

## 'STEADICAM' Style ARM and VEST

### ARM:

7 1/2' of 1" square aluminum tubing, 1/16" wall thickness  
2' of 1 1/2" square aluminum tubing, 1/8" wall thickness  
10" of 1 1/2" aluminum angle, 1/8" thickness  
24" of 1 1/2" wide flat bar aluminum, 1/8" thickness  
(22) rollerblade bearings  
(4) 3/16" X 2" eyelets (machine threads)  
Nylon Locknuts for above  
(2) small turnbuckles, about 4" in length (3/16" size? Rated for 70#)  
(2)-12.3 lb. (1-1/16" x 5-1/2") springs (Lowe's, Mfg. by "Hillman co., Cincinnati, Ohio"- Part# 543013)  
(8) 2"X 5/16" bolts (allen head if desired)  
(3) 3"X 5/16" bolts (allen head if desired)  
(1) 5" X 1/4" bolt  
(4) 2 1/2" x 1/4" bolt, washers, nylon locknuts  
(4) 1 1/2" x #10 Machine screws, 8 washers, 4 lockwashers, 4 nuts  
(60) 5/16" washers (SAE size, NOT cut washers—Their outside diameter is too big)  
(12) 5/16" nylon locknuts  
(1) 5-6" reinforced corner brace  
(2) 3" x 1" brace plate  
7/8" square hardwood dowel (preferably oak) --you want this to fit snug (but not overly tight) into the 1" square aluminum... (\*note)  
(28) #10 X 1/2" flathead machine screws, with lockwashers and nuts to match  
4 1/2" X 7/8" hardwood dowel  
Small wood screws  
Pinstriping tape (1/4")

### VEST:

Evenflo 'Snuggly' front and back pack carrier (yes, I said a Baby carrier!)  
26" x 3" wide X 3/16" thickness Aluminum plate  
18" x 2" wide x 1/8" thickness aluminum plate  
2 sets of 'luggage straps' OR Shotgun ammo belts (2" wide nylon, with quick release buckles)  
12" of 1" aluminum angle  
(12) 1"x 1/4"-20 screws  
(12) Nylon Locknuts for above  
(2) 1-1/2"x1/4"-20 allen bolts  
(2) 1/4"-20 wing nuts  
(16) 1/4" washers

## TOOLS:

Drill

Drill Press

Wood saw (I used a radial arm saw)

Band saw

Hammer or mallet

Assorted drill bits, including 3/8", 5/16", 3/16" bit, small pilot drill bit

Spring-loaded scribe punch (helpful, not absolutely necessary)

7/8" forstner bit (for wood)--Paddle bit can be used, but won't make as good a result...

3/8" spire-point wood bit

7/8" hole saw (unless you can use a 7/8" metal drill bit in your press)

Countersink bit

Angle vise or drill press vise

Dremel

Fabric/leather hole punch for 1/4" hole

Flat metal file, less than 7/8" wide

Sanding block w/100 grit sandpaper

Fine grit sanding paper (for paint prep)

Flat Black spray enamel

## ANGLE VISE



## MACHINIST'S SQUARE



## PUNCH SCRIBE



## COSTS (approximate):

Nut & bolt hardware:	\$60
Aluminum:	\$50
Bearings:	\$45
Baby Carrier:	\$25
Belts/straps with buckles:	\$10
Springs/wood/brackets/etc.:	<u>\$50</u>
Approximate total:	\$250

## \*\*\*IMPORTANT NOTE\*\*\*

PLEASE read the instructions through AT LEAST once and study the pictures before beginning, in order to get a clearer understanding of the process... You'll be glad you did... Get the pieces as close in length as possible to one another---Precision is the key to the entire assembly. The best route is to study the photos, and mark out where you need to cut or drill---DOUBLE CHECK to make sure it looks right---then cut or drill. The old adage goes, "measure twice, cut once"... Unless noted, hole measurements are center-to-center, I.E. the measurement between holes is from the center point of one hole to the center-point of the other.

First, cut the 1" aluminum tubing into (4) 18" pieces ("Bones"), (2) 4" pieces ("Joints"), and (2) 3" pieces ("Vest Mounts"). Clean edges with Dremel and/or metal file.

Cut the 1 1/2" tubing into (4) 6" pieces. Then CAREFULLY, using bandsaw (or even the Dremel, which is more time consuming) cut one side out to make 1 1/2" deepwall channel. The piece still needs to be 1 1/2" on all sides, however. Clean edges.



Cut the 1 1/2" angle into (6) 1 1/2" long pieces. Round the one side per the diagram. Clean edges.

Cut the 1 1/2" flat bar into (2) 2" long pieces. Clean.

From the 7/8" square dowel, cut (16) 1 1/4" long pieces. \*NOTE\* if you cannot find 7/8" square dowel (you may have to look at furniture-building suppliers or specialty/hobby stores) you may also cut a 1" square down--But trust me, it's tricky, exacting, and VERY time consuming....But it CAN be done...This is what I had to do.



Mark the 18" 'Bones' on each end- 5/8" from the end, dead center...Do the same with the 4" 'Joints', and the 3" 'Vest Mounts'.

On the 18" Bones, using the drill press and Pilot bit, drill a small hole exactly on center of the marks on each end--You can drill all the way through and mark both sides at once. Do the same on the 4" Joints and 3" Vest Mounts. Clean edges with Dremel and/or metal file.

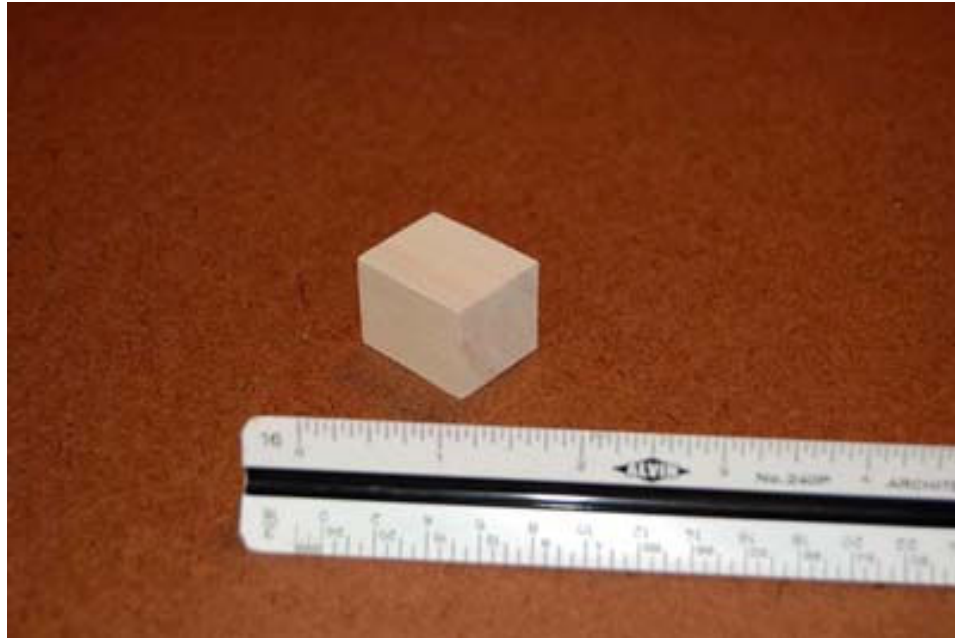
On the 18" Bones, using the drill press and 7/8" drill bit or hole saw, cut out holes on either end, using pilot holes as guides...This is one of the most difficult parts--Take your time!! Afterwards, drill a hole through one side of each Bone--1 1/2" from the end...Using 3/16" drill bit. Clean edges.



On the 4" Joints, cut 7/8" holes in top side, and drill out bottom side with 3/8" metal drill bit. Clean edges.

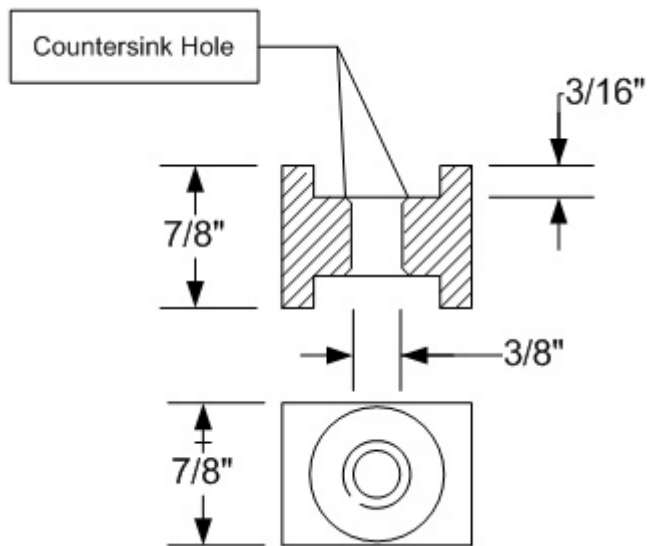
On the 3" Vest Mounts, do the same--ONLY ON ONE END. Leave the other end blank for now.

On 8 of the 1 1/4" dowel pieces, mark the dead center of two opposing sides (not including the ends). Using the Drill press and Forstner bit, drill out the bearing space on both sides--to a depth of 3/16". This creates a part called a "Bearing Carrier", these being the "two-sided" variety.

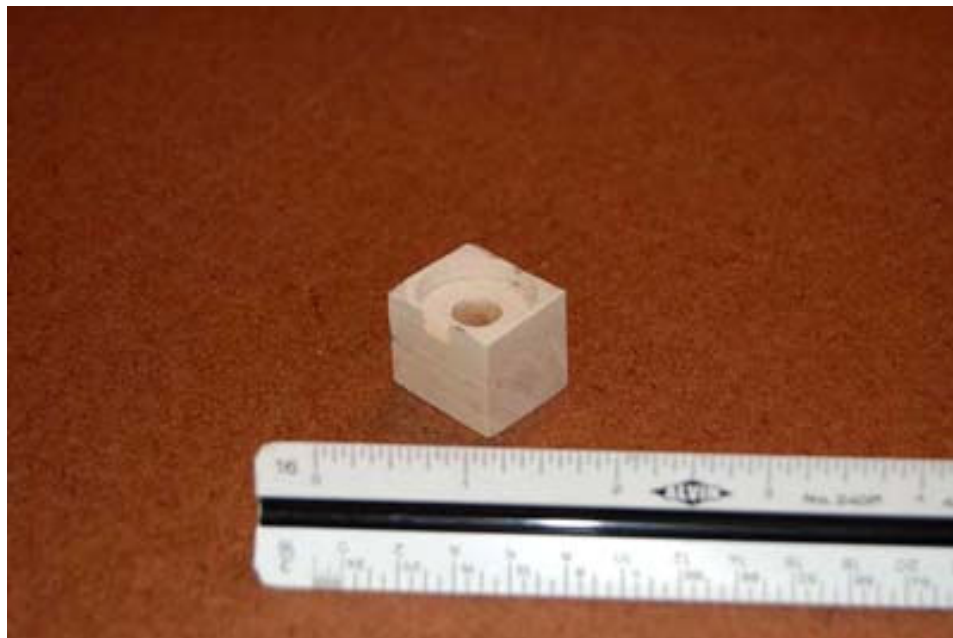




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On another 6 X 1 1/4" dowel pieces, do the same--but only drill out one side of each. These are "one-sided" Bearing Carriers.





Leave 2 dowel pieces blank.

Using the drill press and 3/8" spire-point bit, drill out the center of each bearing space, all the way through the block.

Using drill or drill press and Countersink bit, countersink hole in bottom of each bearing space so that inner bearing ring clears well. You may use one of the bearings to make sure the inner ring turns freely when placed into the block--the fit will be a little loose...The inner ring should not rub the wood anywhere...

On the 4 X 18" Bones, insert a two-sided bearing carrier into each end, making sure bearings pop through the holes in the aluminum and seat into the wood Bearing carriers--The bearings should be nearly flush with the surface of the aluminum, but should protrude slightly. Secure the Carriers by drilling and screwing 2 small wood screws into the bottom on each end....

On the Joints, insert a one-sided Bearing carrier into each end and seat a bearing into it. Repeat securing with the small screws.



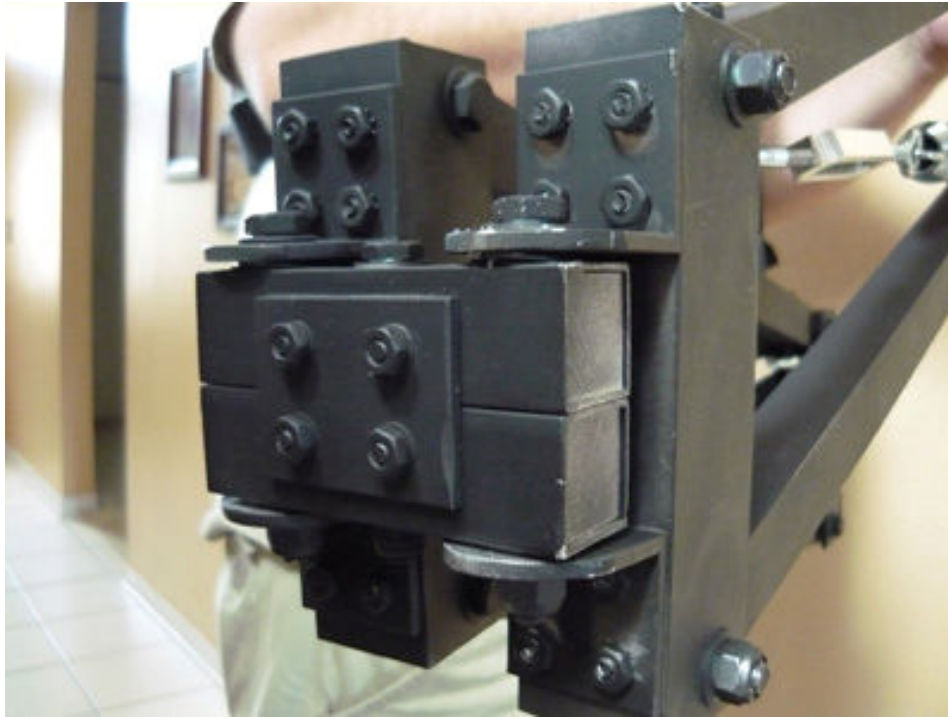


On the Vest Mounts, insert the two remaining one-sided Bearing Carriers in to the ends that match. Place blank, undrilled 'bearing carrier' wood pieces into other ends to aid in support. On the 'Blank end', drill a 1/4" hole through the middle of each side—all the way through, cross ways.

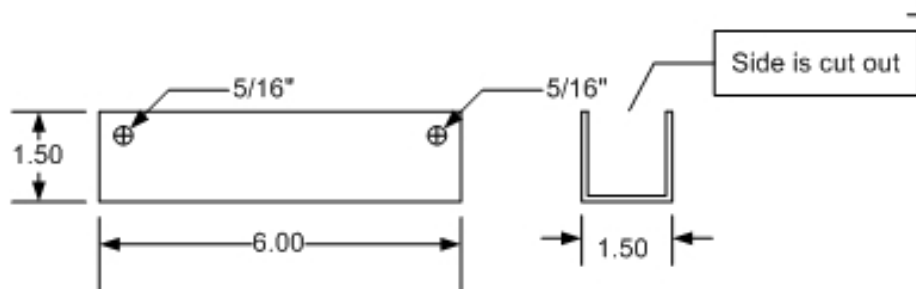


On the Joints and vest mount pieces, drill a hole dead-center through the middle top and bottom of each using the drill press and 3/8" metal bit. Clean edges. If any particles remain inside the tube and rattle, they may be blown out with air.

Bolt Joints or Vest mounts together using 1 X 3" X 5/16" bolt, washer at each end, and Nylon Lock nut. The ends and sides should line up exactly--so that the holes through the bearings, Carriers, and Joints all line up... Drill the 4 corner holes into the 2 2"x1 1/2" plates—1/2" from each end, and 3/8" from the top and bottom edges... Drill corresponding holes through the sides of the assembled Joint. Affix the two as side plates, using the (4) 1 1/2" #10 screws/washers/nuts.



On the 4 X 1 1/2" channels, mark and drill 5/16" holes, 1/2" from the outer corners...Clean edges. These will now be referred to as "Hinge Blocks".





On the 6 X 1 1/2" angle pieces, mark out and drill (see diagram), first the attachment points (using 3/16" bit), then pivot points (using 5/16" bit). These will be called "Hinges"...Note that the hinge in this photo has not had its end rounded, but it is scribed....



Drill corresponding holes for attachment points on 3 of the Hinge blocks, using 3/16" drill. (The hinges should be 2 3/16" inches apart.) Countersink these holes on the inside of Hinge Blocks.



On fourth Hinge block, drill holes corresponding to the angle bracket...Bracket should be flush with the top of the Hinge Block. Countersink interior holes, and bolt Angle Bracket to Hinge block, using #10 screws/lockwashers/nuts.



Attach Hinges to Hinge blocks, using the #10 screws, lockwashers, and nuts...

On the assembled Joint, insert bearings in one side (top and bottom). Place between Hinges, then through-bolt using 3" X 5/16" bolt--The bolt should go through things in this order: washer, top Hinge, 1 more washer, Joint assembly (with bearings), one more washer, bottom Hinge, washer, Nylon 5/16" locknut.

Repeat this with another Hinge block, on the other end of the Joint assembly.





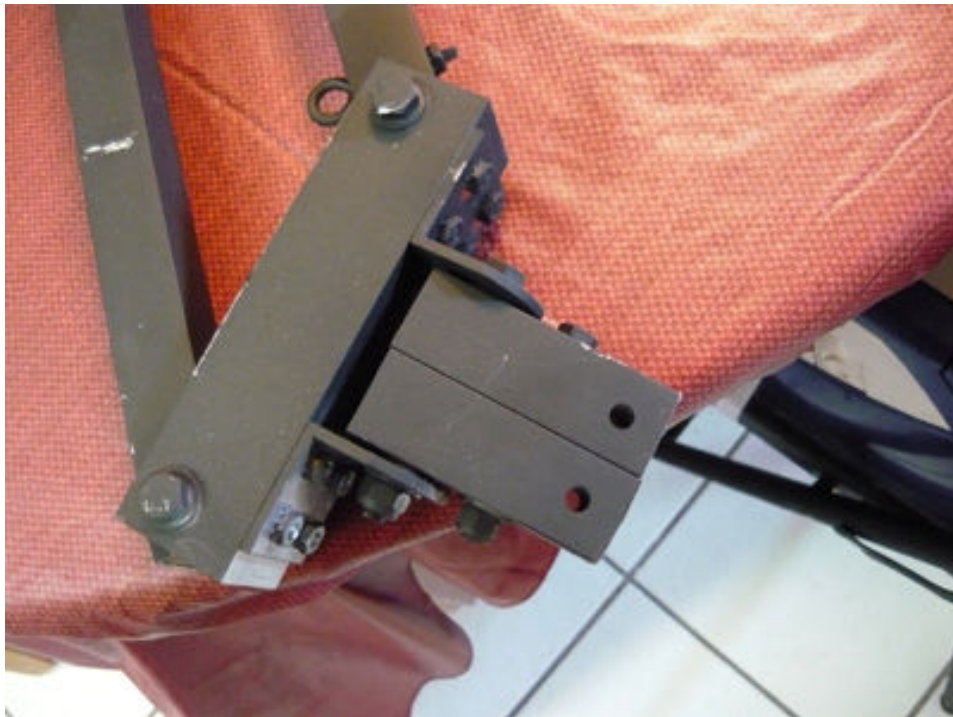
Now, using the other 2 Hinge Blocks and 4 Bones, assemble arms: **IMPORTANT!!!** holes for eyelets should be in marked locations...Using 8 X 2" X 5/16" bolts, bolt Bones to Hinge Blocks...Similar to Joint assembly, the bolts should go through in this order: Washer, Hinge Block, 2 more washers, Bone assembly (with Bearings), 1 more washer, Hinge Block (other side), washer, Nylon Locknut.



Once this is done, assemble the two arms to the Joint assembly, using the same methods used to assemble the Arms previously...NOTICE location of eyelets on inside corners.



Finally, mount the Vest mount where it goes, in a similar fashion to the Joint assembly (only just on one side.)



Using a  $\frac{5}{8}$ " forstner bit, countersink one end of the  $\frac{7}{8}$ " round dowel, so that the bolt head is not exposed. Drill a  $\frac{5}{16}$ " diameter hole all the way through the radius of the dowel. Using the  $5 \times \frac{1}{4}$ " bolt, affix the dowel through to end of the Angle bracket, being sure to use washers on each end, and topping off with a Nylon Locknut. This is the "Sled Mount".





Insert eyelets on inside of arms, and bolt in place. Attach spring on one end, and turnbuckle on the other.



Now, let's turn our attention to the Vest.

Cut the 3" plate aluminum into two sections: 12", and 14".

Cut the 2" plate aluminum into a 12" piece and 4 1-1/2" pieces.

Cut the 1" angle aluminum in half, to get 2- 6" sections.

Now, take the Baby carrier out and remove the portion that the 'Lil tyke sits in—this is permanently attached (the rest can come off by hand) by a set of two 1" black nylon straps that are looped around a portion near the waist belt and snap into place. Cut through the black nylon strap near the snaps. You should now be left with just the harness portion.



DISCARDED PIECE:



Cut off the waist straps (but DO NOT cut into the pad---ONLY the 1" strap).

On the 14" plate aluminum, bend both ends about 4" from each end—I bent them about 30 degrees. I used a vise, which I clamped 4" of the plate in (just below the 4" line), leaving the rest exposed...I then clamped a piece of 2x4 to the exposed portion with a pair of wood clamps, and used it as a cheater bar to bend the piece. I used a protractor to measure the angle of bend.

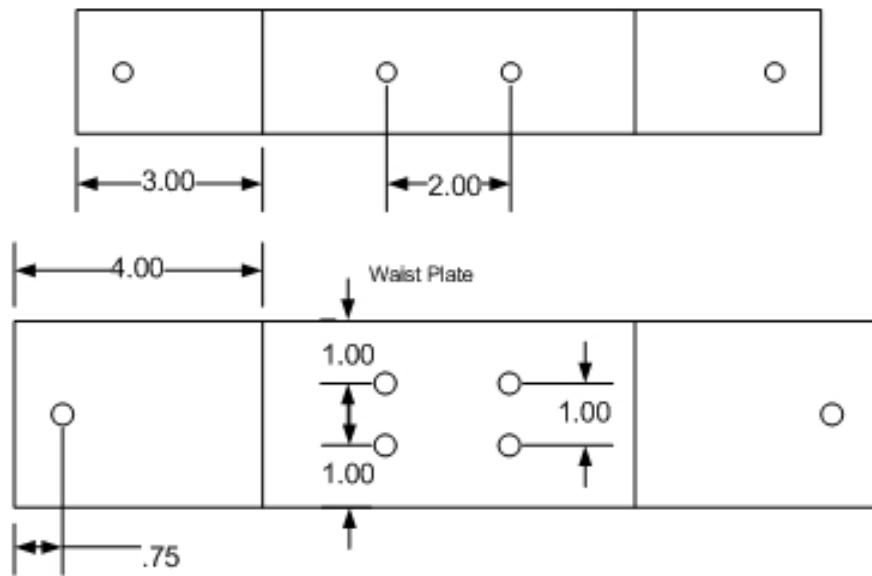
Repeat this with the other end—You'll have to clamp the 2x4 to the top of the piece so it doesn't interfere with the already bent portion.

Perform this same procedure with the 12" thinner plate aluminum, about 3" from each end. You should not need the 2x4 and clamps to do this.

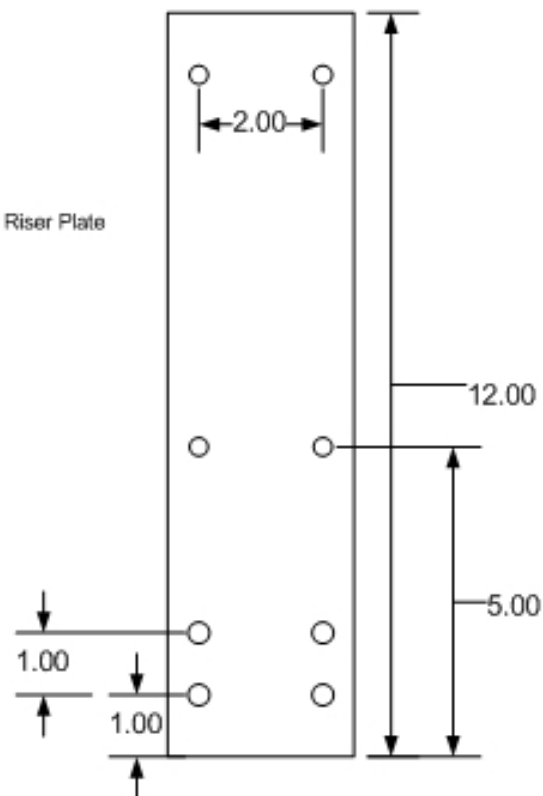
Drill a 1/4" hole at the end of each bent piece, 3/4" from each end.

The larger bent plate will now be called the 'Waistplate', and the smaller, the 'Chestplate'.

Chest Plate



Riser Plate





On the Chest Plate, drill the 1/4" holes to attach the 'Riser Plate', the remaining 12" heavy plate. They should be centered on the bar (1" from both sides), and each should be 1" from the centerline---making them 2" apart( as always, center-to-center) from each other. (see photo.) Use these as a guide to drill matching holes in the top of the Riser Plate: These holes should also be 1" from the top edge, and 2" from each other, or 1" from the centerline of the plate. Wait until later to assemble the Chest plate, vest, and Riser plate together.

Next, take aside the 2 6" pieces of Angle aluminum---This will become your 'Socket Block'. Each is a 'Socket Rail'.

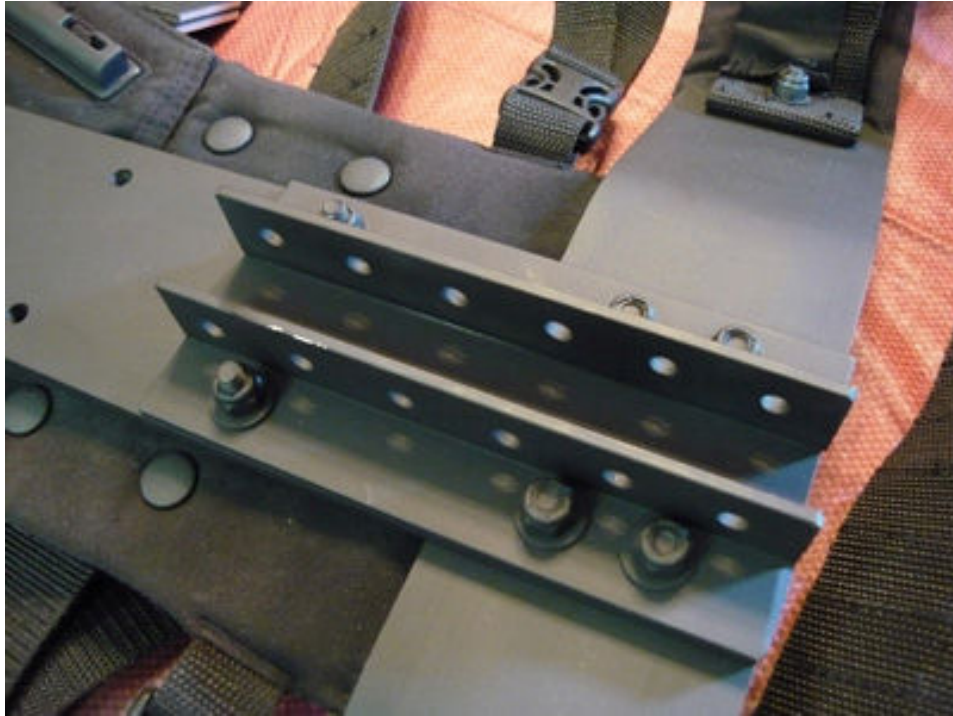
On each, mark out and drill a set of 6 1/4" holes on one side---1" apart (center-to-center), beginning and ending 1/2" from the ends of the pieces.

Next, drill a set of holes on the OTHER SIDE of the Socket Rails---one 1/4" hole at each end, 1" from the ends and centered on the INSIDE of the angle (should be 7/16" from the side edge.) Study the photo, and drill an additional 1/4" hole on each---2" from the bottom end. You should have one hole on the top, and two on the bottom---the ones on the bottom should be 1" apart. These are the holes you will use to mount the Socket block pieces to the Riser AND Waist Plates.

Use a piece of the scrap 1" square box aluminum to get the spacing right between the socket rails---slide the piece of box aluminum and a business card in between the rails and clamp them together. The Business card will give just a little extra spacing between the Socket rails to make it easier to mount the arm...Once the project is finished. Now, use the hole spacing to mark out and drill the holes for attaching the Waistplate and Riser plate---The 4 holes at the bottom should be 1" from top to bottom, and about 2" side-to side from each other. The bottom edges of the Socket Rails, Waist Plate, and Riser plate should all be flush. Also, don't forget to drill the holes to mount the top end of the Socket rails to the Riser Plate. As usual, clean the holes using a dremel or file.

Finally, mount it all together---You'll need to line up the Waistplate on the waist pad on the Baby carrier---The plate should go on top of the pad. Punch holes in the pad to correspond with the holes in the Waistplate, then use the 1" bolts, washers, and locknuts to bolt it all together...Mount the tops of the socket rails to the Riser plate. Then push the 1" machine screws with washers through---starting from the holes in the back of the Vest Pad (starting with the 4 in the center), then through the matching holes in the Waist Plate, then Riser Plate, and finally the Socket Rails. Top the bolts off with another set of washers, and finally a locknut. It's a good idea to wait until all the bolts and hardware are installed to tighten the entire assembly down. Once the Socket rails/Socket block is all tight, check clearance by mounting the Arm mount into it---The fit should be snug but not tight---You shouldn't have to force it together, but it shouldn't be rattling around in there.....





Next, let's mount the securing belts.

Take the 4 pieces of 2" x 1 1/2" aluminum plate, and drill a 1/4" hole in the direct center of each.

Next, grab the 2" nylon belts---I used the shotgun shell carriers. You will need to cut each so that you have the 'open' or 'female' end (not the part that goes into it, the 'male' end) of the quick-release buckle and about 3" of strap, and the remainder of the strap attached to the 'male' end---the adjustment buckle. Punch a 1/4" hole centered on the strap ends, about 3/4" from the cut ends. Use a lighter or match to singe both the ends and the punched holes so that they don't unravel. Next, place a 1" bolt and washer in to the Chest Plate from behind. The threaded end should protrude from the front. Place the strap ends on the bolts using the punched holes (make sure on the male end to get it right-side up!), then place the drilled 1 1/2" plate on top. Follow this with a washer and finally a locknut....Tighten the assembly together.



Repeat the basic assembly with the ends of the Pad Belt/Waistplate---using a bolt with washer, pushing it through the punched hole, through the corresponding holes in the Waist plate ends. Repeat the procedure for preparing and mounting the Chest Strap for the Waist Strap---Using the bolts you just pushed through---So, it should be a bolt pushed in through the back, passing through the Pad, Waistplate, Waist strap, 2 x 1 ½" plate, then finally another Washer and locknut. (See the photos, front and back)





Finally, use the holes at the top of the Riser plate as a guide to punch two  $\frac{1}{4}$ " holes in the chest of the Baby Carrier---Then bolt the Chest plate, vest, and Riser together using the  $\frac{1}{4}$ " hardware as before.

So...You're done! Put the vest on and adjust the fit straps so that the Vest is tight on you (but not uncomfortable).







Once you're all fitted, mount the Arm next. It's tricky, as the arm will want to swing around and do a little impromptu Dentistry on you...So be careful. I use a Velcro strap to help keep the arm in check until I'm ready to mount the sled. Use the two 2 1/2" allen-head bolts with washers and Wingnuts to secure the arm. I used eye-nuts instead of Wingnuts, but each will work just as well. I jammed my allen wrench through the two eye-nuts in this picture...





Make sure there's tension on the arm springs, then grab the Glidecam sled by the handle. You'll notice the handle is hollow—the post at the end of the arm fits snugly inside of it. Slip the handle down until it stops...



And make any adjustments to the turnbuckles on the Arm to put the camera at the height you want...I usually put my camera's flip-out monitor at about chin level.

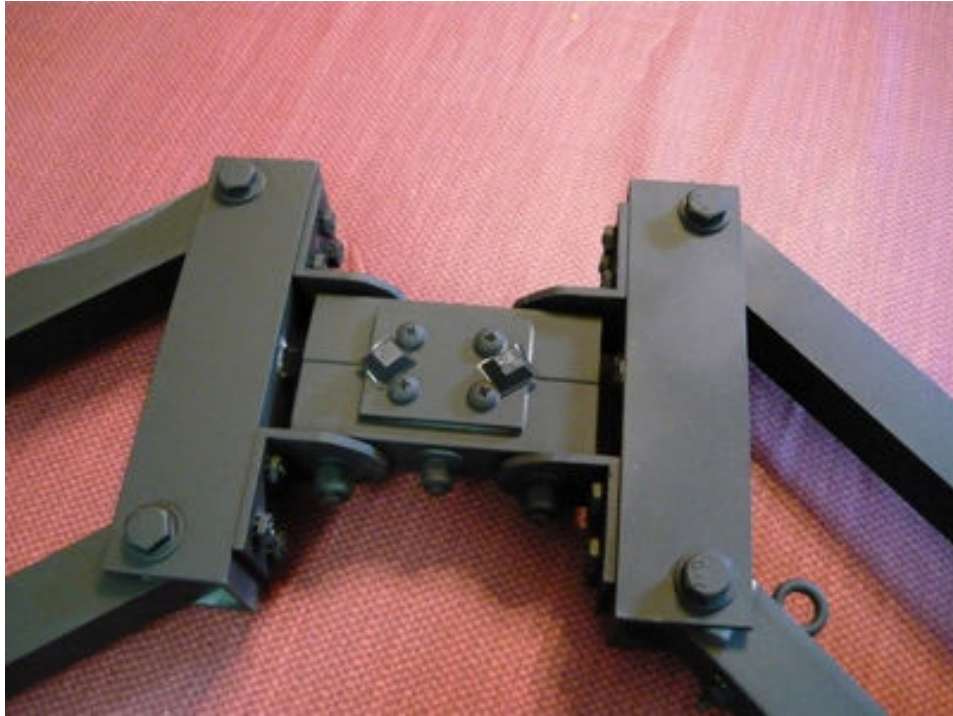




Finally...Once you get everything adjusted and balanced...PRACTICE, PRACTICE, PRACTICE! It takes quite a while as an operator to smooth out your form---and there's really no substitute for the real thing. It takes skill, coordination, and muscle fitness to be a good Steadicam operator. At first, you'll be sore...And the footage will most likely not be as smooth as you want. Stick with it!

One thing I added after a few practice sessions was a few well-placed stick-on rubber bumpers. I used them on the inside of the Knuckle assembly as well as at the arm-to-vest mount, to provide a soft limit-stop...It helps keep the arm from getting too close and bumping into you, and doesn't greatly interfere with its operation.



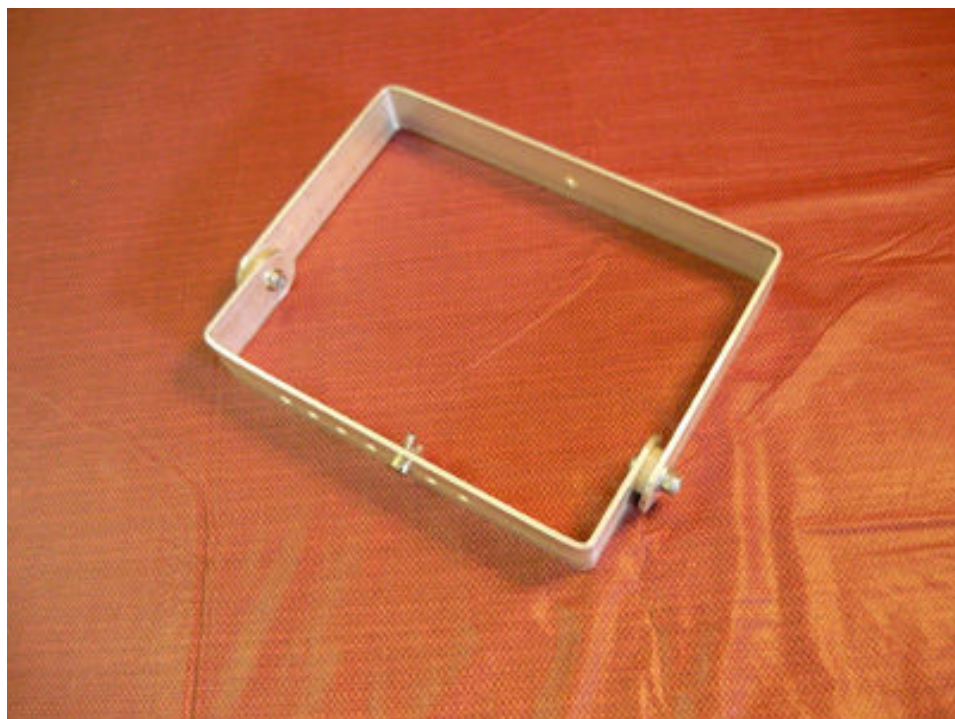


I'd also like to say that one site I got lots of ideas from is [www.homebuiltstabilizers.com](http://www.homebuiltstabilizers.com) . The whole site is dedicated to people who build their own rigs---From the steadicam here, to cranes, booms, dollies, etc.

As for my rig, I operate my camera's controls using a Lanc controller---that's the wire you see near the top rear of the sled. The wire is thin enough to not be a huge issue....but be aware that anything like this will affect stabilization to some degree. The thinner the wire, the better. I'm currently building a patch cable out of super-thin Litz headphone cable to minimize this effect.

I've also built a low-mode adapter from scratch, but have yet to test...





Have fun...Practice, and be safe!