Skybolt V2



Construction Manual

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Skybolt V2 – Construction Manual

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Warnings & Disclaimers.

This product shows how to build a basic frame only for Powered Paragliding. It is the responsibility of the builders and operators to install any and all safety features they deem necessary for safe operation of this equipment. There are no industry standards or regulations. You are responsible for your own safety.

Do not build or fly this product unless you are willing to assume all risks inherent in the sport of Powered Paragliding and all responsibilities for any property damage, injury, or death which may result from the use of this product.

Failure to perform a complete and thorough preflight has been a contributing factor to accidents in all kinds of aircraft. Equipment damage, bodily injury, even death can occur due to equipment problems not caught in a proper preflight inspection.

Acknowledgements

The initial design of the Skybolt V2 (& V1) frame is credited to **Jeff Baumgartner**, pioneer of the self-made paramotor.

Jeff Goin, as president of USPPA and in favor of the growth of the sport worldwide acquired the rights to the design from Jeff Baumgartner and made available to the public, free of charge on the website www.ppgplans.com

To all those other handy-men, garage tinkerers and in general, all those involved with the growth and development of the PPG sport, we acknowledge your support, feedback, critique, pictures, comments, that have been the basis for developing this manual.

This manual was last revised and updated by **Jorge Hidalgo**
Final version published on **January 2010**.

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Tools Used.

Drill press with table mounted vise.

¾", 1/2", ¼", 7/32" metal drilling tips

Bench mounted vise.

Power cutoff saw with 60 tooth carbide blade.

¾" EMT / ½" rigid electrical conduit bender.

Electric or cordless hand drill.

Hemostat, straight 10 inch.

Files, flat and round.

Various common hand tools.

Tips.

When drilling the ¾ inch holes in the square tubing, extreme accuracy is necessary, in both location from the end of the tube and being centered on the tube for good fit and finish.

Use a metal cutting saw (hack saw) for cutting chromoly, a carbide tipped power cutoff saw is fine for aluminum, but will destroy itself on chromoly.

Make sure your work surface is flat.

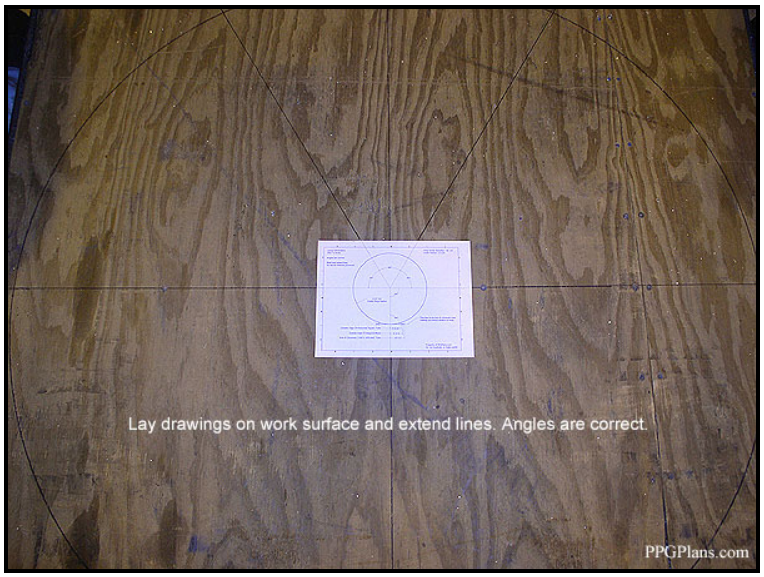
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Layout

Starting with an 8x4 foot sheet of at least ½ inch thick plywood, cut an 18x48 inch piece and two 2x48 inch pieces off of one end. From the two 2 inch strips, cut a bunch of 2x4 inch blocks for hold down purposes later.

Center the 18x48 inch piece along the edge of the 74x48 inch piece to make a work area large enough for the layout drawing. Scale up the layout drawing on this work surface.

Pictures of a flatbed trailer used as a work surface.





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Frame: - Center Section

Tip: The 0.750 (3/4") chromoly tubes generally fit snug into the ends of the square aluminum tubes, if they do not, slightly dent in one side of the square tube, just enough to hold the chromoly tube in place.

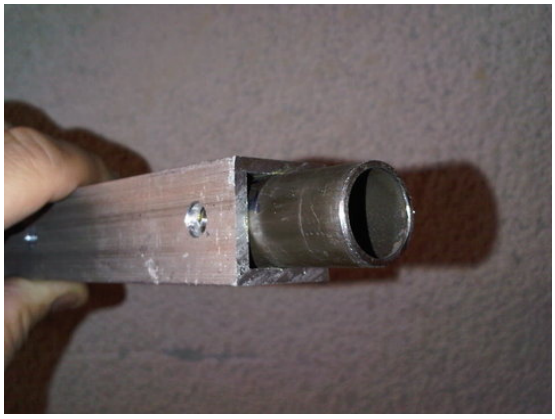
Tip: If your vertical tubes are just short of 36 inches do not worry, just be sure the ¼ inch hole for the diagonal brace is 7 5/8 inches up from the BOTTOM of the vertical tube to keep things square. The rest of the measurements should be from the top of the vertical tube.

1) Drill all of the ¾ inch holes in the square tube parts.

   Tip: Do not try to do the ¼" holes yet, as they will require the round tubes to be inserted first to allow for precise alignment.

   Tip: On the bottom horizontal square tubes, have the holes go all the way through both sides, this way the steel on the vertical square tubes will have another anchor point to prevent it from possibly moving within the square tube.

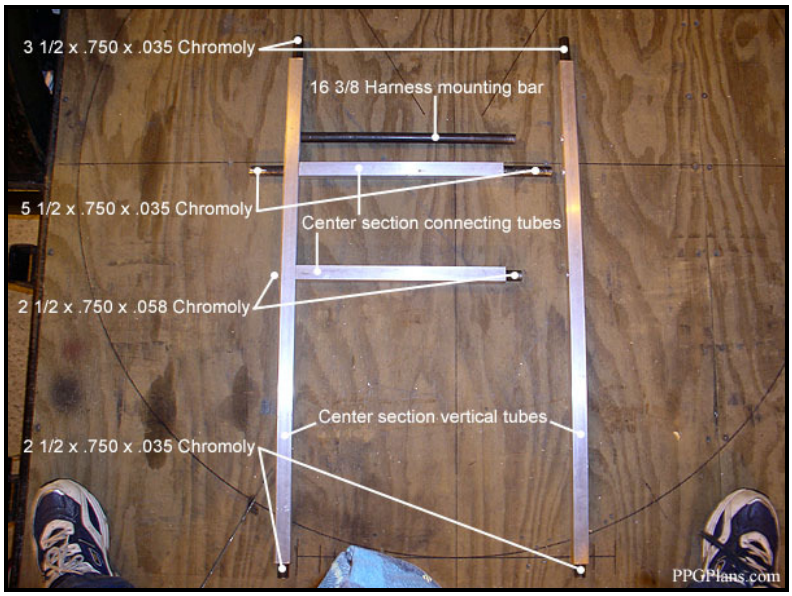
2) Insert the two 5 ½" chromoly tubes 1 ½ inches into the ends of one of the 14 3/8" long connecting tubes. Insert the two 2 ½ inch x 0.058 wall chromoly tube 1 ½ inches into the second 14 3/8" connecting tube. Be sure to use the 0.058" wall chromoly in the second one for an optional weight shift kit later.



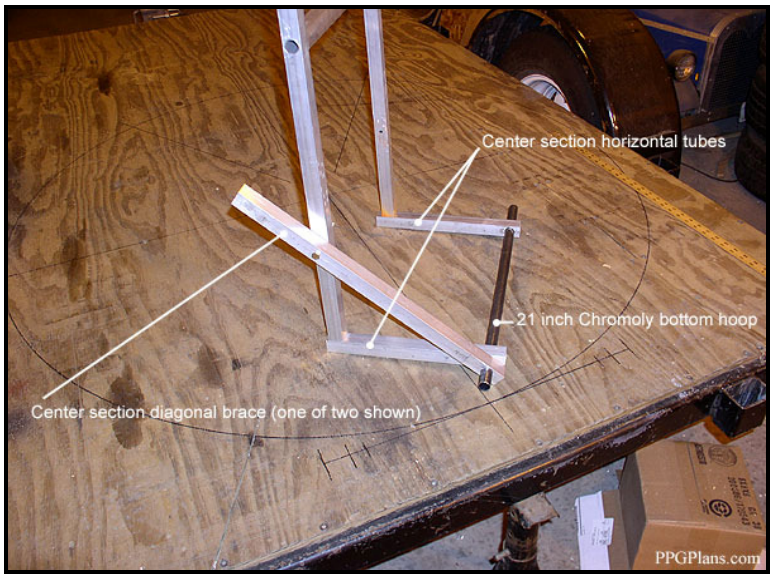
3) Insert the 1st connecting tube with 5 ½ inch chromoly inserts into the ¾" hole that is 8 ½ inches from the top of one of the 36 inch long square vertical tubes. Then the second connecting tube with the 0.058 wall chromoly into the lower ¾ inch hole in the vertical tube. Then one end of the 16 3/8 chromoly tube into the top ¾ inch hole in the vertical tube. Now install the second vertical tube onto the assembly.

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4) Insert two 3 ½ inch x 0.035 wall chromoly tubes into the top square openings of the 35 5/8 long vertical tubes 1 ½ inches, leaving 2 inches sticking out. Insert two 2 ½ chromoly tubes into the bottom of the vertical tubes, leaving 1 inch sticking out.



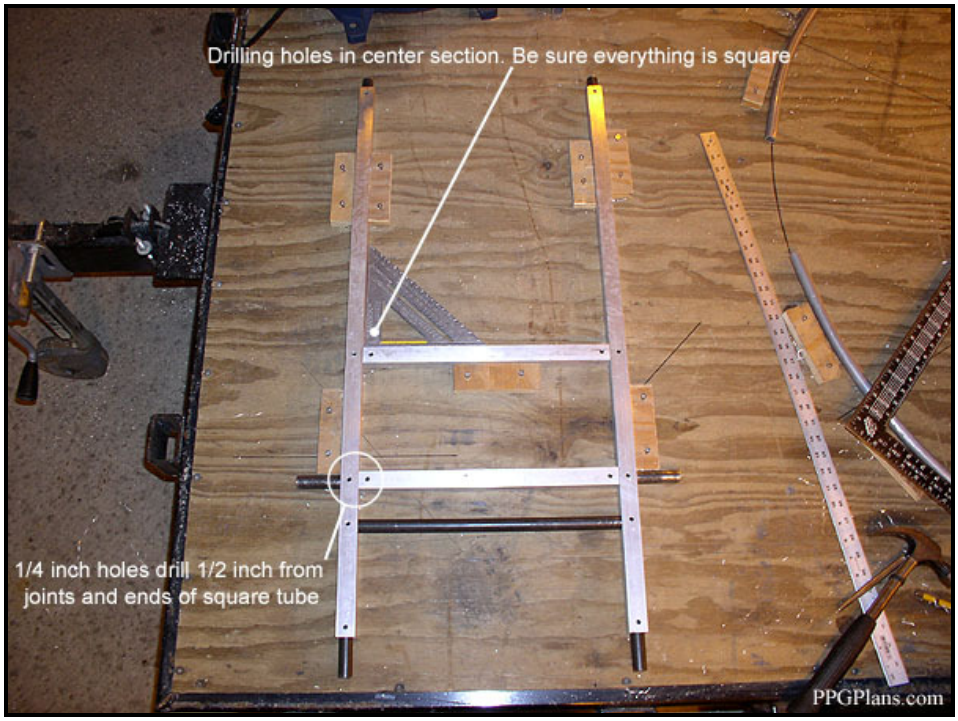
5) Temporarily install the two lower square horizontal tubes onto the bottom of the vertical tubes using the ¾ inch hole drilled closer to one end of the horizontal tube; this should leave approximately ¼ of an inch of the horizontal tube sticking out in front of the vertical tube. The diagonal brace tubes will be installed later.



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6) Remove the horizontal square tubes from the bottom of the center section, lay the rest of the center section on the flat surface, use blocks screwed down to hold in place, make sure all joints are tight and all chromoly inserts are in place

7) Drill ¼ inch holes ½ inch in from each side of joints in square tubing. Lift the assembly out and use AN4-14A bolts to bolt together (1 bolt, 2 washers & 1 nut per hole) Leave the bottom square tubes off yet.



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Building the Hoop

Tip: It is advised to buy at least one 10 foot length of cheap ½ inch thinwall steel electrical conduit and make some practice bends with this before attempting the bends on the aluminum. This will give you a good feel for it and decrease the odds of a mistake by a large margin.

All tubing mentioned in this section is round aluminum, 0.058" wall unless otherwise noted.

Lower Cage Section (2 Pieces)

1) Start with a 6 foot piece of 0.875 tube. At one end, make the 50 degree reference bend Note: On "lower hoop reference bend" drawing, forget the measurements on that drawing, they mean nothing.

2) Insert the 21 inch chromoly tube into the end near the bend and place the tubes on the layout surface with the top of the chromoly tube on the straight line below the hoop circle.

3) Slide this whole assembly side ways as needed until the 0.875 tube meets the inside hoop diameter line on your layout surface. You may need to tweak the reference bend if this does not work out due to the radius of your specific bender.

4) Form the remaining 0.875 tube with a series of VERY small bends with the conduit bender to shape the tube to match the inside hoop diameter line on the layout surface until it points straight upwards at the 3 or 9 o'clock line on the surface.

5) Cut the 0.875 tube off 3 inches above the 3 or 9 o'clock line. The remaining tubing will make one top radial tube.

Now you can hold the tube in place (use 2" x 4" blocks screwed down) on the surface and mark it at the outside of edge of diagonal brace line on the layout surface

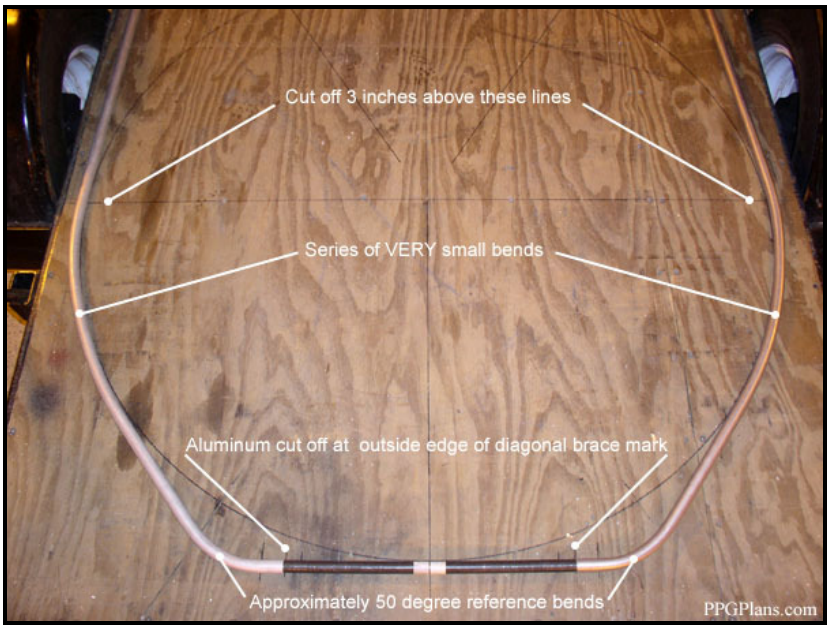
BE SURE THERE IS ENOUGH STRAIGHT TUBE LEFT BELOW THE BEND TO PLUG THE CHROMOLY BOTTOM TUBE IN,

6) Remove the chromoly tube and cut the 0.875 tube off at the outside edge of diagonal brace mark on your work surface.

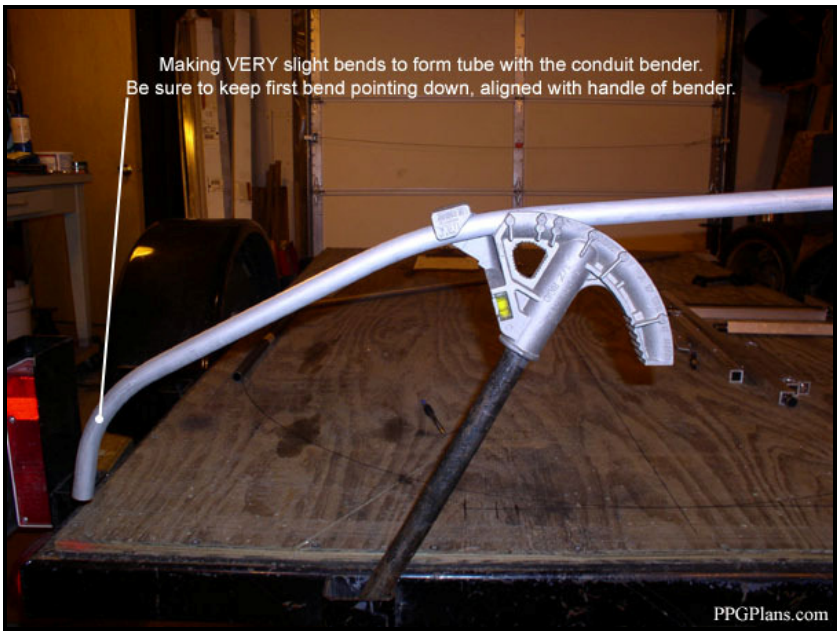
7) Repeat this process for the other lower hoop tube.

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Remember, if you bend a tube too much, you can always rotate it 180 degrees in the bender and straighten it back out with a series of very small bends in that area. To make these curved hoop sections, you are using the conduit bender to FORM the tube, rather than bend the tube.



TIP: It is fairly easy to straighten a tube that does not lay flat by inserting a tube in each end and twisting it, much easier with a second person to help. By being careful to bend straight, the twisting is avoidable.



Tip: Once again, it is strongly recommended to practice these bends on some thinwall conduit, it is very cheap and will save you money in the end.

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Upper Cage Section (2 Pieces)

1) Take a 6 foot piece of 0.750 and form it with a series of small bends with the conduit bender to match the inside hoop diameter circle. It is best to start with the whole 6 foot length and mark it at 3 feet for cutting later, this will save waste. Start at one end and form the tube past the 3 foot mark as far as possible. Cut it off at the 3 foot mark and continue to bend the second half. Be sure to watch that the tube remains as straight as possible when it exits the bender, keep it aligned with the handle of the bender.

2) Once you have the two 0.750 sections formed, lay them on the surface and screw down some blocks to hold them in place along the inside diameter line. Do not attempt to plug them into the 0.875 tubes yet, just lay them above the 0.875 tubes and let them run past the 2 and 10 o'clock positions at the top.



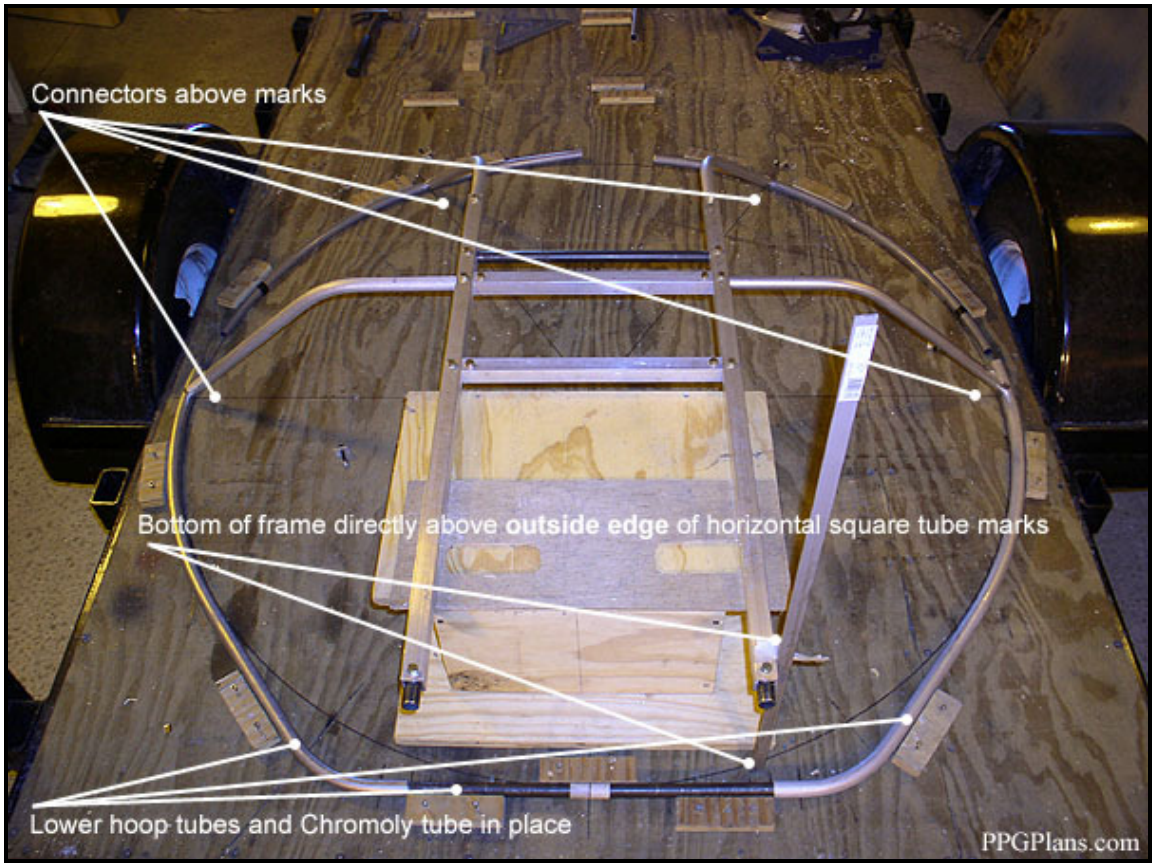
3) Next bend your 4 radial tubes out of 0.875 tube, <u>making the top ones from what you have left from the lower hoop sections.</u>

4) Next slide the short ends of the radial tubes onto the chromoly stubs, Slide the radial tube to hoop connectors into the longer ends of the radial tubes, 0.750 radius connectors in the top

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radial tubes and 0.875 radius connectors in the side radial tubes, temporarily hold them in place with tape. Lay the entire assembly over the layout surface with hoop tubes in place. Use a box or an object about 9 7/8" tall to hold up the bottom of center section. Line up the radial tubes with connectors on top of the hoop sections where they meet the 60 degree lines. Making sure all joints are tight on both ends of the radial tubes, check to make sure the side radial tubes are straight above the lines on the surface. Also be sure the bottom of the center section is centered, and remains centered throughout the rest of the build. Use a framing square to check from the surface up to the center section. Use concrete blocks or build a wood frame to hold it in position from side to side. Let the radial tubes determine the height.

5) Now be sure the two lower hoop sections are in place on the surface with the 21 inch chromoly tube floating between them (inserted but not permanently connected) with the lower ends of the lower hoop sections at the Outside edge of diagonal brace line.



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Hoop Connectors

1) Once the center section and radial tubes are in place on top of the hoop with the 4 radial tubes to hoop connectors on the 60 degree lines, use a sharp marker or pencil and mark the lower hoop tubes by tracing around the tube to hoop connectors and marking the tube to cut off 1 inch above the connector. Be sure everything is in place. Mark the connector locations on both lower hoop tubes.



2) Now remove the lower 0.875 hoop section. Cut the lower 0.875 section off 1 inch above the connector outline. Use a file and round off the cut end inside and out, you do not want any sharp edges that can come in contact with your paraglider lines.

3) Next take the 0.750 upper hoop section and cut off any straight end of the tube (it is impossible to bend the curve all the way to the end of the tube)

   NOTE: BE SURE THE TUBE IS AT LEAST 2 INCHES LONGER THAN THE DISTANCE BETWEEN THE 60 DEGREE LINES WHEN IT IS LAYING ON THE WORK SURFACE ALONG THE INSIDE HOOP DIAMETER CIRCLE.

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4) Insert the 0.750 tube at least 1 inch into the 0.875 tube; you may need to reshape the ends of the tubes to accomplish this by squeezing them in a vise. A small amount of grease works wonders here. Mark the tubes so you can always make the same joint for the rest of the build.



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5) Now you can remove the connector from the side radial tube, place it on the lower hoop tube where you traced around it, use a center punch through the center of the connector to mark the tube. Drill a 7/32 hole on this mark through one wall of the tube only and bolt the connector to the tube using the half round anchor inside of the tube. This is where is hemostat comes in handy to hold the nut inside of the tube.





Repeat these procedures for the other lower hoop tube. Then use the same procedures for installing the connectors to the 0.750 hoop section, being sure they slide into the lower sections

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all the way to the connector anchors. Now you can form the top 0.625 hoop tube, be sure it slides into the 0.750 tube all the way to the anchor, insert a pencil or nail into the other 0.750 tube and determine where the end of the anchor is and mark it on the outside of the tube. Mark and cut off the 0.625 upper tube to length.

Once again being sure the lower part of the center section is in place above the layout surface. Also being sure all joints at both ends of radial tubes are tight, you can now drill the ¼ inch holes ½ inch from the ends of the radial tubes, all the way through for double button clips, do your best to drill these straight and centered, the clips will work better. Insert the clips.

Finished radial tube and hoop joints



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Final Assembly

1) Remove the hoop and radial tubes from the center section. Re-install the bottom horizontal square tubes to the bottom of the vertical square tubes. Slide the 21 inch chromoly bottom hoop section through the holes at back of the bottom square tubes, roughly centered. Slide the square diagonal brace tubes onto the 21 inch chromoly tube tight to the bottom square tubes. Install the two AN4-24A bolts through the vertical tubes and the diagonal brace tubes with a large area washer on each side.

2) Check that everything on the lower section is square and the 21 inch chromoly tube is centered and drill and bolt the connections at the bottom of the vertical square tubes. Also bolt the 21 inch chromoly tube to the bottom horizontal square tubes. Use AN4-14A bolts to bolt together (1 bolt, 2 washers & 1 nut per hole)

   Note: You can also bolt the diagonal brace tubes to the 21 inch chromoly tube but it is not necessary as the lower hoop tubes will trap them in place.





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3) Stand the frame up and install the radial tubes and cage hoop, make sure everything looks straight and square. Look at it from the side and check that the hoop is straight. If it is a bit warped looking you may need to adjust the radial tube to hoop connectors by loosening them a bit and twisting that hoop section. Once you are satisfied you can drill the 7/32 holes through one wall of each of the tubes being connected to hold the hoop section joints in place above the radial tubes with the single button clips. Finally drill the ¼ inch hole all the way through for double button clips to connect the lower hoop sections to the bottom 21 inch chromoly tube.



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J Bars & Harness

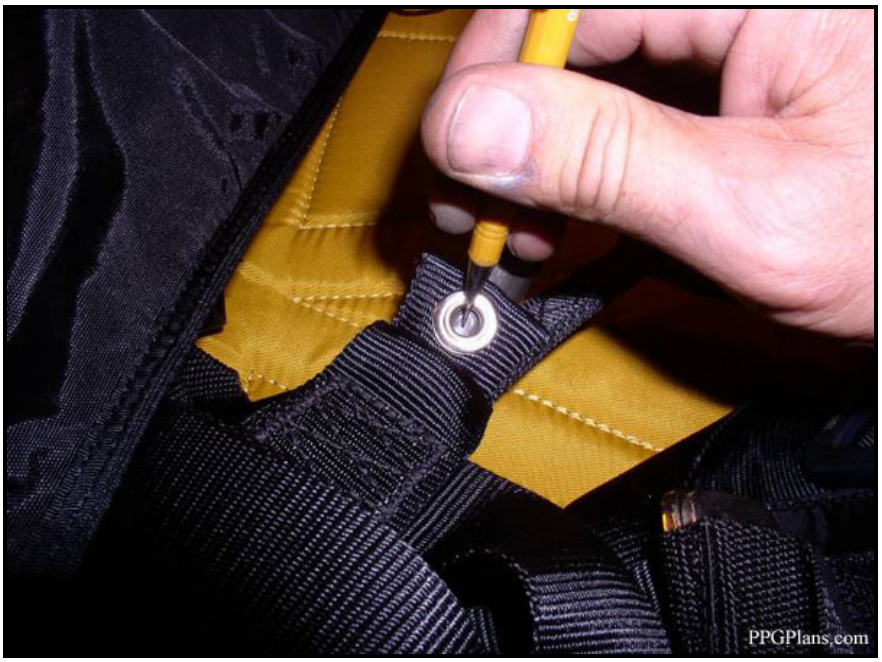
For Paracruiser, Aerothrust, Blackhawk, Miniplane and Fantom harnesses.

Flatten the end of the J bar closest to the harness in a vise. Flatten this end 90 degrees to the small hole. It does not need to be closed tight, only about halfway closed. File all sharp edges nice and round, this flat end will slide into the pocket on the harness webbing, you want no sharp edges there.



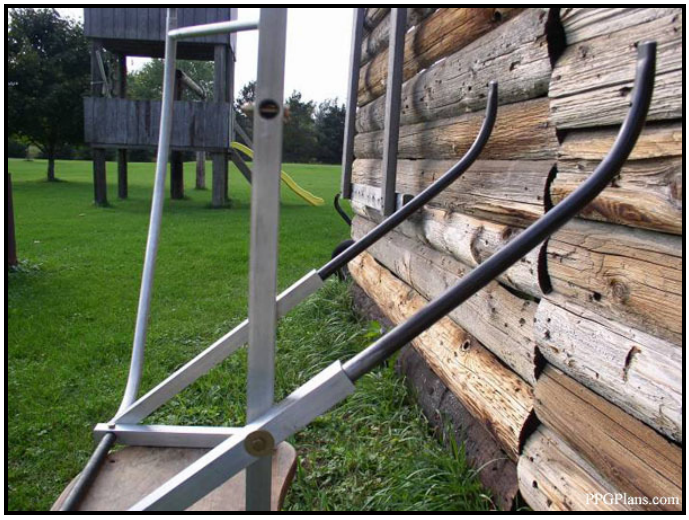
For locating the position of the hole, it is best to have your harness and slide the J bar into the pocket and mark your holes location. Drill a 7/32" hole, use a 10-32 flathead bolt through the grommet on the harness and through the J bar, with a nylock nut on the backside. Cut off and bolt protruding past the nut and file smooth.

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Note: For Fly Products harnesses, a J bar with different dimensions is needed. A drawing for this J bar will be available in the future. Also needed are the plastic J bar ends available from www.aerolight.com for the webbing to slide through.

Slide the long straight part of the J bars into the protruding ends of the diagonal braces all the way to the bolt. This can be a challenge as the J bar can be a tight fit in the square tube. File or grind a nice bevel on the end of the J bar, use a Scotch Brite pad or steel wool to remove the coating on the chromoly, use some grease and just twist and turn until the J bar bottoms out on the bolt. It can be done! Drill a ¼ inch hole through the diagonal brace and J bar and install a double button clip or AN4-14A bolt. (Picture 16)



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Attach the lower end of the shoulder straps to the bottom part of the vertical square tubes. Melt hole on the strap about 1 inch above the end, attach to the tube and tighten with a wide washer as seen below.



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Engine Mounts.

If using the Corsair M25Y or M19Y make the motor mounts as on the drawing. The radius to clear the starter can be cut with a jig saw with metal blade. The dimensions for attaching these engine mounts are on the drawings.

Fuel Tank Mounting.

Use the 1 inch x 1/8 angle to mount the fuel tank of your choice.
Recommended is the tank from www.paracruiser.com it is tall and narrow providing the best prop clearance available. Shown below are some examples of the Paracruiser tank mounted in a V2 frame.

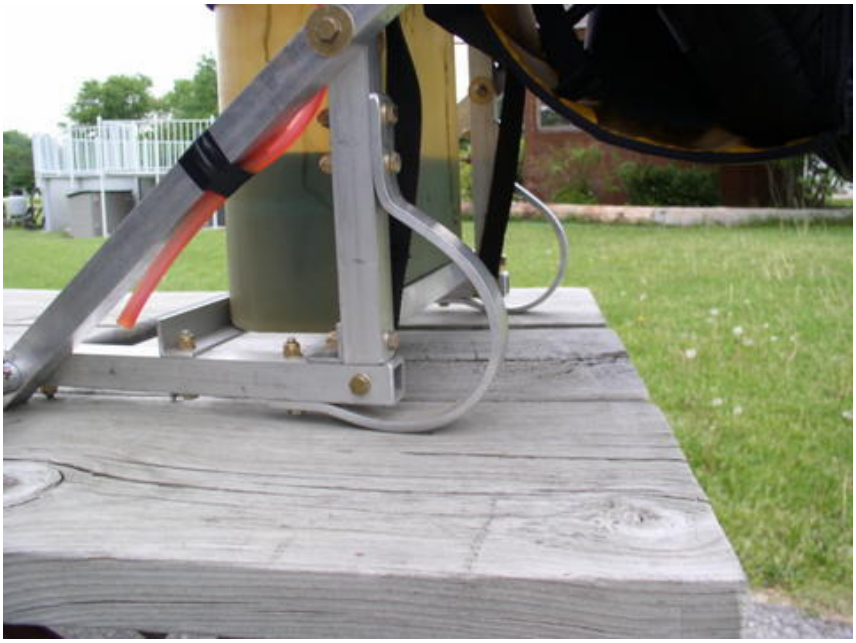




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Finish

Round off all sharp edges, especially near the harness and where paraglider lines will meet the hoop. You may want to add foam padding around the tubes at the bottom of the frame such as the 90 degree corner in the square tubing in case of contact with your legs. Adding wheels at these corners will reduce the chance of the frame "digging" in on a "not so good" landing, as well as making the unit easy to roll around the garage. A couple of 4-6 inch off road skate board wheels make a good choice.



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Appendix A - More photos.



Pull Start pulley attached to side vertical bar



Finshed Frame

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Close up view of finished netting at the sides.



Finished Unit

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Appendix B – List of Materials

Material	Size / Specs	Amount
4130 Chromoly Steel Round	0.750 x 0.035 wall	6 ft.
4130 Chromoly Steel Round	0.750 x 0.058 wall	5 ft.
6061 or 6063 aluminum square	1 x 0.125 wall square tube	2 - 3 ft sections 1 – 6ft section 1 - 2 ft section
6063 aluminum angle	1 x 0.125 angle	5 ft
6061 T6 aluminum round	0.875 x 0.058 wall	3 – 6 ft sections
6061 T6 aluminum round	0.750 x 0.058 wall	6 ft
6061 T6 aluminum round	0.625 x 0.058 wall	3 ft
2024 T3 or T4 aluminum flat	2 x 0.250 wall	18 inches
BOLTS	AN4-14A	18
	AN4-15A	12
	AN4-16A	4
	AN4-24A	2
NUTS	AN365-428A	40
WASHERS	AN960-416A (SMALL)	70
	AN970-4 (LARGE)	12

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Appendix C – Contacts & References

Skybolt V2 Cosntruction Manual & Specs

(This Manual)	www.ppgplans.com

Material Suppliers

Aircraft Spruce	www.aircraftspruce.com
Wicks Aircraft	www.wicksaircraft.com

Equipment Suppliers

Motor

AeroCorsair	www.aerocorsair.com

Harness (Under arm comfort bar)

Apco	www.apco.com
Paratoys	www.paratoys.com
AerotThrust	www.aerothrustppg.com
Francesco De Santis	www.powerglider.biz francesco@powerglider.biz

Netting

John Fetz	botmom@yahoo.com
Marc	mcd0213@yahoo.com

Throttle Assembly

Paracruiser	www.paracruiser.com
Francesco De Santis	www.powerglider.biz francesco@powerglider.biz

Fuel Tank

Paracruiser	www.paracruiser.com

Internet's Yahoo! Forums (Groups)

Skybolt Builders	http://groups.yahoo.com/group/Skyboltbuilders/
PPG Homebuilt	http://groups.yahoo.com/group/ppghomebuilt/
PPG Big List	http://groups.yahoo.com/group/ppgbiglist/

Others

United States PPG Association	www.usppga.org

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