

Center for International Rehabilitation

Chapter 13 Building the Footrests

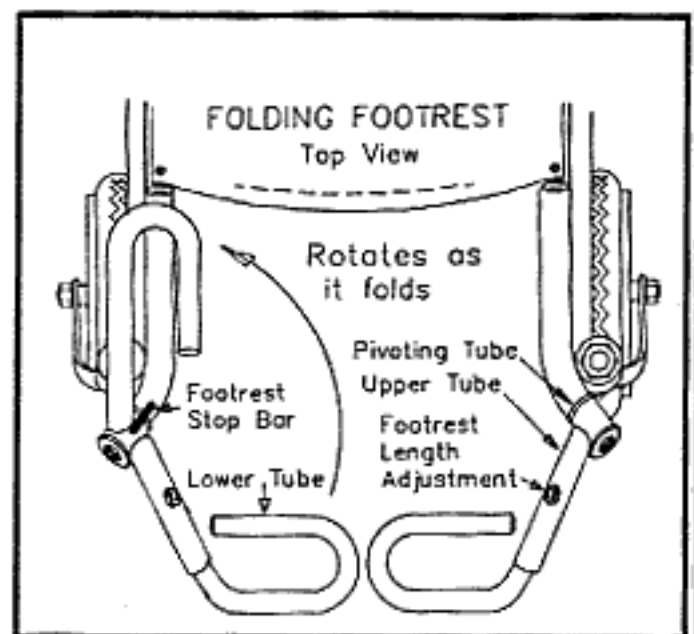


A well-designed footrest must serve several functions. It must hold the rider's feet comfortably and securely; it must serve as a bumper, withstanding impact forces of over 300 pounds; and it must either fold out of the way or be completely removable, allowing the rider to maneuver the chair in very tight spaces and to fold the chair up.

Our favorite footrest design is lighter and less complicated than commercial swing away footrests, yet still provides similar advantages. While most folding footrests need two pivots, one to fold the footplate and one to fold the entire footrest, our design needs only a single pivot. Our footrest rotates as it folds, tucking its footplate compactly ahead of the frame of the chair. Because our chair can still be ridden and folded while the footrests are folded, the footrests do not have to be removable.

When unfolded the footrests on the Torbellino angle inward, narrowing the front of the wheelchair. This makes it easier to maneuver the chair in tight spaces.

Each footrest consists of a pivoting tube, an upper tube, a lower tube, and a stop bar. The pivoting tube rotates on the frame of the chair and is welded to the upper tube. The lower tube forms the actual footplate. It slips inside and bolts to the upper tube, adjusting to the length desired by the rider. The stop bar is welded to the pivoting tube. As the pivoting tube rotates, the stop bar hits the caster barrel and keeps the footrest from falling below the proper position. A heel strap connected to the two footrests supports the rider's legs.



MATERIALS FOR TUBULAR FOLDING FOOTREST

ITEM	LENGTH	QUANTITY	PART OF CHAIR
3/4" O.D. Tubing*	21" (53.3 cm)	2 pieces	lower footrest
7/8" O.D. Tubing**	5-1/2" (14 cm)	2 pieces	upper footrest
1" O.D. Tubing***	1-3/4" (4.4 cm)	2 pieces	pivoting tubes
5/16" (8 mm) bolts & nuts (fine thread)	1-1/4" (3.2 cm)	4 sets	adjusting and stopper bolts
3/8" (10 mm) round bar	2" (5.1 cm) long	2 pieces	stop bars
2" wide auto seat belt*	24" (61 cm) long	1 piece	heel strap
3/4" O.D. rubber plug	1" (2.5 cm) long	2 pieces	stoppers
Washers	1" O.D.	2 washers	stoppers

* These lengths are appropriate for a chair with a 16" (40.6 cm) seat width. For every additional inch (2.54 cm) of seat width, add 1/2" (1.3 cm) to the length of each piece of lower footrest tubing. Heel strap lengths will also need to be adjusted accordingly.

1/2" thin wall conduit or 18 mm O.D. tubing can be substituted for the 3/4" tubing.

** 5-1/2" (14 cm) is the standard length for the upper footrest tube. A taller person may need a 7-1/2" (19 cm) upper footrest tube. See Chapter 4 for details.

3/4" thin wall conduit or 22 mm O.D. tubing can be substituted for the 7/8" tubing.

*** This tubing must swivel snugly on the tubing of the wheelchair frame. Loose fitting tubing can be tightened with the indenting tool. If the only tubing available is much too large, it can be cut and rewelded. Chapter 6 includes descriptions of both of these procedures.

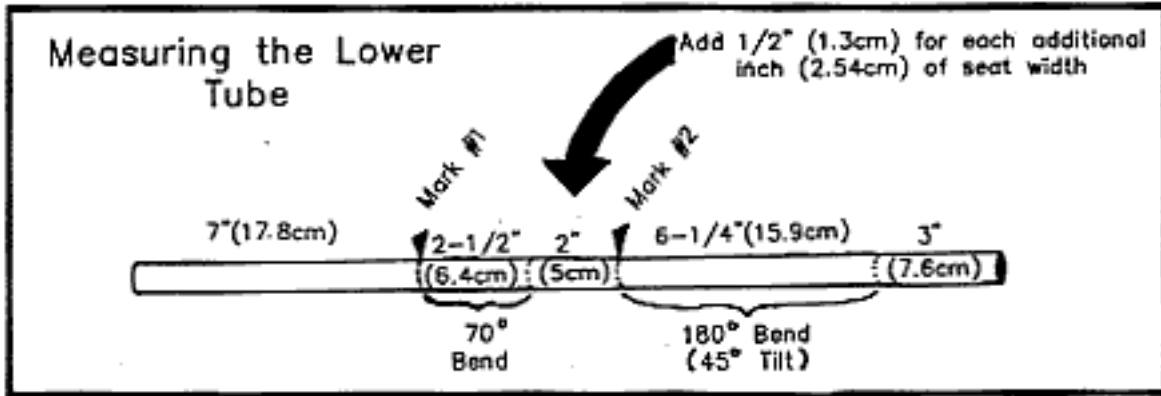
JIGS AND BENDERS

- Hossfeld Style Tubing Bender (see Chapter 2)
- Pivoting Tube Welding Jig
- Stop Bar Welding Jig
- Upper Footrest Drilling Jig
- Lower Footrest Drilling Jig

Directions for making the jigs are found in Appendix B. The jigs can also be purchased as part of The Basic Tool Kit.

DIRECTIONS: LOWER FOOTREST TUBE

1) Measure and mark the bends on the two pieces of 3/4" tubing (or the 1/2" conduit or 18 mm tube). They will be bent into the lower footrest tubes. The following measurements are for a standard size footrest. For chairs wider than 16" (40.6 cm), add 1/2" (1.3 cm) where shown for every additional inch (2.54 cm) of seat width.

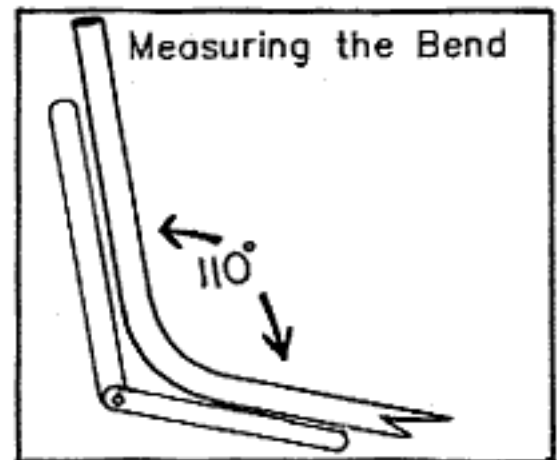
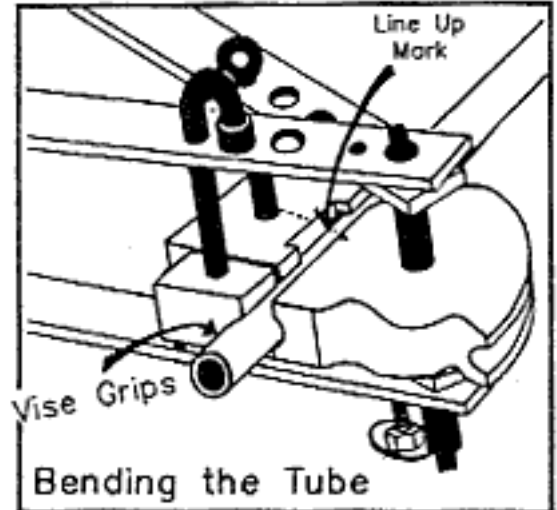


2) Set up the Hossfeld style bender to bend tubing using the die set for 3/4" O.D. tubing with a 1-7/8" bending radius. Chapter 6 includes a complete description of how to set up the bender and bend tubing.

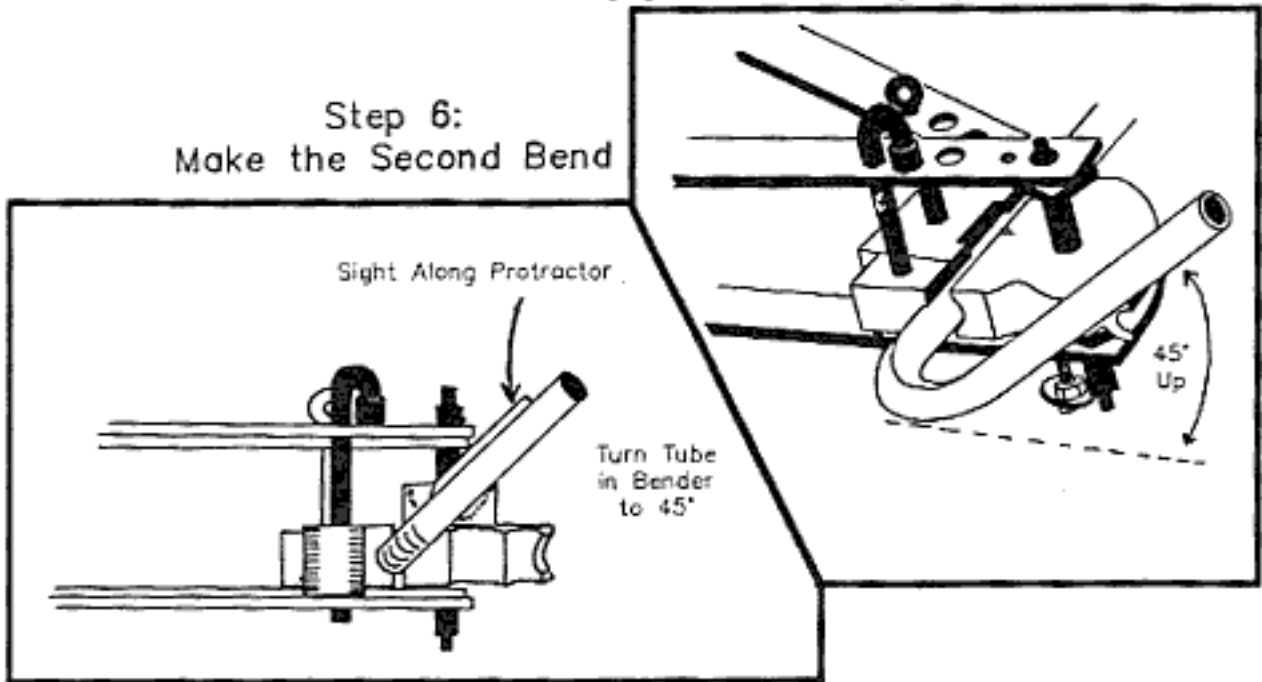
3) Line up Mark #1 on the tubing with the positioning mark on the form die. Clamp the vise grips onto the tubing right next to the back block. If you forget to put the vise grips on you are likely to kink the tubing!

4) Bend the tubing to a 110~ angle. Check the accuracy of the bend with the angle measuring tool and compare it to the sample footrest in the Basic Tool Kit.

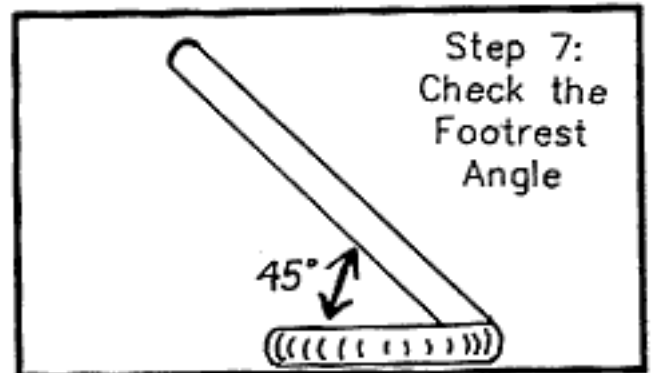
5) Repeat steps 3 and 4 with the second piece of tubing.



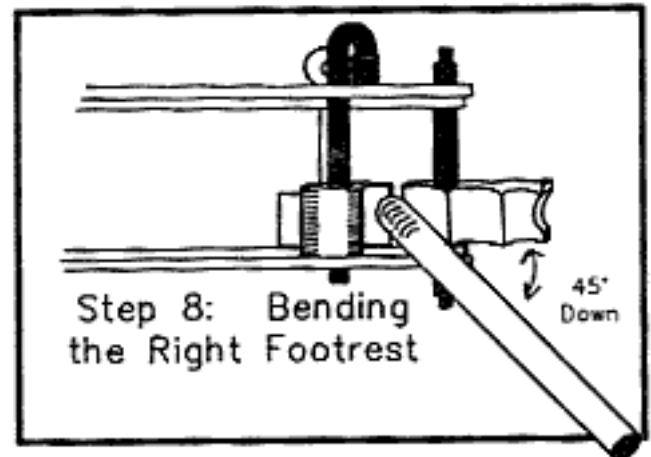
6) To make the left footrest, line up mark #2 with the positioning mark on the form die. Position a protractor on the form die as shown. Rotate the tubing in the bender and site along the protractor until the first bend is positioned at a 45~ angle up from the plane of the bender. Clamp the vise grips onto the tubing right next to the back block.



7) Bend the tubing 180~. If the tubing was properly tilted in the bender, the footplate (the 180~ bend) will be tilted back 45~ from the angle of the upper part of the tube.



8) Make the right footrest tube by lining up mark #2 with the positioning mark on the form die, and by rotating the tubing in the bender until the first bend is 45~ down from the plane of the bender. Clamp the visegrips onto the tubing right next to the back block, and bend the tubing 180~. Check it with the angle measuring tool.

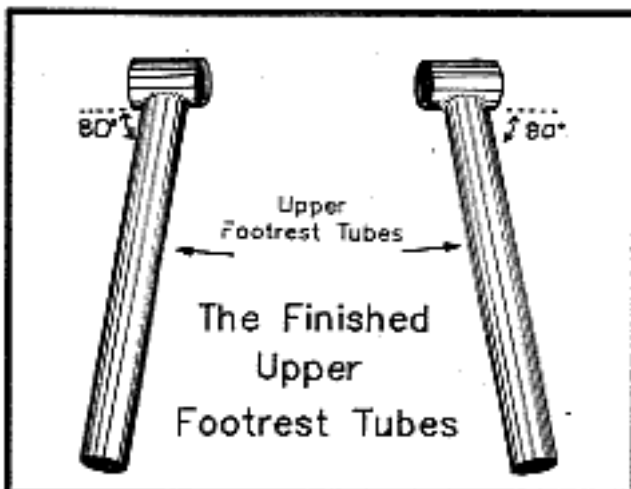
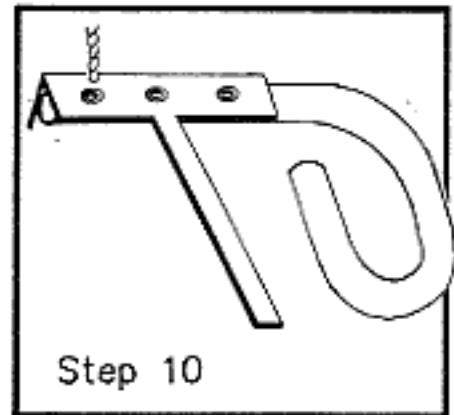
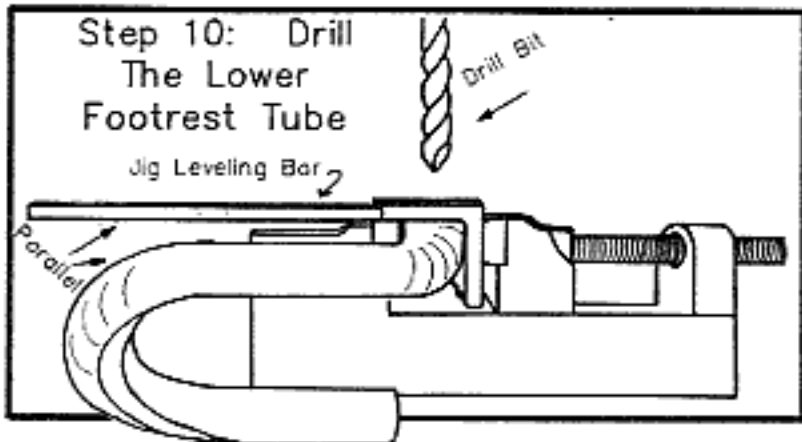


Note: For customers who prefer a different angle for the footplate, simply rotate the tubing in the bender to the angle you want.

9) The exposed ends of the lower footrest tubes can be quite sharp. To protect the rider from injury, weld a rounded washer onto the lower end of each lower footrest tube. To make a rounded washer, place a 3/4" O.D. washer on top of a large nut. Place the rounded end of a ball peen hammer on the center of the washer. Hit the ball peen hammer with a soft mallet. Weld the washer on the end of the footrest tube with its rounded side outward.



10) Use the lower footrest drilling jig to drill three 5/16" (8 mm) holes in each lower footrest tube. Position the jig so that it is flush with the top edge of the lower footrest tube. Put the jig and footrest tube in the drill press vise. Sight along the leveling bar of the jig to make sure that it is parallel to the footplate. The leveling bar may need to be bent to change the angle of the footplate. Drill three 5/16" (8mm) holes. The first hole is located approximately 3/4" (1.9 cm) from the top end of the lower footrest tube. All three holes should be 1" (2.54 cm) apart.



DIRECTIONS: UPPER FOOTREST TUBES

- 1) Cut two 5-1/2" (14 cm) lengths of 7/8" O.D. tubing for the upper footrest tubes (standard size).
- 2) Cut two 1-1/2" (3.8 cm) lengths of 1" O.D. tubing for the pivoting tubes.
- 3) Using an 8" long, half-round file, shape the top end of each length of 7/8" tubing until it fits against a pivoting tube at an 80~ angle.

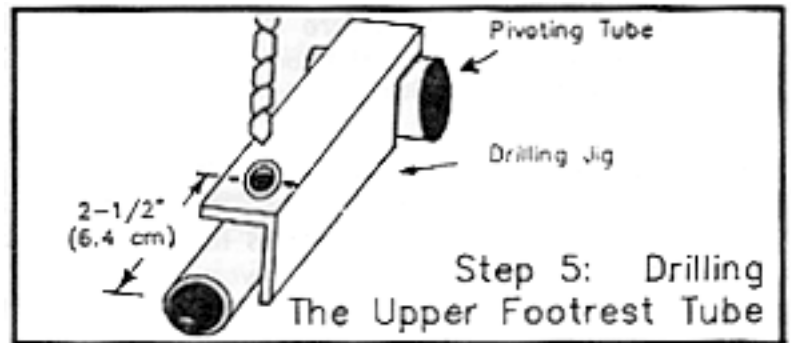


The Footrest Welding Jig

4) Hold the tubes in place with the pivoting tube welding jig and braze them together.

5) Use the upper footrest drilling jig to drill one 5/16" (8 mm) hole in the upper footrest tube. Position the jig as shown in the diagram, secure it in the drill press vise and drill.

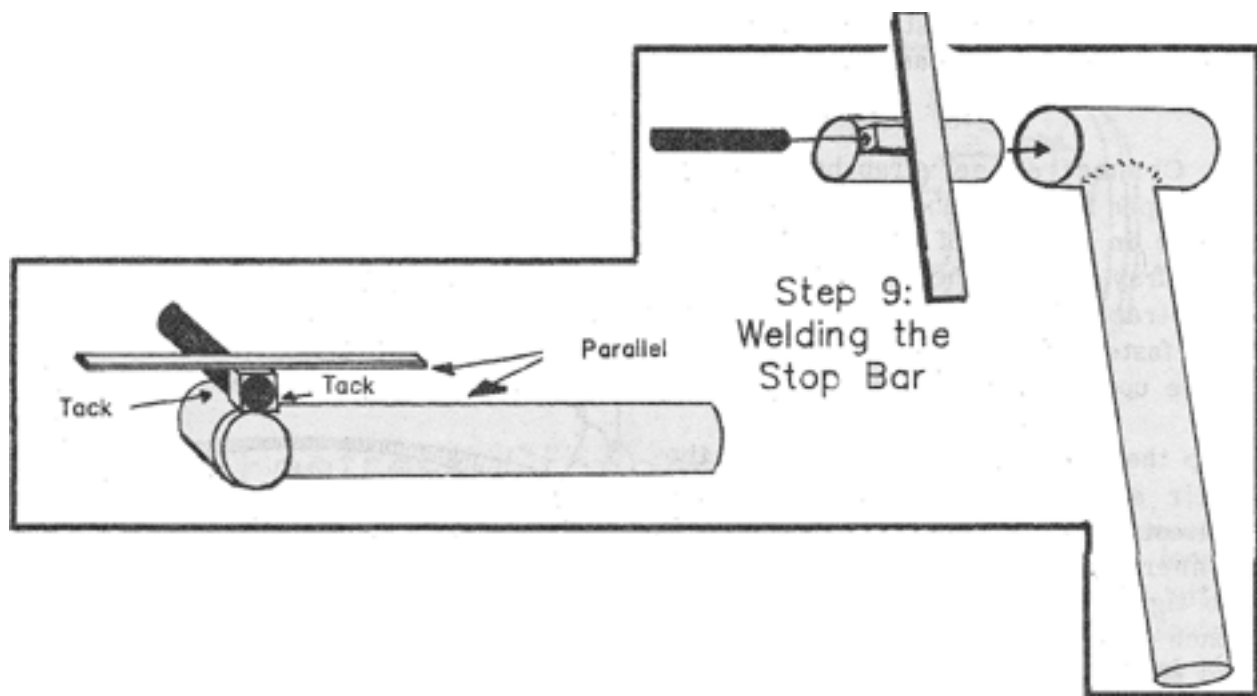
If you are using a regular length upper footrest tube, slide the jig as far up on the upper footrest tube as it will go. For both the regular and long length upper footrest tubes, the center of the hole should be 2-1/2" (6.4 cm) from the tube's bottom edge.



6) To make the stop bars, cut two 2" (5 cm) lengths of 3/8" (10 mm) steel rod.

7) Slip the brake stop welding jig into the pivoting tube on the side where it meets the upper footrest tube at a 100~ angle as shown.

8) Insert a 3/8" (10 mm) stop bar into the square tube of the stop bar welding jig as shown. Push the tube in until the end is flush with the end of the welding jig.



9) Before brazing the stop bar to the pivoting tube, sight along the leveling bar on the stop bar welding jig to make sure that it is parallel to the upper footrest tube. The leveling bar may need to be bent up or down until a good angle for the stop bar is found.

10) Tack the stop bar to the pivoting tube, remove the jig, and finish the weld.

11) Bend two rings of 1/8" (3mm) steel wire around the ends of the pivot tube. Braze the rings in place to reinforce the pivot tubes.

12) File and sand the lower end of the upper footrest tube until it is well rounded. Even though this end is not fully exposed, it can still cut a rider's foot badly.

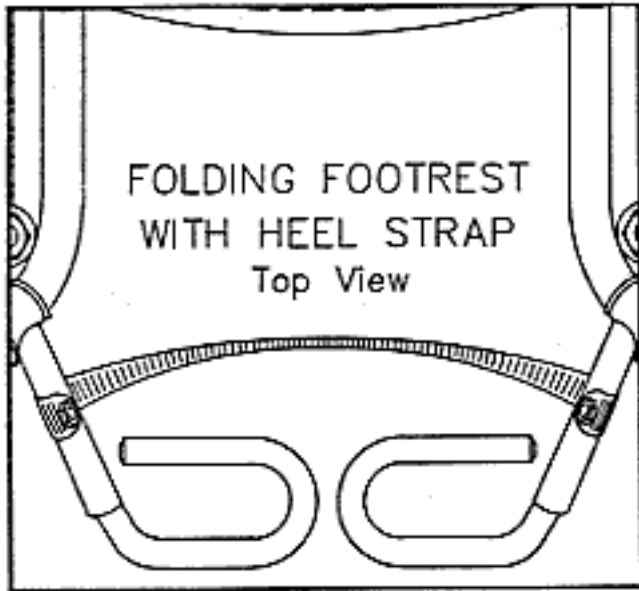
ASSEMBLING THE FOOTRESTS

1) Slip the lower footrest tubes inside the upper footrest tubes, adjust them to the desired length, and bolt the footrests together.

2) Put the footrests on a wheelchair by slipping the pivoting tubes over the ends of the sideframe pieces. Make sure that when the front wheels pivot they don't hit the footrests. Check to see if the footrests fold correctly. When folded, they should tuck in close to the seat.

3) If a footrest doesn't open or fold to the correct positions, try to correct it by bending the stop bar (using heat) or by turning the lower footplate. If the footplate needs to be turned, drill extra holes in the top of the lower footrest tube until it is mounted at the right angle. Don't worry if you ruin some trial footrests - - just get them to fold well, then save them as examples. Once a footrest works well, bend the leveling bars on the welding and the drilling jigs so that you can copy that footrest.

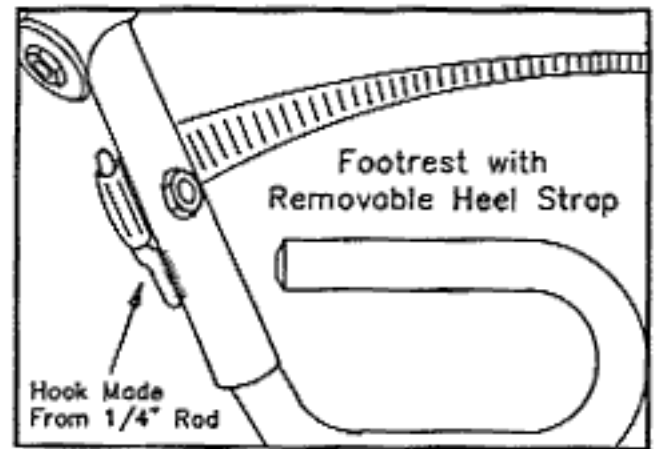
4) Once you have made a pair of well aligned footrests, remove them from the chair, take out the adjusting bolt, and plate or paint them. If you can afford limited plating, plate the lower footrest tubes; they will be subjected to a great deal of wear. If you paint, remember to clean the metal thoroughly (sand and use a metal conditioner). See Chapter 5 for painting details.



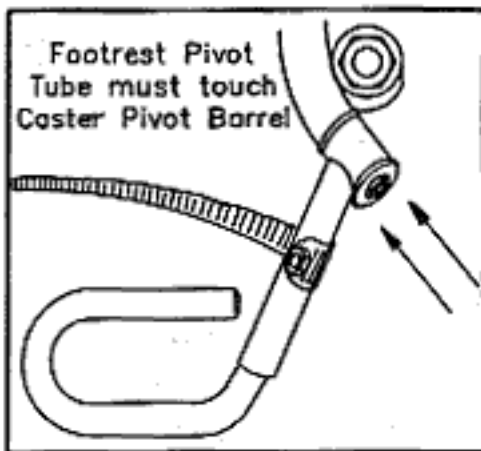
5) Connect a heel strap between the two upper footrest tubes. Punch or melt a hole in one end of the strap. If the holes fray, sew leather over the end of the strap. Using the footrest adjusting bolt, fasten the strap to the front side of the upper footrest tube.

Wrap the strap toward the outside of the chair and around the back of both footrests. Wrapping the footstrap in this manner will prevent it from becoming too tight when one footrest is folded. Punch or melt several holes in the other end of the belt to make it adjustable.

6) Some people prefer a removable footrest strap. To make the footrest strap removable, weld a 2-1/2" (6.4 cm) length of 1/4" (6 mm) diameter solid steel rod to the upper footrest tube as shown. Hook one end of the footrest strap over this rod.

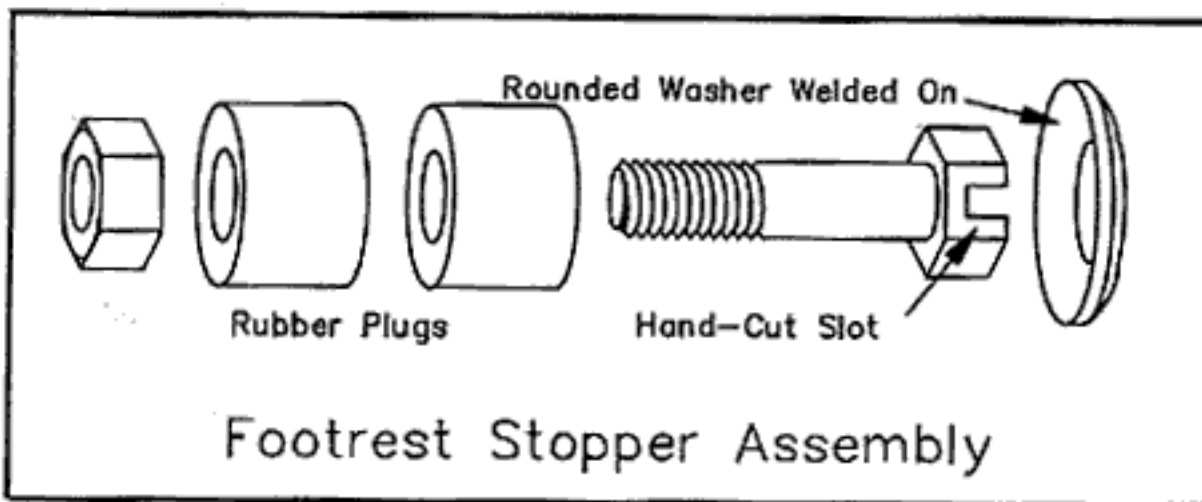


7) Slide the upper footrest tubes as far back on the sideframe as it will go. It is very important that the footrest pivot tube is touching the caster barrel. Some bronze may have to be filed off to do this.



8) Cut the extra sideframe tubing off even with the ends of the footrest pivot tubes.

9) Connect each footrest securely to the chair using stoppers. To make the stoppers, weld a 1" O.D. (2.5 cm) rounded washer to the head of a 5/16" x 1-1/4" (8 mm x 3.2 cm) fine thread slotted head bolt. Make rounded washers using the same procedure described earlier in this chapter. If slotted bolts aren't available with fine threads, use a hacksaw to cut slots in the heads of two fine thread bolts.



Thread a 3/4" O.D. x 1" long rubber plug over the bolt and tighten the nut loosely. Tap the stopper into the end of the sideframe tube and tighten the bolt with a screwdriver. The nut should squeeze the rubber plug enough to hold the footrest securely on the chair. Indenting the sideframe tube will help retain the footrest plug.

THE SINGLE REMOVABLE FOOTREST

While the folding tubular footrest is our favorite, we have also included directions for another simple footrest. One of the simplest types of removable footrests is made out of two bent tubes spanning the front of the wheelchair. The footrest can be lifted and removed completely when the rider wishes to fold the chair or pull it close to the furniture.

MATERIALS

ITEM	LENGTH	QUANTITY
1" O.D. tubing	1-1/2" (3.8 cm) long	1 piece
3/4" O.D. tubing	16" - 22" (40.6 - 55.9 cm) long	2 pieces
5/16" (8 mm) rod	8" (20.3 cm)	1 piece
3/8" (10 mm) rod	3" (7.6 cm)	1 piece

DIRECTIONS

- 1) Cut one 1-1/2" piece of 1" O.D. tubing (or other tubing that will fit over the front of the main sideframe tubes).
- 2) Using the Hossfeld type bender with the die set for 3/4" O.D. tubing and a 1-7/8" bending radius, bend the 3/4" O.D. footrest tubes as in the drawing.
- 3) Weld one end of the footrest tubes to the 1" O.D. pivot tube. Weld the other ends to a hook bent out of 5/16" (8 mm) rod.
- 4) To prevent the footrest from falling off, make a catch out of 3/8" (10 mm) rod and weld it to the chair as shown. Add a heel strap if needed.