



# Flying Squirrel CONSORTIUM

## Multi-Height Freestanding Aerial Frame 20/18.5/15.5/14 foot height

Parts List

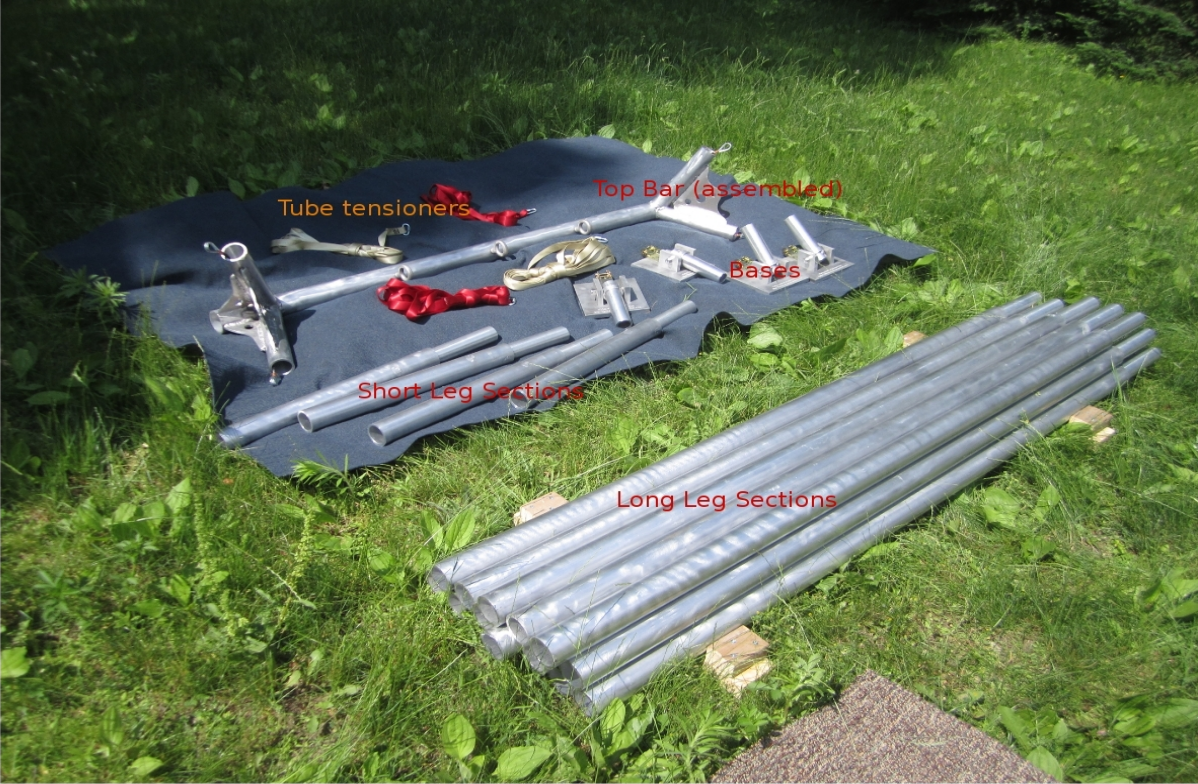
Assembly Instructions

Usage Guidelines

Document revision: 0.1 (Preliminary)

Unpack everything. You should have the following parts:

1. Top Bar assembly (1)
2. Bag of Top Bar components, consisting of:
  - 5/8ths-11x6 eyebolts, 304 stainless (3)
  - 5/8ths-11 hex nuts (6)
  - thick cylindrical “washers” (1-side flat/1-side curved) (3)
  - safety clips (3)
3. Long [6'8”] Leg Sections (16)
4. Short [2'8”] Leg Sections (4)
5. Bases (4)
6. Tube Tensioners (1-inch tubular webbing lengths w/quick-link) (4)
7. Carpet Pads (6)
8. Friction Enhancing Pads (4)





## Tools Required:

- $\frac{3}{4}$  inch open-end, box-end , or adjustable wrench

## Top Bar Assembly:

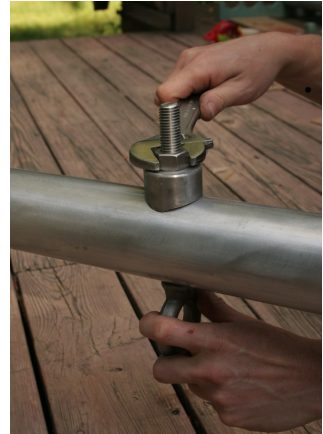
[ Note: “leg sections”, “tubes”, and “poles” all refer to the same pieces, and the terms are used interchangeably ]

Start with the required components: the top bar itself, eyebolts, cylindrical “washers”, nuts, and safety clips.



Insert an eyebolt, cylindrical “washer”, and nut. Tighten nut against washer until shoulder of eyebolt rests against bottom of top bar tube. Then thread on

a second nut, and tighten against first nut. Finally, attach one of the safety clips through the hole on the eyebolt threads.



Repeat for the remaining 2 eyebolts.



## Initial Inspection and Tube Lubrication

It will be tempting to immediately take your new frame and assemble it and start working with it. **RESIST THIS TEMPTATION!** Before assembling the frame for the first time, 3 things must be done:

1. inspect each tube and sleeve for any damage that may have occurred during transport. See the section on “periodic inspection and maintenance” for tips on how to handle such issues.
2. Clean the ends of the tubes with a rag or cloth to ensure there is no grit, dirt, or other debris on the inside surface of the tubes where the sleeves are inserted. In order to minimize the column flex in the frame, the clearances between the tube sleeves and tube ends are very small. Dirt, grit, sand, etc can cause a seize or jam that can be very difficult to undo. Grit, sand, dirt, etc are your enemy! Make sure the tubes are clean before assembly!
3. Lubricate the tube ends and tube sleeves with a suitable spray-on lubricant. WD40, PB Blaster, or similar are all fine.



It is not strictly necessary to lubricate the tubes/sleeves every time you assemble, but ensuring that there is a light film of lubricant will minimize the chance of problems. Be sure to check this at least every 3 times the frame is assembled/taken down, or if it has been sitting idle for any significant length of time. It *\*is\** vital to check the tubes for debris, grit, etc and wipe out with a soft cloth each time you assemble.

## Assembling the Aerial Frame

The aerial frame is assembled from the top down, starting with the top bar and inserting leg sections from the bottom. For an 18.5 foot height, each of the 4 legs is assembled from 4 of the 6'8" leg sections. For 20', a 2'8" short section is added to each leg. This short section can be added at the top, or at the bottom, of the stack. The frame will be easier to assemble if the short section is added at the top of the stack, such that it is the short section that is inserted into the top bar. Do not add the short section in the middle as this will increase the column flex more than is wanted.

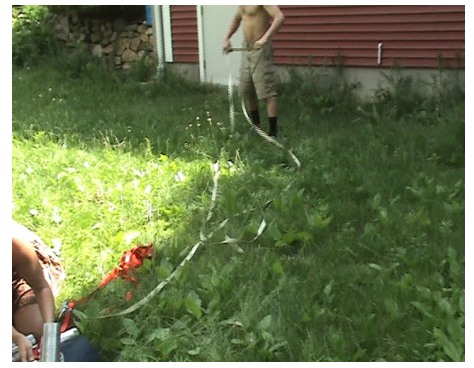
4 people are optimal for assembling the frame. Leg sections are added 2 at a time, simultaneously, to one side of the frame. 2 of the people lift the frame from one side (one person per leg), while the other 2 people insert the next tube into the column. After adding tubes to one side, switch to the other side and add the next 2 tubes, such that the frame is assembled level by level. Some pictures here will show the process. This document shows the frame being assembled to full 20' height.

Step 0: Locate the carpet pads supplied. You can use these or something similar during frame assembly. Their purpose is to prevent the tubes from digging into the ground surface and picking up debris that will cause a sleeve to jam. On wooden or stone floors, or other such indoor surfaces, they will protect against scratching or marring the floor. Do not try to assemble the



frame on grass, sand, etc without having some sort of system to keep grit out of the tubes! Never allow the tube openings to contact such a surface! If you see that that has happened, make sure to inspect and wipe clean the tube opening.

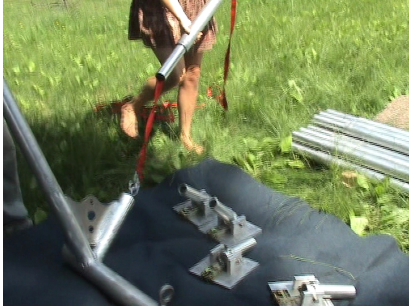
Step 1: Attach the tube tensioning straps to the top bar. Each leg of the top bar contains a cable with a thimble eye. Pull these thimbles out from the tube ends and attach a tensioning strap to each with the supplied quick-link. Note the carpet being used to initially set up the top bar on. As with the carpet pads, this or something similar is a very good idea to keep debris out of the tube ends.



Step 2: first set of leg sections:

Feed the free end of a tensioning strap through the tube to be inserted, starting from the sleeve end. Pull through all the way and insert the tube into the top bar. Repeat for all 4 of the first set of leg sections. For full 20' height, this would be 4 short leg sections.





Once all of the first 4 leg sections are in place, turn the assembly over. Be sure to make sure the tubes do not dig directly into the ground, by positioning carpet pads for the legs to stand on.





Step 3: Adding more leg sections: front/back, front/back, ...

Feed the tensioning straps through the next set of leg sections on two legs of the frame. Think of the top bar as separating the frame into a “front” section and a “back” section. Pick either the front side or the back side, and work with those two legs as a group first. Once that pair of leg sections is done, go back and do the other side. You will alternate putting in pairs of legs, front then back, front then back. Each time the frame is raised upwards one complete level, until we have raised the frame to the height level desired.



Feeding tensioning strap through next pair of leg sections.





Ready to lift and insert...



Lifting frame and inserting the next pair of leg sections on the front side. Note the carpet pads placed such that the tube ends rest of them once they have been inserted, and the tubes will stand on the carpet pads when the frame is then lifted from the other (back) side, to put the back side leg sections in.

Note that there are 6 carpet pads. At any time during assembly, 4 of them will be under tube ends, protecting the tubes from ground debris. The other two will be free. Before lifting the frame and inserting the next pair of leg sections, position the two free pads such that they can be easily moved under the newly inserted leg sections. With practice, you will learn exactly where to place them for each lift-and-insert operation (It is slightly different for each lift in the assembly), so that they will be in the right place and no extra scrambling will be needed.





## Moving and placing free pads to where next set of leg sections will land



note non-alignment of tube and sleeve above! To the person inserting the tube this may look OK, but it is far enough off the tube will not slide in.



Now it is aligned, and will slide in easily



first set of long leg sections installed!

Note: the tube and sleeve joint should slide fairly freely, even though they are a close fit. If you have any problems getting a tube inserted, make sure the sleeve and tube opening are really aligned! Problems inserting a tube sleeve are almost always caused by trying to insert the tube with the back end too high, and thus not aligned correctly. It is very easy to misread the angle the tube is at, since you will not be able to directly sight along it.

More importantly, **DO NOT FORCE A JOINT TOGETHER!** If you are having problems, check your alignment. If that is OK and a joint will still not slide easily, back it out and check for foreign debris in the tube or on the sleeve. Forcing a joint to slide when it does not want to may leave you with 2 tubes you cannot get apart again without having to resort to a hydraulic press, which you probably do not have on hand at your event site :-)

The remaining levels of the frame are done in exactly the same way. In pairs, front, then back, until you have used all of the leg sections:

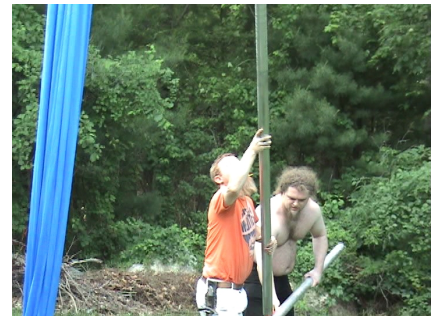
Before raising the frame to full height, however, this stage is a good time to attach any apparatus you want to hang. It's much harder to hang your equipment once the mount points are 20 feet up.



Continuing to add poles, 2 at a time, front-side, back-side:

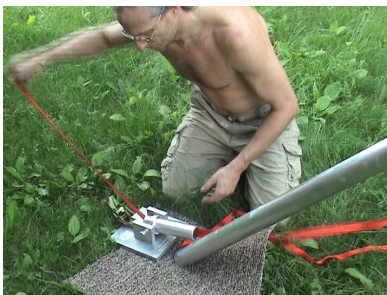
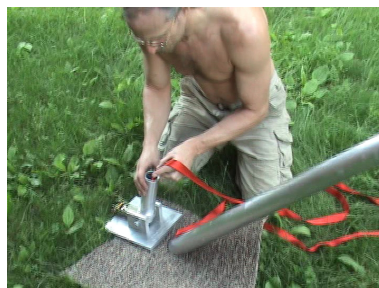






until you have the frame raised to the desired level.

Step 5: Add the bases. One person can do this, though having a second as a helper may make it easier. For each column, get a base, and thread the tensioning strap through the sleeve of the base pad:



then thread the strap through the ratchet mechanism at the rear of the base pad:





position the base pad near the tube end, and pull any slack out. Then lift the tube upward and slide the base sleeve in. Try to lift as little as possible in order to insert the base pad without opening up any gaps in the tube-sleeve joints on the opposite side leg.



Once the base pad is inserted, pull out any slack, and then tighten the ratchet mechanism several turns. Excessive tightening is not required, merely enough to maintain a small amount of tension on the tubes to keep them from separating while in use. Without these straps the tube joints will slowly “walk” open as the frame is used and the tubes flex under dynamic load. **UNDER NO CIRCUMSTANCES SHOULD THE FRAME BE USED WITHOUT THE TENSIONING STRAPS INSTALLED AND UNDER TENSION.**

Step 6:

Congratulations, you now have a completely assembled aerial frame. Time to play!



## Disassembly

Disassembly is exactly the same process in reverse. Again, have 2 lifters and two pole-handlers. Lifters should lift from the bottom of the second-to-the-ground tube, and the pole-handlers then remove the bottom tube. As with assembly, work in pairs, taking out 2 tubes from the same side (front or back), then switch to the other side and remove the opposing 2 tubes. Repeat until the top bar is back on the ground.

## Assembly Pitfalls and Hints

- Work slowly, especially the first few times you assemble until the process becomes familiar. A well-experienced team can assemble one of these in less than 10 minutes, but don't expect to be able to do this the first few times you attempt it.
- Synchronize your lifting! When assembling, it is important to have both sides lifting at the same speed and at the same time, to the same level. If you do not do this, and one side is lifting faster than the other, you will open up gaps in the tube joints on the side that is lagging. These gaps will *\*not\** always close up again when the frame is lowered back to the ground, due to the bending moment applied at the joint and internal friction. They will sometimes tend to get bigger over time, and if not corrected, could eventually get large enough that a tube falls out. Carefully synchronized lifting will minimize the chances of gaps forming. Hints on lifting:
  - Have a well defined system of communication for your lifters to follow in order for them to lift in sync, and start, stop, slow down, etc, in a consistent and predictable manner.
  - Lifters should look *\*upward\** towards the top bar while lifting. This allows them to see if any gaps are forming, and they can call out a predefined “stop and hold” signal to indicate a problem to the other lifter. The lifters do not need to see what the pole-insertion person is doing. If, as a lifter, you see a gap forming in the other lifters column, this means that you are lifting faster than they are!
  - The pole-insertion person should hold the pole being added with two hands. The hand closest to the bottom of the pole should also hold the tensioning strap. This way the strap can be pulled as the pole is being inserted, which avoids slack in the strap interfering with inserting the sleeve into the tube.



- Regardless of how careful you are, gaps will occasionally occur. They are more likely the more uneven the ground is, as the frame legs will not share the load perfectly on such ground. Gaps may appear after the frame is set back down after a pole-insertion operation. (in fact, that is the most likely time for them to appear). So: What to do about them?



gap opening between top bar and pole.  
This one is large and should be shaken out before continuing.

- Gaps of 2" or less: Ignore them until the very end. After putting in the base pad on a column that has a small gap, shake the column and the column opposite (same end of the top bar). The internal tensioning will reduce the gap. Retension the ratchet strap after the gap shrinks, and repeat until the gap is gone.
- Gaps of more than 2": If a gap has opened to more than 2", it is probably best to try to reduce it before it gets too much larger. Shake the opposite column while another person lifts the problem column slightly toward the top bar. This should get rid of it. If a gap is particularly troublesome, put in a base pad, tension the strap, and then shake the gap out. Leave the base pad in until it is time to add the next pole on the troublesome column.

# Periodic Inspection and Maintenance

Each assembly:

- Inspect tubes for debris, wipe clean with a clean cloth/rag. Add spray lubricant (wd40, etc) if needed to mating surfaces.
- Check eyebolt nuts for tightness. Verify safety clip on end of eyebolt.
- Check for burrs/dents/on sleeve surfaces. File out with flat file if necessary. Smooth with 220/400 sandpaper, then wipe clean.
- Inspection ratchet mechanism on bases for smooth operation.

Monthly (assuming frequent usage):

- Inspect welds on top bar for any signs of cracking. [Repairs should only be attempted by a qualified welder]
- Inspect bases for any loosening of components.

Troublesome Tube/Sleeve joints?

- Thoroughly inspect mating surfaces for dents/burrs, embedded grit/sand/debris. For burrs, scratches, etc on the internal surfaces of the tubes, the proper tool to use to restore a good surface finish is a brake cylinder honing tool:



Attach to a power drill and insert into the tube, and spin while moving back and forth to sand out the imperfections:





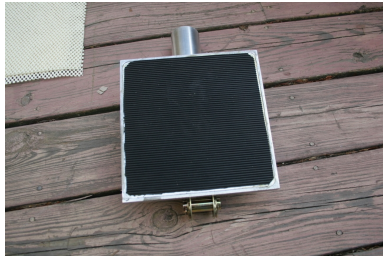
- Be sure to clean out the internal tube surface after this operation as the tool can leave behind debris.

## Usage Notes and Recommendations

- The footprint of this frame is roughly 27 x 31 feet when set up to full height. Diagonals will be roughly 41'. Don't worry if you don't see these exact numbers; column flex will allow deviation from the ideal, and uneven ground will affect your final measurements. When done, sight up each column and adjust the bases so that the columns are reasonably straight. There will always be **some** curvature in the finished assembly.
- Try to find as flat a surface as possible to erect the frame on. It is not necessary that the surface be perfectly level, what is more important is for the 4 endpoints of the columns be relatively coplanar.
- The angles at which the columns extend from the top bar are not the same in the front-to-back and side-to-side axis. The assembled frame spans a rectangle, not a square. This should be expected, since the top bar has length, but what may not be expected is that when assembled, the long axis of the rectangular footprint is perpendicular to the axis of the top bar. Keep this in mind when laying out your setup.
- The frame is designed to handle loads suspended from the top bar only. Do not put any significant side loading on the columns. It is OK to tie off apparatus to the columns (as long as it doesn't weigh too much; Silks, lyras, trapezes, etc, all OK) but it is not OK to have your rigging person climb up the poles to access the top bar.
- The base pads have a rubber bottom which will provide enough friction



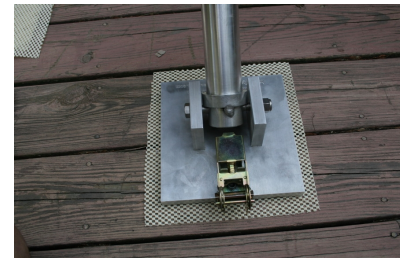
for the frame to be used without any ground attachment on most, but not all, surfaces without slippage.



For indoor surfaces which are problematic, small square pads of an extra-grippy material are provided:



Place them between the pad and the ground surface:



- These pads are grippy, but will wear out faster than the attached rubber layer on the base pads, so use them only when needed. These pads are nothing more than non-slip drawer liner you can find in hardware and kitchen stores, under such brand names as “Wonderliner”, and are easy to obtain. Polished marble tends to be problematic, as well as some school gym floors which collect this layer of dust which makes everything slippery. On outdoor surfaces which can be problematic, such as wet grass, your best bet is to drive in stakes close to the inside of the legs and tie off the base pads to them:



More dynamic acts will of course increase the chances of slipping. Running boundary lines/cables around the perimeter is another way of handling the problem, but creates other hazards. Best to stake if possible. The carpet pads work fairly well on grass to increase ground

friction.

- It is OK to swing on apparatus hung from the top bar, within reason. [This frame is not designed to be used for flying trapeze] If you plan on doing a lot of swinging, adding a dab of grease on the eyebolts is recommended to reduce unwanted noises, and to reduce wear.
- Load the rig such that any dynamic loads are handled in a symmetrical fashion. Rig your fabric, lyra, corde-lisse, straps, etc. from the central point; trapeze from the two outer points. While it is possible to work on a single point apparatus rigged from an outside point, any routines which generate large dynamic loads should be done from an apparatus rigged in a symmetric fashion. Working a single-point apparatus from one of the outer eyebolts will produce much more frame flex than if done from the center point. It is OK to hang a rope from one of the outer points (or even from a spanset/sling wrapped around the top bar toward the outer end) to be used for rigging access, by someone climbing up.
- It is NOT recommended to use pulleys and lines to support any apparatus being used. Doing so almost doubles the forces seen on the top bar, and will load whichever leg the end of the line is tied off to at almost 4x the other legs. Do not do this. Rig your equipment directly from the eyebolts, and rig an access line off of an outside eyebolt or sling wrapped around the end of the top bar. Climb up with a harness, clip in, do your changeout, and climb back down.
- Questions? Send them to “[equipment@flyingsquirrelconsortium.com](mailto:equipment@flyingsquirrelconsortium.com)”
- Enjoy!