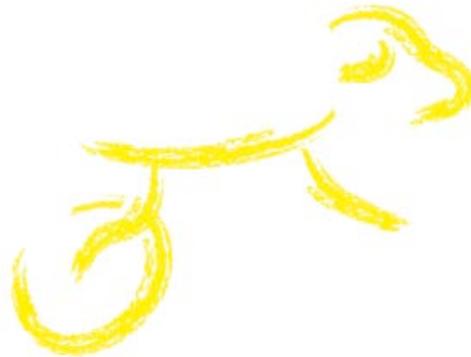


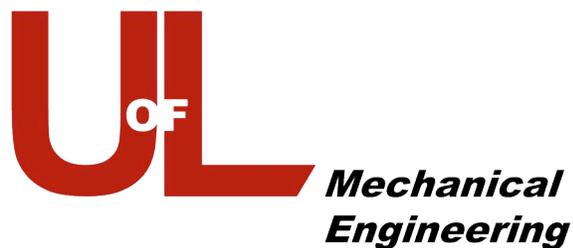
# **CANINE WHEELCHAIR ASSEMBLY INSTRUCTIONS**

## **MEDIUM AND LARGE SIZE WHEELCHAIR**



**UNIVERSITY OF LOUISVILLE**

**CANINE REHABILITATION AND BIOMECHANICS LABORATORY**



**Gina Bertocci, PhD, PE  
Edward Fowler, MEng**

***SUBJECT TO UNIVERSITY OF LOUISVILLE RESEARCH FOUNDATION TERMS OF  
USE AND CREATIVE COMMONS LICENSE AGREEMENT***

## **WARNINGS:**

- 1. Before your dog uses the canine wheelchair, seek approval from your dog's veterinarian certifying that your dog's physical condition is suitable for using a wheelchair. Use of the wheelchair can introduce added cardiovascular stress, which may lead to adverse health conditions or death in dogs that are not physically fit or with certain medical conditions.**
- 2. When first introducing your dog to wheelchair use, limit their usage to 15-minute intervals with adequate periods of rest between usage. Monitor your dog closely during wheelchair usage for any signs of pain, discomfort or labored breathing.**
- 3. If your dog exhibits any pain, discomfort or labored breathing when using the wheelchair remove him or her immediately from the wheelchair and consult a veterinarian.**
- 4. Human adult supervision is advised at all times when your dog is using their wheelchair.**
- 5. Consult with a local veterinary rehabilitation professional to assure that your dog will receive maximum benefit from their wheelchair. Certified veterinary rehabilitation professionals can be found at:**
  - a. [http://www.caninerehabinstitute.com/Find\\_A\\_Therapist.html](http://www.caninerehabinstitute.com/Find_A_Therapist.html)**
  - b. <http://www.canineequinerehab.com/practitioners.asp>**

MEDIUM CANINE WHEELCHAIR - BILL OF MATERIALS									
Ref #	Part	Part Size (in)	Quantity	Length (in)	Supplier	Manuf - Model - Notes	Price (\$/in, \$/part)	Shipping	Total Cost
1	10.5" Sch 40 PVC	1	2	21.00	Lowe's		\$0.02		\$ 0.40
2	16" Sch 40 PVC	1	2	32.00	Lowe's		\$0.02		\$ 0.61
3	8.5" Sch 40 PVC	1	2	17.00	Lowe's		\$0.02		\$ 0.33
4	2.5" Sch 40 PVC	1-1/4	4	10.00	Lowe's		\$0.03		\$ 0.27
5	3.25" Sch 40 PVC	1-1/4	4	13.00	Lowe's		\$0.03		\$ 0.35
6	4.75" Sch 40 PVC	1-1/4	2	9.50	Lowe's		\$0.03		\$ 0.25
7	5.5" Sch 40 PVC	1-1/4	2	11.00	Lowe's		\$0.03		\$ 0.29
8	6.5" Sch 40 PVC	1-1/4	2	13.00	Lowe's		\$0.03		\$ 0.35
9	4.1" Sch 40 PVC	1-1/4	4	16.50	Lowe's		\$0.03		\$ 0.44
11	90° elbow	1-1/4	4		Lowe's		\$0.69		\$ 2.76
12	90° reduction elbow	1 : 1-1/4	2		Lowe's		\$1.11		\$ 2.22
13	45° wyes	1-1/4	4		Flexpvc.com		\$3.95	\$9.00	\$ 24.80
14	T-joint	1-1/4	2		Lowe's		\$1.22		\$ 1.22
15	Clevis Pin	1/4	8	2.00	Lowe's	Hillman-H# 881075	\$1.87		\$ 14.96
16	Hitch Pin Clip	5/64 x 1-5/16	8		Lowe's	Hillman-#881095	\$0.68		\$ 5.44
17	Plastic Buckle	1	10		ITW Nexus	WSR 25 Assembly (w/Latch 525-1100)	\$1.10		\$ 11.00
18	PVC Glue		1		Lowe's	Gorilla Glue	\$4.96		\$ 4.96
19	12.5" pneumatic wheels	12.5 x 2.5	2		Northern Tools	#40148	\$8.99	\$7.99	\$ 25.97
20	Hex Head Bolt - Axle	1/2	2	4.50	Lowe's	Steel Grade 8	\$1.82		\$ 3.64
21	Heavy Duty Cable Ties	175 lb	18	18.00	Lowe's	Gardner Bender or equivalent	\$0.28		\$ 5.04
22	Nylon Spacers	1/2	2	0.75	Lowe's		\$0.69		\$ 1.38
23	Tubular Nylon Webbing		1	84.00	Strapworks.com	or equivalent webbing	\$0.40		\$ 2.80
24	Pelvic Harness	MED or LG	1		handicappedpets.com	Walk About	\$55.00	\$8.05	\$ 63.05
25	Chest Harness	MED or LG	1		ForDogTrainer.com	Dog Pulling Harness - H6	\$34.90	\$9.00	\$ 43.90
26	SAE Washer	1/2	6		Lowe's		\$0.34		\$ 2.04
27	Ladderloc Plastic Buckle	1	2		ITW Nexus	LL-1 or equivalent	\$0.70		\$ 1.40
28	Hex Steel Nut	1/2	2		Lowe's	Steel Grade 8	\$0.14		\$ 0.28
<b>Total</b>									<b>\$ 220.15</b>
<b>Total (w/o harness)</b>									<b>\$ 113.20</b>

**Alternate Dog Harness**

Ref #	Part	Part Size (in)	Quantity	Length (in)	Supplier	Manuf - Model	Price (\$/in, \$/part)	Shipping	Total Cost
25	Chest Harness*	MED or LG	1		Altrec.com	Ruff Wear Web Master Dog Harness	\$49.95	\$9.00	\$ 58.95

*Note: A 10% discount is available for the Walk About Pelvic Harness from Walk About Harnesses at (800) 779-0439 by indicating that you are a "University of Louisville Wheelchair Referral" client.*

**BILL OF MATERIALS FOR MEDIUM-SIZED CANINE WHEELCHAIR**

LARGE CANINE WHEELCHAIR - BILL OF MATERIALS										
Ref #	Part	Part Size (in)	Quantity	Length (in)	Supplier	Manuf - Model - Notes	Price (\$/in, \$/part)	Shipping	Total Cost	
1	16" Sch 80 PVC	1	2	32.00	Grainger		\$0.06		\$ 1.81	
2	16" Sch 40 PVC	1	2	32.00	Lowe's		\$0.02		\$ 0.63	
3	8.5" Sch 40 PVC	1	2	17.00	Lowe's		\$0.02		\$ 0.33	
4	2.5" Sch 40 PVC	1-1/4	4	10.00	Lowe's		\$0.03		\$ 0.27	
5	3.25" Sch 40 PVC	1-1/4	4	13.00	Lowe's		\$0.03		\$ 0.35	
6	4.7" Sch 40 PVC	1-1/4	2	9.50	Lowe's		\$0.03		\$ 0.26	
7	5.5" Sch 40 PVC	1-1/4	2	11.00	Lowe's		\$0.03		\$ 0.30	
8	6.5" Sch 40 PVC	1-1/4	2	13.40	Lowe's		\$0.03		\$ 0.36	
9	4.1" Sch 40 PVC	1-1/4	4	16.40	Lowe's		\$0.03		\$ 0.44	
11	90° elbow	1-1/4	4		Lowe's		\$0.69		\$ 2.76	
12	90° reduction elbow	1 : 1-1/4	2		Lowe's		\$1.11		\$ 2.22	
13	45° wyes	1-1/4	4		Flexpvc.com		\$3.95	\$9.00	\$ 24.80	
14	T-joint	1-1/4	2		Lowe's		\$1.22		\$ 1.22	
15	Clevis Pin	1/4	8	2.00	Lowe's	Hillman-H# 881075	\$1.87		\$ 14.96	
16	Hitch Pin Clip	5/64 x 1-5/16	8		Lowe's	Hillman-#881095	\$0.68		\$ 5.44	
17	Plastic Buckle	1	10		ITW Nexus	WSR 25 Assembly (w/Latch 525-1100)	\$1.10		\$ 11.00	
18	PVC Glue		1		Lowe's	Gorilla Glue	\$4.96		\$ 4.96	
19	12.5" pneumatic wheels	12.5 x 2.5	2		Northern Tools	#40148	\$8.99	\$7.99	\$ 25.97	
20	Hex Head Bolt - Axle	1/2	2	4.50	Lowe's	Steel Grade 8	\$1.82		\$ 3.64	
21	Heavy Duty Cable Ties	175 lb	18	1.50	Lowe's	Gardner Bender or equivalent	\$0.28		\$ 5.04	
22	Nylon Spacers	1/2	2	0.75	Lowe's		\$0.69		\$ 1.38	
23	Tubular Nylon Webbing	1	1	84.00	Strapworks.com	or equivalent webbing	\$0.40		\$ 2.80	
24	Pelvic Harness	LG or XL	1		handicappedpets.com	Walk About	\$55.00	\$8.05	\$ 63.05	
25	Chest Harness*	LG or XL	1		ForDogTrainer.com	Dog Pulling Harness - H6	\$34.90	\$9.00	\$ 43.90	
26	SAE Washer	1/2	6		Lowe's		\$0.34		\$ 2.04	
27	Ladderloc Plastic Buckle	1	2		ITW Nexus	LL-1 or equivalent	\$0.70		\$ 1.40	
28	Hex Steel Nut	1/2	2		Lowe's	Steel Grade 8	\$0.14		\$ 0.28	
									Total	\$ 221.61
									Total (w/o harness)	\$ 114.66

## Alternate Dog Harness

Ref #	Part	Part Size (in)	Quantity	Length (in)	Supplier	Manuf - Model	Price (\$/in, \$/part)	Shipping	Total Cost
25	Chest Harness*	LG or XL	1		Altreco.com	Ruff Wear Web Master Dog Harness	\$49.95	\$9.00	\$ 58.95

Note: A 10% discount is available for the Walk About Pelvic Harness from Walk About Harnesses at (800) 779-0439 by indicating that you are a "University of Louisville Wheelchair Referral" client.

## BILL OF MATERIALS FOR LARGE-SIZED CANINE WHEELCHAIR

**MEDIUM AND LARGE WHEELCHAIR ASSEMBLY INSTRUCTIONS**

The following medium sized wheelchair is suitable for dogs weighing  $\leq 70$  lbs with a wither height of 14-19 in and a hip to shoulder length of 12-20 in.

The following large wheelchair is suitable for dogs weighing  $\leq 100$  lbs with a wither height of 20-27 in and hip to shoulder length of 12-20 in.

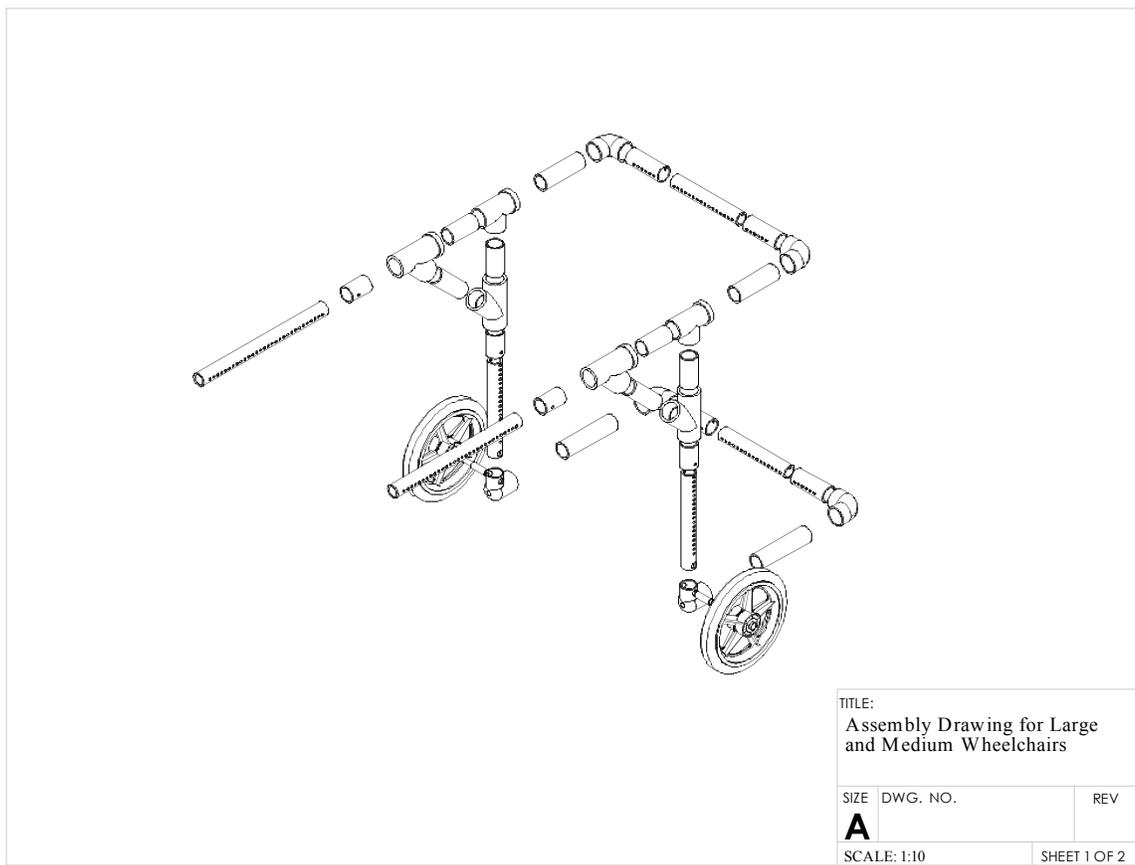


FIGURE 1 – Exploded View of Wheelchair Assembly.

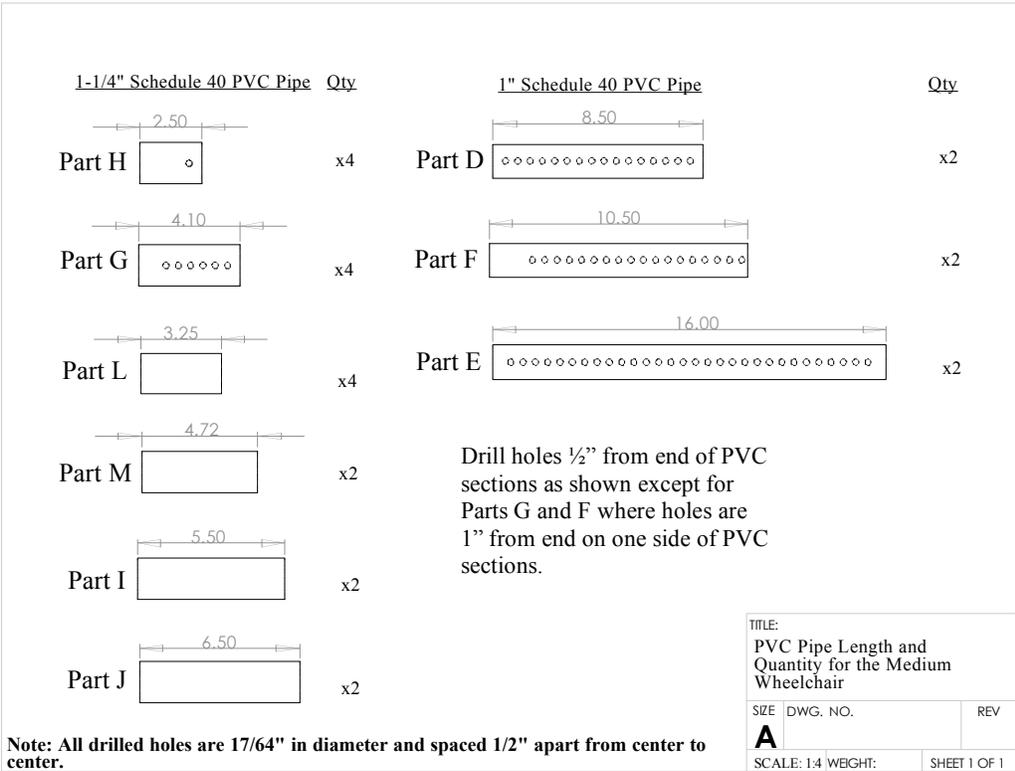


FIGURE 2 – Linear Sections of PVC Pipe and Quantities for Medium Wheelchair.

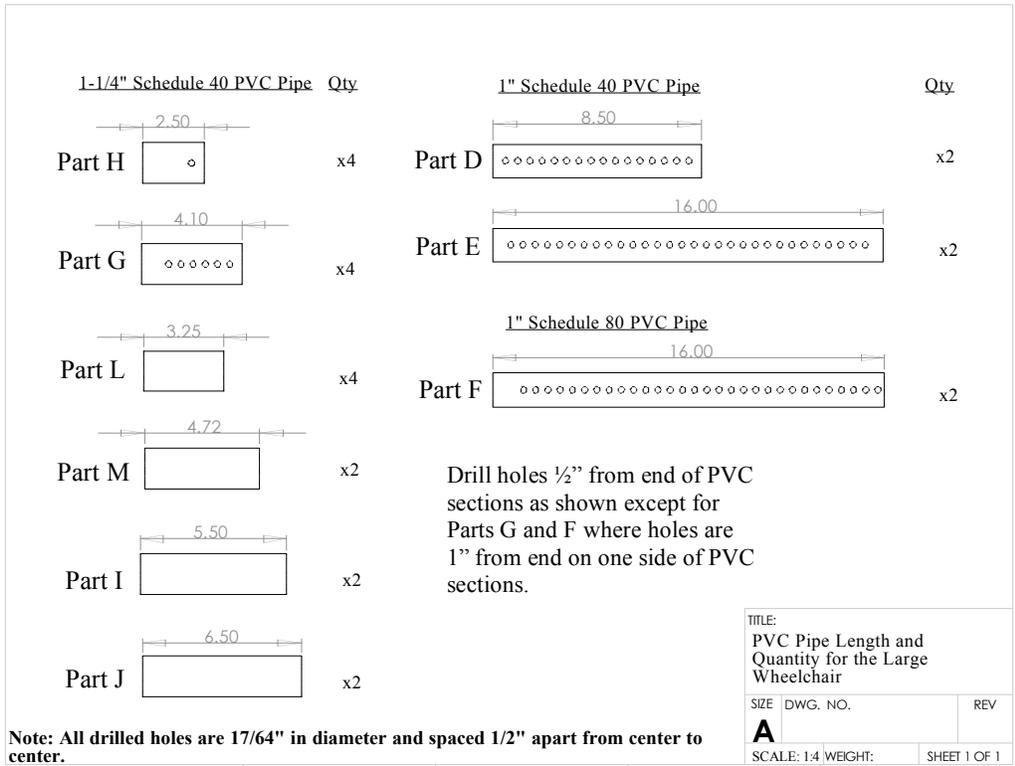


FIGURE 3 – Linear Sections of PVC Pipe and Quantities for Large Wheelchair.

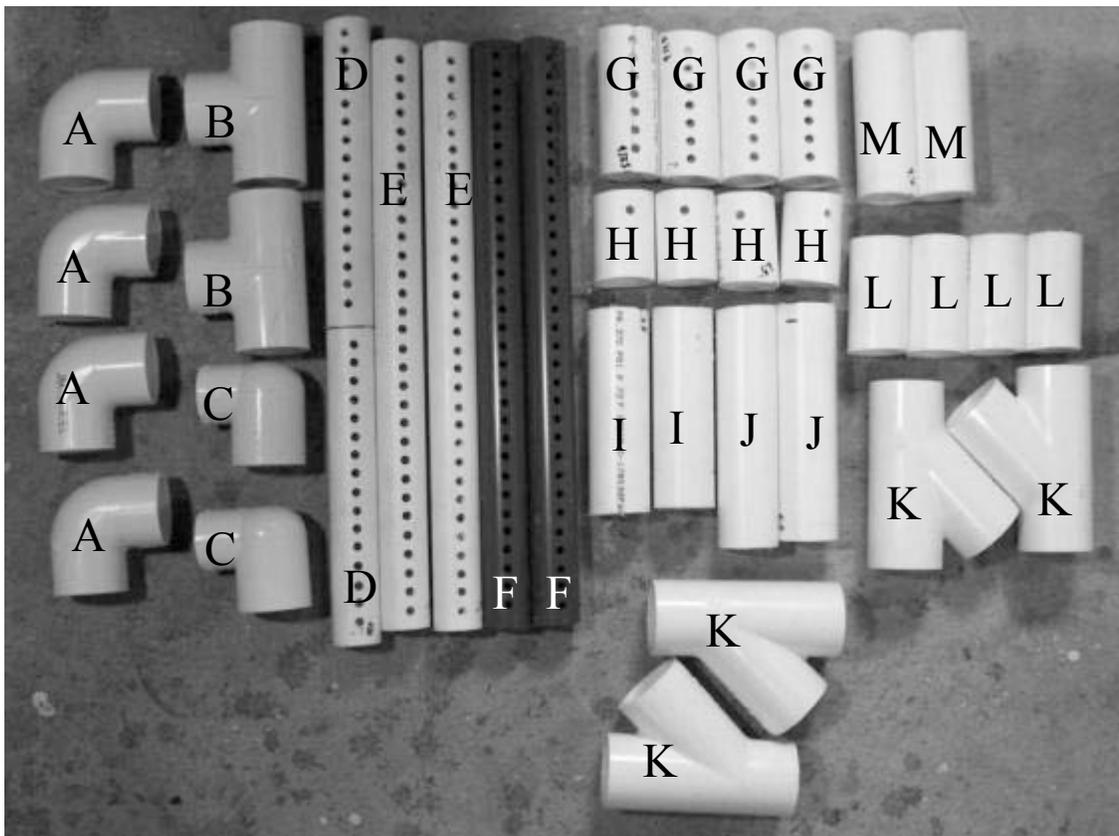


FIGURE 4 – PVC Parts Needed to Assemble Large Wheelchair Frame.  
 Note: PVC parts for medium wheelchair are the same with the exception of Part F.

TABLE 1  
 PARTS LIST FOR MEDIUM/LARGE WHEELCHAIR FRAME AND WHEEL ASSEMBLIES

Part Label	Part Name	Quantity
A	1-1/4" PVC Elbow	4
B	1-1/4" PVC Tee Fitting	2
C	1-1/4" to 1" PVC Reduction Elbow	2
D	8.5" Schedule 40 PVC Pipe	2
E	16" Schedule 40 PVC Pipe	2
F*	16" Schedule 80 PVC Pipe (large wheelchair)	2
F*	10.5" Schedule 40 PVC Pipe (medium wheelchair)	2
G	4.1" Schedule 40 PVC Pipe	4
H	2.5" Schedule 40 PVC Pipe	4
I	5.5" Schedule 40 PVC Pipe	2
J	6.5" Schedule 40 PVC Pipe	2
K	1-1/4" PVC Wyes	4
L	3.25" Schedule 40 PVC Pipe	4

M	4.7" Schedule 40 PVC Pipe	2
N	1/4" x 2" Clevis Pin & Clips	8
O	5" x 1/2" bolt for axle	2
P	3/4" x 1/2" Nylon Spacer	2
Q	1/2" SAE Washers	6
R	12.5" Pneumatic Wheels	2

\*Note: The only difference in the large wheelchair and the medium wheelchair is the length and type of PVC used for Part F. For the large-sized wheelchair Part F is Schedule 80 PVC and is 16 in. For the medium-sized wheelchair, Part F is Schedule 40 PVC and is 10.5 in.

### Tools and Supplies for Assembly

- Gorilla PVC Glue™ (Non-toxic and no primer required)
- Mallet or hammer
- Drill press (preferable) or drill
- 1/2 in and 17/64 in diameter drill bits
- Adjustable wrench (2)
- Cable Tie Tensioner
- Heavy Duty Thread
- Heavy Duty Needle
- Thimble
- Lighter or matches
- Self centering drill jig (optional - can be purchased online at: HarborFreight.com - ITEM 92046-9VGA \$7.99)

**NOTE:** Even though the Gorilla PVC Glue has slower setting time than other PVC Glues it will still set in under 1 minute. In all cases, liberally apply a thick strip of PVC glue on the entire inner circumference of the PVC fitting for each joint. Read instructions carefully before starting to assemble the frame.

**Step 1:** Cut linear sections of PVC to lengths specified in Figure 2 (medium-sized wheelchair) or 3 (large-sized wheelchair). Mark locations and drill holes as specified in Figure 2 or 3 (depending upon wheelchair size) using a drill or preferably drill press (Figure 5). Be certain to align all holes at the mid-point of the PVC pipe section and assure that holes are parallel to each other. Failure to do so will result in difficulty in adjusting wheelchair dimensions. (Details on constructing a jig to aid in drilling the holes in PVC pipe will be forthcoming.)

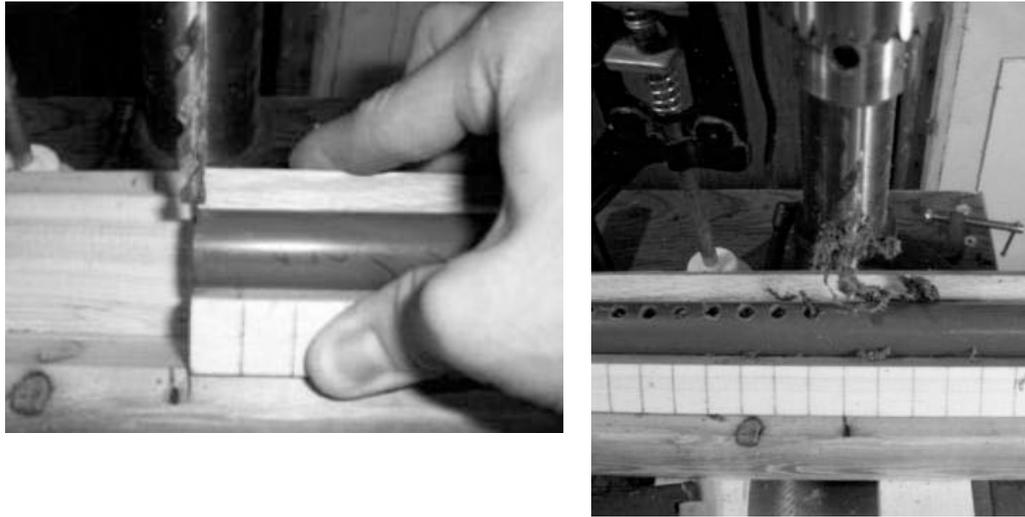


FIGURE 5 – Step 1 – Drilling Holes.

### Wheelchair Side Frame

**Step 2.** Coat the inner surface of the middle opening of Part B with PVC glue and insert Part L into Part B. Gently and evenly tap Part L with a mallet until it is completely seated.

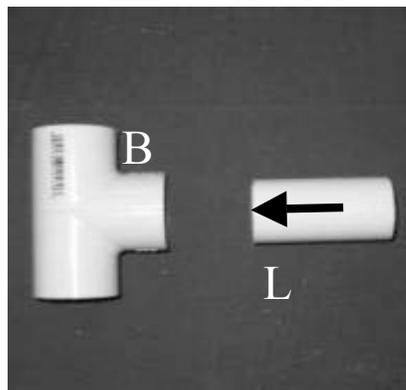


FIGURE 6 – Step 2 – Wheelchair Side Frame.

**Step 3.** Coat the inner surface of one of the side openings of Part B with PVC glue and insert Part L into this opening. Use the mallet to properly seat the connection.

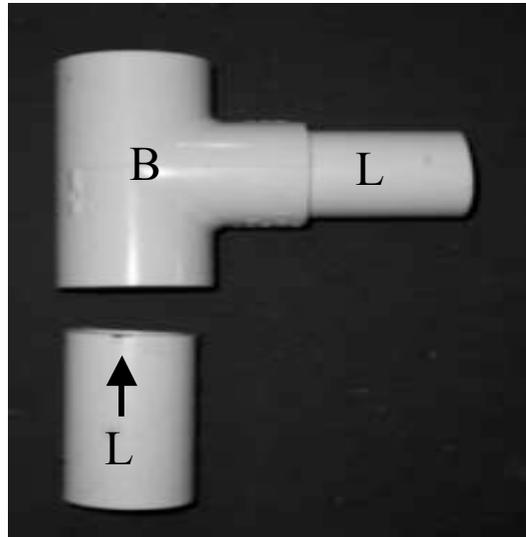


FIGURE 7 – Step 3 – Wheelchair Side Frame.

**Step 4.** Coat the inner surface of the angled opening of Part K with PVC glue and insert Part M into that opening. Use the mallet to properly seat the connection.

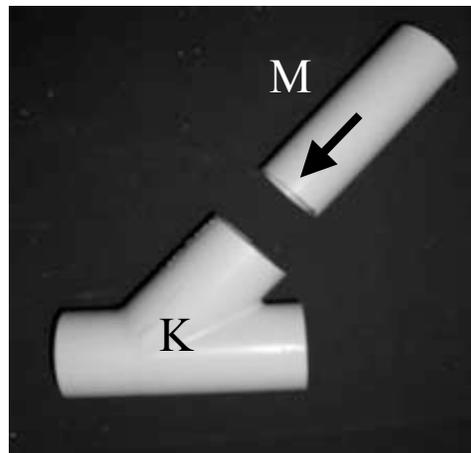


FIGURE 8 – Step 4 – Wheelchair Side Frame.

**Step 5.** Coat the inner surface of the three openings on the two Part K fittings shown by arrows in Figure 9 with PVC glue. Carefully align the openings and PVC pipe to slide into each other simultaneously. Use the mallet to properly seat each connection at an even rate by

hitting each end two to three times then rotating the assembly to hammer the other fittings into place in the same manner.

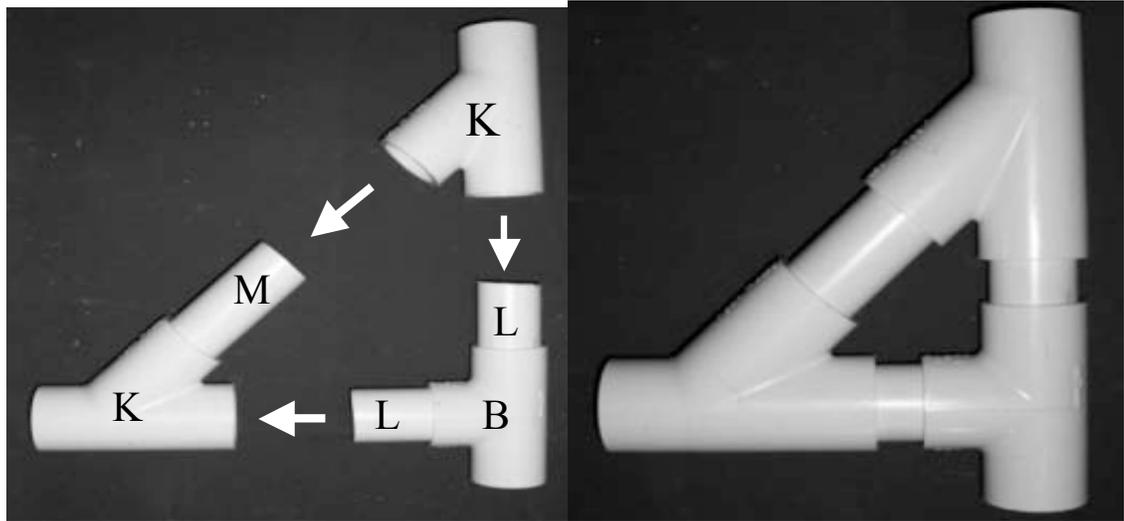


FIGURE 9 – Step 5 (Left) and Finished Section (Right) – Wheelchair Side Frame.

**Step 6.** Coat the inner surface of the remaining opening on the horizontally oriented Part K with PVC glue and insert Part H (end without drilled hole) into the opening, making sure to align the holes horizontally at the midpoint as shown in Figure 10. Use the mallet to properly seat the connection.

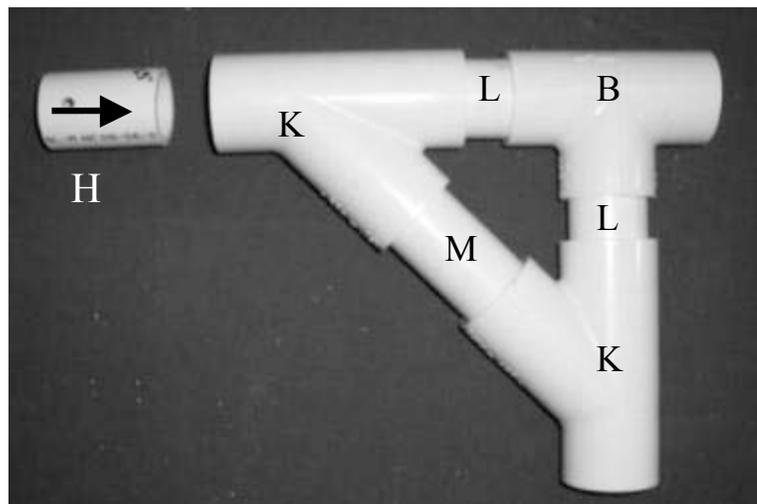


FIGURE 10 – Step 6 – Wheelchair Side Frame.

**Step 7.** Coat the inner surface of the remaining opening on the Part B with PVC glue and insert Part I into the opening. Use the mallet to properly seat the connection.

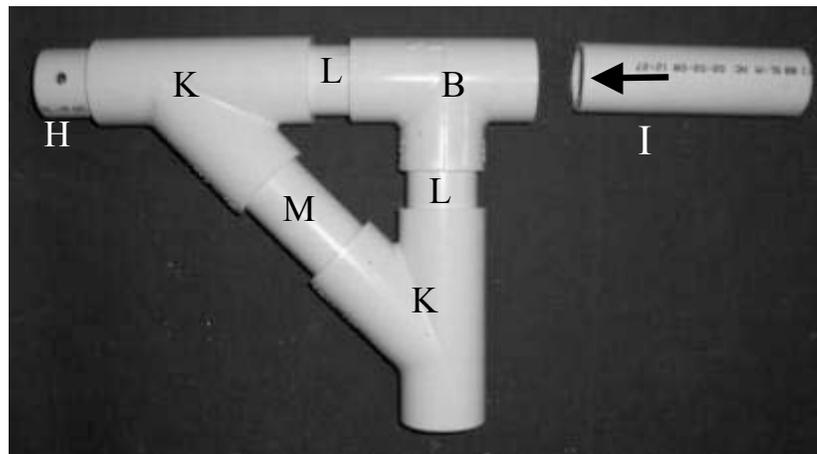


FIGURE 11 – Step 7 – Wheelchair Side Frame.

**Step 8.** Coat the inner surface of the remaining opening of the vertically oriented Part K with PVC glue and insert Part H (end without drilled hole) into the opening, making sure to align the holes at the midpoint as shown in Figure 12. Use the mallet to seat the connection.

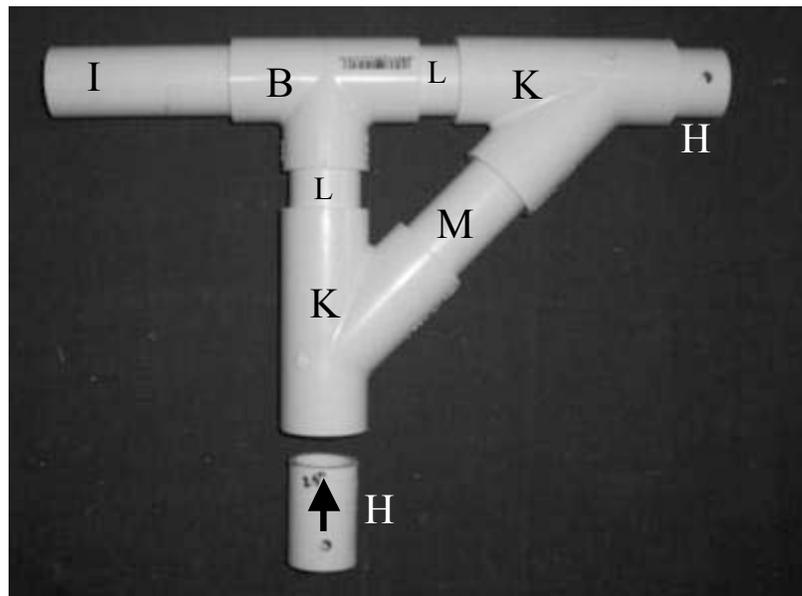


FIGURE 12 – Step 8 – Wheelchair Side Frame.

**Repeat Steps 2-8 to create the opposite side of the wheelchair frame.**

### **Upper and Lower Rear Wheelchair Frame**

**Step 9.** Coat the inner surface of an opening of Part A with PVC glue and insert Part G into this opening. Align the holes horizontally at the midpoint of the pipe (Figure 13). Use a mallet to seat the connection.

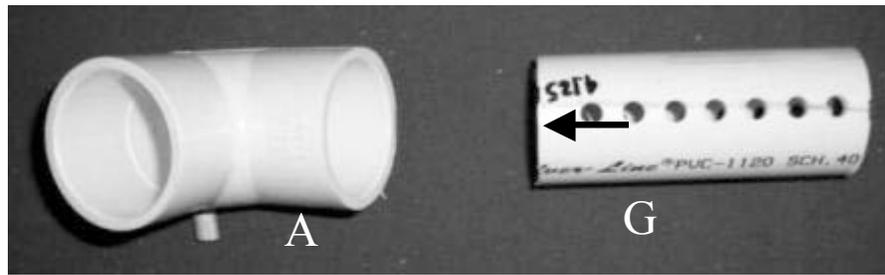


FIGURE 13 – Step 9 – Upper Rear Wheelchair Frame.

**Step 10.** Use clevis pins (or dowel rods if clevis pins are unavailable) to align the holes of two Part G components with Part D as shown in Figure 14.

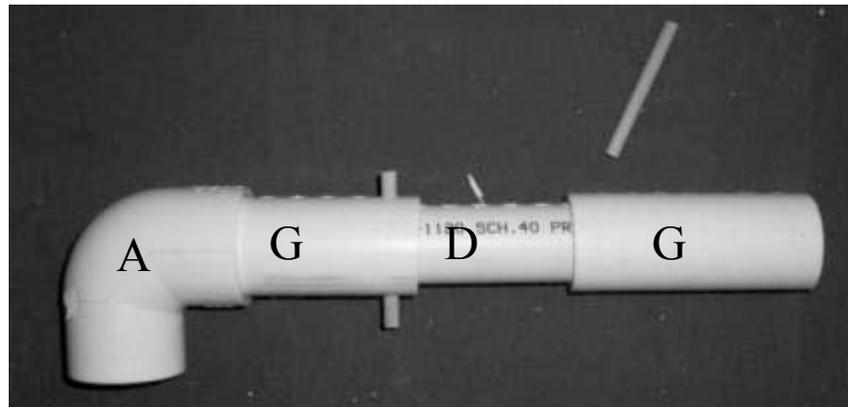


FIGURE 14 – Step 10 – Upper Rear Wheelchair Frame.

**Step 11.** Coat the inner surface of the opening on another Part A with PVC Glue and insert onto Part G joined with a clevis pin in Step 10, being careful to keep Parts A, G, and D oriented in the same horizontal plane as shown in Figure 15. Be sure that holes in Parts D and G are aligned and at the mid-point of the pipe. This is best accomplished by placing all components on a flat horizontal surface. Use the mallet to seat the Part G-Part A connection.

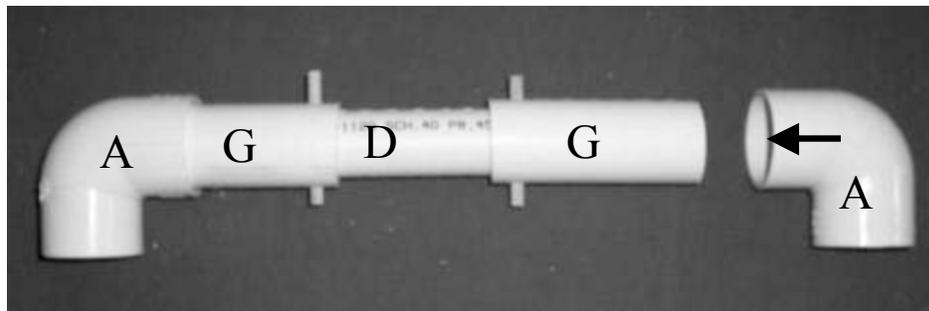


FIGURE 15 – Step 11 – Upper Rear Wheelchair Frame.

**Repeat Steps 9-11 to create the lower rear wheelchair frame.**

### Joining the Side Frame to the Rear Frame of the Wheelchair

**Step 12.** Use a clevis pin or dowel rod to align the drilled hole in Part H of the side frame structure created in Step 8 with Part F as shown in Figure 16.

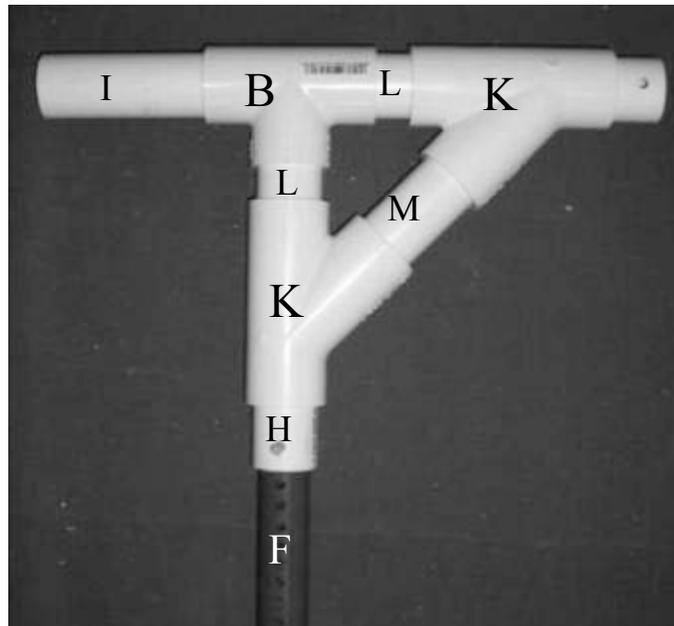


FIGURE 16 – Step 12 – Joining Side Frame to Rear Frame.

**Step 13.** Coat the inner surface of the 1 in opening of Part C with PVC Glue and insert it onto the free end of Part F. Use the mallet to seat the connection while carefully making sure that Part F holes align with the midpoint of Part C and is in the same plane with the side frame structure.

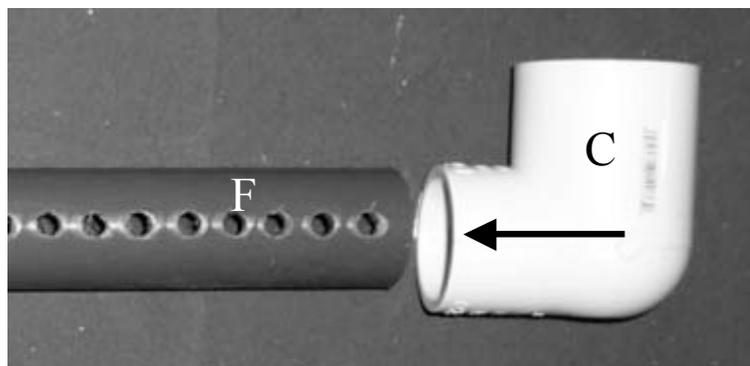


FIGURE 17 – Step 13 – Joining Side Frame to Rear Frame.

**Step 14.** Mark a point 1/2 in from the intersection and mid-plane (Figure 18) of the Part F and Part C (1 in opening side) connection to drill a 1/2 in hole for the axle (Figure 19). Drill a 1/2 in diameter hole through both walls of Part F and C assuring that the hole is perpendicular to the surface of Part C.

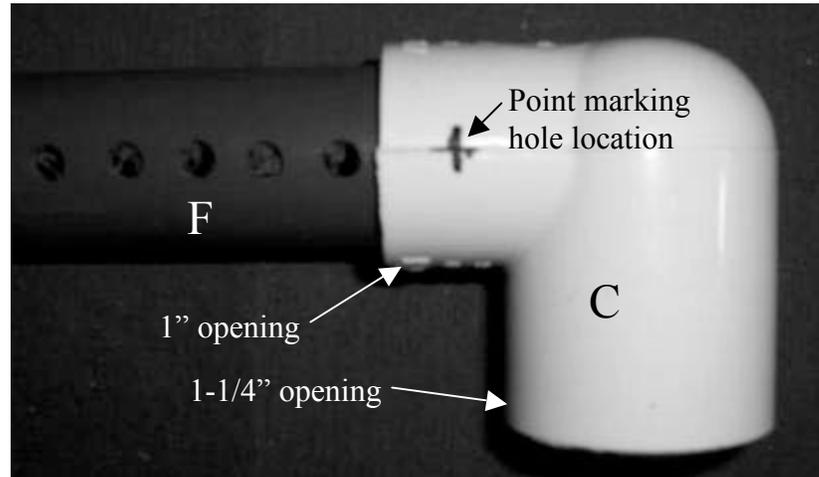


FIGURE 18 – Step 14 - Marking the Hole to be Drilled.

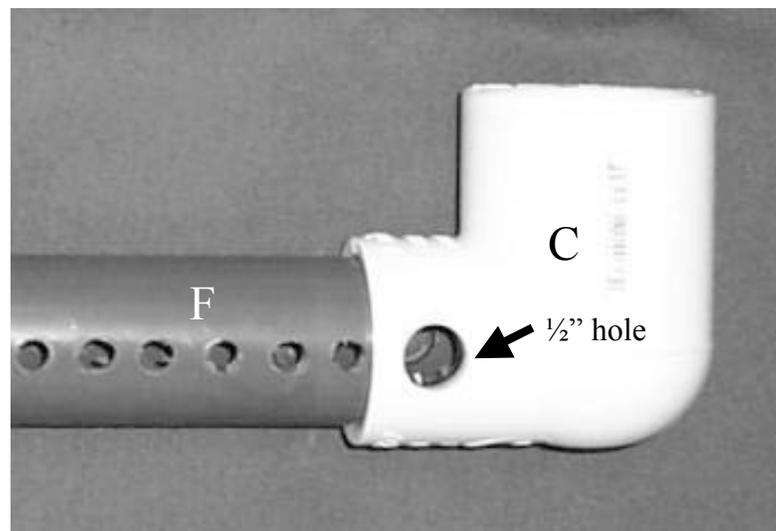


FIGURE 19 – Step 14 - 1/2 in Hole for Axle.

**Step 15.** Coat the 1-1/4 in opening of Part C with PVC Glue and insert Part J into the opening.

Use the mallet to seat the connection.

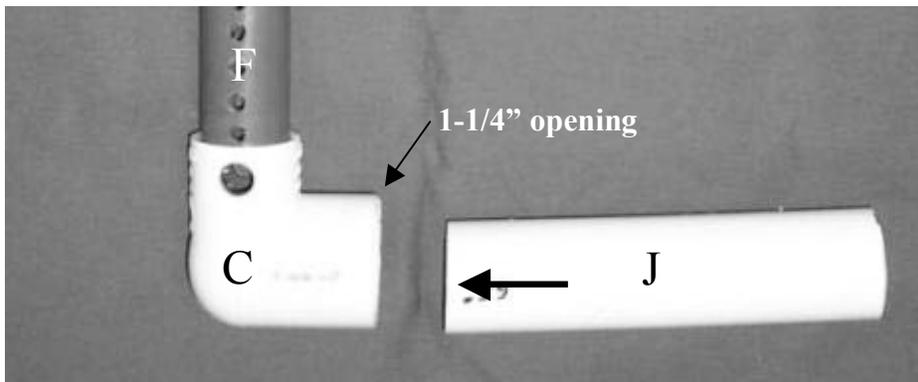


FIGURE 20 – Step 15 – Joining Side Frame to Rear Frame.

**Repeat Steps 12-15 for the opposite side of the frame.**

**Step 16.** Remove Part F from Part H by removing the dowel rod or clevis pin. Coat the inner surface of the opening of Part A on one side of the lower rear frame structure (created in Steps 9-11) and insert the free end of Part J (attached to the side frame structure created in Steps 12-15) into the opening. Keep the dowels/clevis pins in the lower rear frame structure (Part G and D) for alignment. Use the mallet to seat the connection.

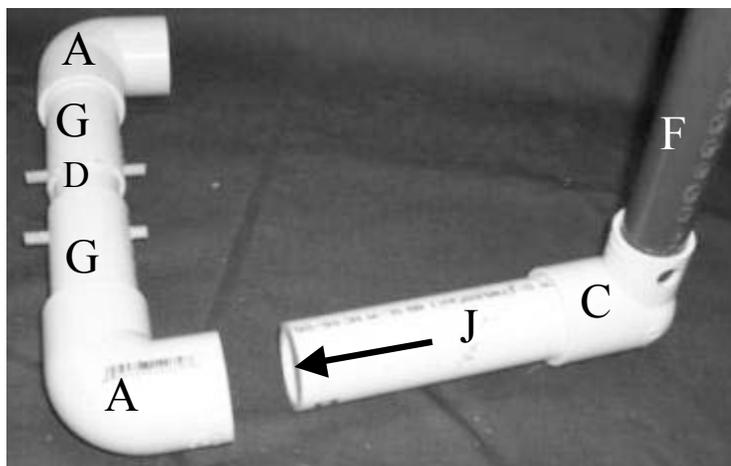


FIGURE 21 – Step 16 – Joining Side Frame to Rear Frame.

**Step 17.** Repeat Step 15 for the opposite side (Figure 21).

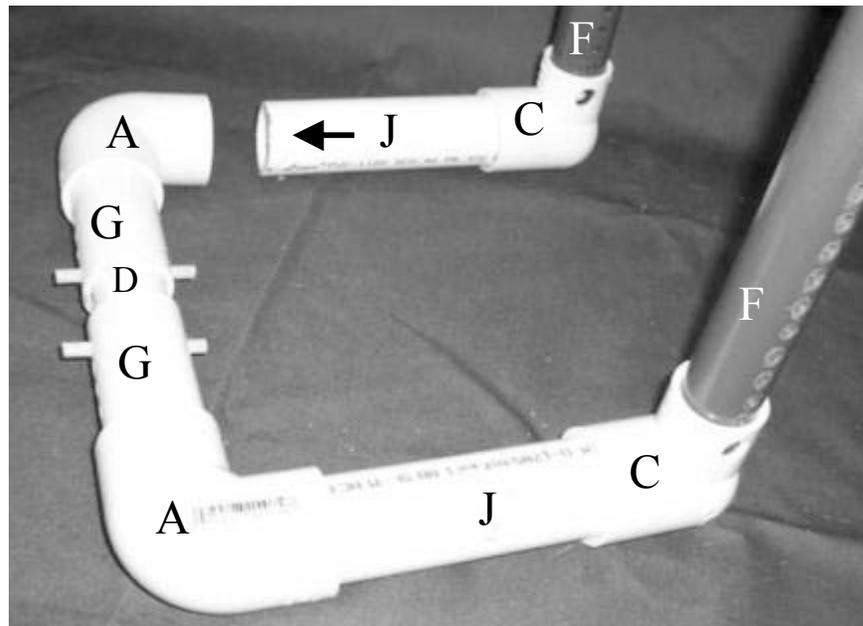


FIGURE 22 – Step 17 – Joining Side Frame to Rear Frame.

**Step 18.** Check the alignment of the vertical supports (Parts F) to assure they are parallel to each other and vertical. If not, correct before the glue sets.



FIGURE 23 – Step 18 – Joining Side Frame to Rear Frame.

**Step 19.** Place clevis pins or dowel pins through holes to align Parts F and H (both sides of the frame), attaching the structures created in Steps 2-8 to the lower portion of frame (created in Steps 9-11).

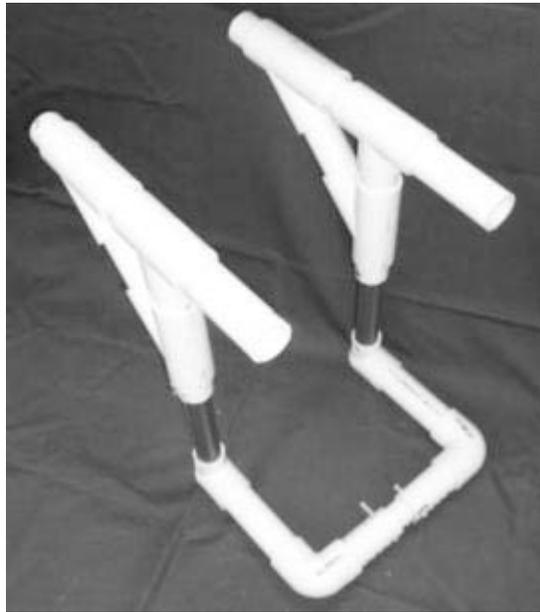


FIGURE 24 – Step 19 – Joining Side Frame to Rear Frame.

**Step 20.** Coat the inner surface of both ends of the upper rear wheelchair frame (Part A) with PVC glue and insert into both Part I's of the side frames as shown in Figure 25. Once again, be sure to maintain the alignment of the frame such that the sides are parallel and top horizontal with the floor. Use the mallet to seat the connections.

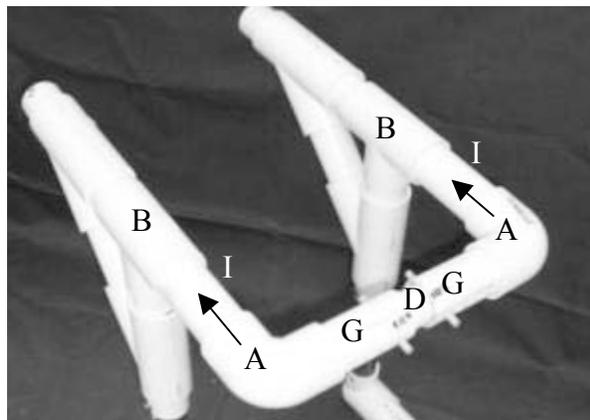


FIGURE 25 – Step 20 – Joining Side Frame and Rear Frame.

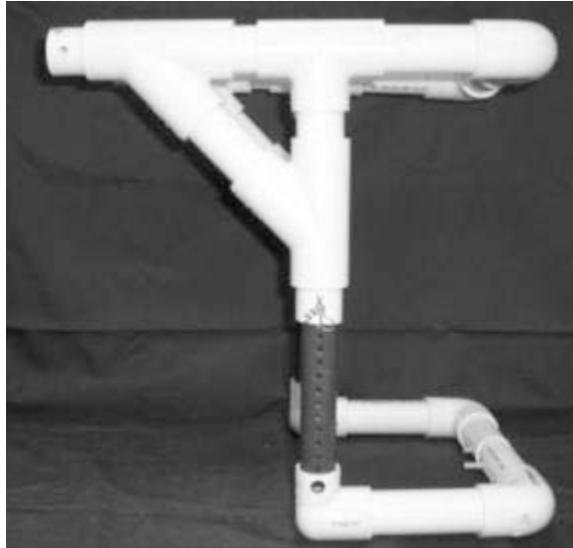


FIGURE 26 – Side View of Wheelchair Frame Subassembly.



FIGURE 27 – Front View of Wheelchair Frame Subassembly.

## **Wheel Assembly and Attachment**

**Step 1.** One wheel axle assembly includes: (Parts O-R, TABLE 1).

TABLE 2  
LIST OF PARTS FOR WHEEL ASSEMBLY

<b>Parts for One Wheel Assembly</b>	<b>Quantity*</b>
1/2 in diameter, 4-1/2 in long steel bolt (axle) with threaded end	1
1/2 in SAE steel washers	3
3/4 in x 1/2 in nylon spacer	1
1/2 in bolt nut compatible with threaded bolt	1
12.5 in pneumatic wheel	1

\* - quantities should be doubled for both wheel assemblies

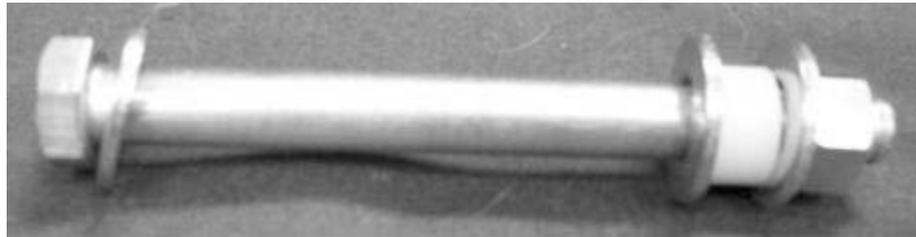


FIGURE 28 - Axle Assembly for Attaching the Wheels to Frame.

**Step 2.** Place washer on 4-1/2 in bolt to serve as wheel axle. Insert into 1/2 in diameter hole through Part C so that the head of the bolt (axle) is located on the inside of the frame structure. Place another washer onto the axle adjacent to the outboard side of Part C, followed by the nylon spacer and another washer. Place the wheel on the axle followed by the 1/2 in bolt nut. See Figure 29 for complete wheel assembly. Use the adjustable wrench to tighten the nut onto the axle. Repeat these steps for the other wheel assembly.

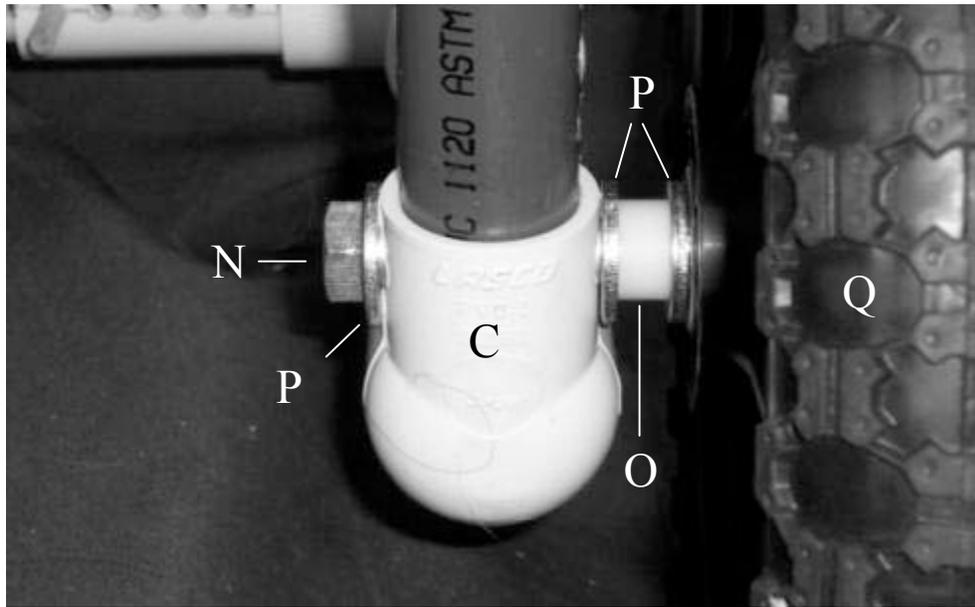


FIGURE 29 - Axle/Wheel Assembly.

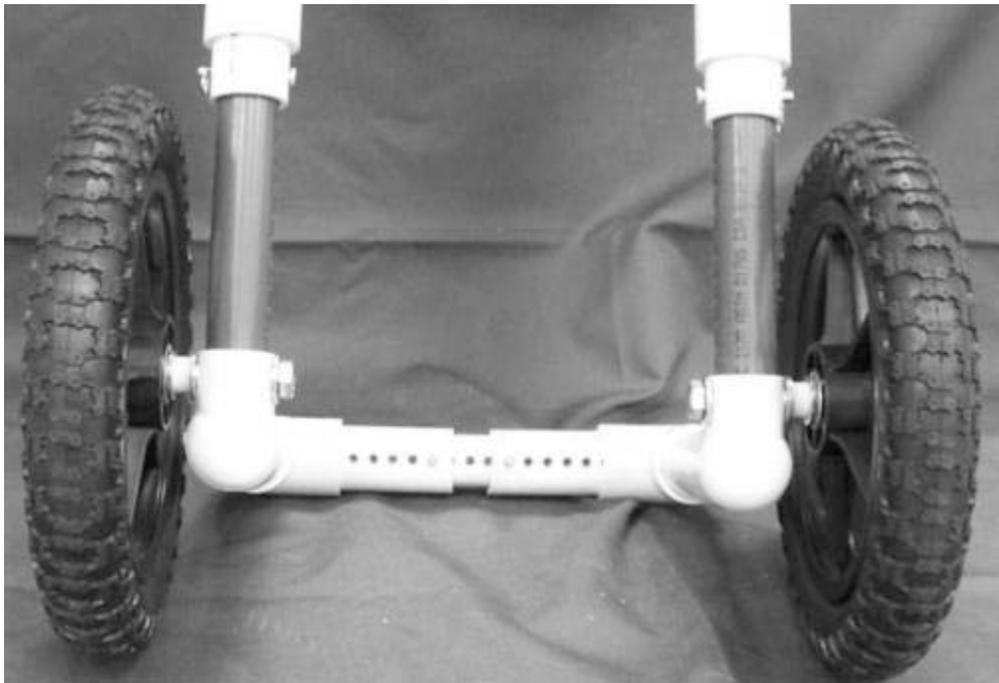


FIGURE 30 – Lower Portion of Wheelchair Frame with Wheels Joined to Frame.

### **Final Wheelchair Frame Assembly**

**Step 1.** Finally, insert Part E into Part H on both sides of the frame. Align holes in Part H and E and insert clevis pin to fix position. (Note: guidelines for adjusting Part E will subsequently be provided.)

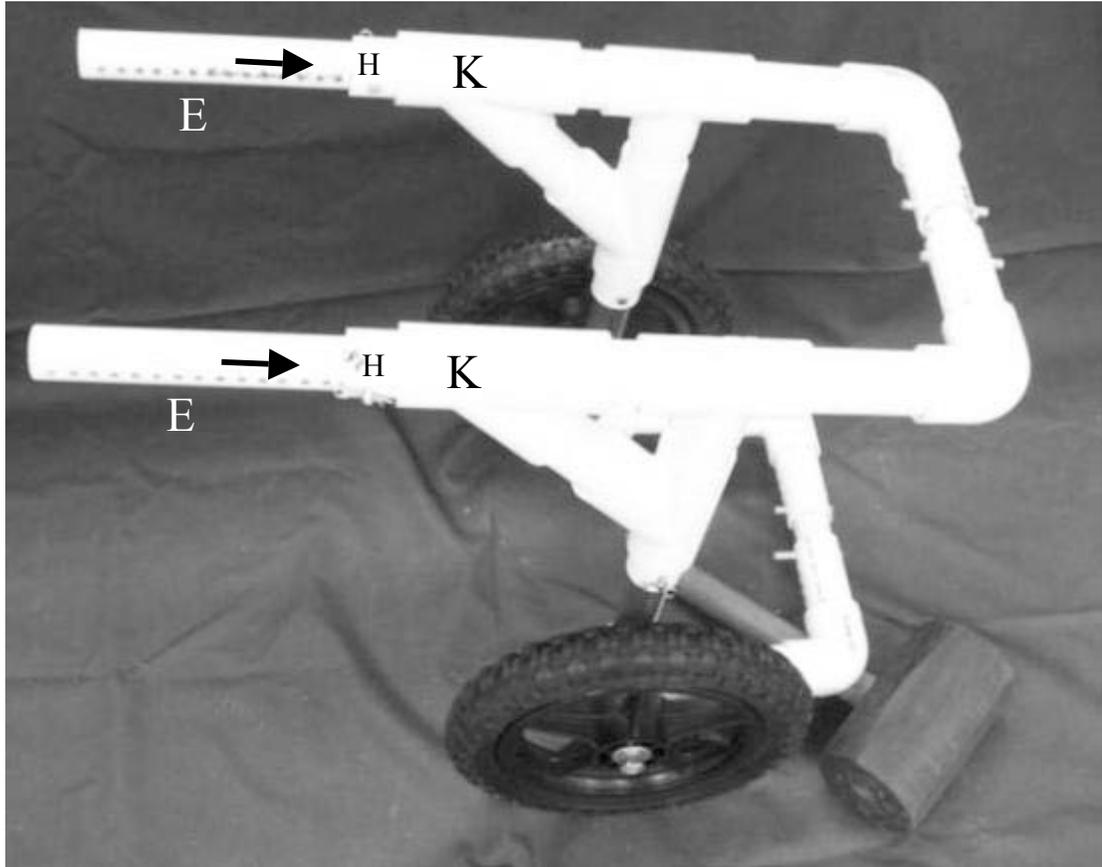


FIGURE 31 – Final Canine Wheelchair Frame Assembly with Wheels.

**Harness to Frame Interface**

TABLE 3  
LIST OF PARTS FOR HARNESS-FRAME INTERFACE

Part	Quantity
Cable Ties (120 lb or heavy duty capacity)	16
Plastic Side Snap Buckles	8
Front Chest Harness*	1
Rear Pelvic Harness*	1
1" Nylon Webbing	1 ft

\* - sized to fit dog

Rear Pelvic Harness:

Attach plastic side snap buckles to the frame (two on each side of the frame) with two heavy-duty cable ties each to minimize the twisting of the buckles and to constrain their ability to slide on the PVC wheelchair frame. Use the cable ties to attach the receiver end of the buckles to the wheelchair frame at the locations described below (Figure 31). Tension the cable ties and clip the excess.

Figure 32 shows the four buckles (two on each side of the wheelchair frame) used to attach to the rear harness to the frame. Notice two buckles (one of each side of the frame) are positioned between the horizontal 1-1/4 in wye fitting (Part K) and the 1-1/4 in tee fitting (Part B). The other two buckles are located directly to the rear of the 1-1/4 in tee fitting (Part B) on each side of the wheelchair frame. The distance between the buckles on each side of the wheelchair frame is approximately 4-5 in.

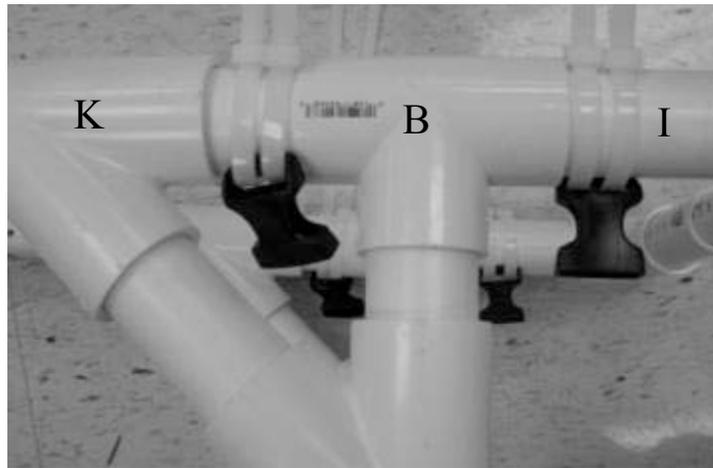


FIGURE 32 – Location of the Buckles for Rear Harness.

Cut the webbing straps of the pelvic harness that were originally design as a hand-hold for the human at their mid-point. (These straps will be trimmed later once their position is adjusted.) Weave each of the four ends of the webbing straps (just cut) through the mating insertion end of the plastic buckles attached to the wheelchair frame. Figure 33 provides the webbing lace pattern for the side snap buckles. (Note: webbing lace pattern should be provided by manufacturer of plastic buckles.)



FIGURE 33 – Side Snap Buckles: Webbing Lace Pattern (ITW Nexus WSR)

Figure 34 shows the underside of the pelvic harness with the buckles attached to the cut webbing support straps (indicated by arrows).

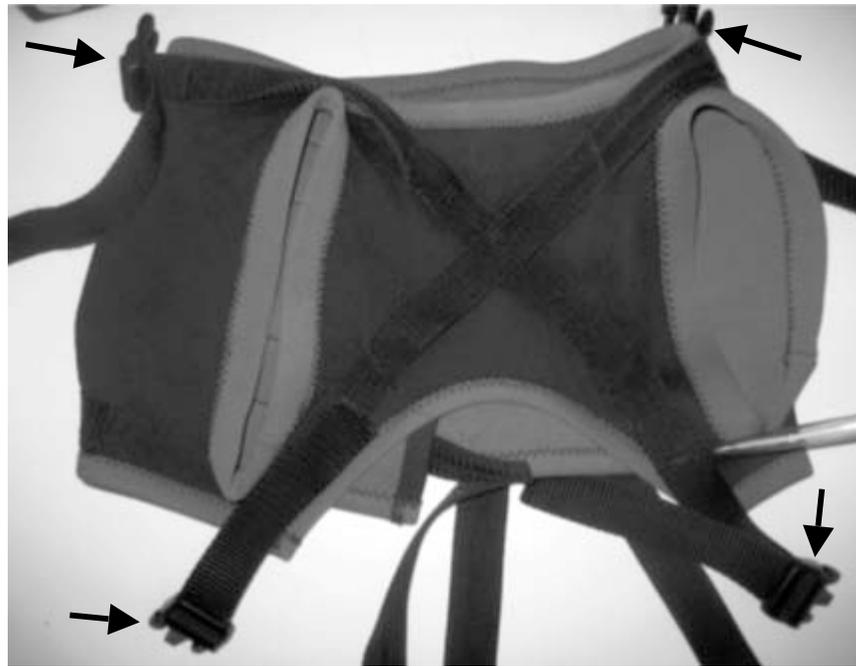


FIGURE 34 – Underside of the Pelvic Harness Showing Plastic Buckle Ends Attached to Webbing Support Straps.

Figure 35 illustrates a dog within the pelvic harness positioned in the wheelchair. Cut the loose ends of the webbing straps such that there is approximately 5-6” remaining for adjustability. Seal the ends by briefly holding them over an open flame until the nylon begins to melt.



FIGURE 35 – Top View of the Pelvic Harness Attached to Wheelchair Frame.

#### Front Chest Harness:

To balance the dynamic forces placed on the front of the wheelchair during walking, four (4) plastic side snap buckles must be adapted to the harness. Figure 36 illustrates the necessary buckle orientation on the chest harness and Figure 37 shows the approximate location of the buckles on the chest harness. One buckle should be oriented upward and the other downward as shown. Once the proper position of each buckle is identified, attach the receiving end of the buckle to the harness using a section of nylon webbing routed through the buckle end and stitched with heavy-duty thread through the harness (Figure 35). An “X” patterned stitch is recommended for attaching the buckles to the harness. (Note: sewing through the harness material is rather difficult and requires a robust thimble and much patience.)

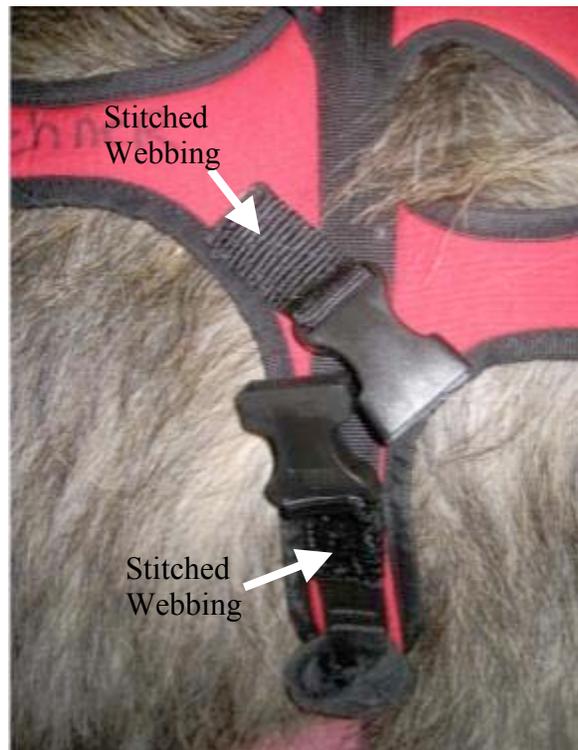


FIGURE 36 – Orientation of the Buckles for the Chest Harness

The chest harness should be fit to the dog to determine the proper location of the mating buckle ends to be attached to the wheelchair frame. To determine this position, place the dog in the pelvic harness, attach the harness to the wheelchair frame, and extend Part E on both sides of the wheelchair such that they are positioned with their ends approximately 2-3 in beyond the location of the buckles mounted on the chest harness. Place a clevis pin in each Part E to secure this position. Now determine the location of the buckle mating ends by projecting an imaginary line from the chest harness buckles to the wheelchair frame when the frame top support member is in a horizontal position. Mark these locations and then attach the mating ends of each buckle (two buckles per side) to the frame with two wire ties per buckle (Figure 37). Once the buckles are properly oriented in the correct direction the cable ties can be tensioned and the excess trimmed. Figure 37 shows the chest harness attached to the wheelchair frame.



FIGURE 37 – Top View of the Chest Harness Attached to the Front of the Wheelchair Frame. Note: position forward chest harness buckle 2-3” from the end of Part E to prevent impingement during turning.

**Hind Limb Suspension Straps**

In cases where one or both of the dog’s hind limbs must be suspended, the following suspension straps should be constructed and installed on the horizontal member of the rear portion of the wheelchair frame. The hind limb suspension straps are designed to adjust to paw size and the desired tension to retain the paw, as well as the desired height of the paw.

TABLE 4  
LIST OF PARTS FOR HIND LIMB SUSPENSION STRAPS

<b>Parts for Two Hind Limb Suspension Straps</b>	<b>Quantity</b>
Cable Ties (120 lb or heavy duty capacity)	4
Plastic Side Snap Buckles	2
Ladderloc Adjustment Buckles	2
1” Nylon Webbing	5 ft

**Step 1.** Cut two lengths of nylon webbing; one measuring 24 in long and the other approximately 12 in long.

**Step 2.** Loop the end of the 24 in long webbing through the upper ladder of a ladder lock adjustment buckle and back onto itself with an overlap of approximately 2-3 in. Sew the overlapped section of webbing back onto itself at point “A” shown in Figure 38 creating a loop. Use an “X” pattern stitch to join the webbing.

**Step 3.** Sew one end of the 12 in section of webbing to the 24 in section of webbing at point “B” shown in Figure 38. Use an “X” pattern stitch to join the webbing.

Step 4. Loop the remaining free end of the 12 in section of webbing through the lower ladder of the ladder lock buckle (point “C” on Figure 38). See Figure 39 for ladderloc buckle lacing pattern.

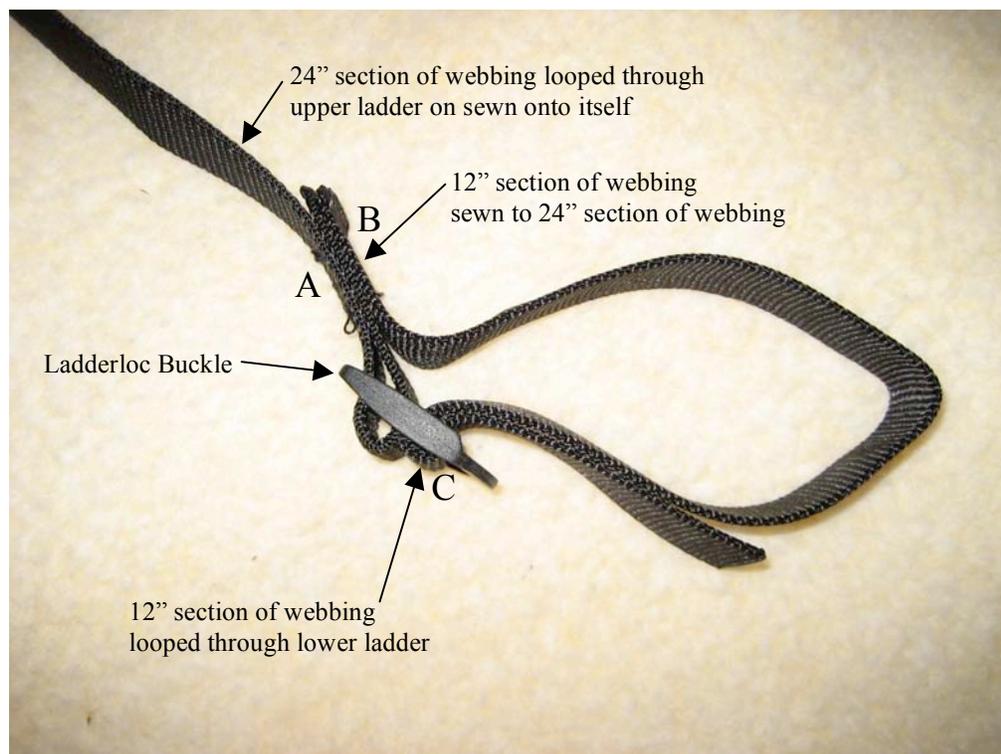


FIGURE 38 – Steps 2 and 4 – Hind Limb Suspension Straps.



FIGURE 39 – Lacing Pattern for Ladderloc Buckle (ITW Nexus).

Step 5. Loop the remaining free end of the 24 in section of webbing through the insertion end of a side snap buckle (point “D” shown in Figure 40).

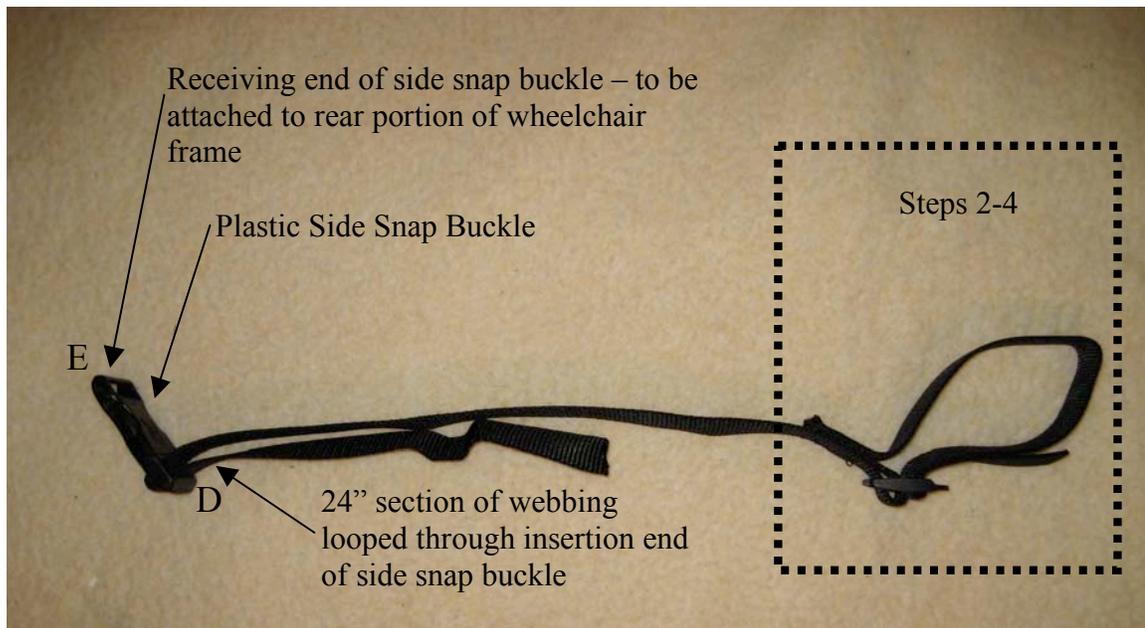


FIGURE 40 – Step 5 – Hind Limb Suspension Straps.

**Step 6.** Repeat steps 2 through 5 to create a second hind limb suspension strap if needed.

**Step 7.** Attach the hind limb suspension straps to the horizontal member of the rear portion of the wheelchair frame using two cable ties (per buckle) threaded through the receiving end of the plastic side snap buckle and around the wheelchair frame. Tension the cable ties to obtain a snug fit.

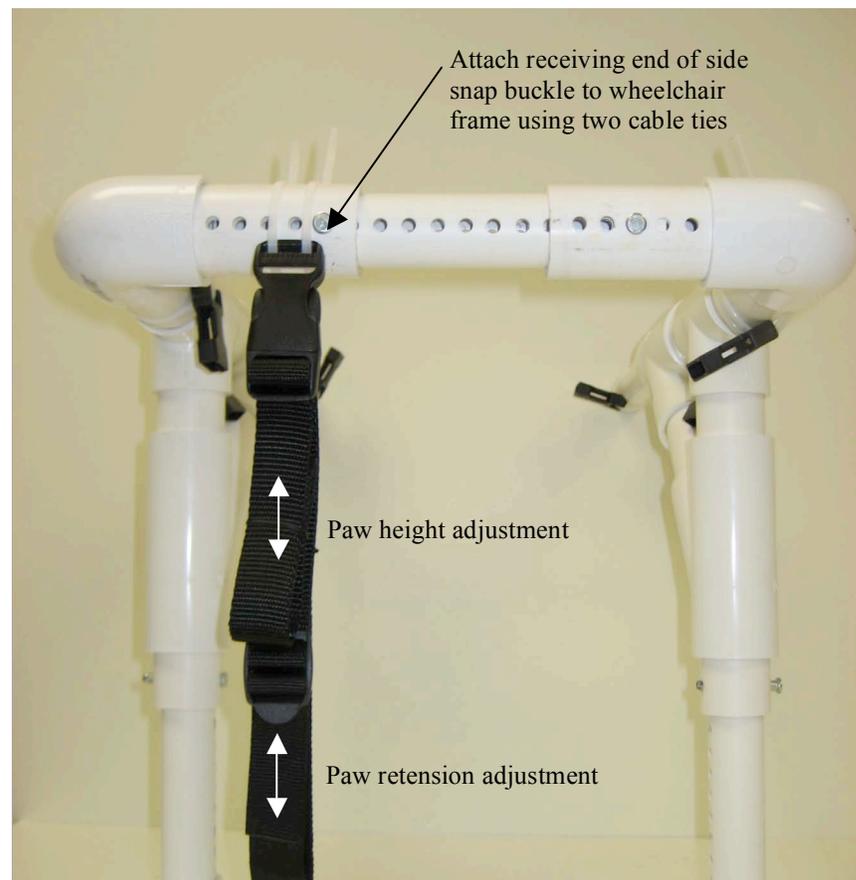


FIGURE 41 – Step 7 – Hind Limb Suspension Strap.

**Step 8.** Adjust the 24 in section of webbing using the side snap buckle adjustment (point “D” above) to obtain the desired paw suspension height. Adjust the 12 in section of webbing using the Ladderloc buckle adjustment (point “C” above) to fit the desired paw size and retention.

**Step 9.** Trim excess webbing and seal ends by passing briefly over open flame until nylon begins to melt.

### **Positioning Dog in Wheelchair**

Place the chest and pelvic harnesses on the dog and adjust any straps to provide a comfortable but snug fit. Support the dog in a standing posture and position the wheelchair such that the plastic buckles mounted on the wheelchair frame for the chest and pelvic harnesses align with the chest and harness buckles. Adjust the height, width and length of the wheelchair by

inserting the cotter pins in matching holes on each side of the wheelchair to attain the desired height and width. The height of the wheelchair should be adjusted so that the upper frame members are horizontal and parallel with the ground when ultimately attached to the dog's harnesses. The width of the wheelchair frame should be adjusted such that the dog's hind limbs have clearance with the inboard portion of the axle (head of bolt). (Note: in cases where the dog is able to use their hind limb(s) for mobility it may be necessary to cover the axle head with soft padding to prevent contact injuries to the hind limb.) The length of the wheelchair (Part E) should be adjusted such that the previously positioned buckles on the wheelchair frame align with buckles on the chest harness. Be certain to adjust the length (Part E) such that the ends of the PVC section do not impinge on the dog when they are making a turn.

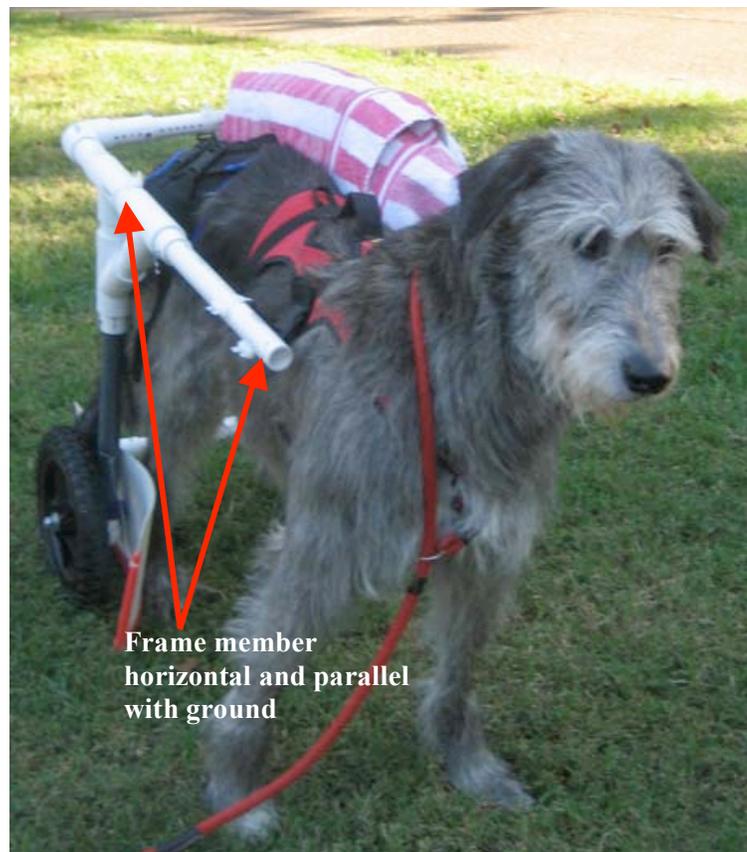


FIGURE 42 – Adjust Height of Wheelchair to Position Upper Frame Member Horizontal and Parallel with Ground

Once the approximate height and width of the wheelchair are fixed, connect the mating ends of the pelvic harness buckles joining the pelvic harness and wheelchair. Connect the mating ends of the chest harness buckles joining the chest harness and wheelchair. Adjust the straps on the pelvic harness to raise the pelvis such that the top line of the dog is horizontal. This typically requires that the straps on the pelvic harness be adjusted to a position of minimal length raising the pelvis upward to a horizontal position. Adjust the chest harness straps so that there is little to no slack in the straps.

If the dog is unable to use their hind limb(s) for mobility, flex the stifle joint (knee) to position the hind limb hock joint(s) in the hind limb support strap system (Figure 43).



FIGURE 43 – Hind Limb Suspension

With a human spotter assisting the dog, allow the dog to attempt to ambulate using with the wheelchair. Be certain that the dog can move freely and that there is no interference from wheelchair components. Make any final adjustments to the wheelchair frame dimensions to permit ease of movement.

## **ACKNOWLEDGEMENTS**

This project was supported by the University of Louisville, Endowed Chair in Biomechanics research funds and was inspired by my faithful companion, Rex, who spent last year of his life challenged with hind limb paralysis. It is our hope that our canine wheelchair design will advance the quality of life of dogs and bring much hope to their guardians.