quality oil will tend to separate (or settle) from the gasoline much more and sooner than acceptable. Big companies like Shell etc often have good documentation on the oil and characteristics.. this is usually a worthy read.
My own experience for example is that the anti-smoke oils often tend to leave more carbon in the cylinder. Have not had great luck with semi synthetics either.
One thing a guy can do is take a look at what the high performance two stroke motocross guys are using. This is pretty much the right class of oil –except for some super racing oils which are meant to be mixed and used within a very short time frame. These oils tend to separate from the fuel rapidly and there-after they are a big liability to your engine, able to cause oil starvation and engine seizure.

With regard to cleaning Carbs....

If you have ever ran the engine without a filter - or the filter was not changed for an extreme long time it is worth "at the least" cleaning the internal filter in the carb.
Radne uses the simple walbro carb and like most carbs it has an internal fuel screen / Filter. You can get at this by removing the small cover above the actual fuel line inlet on the carb itself. The cover is held on by four screws, remove these together with rubber diaphragm and you can see a round hole where the screen is .
If screen plugs in flight - although it is usually a gradual rpm decrease, (over some minutes) it will shut the engine down by fuel starvation.
If carb is really old and has not been used for a long time then it can also be that the rubber diaphragms may have dried over time and are no longer operational - or even if they are - certainly not dependable. Most manufacturers recommend replacing these every few years...or even every year.
Less chance the diaphragms are in bad shape if engine is used more often. Like the consideration of aeroplanes, planes flown more often are usually considered a safer bet - usually in the unused or lesser flown machines the problems tend to accumulate and occasionally the surprises turn into accidents....
In general proper maintenance is cheap insurance..

Fuel Tank

As the fuel tanks must be transported clean without fuel or fumes inside we do not rinse the inside of the tanks before sending. When you receive your new harness however we highly recommend it as necessary to rinse it out the tank with a litre of mixed 3% (two stroke synthetic oil to fuel ratio) gasoline before running the engine.

Attaching fuel tank to glider

The fuel tank has a recessed section which fits the control bar shape and a 25 mm wide strap and buckle which are used to attach it to the gliders control bar. The attachment point should be about 10- 20 cm below the top apex of the control bar. Always remember to string the fuel breather line to finish in a position higher than the fuel tank itself and pay attention that it is not pinched or blocked in any way. A blocked fuel breather hose will stop the engine after a short time – typically just on or after take off...

Filling fuel circuit

Remember that your engine is shipped dry – which means there is no fuel in the lines. To fill the fuel circuit, do as follows:

6) Always put the fuel tank in a position slightly higher than the engine itself to assist fuel transfer by gravity feed. To make things easier for the first time

start it you can do as follows. Place fuel tank where you can comfortably reach it just forward of the engine.

7) Lightly push in the small pin on the very bottom of the carburettor, which opens the fuel intake diaphragm.

8) Take the fuel breather hose from the top of the fuel tank and blow into it while keeping the carburettor diaphragm pin lightly inserted (this allows the air in the fuel line to exit the carburettor). Continue blowing into the fuel breather hose while observing the transparent fuel filter in front of the engine. You will be able to see when then fuel begins to arrive at this level. This may take a minute or so. Continue until you see fuel exiting the carburettor and that the fuel filter has little or no air in it. As a safety measure we do not place a bulb pump in the fuel circuit.

The Magnapull Rope starter - precautions

You must remember two simple rules:
When starting engine never pull out the rope to its full length.
Pull starter cord out very slowly for the first times and note exactly where the cord length ends. Note this length and never pull it out so far again.
The life of the starter rope is very long – subject that you don't pull it completely to the end. It is the full extension of the rope, which cuts off the knot at the end.

Never just pull out the rope. Grab the rope handle and pull out the rope slowly until you feel the starter mechanism is engaged. Then you should pull the rope with a powerful stroke (without over-extending to end of start cord).

Electric start

Obviously, like any battery powered starting system Rule No. 1 is to keep your battery charged.
The best way to manage this is have two batteries , keep track of their charges and usage, keeping at least one of them always topped up.
Because they are Ni-Cad batteries they do work best when drained to low power – then re-charged.
Easy to recognize symptoms of a low battery as the starter gear begins to fail to engage , just whining and spinning without turning over the engine. When you have a second battery this is no big deal, just change it out, when not - it can ruin you day.. Basically batteries are cheap and the risk of not having an extra one on hand is that sooner or later you may miss a flight.

Your Raven harness is equipped with a safety switch located on the rear of the console. As a "safety feature" this safety switch must be in the on position before the starter will engage. The switch has a low profile and has reasonable resistance to moving from on to off / off to on position to limit the chance of inadvertently changing switch position.
In every case, before and after flying we do recommend to always keep one of the battery cables disconnected to avoid engaging starter engine inadvertently during handling or transport.
When you are ready to check the engine you should either have the harness on and secure – or have it firmly placed on the ground with the front end of the two

30mm side bars dug in / secured. Good idea to sit on the front of the harness just at the end of the side bars to help secure it.
Fuel line must be connected and check to make sure the propeller is connected and properly pinned. Check all people or things are well clear of the prop and that no persons are standing at the rear - or on either side of the propeller where things entering the prop can be thrown out at high velocity.
Check transparent fuel filter at end of harness to control that there is indeed fuel in the line.
Whether the filter is empty or full, you can follow the normal start procedure as listed below.
Pull the choke full on and turn the engine over until the filter fills – or until the you hear the engine fires/catches.
Once you here the engine catch, stop , release the choke and apply 1/8 gas on the shoulder consol accelerator.
Now turn the engine over again and it should catch and run at least for a few revolutions.
If it Runs a few seconds and then stops, simply repeat the previous sequence applying the choke (you can leave the accelerator at 1/8) until the engine fires once more. After this release the choke once more and start engine with the slight acceleration as indicated. Generally the engine fires and runs best the second or max. third time round. Let the engine run 15-20 seconds at the slightly high idle setting and then throttle it down to minimum where it should then run on its own. BE SURE TO HAVE HARNESS SECURED BEFORE STARTING –remember IF you have the engine more accelerated than expected the thrust can easily and abruptly move the harness and spinning propeller forward into you or any other object in the vicinity. Absolutely exercise caution whenever starting your engine and treat this phase seriously - as must be done to ensure safety.

Once engine you have checked engine and run up the rpm a few times to check that it is operating smoothly at higher rpm also. You want to run it a minute or so to have the small air lock (which comes from connecting and disconnecting the fuel line) pass through the carburettor so you have no engine decelerations(which happen when the airlock is passing the carburettor) on start. Once you are sure everything is running smoothly as it should, turn the engine off with the kill switch and allow it to cool some minutes while you re-check your harness and glider. Important to leave the fuel line connected after checking engine so that you do not create any air lock inside fuel line. IF you do disconnect the fuel line again the doing another engine run-up before start is mandatory.

Once you are hooked in and fully check on the start – ready to go, repeat the starting procedure. If the engine has cooled down for more than a few minutes it is usually necessary to use the choke again to re-start. It is always a good idea to try starting it first with just $1/8^{th}$ accelerator but if it does not catch in a few tries then it this means it needs the choke sequence again.

Once you are on start and ready to go do start the engine and do a short run-up to re-check operation before launch while you are hooked in and BEHIND the control bar. NEVER step in front of the control bar with engine running as this can bring the propeller in contact with the keel.

Engine Start Proceedure

1) Place the fuel tank near the front of the harness in a position slightly higher than the engine itself.
2) Check position of accelerator levers to be sure they are both in idle position.
3) Make sure the harness is braced firmly with sidebars on the ground and all persons including yourself are well clear of propeller
4)) Your Ravens engine has a small AUTOMATIC de-compressor which is hidden under the fan cowling . This operates automatically as it is self-described. The engine remains decompressed until it ”fires” the first times. Once the engine fires the vacum developed in the intake port closes the valve automatically. Eventually you can notice what appears to be some oil leakage at the rear of the engine cylinder coming from under the cowling. A small fuel/oil mixture comes out of the cylinder together with the de-compressed air in a small quantity each time you start your engine. The fuel evaporates however the oil remains. It is best to check for this and clean the cylinder of any oil from this area every few flights
5) Close the choke completely
6) Lightly depress push in the small pin under the carburettor to release fuel intake diaphragm.
7) Now with choke in the closed position pull the starter cord several times until you hear the engine catch and run a few seconds. (It is quite normal that the engine rotates for just a few turns and then stops again due the very rich fuel mixture with the choke closed).
8) Open the choke.
9) Open the throttle to about 1/8 accelerated position to increase the speed of the engine while starting. Pull the starter cord and start engine with the accelerator in this position. After a few seconds running at this increased idle speed you can de-accelerate and the engine should run at normal idle speed.

10) If after a 3-4 good pulls the engine does not catch you can proceed again from points 7 through 9.

How to Stop the engine

Always pay attention to where the "kill switch" is, so you can stop the engine in case of emergency.
If for any reason the kill switch does not function properly you can stop the engine using the choke lever. Pulling this will starve the engine of air while flooding it with fuel which stops combustion.

Engine / Carburettor tuning.

The R 120 engine is equipped with a Walbro diaphragm type carburettor type VG6 with fixed high speed jet.
The second jet is adjustable , it is a needle valve and controls the flow of fuel at low speed. The normal setting of this needle valve is in the one turn open - from its absolute closed position. Before you make any attempts to start the engine make sure that the needle valve is in the "one turn open position". Later you may open it a little farther to make your engine run a little richer or close it just slightly to make it run a little leaner.
NOTE: Never set the low speed needle valve less than 3/4 turn open as leaner settings may cause severe engine problems.

Carburettor Service

Actually there isn't much to go wrong. If your fuel mixture is proper and clean so no deposits clog up the carburettor you should have problem free operation. We recommend that you change the diaphragms once every two years or so. If you haven't used your engine for some time, the diaphragms may have hardened and you may have to change them.

Spark Plug

The spark plug is a special design for this type of engine. When you replace the spark plug make sure that you get an original part or an identical replacement. Other spark plugs can permanently and mechanically damage your Raket engine. The original Raket 120 engine is equipped with a Nippon / Denso park plug W22MP-U Spark plug which exactly matches the threaded part of the cylinder.

The correct gap/ distance between the spark plug centre electrode and the side electrode is 0,4 mm. This distance should be measured with a piece of wire, 0,35mm in diameter.

During normal operation the spark plug shall have a brownish surface on the centre electrode – however this colour can differ a lot. If you stop the engine directly after a heavy load the centre electrode can be light grey or brown. If instead your engine has been idling foe a while before you examine the spark plug the centre electrode may be dark brown or even black. Remember to use only the Nippon Denso W22MP-U spark plug. No hotter or cooler plug is recommended.

The normal service life of a spark plug is 200-300 hours – However we recommend that you always carry extra spark plugs with you as, e.g. repeated attempts to start a flooded engine can destroy a spark plug.

Service Intervals

The table below shows some typical service intervals. Please note that the conditions under which the engine is operated will have a great influence on these intervals.

Every 200 hours

- Change Piston rings
- Change Spark plug

Every 300 hours

- centrifugal clutch drum and weights (if the drum shows signs of wear inside the drum)

Every 400 Hours

- Piston
- Small end connecting rod needle bearing
- Main roller bearings
- Sealing rings
- All gaskets

Extras to remember.

Always carry an extra spark plug and carry take the spark plug wrench delivered together with your RAVEN harness.
(50 hrs) Change spark plug.
(x hrs) Periodically check the drive belt tension and maintain as specified.

Drive belt tension

Periodically check the drive belt tension on your RAVEN as follows.

Scheduled maintenance

When maintained properly your RAVEN harness and engine requires little maintenance and will need very few parts. Pay attention however, for signs of damage such as discoloured tubing which can indicate a stress/bent point or corrosion. Salt water conditions and sea air are highly corrosive. Change all parts, which have any signs of corrosion.

Troubleshooting

Problem:

GLIDERS

Choice of glider

Like any aircraft there can be an incredible difference in the handling and performance characteristics between the different makes and models of hang gliders. What model you choose will have to be based upon your 1) your flying ability 2) your desired handling and performance characteristics 3) your overall hook-in weight etc.
In general it is far better to have a glider which is more pleasant to fly rather than choose the absolute top performer. Higher performance almost always indicates longer take off runs, larger turning radius and longer required landing areas and higher overall stall speed. What you gain instead in pleasure and safety with a manageable wing will always more than compensate for a few points in extra

glide. Besides this , clipping in your harness with auxiliary power gives you an incredible glide ...
In every case it is important to choose a glider which has good take-off , handling and stall speed values.

Wheels

It is **highly recommended** that you use wheels when flying with power. In the event of even a small emergency this precaution can save you money, pain and unnecessary damage.

Keel modification on glider

In order to keep the turning propeller a safe distance from the keel of the hang glider it is necessary to shorten it to the following specified length.
Measure back from the centre of your **pilot hang point position** on the keel exactly 130 cm or (...inches) . Mark this point clearly and double check the measurement (measure twice cut once). With a proper tubing cutter it is possible to make a perfectly straight and clean cut, anything less will look average . After cutting de-burr the tube end with 180 grit sandpaper inside and out.

Keel extension.

Remember that you will still need to have your keel at its usual length for glider set-up and breakdown so do not throw away the final section of keel. After your keel is cut and de-burred inside and out you can measure the tube diameter and make a small inner or outer sleeve to have full keel length for the set up or break down phase.
In every case, before hooking your harness into the glider it is absolutely necessary to take off your keel extension. Forgetting to do so will surely cost you the price of propeller – and the keel section it hits.
To go one step further- flying pieces from a spinning propeller can be lethal for those within range – so pay attention.

Self set up modes

To avoid the necessity of a second person help to hold your glider for you while you hook and check your lines you can use a simple tie down stake. This can consist of something as simple as a well made/sturdy tent peg of sufficient length driven into the ground with a rope tied securely its top section. Fix the quick release mechanism (supplied by Winds) to the front of the keel section and string the small line back to the control bar. Attach it to the supplied Velcro which you should put approximately at shoulder level on the outside section of the upright (on side without fuel tank).
Now take the rope and secure it to the nose of the glider so that the keel is either level or slightly “nose high” which keeps a steady tension on the line.

Glider Tuning / Trim settings

The most common and "dangerous" single defect in the average pilot is to try to fly the glider too slow.

It is very important to note that the trim of your hang glider will in many instances needs to be adjusted to compensate for the movement in weight and balance created by having the engine at the tail end of the harness. In general the cause and effect of this change is to render the trim speed of the glider slightly too slow regardless of the increase in weight.

Remember that the increase in weight = increased wing loading = increased stall speed and necessarily increased overall flying speed . Flying at the same speed as before adding additional weight does not work! Best manoeuvring speed, glide speed and also stall speed all increase correspondingly with the weight increase . Do not forget this! It is the one most important thing which can save you from dangerous, silly and unnecessary accidents.

If your glider is trimmed properly at normal flying weight then you will almost certainly need to adjust the trim position to one position further forward on the keel to increase the trim speed. The actual trim adjustment will vary depending on the model of glider and the actual trim of this glider before mounting the RAVEN harness.

If you are not sure if your glider is trimmed at the proper speed then be sure to consult a "dependable" more experienced pilot - and have them check and test fly your glider for you. Contact your glider manufacturer and consult them about the proper hang point / trim positions for specific " hook in" weights.

Flying and Weather conditions / Limitations

We do not recommend flying with this unit in difficult meteorological conditions. Consider that flying with the RAVEN harness the same meteorological restrictions apply as with free flying – extra margin for safety.

Wind

The amount of wind acceptable to fly in is dependent on glider performance, pilot ability and laminar qualities of the wind itself. Acceptable wind speeds can be anywhere from 5 to 25 kph depending on the above. Gusty conditions are to be avoided. Vertical gusts can cause abrupt changes in the direction of the relative airflow and angle of attack. It is these abrupt increases in angle of attack which produce stalls. Pilots making landing approaches under turbulent conditions generally maintain an approach speed somewhat higher than normal to guard against a stall.

Crosswind.

Acceptable crosswind depends on pilot ability and we recommend no launching in more than 15 degree of crosswind up to 10 kph. The take off run is so short with

the RAVEN harness that there is seldom a valid excuse to take off in any crosswind.

Rain, Frost, Snow Ice:

Absolutely **not recommended** is to fly in **any** of these conditions. Even a light accumulation of rain, frost snow or ice on the wings can cause a significant increase in Stall speed. The accumulation disrupts the smooth flow of air over the wing, decreasing lift and increasing stall speed. The stall speed may be increased so much that the glider may not be able to attain the necessary speed to take off. The decrease in glider reaction time to pilot input caused by any accumulation of matter on the glider's sail make this a potentially dangerous situation.
If by chance you are ever caught out in the rain while flying you will need to increase your flying speed for all manoeuvres and particularly on landing approach & flare. Be prepared to run a bit of extra distance.

Hot Temperatures

As in any aircraft you can expect less take off and climb performance on hot days due to a lower density altitude. This affects your gliders lift to drag performance in a big way. Secondly the engine unit also loses some power since the actual amount of air available to support combustion in the engine has decreased and it is running at a higher temperature.

Cold Temperatures

Cold temperatures can be considered anything less than zero degrees. Depending on humidity and temperature changes in these conditions carburettor icing "can occur" and if it does a complete loss of engine power is a likely result.
If however the temperature and humidity changes are with certain limits then operation is as normal.

Choice of Take off Field !

One of the most important things when first learning to fly the RAVEN is choosing your take off location. Choose a field with the biggest area available which is smooth with short grass and clear of any obstructions ie: trees, wires, buildings etc. The bigger the clear area available the less you have to worry about during and after take off and landing. Grass should be no more than 20 cm tall as it can ruin a propeller – and make take off impossible. Make sure as always to have good wind indicators positioned in safe but visible locations.
The easiest and safest take off is from a flat field - for the reason that if you encounter any trouble you can simply shut the power off and glide to normal landing & flare. This is a luxury! On the contrary, take off from a hill is as usual; "an absolute commitment" as you gain instant altitude with no immediate landing area.

Hooking in

After engine warm up and all pre-flight checks of your powered harness and hang glider unit , hook in as follows:

1) Disconnect keel extension from glider.
2) With hang glider tethered by the nose – or with an assistant holding the nose of the glider enter under from the rear of the keel and hook and lock carabiner into main and secondary hang points.
3) Check fuel line connections are clean and Connect Fuel line.
4) Double check engine accelerator controls to be sure they are working freely and in the idle position.
5) Re-check all leg lines, and complete Suspension system making sure all things are in order with no lines wrapped around the glider frame or harness itself.
6) Step into harness and connect leg straps.
7) Close zip on front section and connect the two front safety clips.
8) Start engine and let it run for at least one minute. Brace yourself to compensate for the thrust and do some light to full accelerations of engine. BE CAREFUL NOT TO STEP OVER - PASS CONTROL BAR. Moving too far forward of the C/G can bring the propeller into contact with the keel of the glider destroying both components.
9) After engine is warmed up you can move into the start position on your chosen field.

Take off – from flat ground

Take off is surprisingly easy with the RAVEN provided you follow simple rules. ABSOLUTELY - do not try to force premature lift off by pushing out. Like any aircraft, your hang glider needs sufficient airspeed to fly. Rule one with a powered harness is to collect necessary airspeed on the ground. A properly trimmed glider will only require the necessary roll corrections to maintain its course on the intended runway. In general as long as the two support legs are on the ground you will find the RAVEN tends to go straight- forward, which greatly simplifies take off.

PS: remember your wheels.

Once you are hooked in and in position on the take off field brace yourself once more and so some slow accelerations of the engine go all the way to full power (or as much as you can retain) and back down. Listen to the engine and feel the thrust to understand if everything is working as it should.

Take off run

With glider pointed into the wind and wings perfectly level brace yourself slightly and bring the engine up to full power. Begin your take off run keeping the wings level and in a few steps you should feel the glider begin to lift from your shoulders. DO NOT PUSH OUT! Continue running/accelerating with wings level until you feet can no longer touch the ground. At this point you are flying.

Aborted take off

One of the great things about taking off with the RAVEN harness from a flat field is that the option to abort the launch. To abort the launch it is necessary to de-accelerate the throttle control, keep the wings level and glide in to land / flare as with a normal hang glider. Remember that virtually all aircraft eventually have at least one aborted take off. Choosing an unobstructed take off site where you have the time "and space" to abort a take off is paramount to making this an uneventful experience. If instead you choose a take of site where its " fly or else" – well, remember Murphy's law...

After liftoff

After the harness legs leave the ground the amount of input needed to continue flying in a straight line increases noticeably. Make all roll corrections as normal moving laterally along the base tube while maintaining front to rear body position parallel with the keel. Always pay attention to not let your legs/feet drop to the bottom of the turn as this will move the trust line and clearly tend to cause spiral instability in the direction of the initiated turn. Remember when flying with power on the front to rear body position must always be parallel with the keel. Read Body position for further clear explanation.

If you encounter difficulty in rolling in or out of turns – note that this is most always caused by insufficient airspeed. Decreasing the power setting also helps but generally this is an airspeed issue.

Climb out

Maintain intended flight direction correcting with smooth side to side body movements as normal and keep accelerator to "full – or near full power" as the glider climbs out. Remember again you give gas to climb with power – you do not push out ! You can lie down in the prone position whenever you feel comfortable however, "to be safe" leave the zipper open and harness support legs extended. In this way if you should ever need to make an emergency landing you can simply glide in to land, move into the upright position and flare as usual. Always keep the harness zipper partially open and legs extended under 200 meters agl.

Bar Position / IMPORTANT !

If in free flight your glider is trimmed properly you know you can be relaxed about the bar position as the glider will nearly always fly at proper trim speed with no front to rear input. The same is with the powered harness with one added difference:

Because of the extra weight at the rear of the harness, the resultant center of gravity is also further back than a normal free flying harness. This means that to maintain the same "**relative trim speed"** the position of the base tube is going to be further back. Remember again that with the higher wing loading your trim speed must also be higher. Therefore do not try to manually correct the bar

position - slowing the glider down. Even with the powered harness a properly trimmed glider flying at a normal attitude will tend to find its own trim speed with little or no pilot input.

Body Position

Try to imagine flying an aeroplane with the engine mounted at a 45 degree angle to its main body (see animation) and you can understand the importance of the thrust line on any aircraft.
While flying "with engine on" it is important to keep your body position parallel with the keel to avoid any unwanted torsional / yaw effect . With engine off you can fly pretty much like usual although keeping foot section from dropping too much in turn is always a good idea.

Pulling up Support Leg / Skids

Most important to remember is: leave the harness legs open until you are at a safe distance from the ground of at least 200 meters or more. Almost certainly the first times you do this there will be a **tendency** to look at the legs – and not where you are heading – DON'T . Do not look at the legs/skids except very briefly when you need to pull them up. Concentrate on where you are flying – and just feel the legs , sliding them into their retaining clips. Practice this instead, as mentioned earlier from a fixed point in you garage - or whatever, so it becomes a natural movement – and not a useless distraction in flight.
The two engine support legs are attached to a linkage, which connects to the harness zipper. Pulling the zipper closed will automatically close the support legs to 80% - putting them within easy reach of the pilot. To close the legs completely it is necessary to take the end of the skids – "one at a time" and pull the legs up into their retaining clips. Again this closing and opening of the harness zipper and legs should be practised first from a hang point in your garage, tree or whatever.

Propeller brake

A spinning propeller is an very effective air brake. In fact if you have a short field landing it is useful to leave the propeller spinning to shorten your approach and ground effect. It is so important in fact - that we put an easy to reach propeller brake control on your shoulder console. To get more glide performance you will need to use the provided prop brake as follows. First make sure the engine is off or at low idle. Then pull on the short brake handle until the retainer ball passes the Propeller brake handle, progressively applying pressure until the propeller stops in the horizontal position. Pulling down slightly, fix the brake in its on position and fly as usual. DO NOT FORGET **ever** .. that you must release the brake before starting the engine or applying power. Failing to do this could cause serious overheating, danger of fire and failure of brake components.

Turns

If ever you should find that your glider seems to be is spiralling to the turn or not responding well in roll reversal this is caused by three things.
Number one cause is insufficient airspeed then *improper/misaligned* body position while the other is flying with too much bank and to much power.
If ever you should find yourself in need of rapid correction then it is usually effective to reduce the power immediately – increase your airspeed and complete your manoeuvre at the reduced power setting.

Turns – power on

Do not make turns of more than 30 degree bank angle and in the beginning less is better. In the beginning it is important to practice only shallow turns with power on. To be avoided at all cost are any steep turns under full power.

Precession

This is caused by the gyroscopic effect of the turning propeller and will tend to make turning in one direction easier than the other. This also means that to maintain straight-line flight "under power" the pilot must counter the precession effect. Surprisingly for a free flying pilot this comes quite naturally. When flying with power on your glider will want to turn slightly in the opposite direction of propeller rotation. Maintain straight flight by shifting your body weight slightly to the **right side** CHECK of the control bar. This also applies for correction of a turn. You will notice that although the left turns are easier to initiate they take more input and a slightly longer time to correct..
As previously mentioned, when flying with power on the single most important thing is (besides proper airspeed)"throughout your roll and pitch movements" is to maintain your front to rear body position parallel with the keel. With thought and practice maintaining the proper body position will come naturally – and you should notice that doing so will even help in your free flying.

Landing

We recommend that you do a normal aircraft landing approach (downwind leg , base leg and final) which gives you the time and composure to examine your chosen field. Maintain enough altitude that you can glide into the field from any one point in your circuit if ever the engine should fail.
Skids down! Airplane pilots have a saying about people who fly with retractable landing gear (RG) and it goes like this; " There are those who have landed with there gear up – and there are those who will".... Evidently the idea is - sooner or later. Lets hope not.. Landing with your gear up is a bit of a mistake however there is no need to panic. You can still land fine. It might cost you a propeller and/ or some drive shaft damage – otherwise no big deal. Better this than a broken glider or person in every case.
Remember; "before you open your zipper" **to dislodge the left and right support legs from their retainer clips**. Once these legs are dislodged you

must open the zipper completely so the legs will extend fully to the most rearward position.
Keep the skids down anytime you are flying or on approach under 200 meters altitude. Doing this will keep things simplified and safer in the event you have should have to make an unexpected landing.

Final approach

When you are on “high final approach” (200 meters or more) , we recommend to “stop the engine” and glide in with power off. This will keep things simpler and safe from accidental last minute accelerations, which can cause dangerous overshooting of the field. .
Keep a slightly higher than usual airspeed on landing approach to compensate for the weight increase and guard against gust or wind gradient induced stalls. We recommend reasonably long final (straight in glides) particularly with first landings. Absolutely do not do any last minute low turns.
On normal approaches when you come in you can generally hear “or feel” the skids touching the ground just before it is time to flare. Your landing flare should be as clean and progressive as usual – always prepared to run a few steps depending on wind conditions. Other than the necessity of coming in with Slightly more airspeed, landing with the RAVEN is very similar to free flying.