

# SOAP BOX DERBY®

**Gravity Racing Challenge  
STEM Team Competition  
High School  
Engineering Design Challenge  
Car Assembly Plans**



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**NOTE: The Floorboard represented in a few photos throughout these plans is a Soap Box Derby Super Stock floorboard. The principles remain the same.**



# Introduction

## General Assembly Guidelines

This plan booklet should be followed when assembling your car. The hardware provided in the International Soap Box Derby, Inc. Car Kit should be used. No changes, modifications or additions, other than the inclusion or omission of specified optional parts, should be made to the car.

Replacement of all hardware, as well as optional parts, is available from the International Soap Box Derby, Inc. In general, replacement parts are sold in bags specified for each installation step of the car's construction and optional parts are available on a per item basis.

## Help, Guidance & Support

If further explanation is needed, questions should be directed to the International Soap Box Derby, Inc. All questions or inquiries for clarification must be e-mailed to [soapbox@asbd.org](mailto:soapbox@asbd.org).

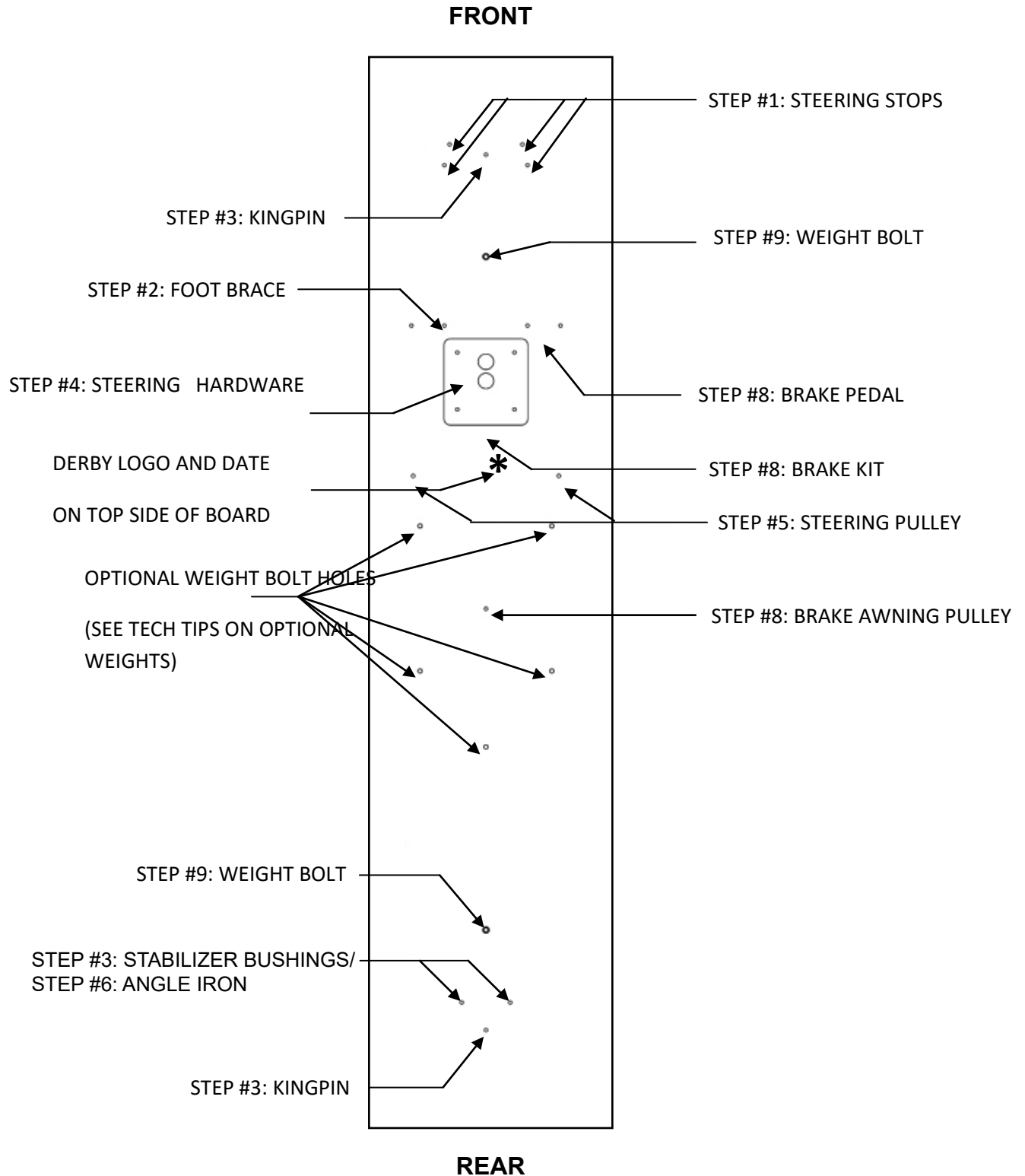
## Supplies And Tools

The following list of tools is a guideline to aid in the basic assembly of the Car Kit. The International Soap Box Derby, Inc. does not provide these tools as part of the kit. Sources for these tools include, but are not limited to, hardware and automotive supply stores.

- |                               |                                     |
|-------------------------------|-------------------------------------|
| 1. Screwdrivers               | 4. Pliers                           |
| - #2 Phillips screwdriver     | - Standard Pliers                   |
| - Wide flat blade screwdriver | - Wire Cutter Pliers                |
| 2. Wrenches or Sockets        | 5. Measuring Tape                   |
| - 3/8" open-end box wrench    | - 10' minimum length                |
| - 7/16" open-end box wrench   | 6. Hammer                           |
| - 1/2" open-end box wrench    | - Standard Hammer or Mallet         |
| - 11/32" open-end box wrench  | 7. Electrical Tape                  |
| 3. Allen Wrench               | 8. Battery Powered Drill (optional) |
| - 5/64" Allen Wrench          |                                     |

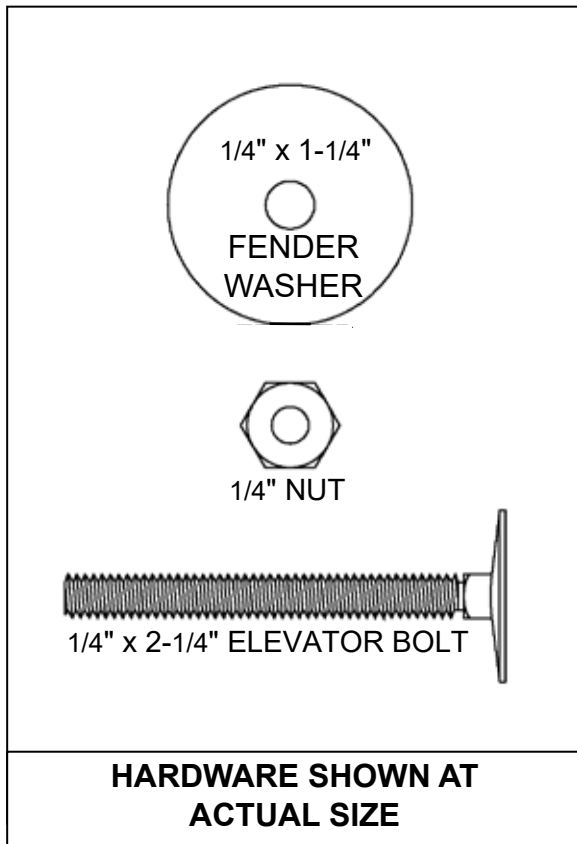
# Adult Floorboard Legend

Below is the **floorboard legend**. This diagram will give you a brief overview of some of the steps in the assembly process. Each step listed on this page will be explored in greater detail in upcoming steps.



# Step One

Steering Stop Installation. Required Items: Steering Stop Bag, Floorboard, Tools



## Steering Stop (Legend Area Highlighted) Steering Stop Installation

- 1.1 Insert one 1/4" x 2-1/4" elevator bolt through the floorboard bottom at a steering stop hole location and press through the floorboard. See legend for location of holes.
- 1.2 Place a 1/4" x 1-1/4" fender washer on the elevator bolt on top of the floorboard.
- 1.3 Install 1/4" nut on 1/4" x 1-1/4" fender washer. Tighten nut until elevator bolt is drawn in flush with bottom of floorboard. Install two additional 1/4" nuts for a total of three. See Photo # 1.3
- 1.4 Repeat Steps 1.1 through 1.3 for the other three steering stop locations. See Photo # 1.4

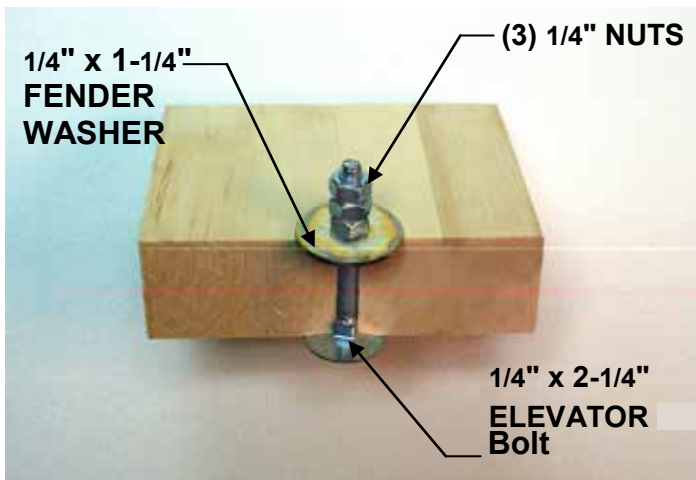


Photo #1.3

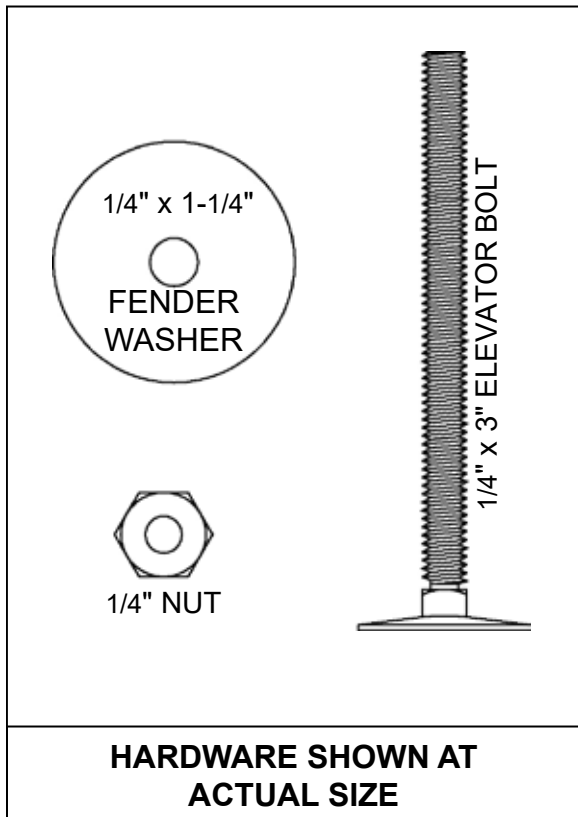


Photo #1.4



# Step Two

Foot Brace Installation. Required Items: Foot Brace Bag, Floorboard, Foot Brace, Tools



## Foot Brace (Legend Area Highlighted)

### Foot Brace Installation

Brake pedal and foot brace may be moved forward or back in brake Pedal/Brace Zone to accommodate a driver.

- 2.1 Insert two 1/4" x 3" elevator bolts through the floorboard bottom at a foot brace hole location and press through the floorboard. See legend for location of holes.
- 2.2 Install 1/4" x 1-1/4" fender washer on elevator bolt along with a nut and draw flush with floorboard. Take off washer and nut.
- 2.3 Place foot brace on the elevator bolt.
- 2.4 Place a 1/4" x 1-1/4" fender washer on the elevator bolt on top of the foot brace.
- 2.5 Install 1/4" nut on 1/4" x 1-1/4" fender washer. See Photo # 2.5.

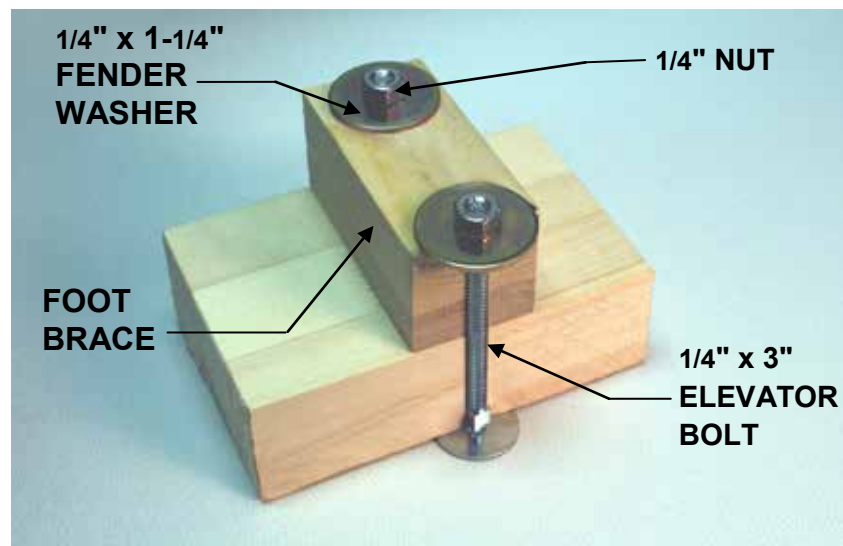
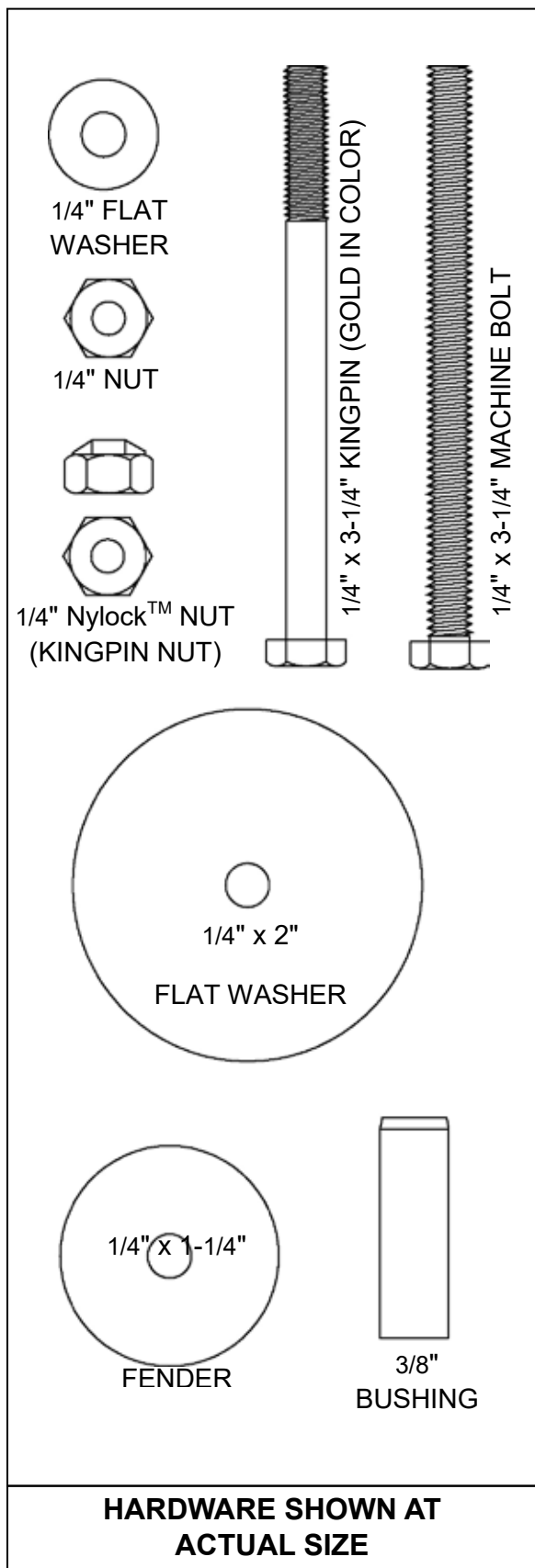


Photo #2.5

# Step Three

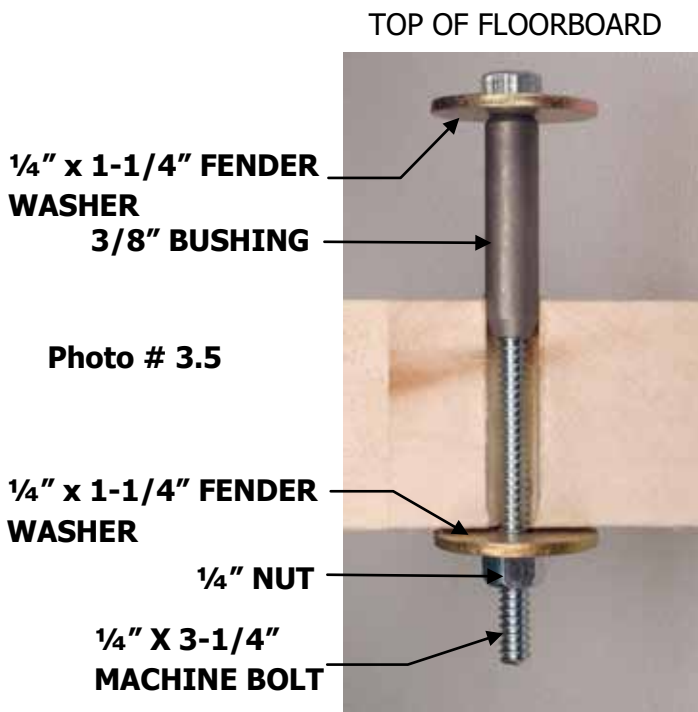
Kingpin Installation/Stabilizer Bushing Sub-Assembly. Required Items: Kingpin Bag, Floorboard, Set of Axles, Rear Axle Plate, Tools



## Kingpin Bushing Installation (Legend Area Highlighted)

### Bushing Installation Sub-Assembly

- 3.1 Place 1/4" x 1-1/4" fender washer on 1/4" x 3-1/4" machine bolt. Bolt is silver in color.
- 3.2 Place bushing with flat end against fender washer on the 1/4" x 3-1/4" machine bolt.
- 3.3 Insert assembly through the top of floorboard with beveled end of bushing against floorboard until bolt extends through opposite side of floorboard at kingpin location. See legend for location of holes.
- 3.4 Place a 1/4" x 1-1/4" fender washer on the machine bolt against the floorboard.



# Step Three

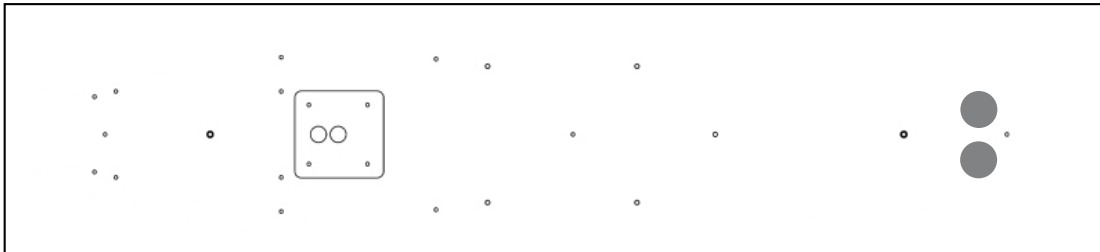
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## Kingpin Bushing Installation Sub-Assembly Continued

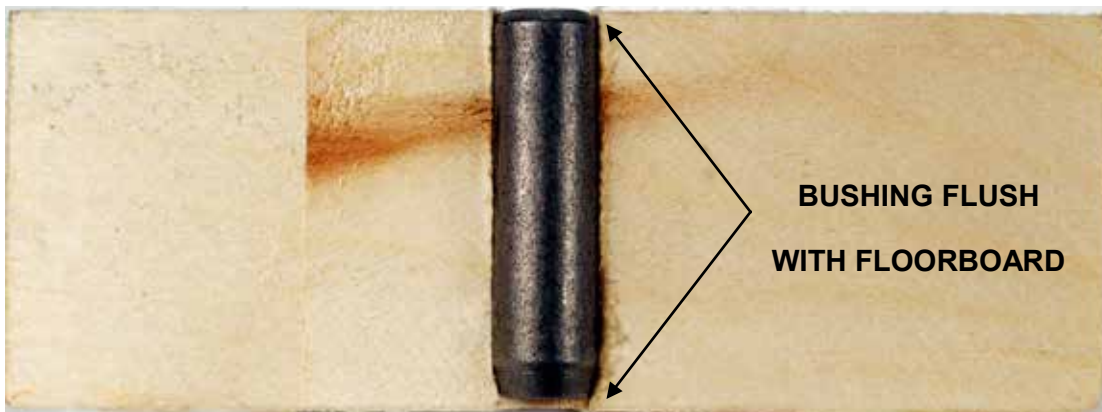
- 3.5 Install a 1/4" nut on 1/4" x 3-1/4" machine bolt. See Photo # 3.5
- 3.6 Tighten machine bolt assembly until bushing ends are flush with floorboard.
- 3.7 Remove 1/4" nut from 1/4" x 3-1/4" machine bolt and 1/4" x 1-1/4" fender washers. See Photo # 3.7
- 3.8 Repeat steps 3.1 through 3.7 for second kingpin bushing location.

## Stabilizer Bushing Sub-Assembly

- 3.9 Repeat steps 3.1 through 3.7 for Stabilizer Bushing (see legend below for hole locations)



TOP OF FLOORBOARD



**Photo #3.7**



# Step Three

Continued

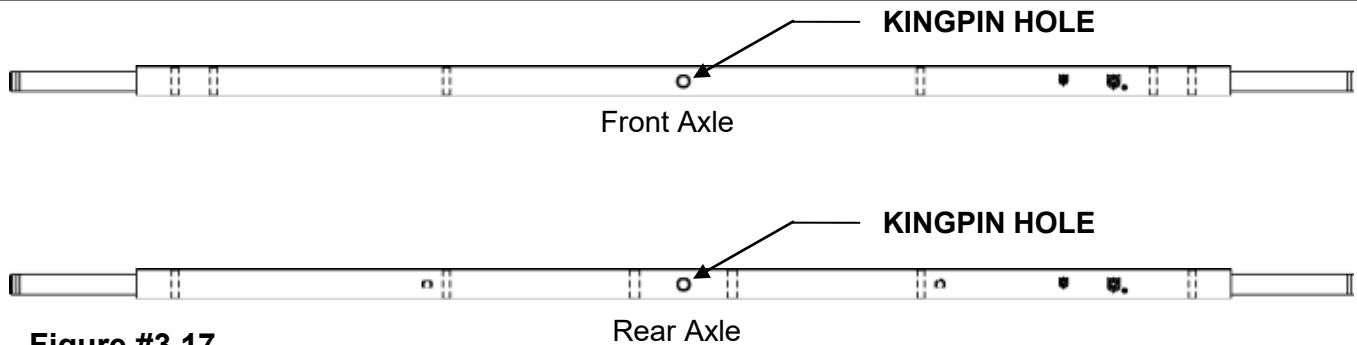


Figure #3.17



Front Kingpin Sub-Assembly  
(Legend Area Highlighted)

- 3.12 Place a 1/4" x 2" flat washer on 1/4" x 3-1/4" kingpin. Kingpin bolt is gold in color.
- 3.13 Insert kingpin/washer assembly through the bottom of floorboard at front axle location and press through floorboard. See legend for location of hole.
- 3.14 Place 1/4" x 2" flat washer on 1/4" x 3-1/4" kingpin.
- 3.15 Place 1/4" x 1-1/4" fender washer on kingpin.
- 3.16 Place 1/4" flat washer on kingpin.
- 3.17 Place front axle on kingpin. See Figure # 3.17 for front axle identification.
- 3.18 Place two 1/4" flat washers on top of the axle.
- 3.19 Install two 1/4" Nylock™ nuts (kingpin nut). Tighten kingpin assembly. See Photo # 3.19

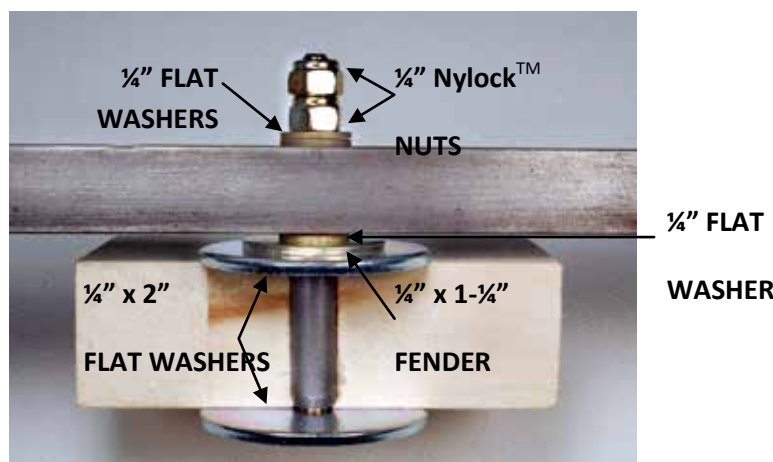


Photo #3.19 (Front Kingpin Washer Stack)

# Step Three

Continued

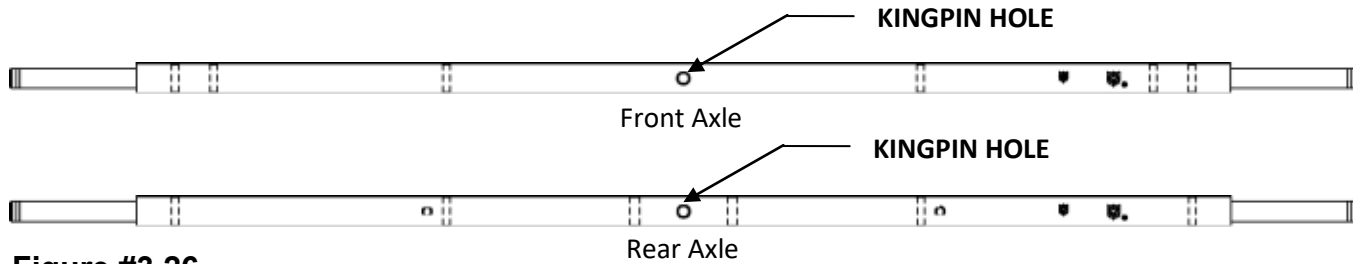


Figure #3.26

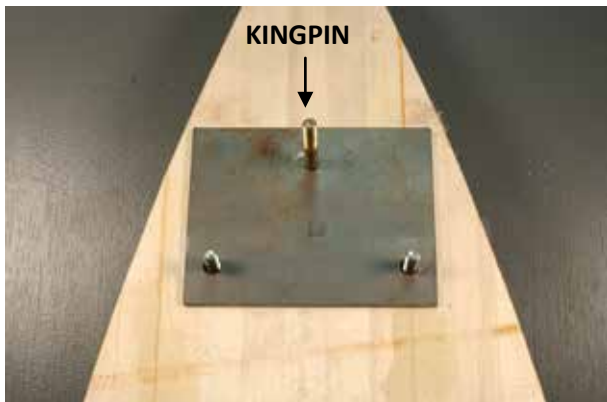


Photo #3.22

(Bolts other than the kingpin are not part of this step; they are shown for clarity only.)

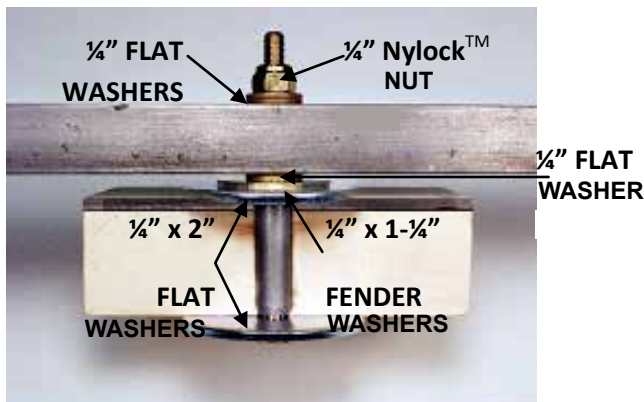


Photo # 3.26

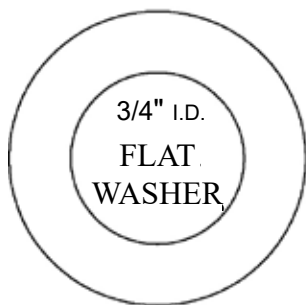
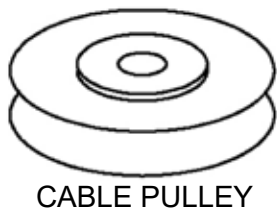
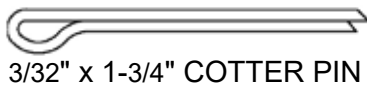
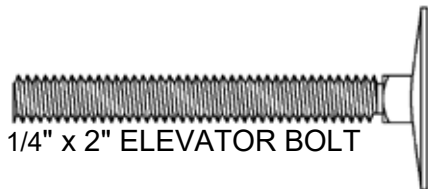
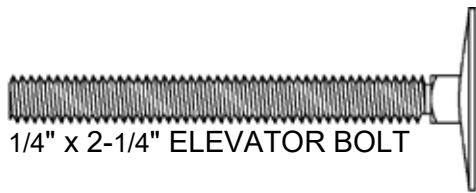
(Rear Kingpin Washer Stack)

## Kingpins Installation (Legend Area Highlighted) Rear Kingpin Sub-Assembly

- 3.20 Place a  $\frac{1}{4}$ " x 2" flat washer on  $\frac{1}{4}$ " x  $3\text{-}\frac{1}{4}$ " kingpin. Kingpin bolt is gold in color.
- 3.21 Insert kingpin/washer assembly through the bottom of floorboard at rear axle location and press through floor board. See floorboard legend for location of hole.
- 3.22 Place SS Rear Axle Plate on  $\frac{1}{4}$ " x  $3\text{-}\frac{1}{4}$ " kingpin. Align holes in SS Rear Axle Plate with those in the floorboard. See Photo # 3.22
- 3.23 Place  $\frac{1}{4}$ " x 2" flat washer on  $\frac{1}{4}$ " x  $3\text{-}\frac{1}{4}$ " kingpin (on top of the SS Rear Axle Plate).
- 3.24 Place  $\frac{1}{4}$ " x  $1\text{-}\frac{1}{4}$ " fender washer on kingpin.
- 3.25 Place  $\frac{1}{4}$ " flat washer on  $\frac{1}{4}$ " x  $1\text{-}\frac{1}{4}$ " kingpin.
- 3.26 Place rear axle on kingpin. See Figure # 3.26 for rear axle identification.
- 3.27 Place two  $\frac{1}{4}$ " flat washers on top of the axle.
- 3.28 Install one  $\frac{1}{4}$ " Nylock<sup>TM</sup> nut (kingpin nut). See Photo #3.26. **Do not completely tighten kingpin assembly.** Further adjustments to occur in future Step 11.

# Step Four

Steering Hardware Installation. Required Items: Steering Bag, Floorboard, Brake/Steering Mount, Steering Wheel, Tools



**HARDWARE SHOWN AT  
ACTUAL SIZE**



**Brake/Steering Mount  
(Legend Area Highlighted)**

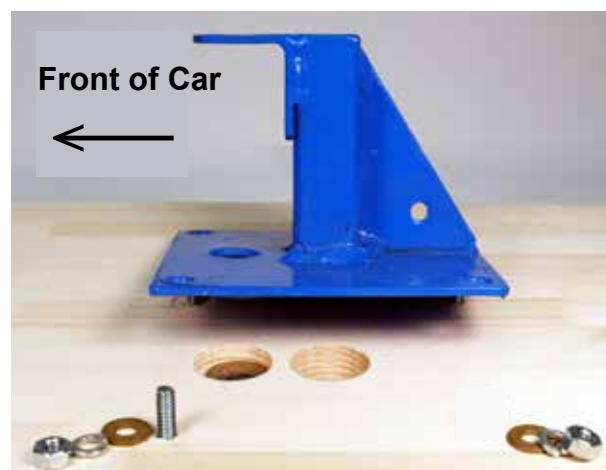
**Brake/Steering Mount Sub-Assembly**

Brake/steering mount may be moved forward only to accommodate a driver.

- 4.1 Insert a quarter or washer (provided by others) into the recessed floorboard area where the steering wheel shaft is to be installed. See Photo # 4.1



**Photo #4.1**



**Photo #4.3  
Brake/Steering Mount  
Bolts Shown For Alignment Only**

# Step Four

Continued

- 4.2 Insert one 1/4" x 2" elevator bolt through the floorboard bottom at front brake/steering mount hole location and press through the floorboard. See floorboard legend for location of hole. Install 1/4" flat washer and 1/4" nut on bolt and draw bolt flush with bottom of floorboard. Remove nuts and washers. Repeat for the second front hole location.
- 4.3 Place brake/steering mount on top of 1/4" x 2" elevator bolts. See Photo #4.3
- 4.4 Place 1/4" flat washer on the 1/4" x 2" elevator bolts on top of brake/steering mount.
- 4.5 Place 1/4" lock washer on the 1/4" x 2" elevator bolts on top of the brake/steering mount.
- 4.6 Install 1/4" nut on bolts. See Photo # 4.6. **Do not completely tighten nut.**
- 4.7 Insert one 1/4" x 2-1/4" elevator bolt through the floorboard bottom at rear brake/steering mount hole location and press through the floorboard. Install 1/4" flat washer and 1/4" nut on bolt and draw bolt flush with bottom of floorboard. Remove nut.
- 4.8 Place cable pulley on the 1/4" x 2-1/4" elevator bolt on top of brake/steering mount.
- 4.9 Place 1/4" lock washer on top of the cable pulley.
- 4.10 Install 1/4" nut on 2-1/4" elevator bolt. See Photo # 4.10 (a) & Photo # 4.10(b). **Do not completely tighten.**
- 4.11 Repeat Steps 4.7 through 4.10 for second rear brake/steering bolt location.
- Steering Wheel Sub-Assembly**
- 4.12 Tighten all four nuts. Insert brake plunger through floorboard and brake/steering mount to check for proper alignment.
- 4.13 Insert steering wheel shaft through the round hole on the brake/steering mount (**steering wheel bow tie may face in either direction**).

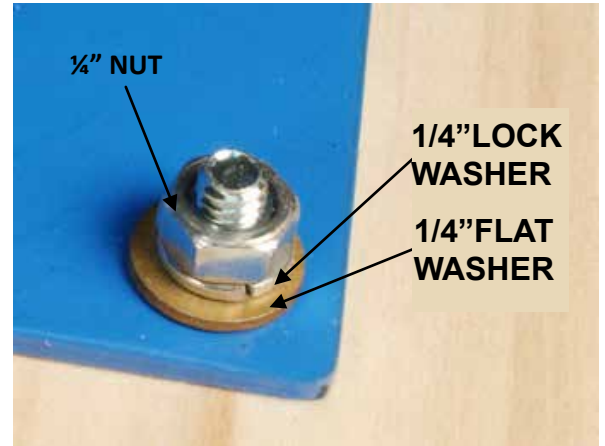


Photo #4.6

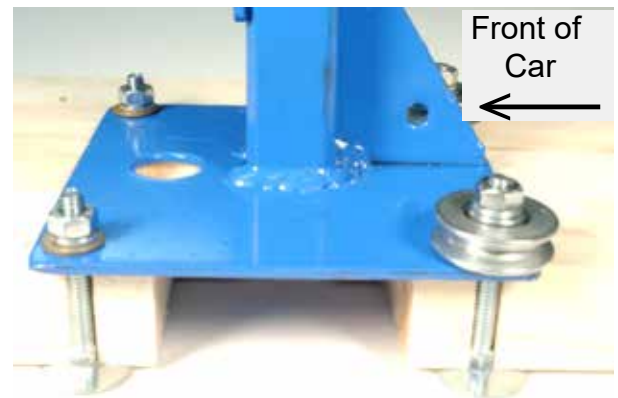


Photo #4.10(a)

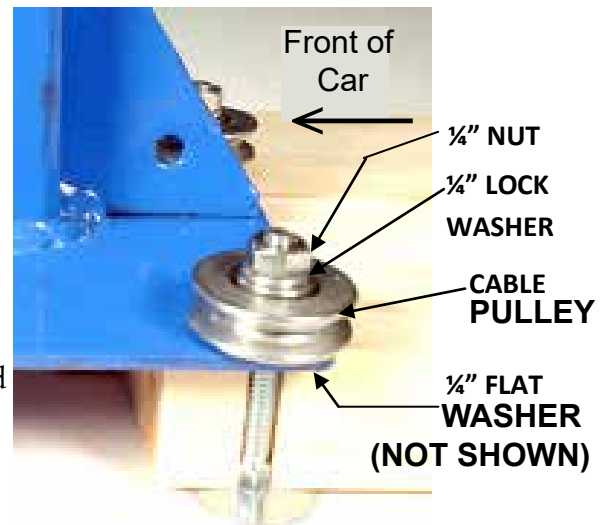


Photo #4.10(b)

# Step Four

Continued

- 4.14 Raise the steering wheel and slide the 3/4" I.D. flat washer on to the bottom of steering wheel shaft.
- 4.15 Push steering wheel down through brake/steering mount hole until shaft rests on top of quarter or washer installed in Step 4.1.
- 4.16 Push the 3/4" I.D. flat washer up against the brake/steering mount and insert 3/32" x 1-3/4" cotter-pin through the upper steering wheel shaft hole. See Photo # 4.16
- 4.17 Bend end of cotter pin around steering wheel shaft.

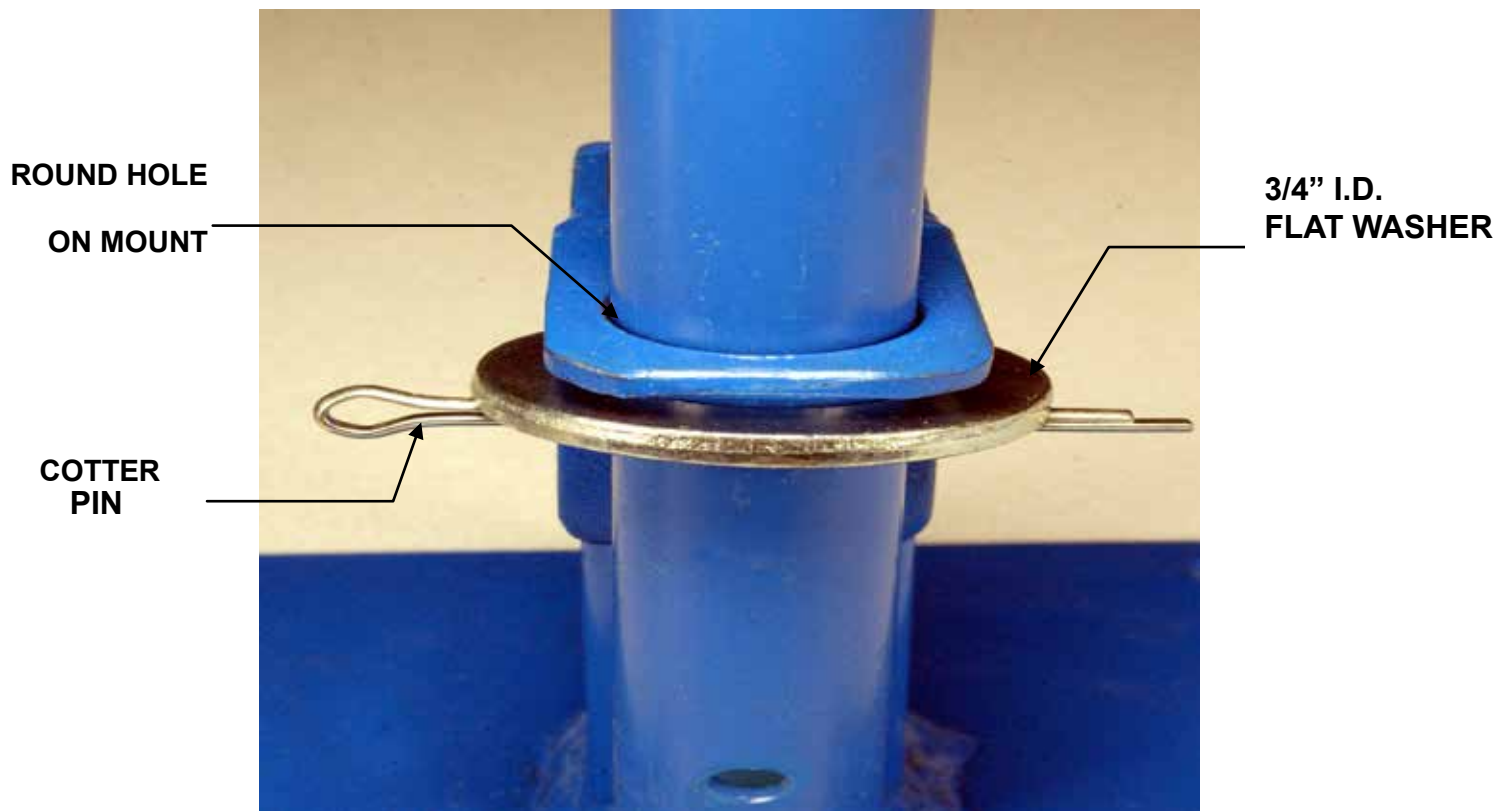
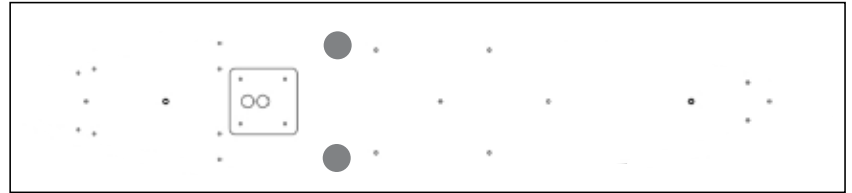
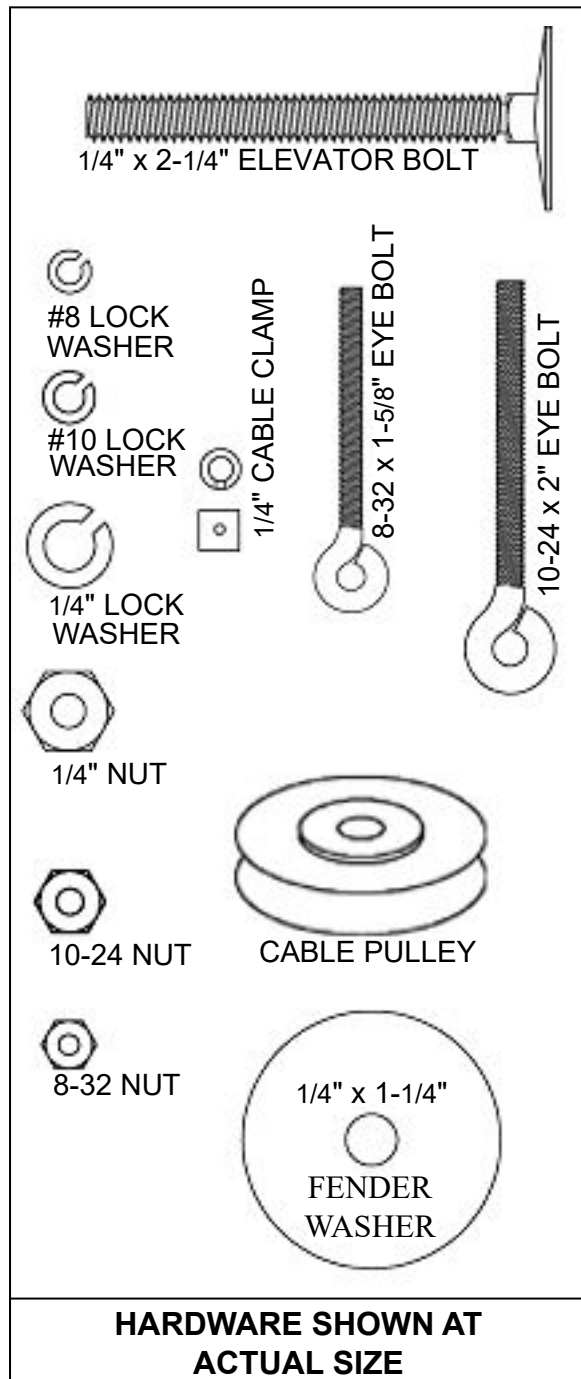


Photo #4.16

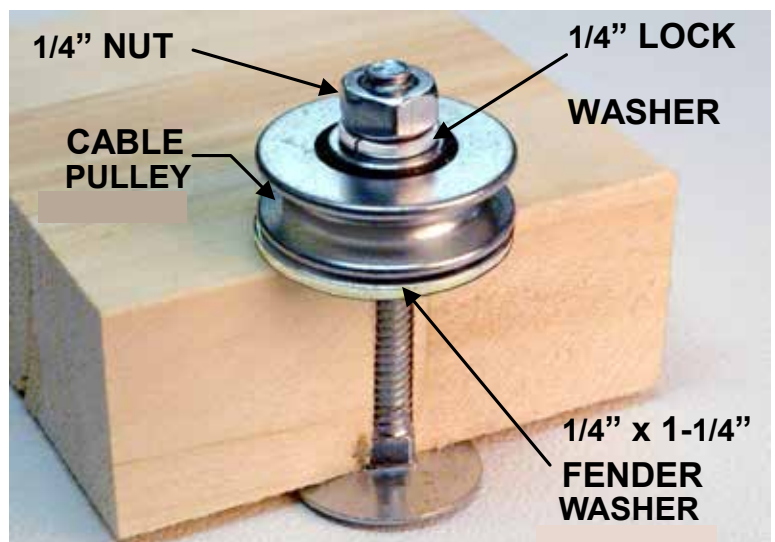
# Step Five

Steering Cable Installation. Required Items: Steering Cable Bag (complete with Steering Cable and Cable Adjuster), Floorboard, Steering Cable, Tools



## Cable Pulley Sub-Assembly (Legend Area Highlighted)

- 5.1 Insert one 1/4" x 2-1/4" elevator bolt through the floorboard bottom at a steering cable pulley hole location and press through the floorboard. See legend for location of holes.
- 5.2 Place a 1/4" x 1-1/4" fender washer on the 1/4" x 2-1/4" elevator bolt on top of the floorboard.
- 5.3 Install 1/4" nut on bolt and draw bolt flush with bottom of floorboard. Remove nut.
- 5.4 Place cable pulley on top of 1/4" x 1-1/4" fender washer.
- 5.5 Place 1/4" lock washer on top of the cable pulley.
- 5.6 Install 1/4" nut on 1/4" bolt. See Photo # 5.6
- 5.7 Tighten nut.
- 5.8 Repeat Steps 5.1 through 5.7 for second cable pulley location.



**Photo # 5.6**

# Step Five

Continued

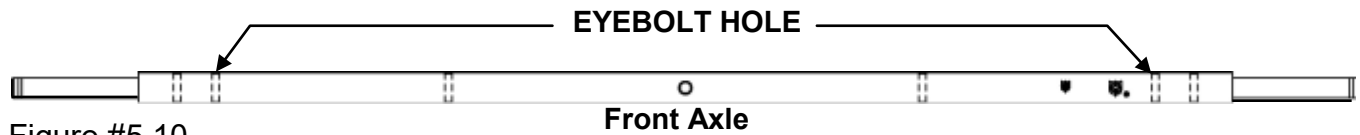


Figure #5.10

## Axle Eyebolt Sub-Assembly

- 5.9 Install 10-24 nut on 10-24 x 2" eyebolt. Tighten the 10-24 nut to the end of threads on eyebolt.
- 5.10 Insert assembly through driver side of front axle at eyebolt location. See Figure # 5.10
- 5.11 Place a #10 lock washer on the bolt.
- 5.12 Install 10-24 nut on eyebolt assembly.
- 5.13 Tighten eyebolt assembly. See Photo # 5.13
- 5.14 Repeat Steps 5.9 through 5.13 for second axle eyebolt assembly.

## Cable Adjuster Sub-Assembly

- 5.15 Install 8-32 nut on 8-32 x 1-5/8" eyebolt.
- 5.16 Insert eyebolt through any of the three holes of the inside of the cable adjuster and push through.
- 5.17 Place a #8 lock washer on 8-32 x 1-5/8" eyebolt.
- 5.18 Install 8-32 nut on # 8 lock washer. See Photo # 5.18
- 5.19 **Do not completely tighten assembly.** Further adjustments to occur in Step 11.
- 5.20 Repeat Steps 5.15 through 5.19 for second cable adjuster assembly.



Photo # 5.13



Photo #5.18



# Step Five

Continued

## Steering Cable Sub-Assembly

- 5.21 Determine the center point of the steering cable by folding the cable in half.
- 5.22 Insert the two loose ends of the steering cable through the lower hole of the steering wheel shaft located horizontally above the floorboard.
- 5.23 Pull the two loose cable ends through the hole until an eyelet is formed at the center point of steering cable.
- 5.24 Wrap one loose end of cable around shaft 180 degrees and thread through eyelet. See Figure # 5.24 – STEP ONE
- 5.25 Wrap other loose cable end in other direction around shaft 180 degrees from first cable, and thread through eyelet.
- 5.26 Pull both cable ends to tighten eyelet to secure cable.
- 5.27 Continue first cable around steering shaft to a minimum of 360 degrees (at least one complete wrap). See Figure # 5.27 – STEP TWO
- 5.28 Center steering wheel and hold steering wheel from turning.

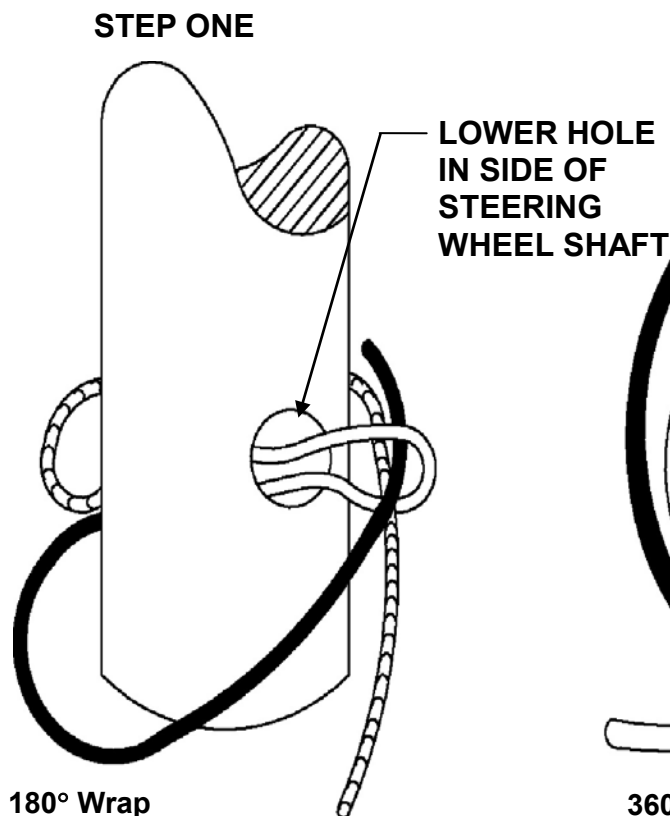


Figure #5.24

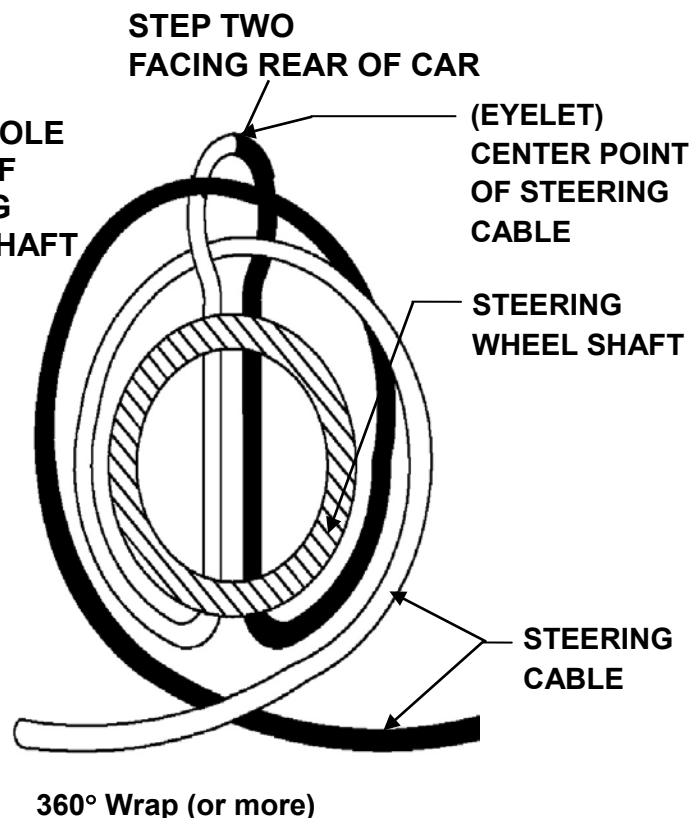
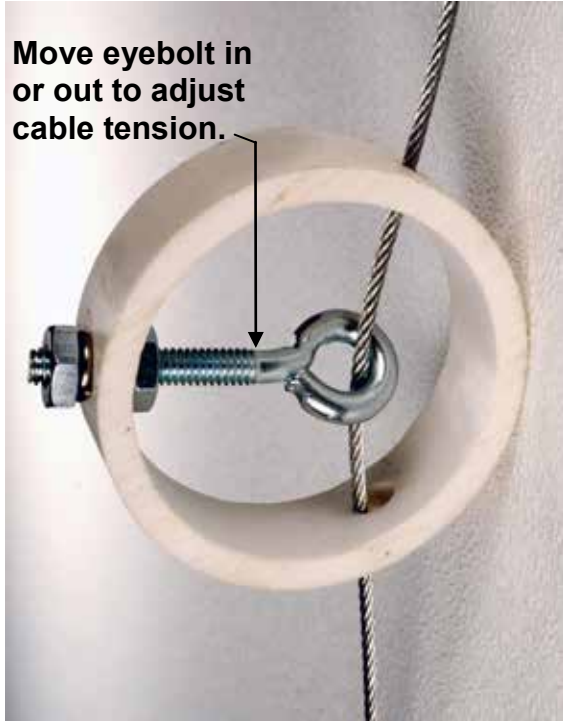


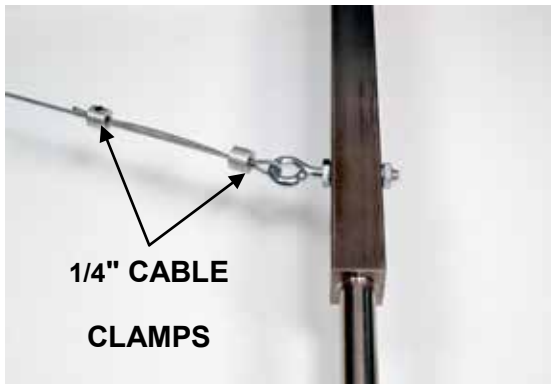
Figure #5.27

## Steering Cable Sub-Assembly Continued



**Photo #5.32**

**(Cable Adjuster Assembly)**



**Photo #5.37**

**(Front Axle Eyebolt Assembly)**

- 5.29 Thread one cable around steering pulley located on brake/steering mount.
- 5.30 Thread this cable through the outside of one of the two remaining holes in the cable adjuster and into the inside of the cable adjuster.
- 5.31 Thread cable through eyebolt inside cable adjuster.
- 5.32 Thread cable through the remaining hole in the cable adjuster. See Photo # 5.32
- 5.33 Thread one cable around cable pulley located on floorboard.
- 5.34 Slide two 1/4" cable clamps on cable end.
- 5.35 Thread cable through the front axle eyebolt assembly.
- 5.36 Insert loose end of cable back through both cable clamps.
- 5.37 Pull cables tight and tighten both cable clamps with a 5/64" Allen Wrench. Cable clamps can be placed next to each other. No space between cable clamps is required. See Photo # 5.37



# Step Five

Continued

## Steering Cable Sub-Assembly Continued

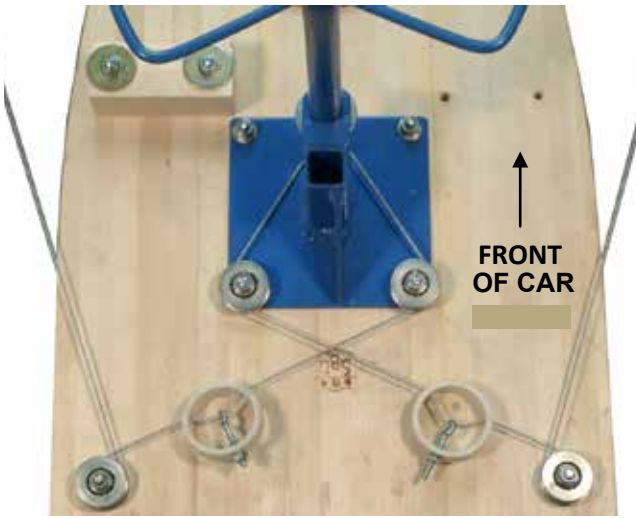


Photo #5.38(a)

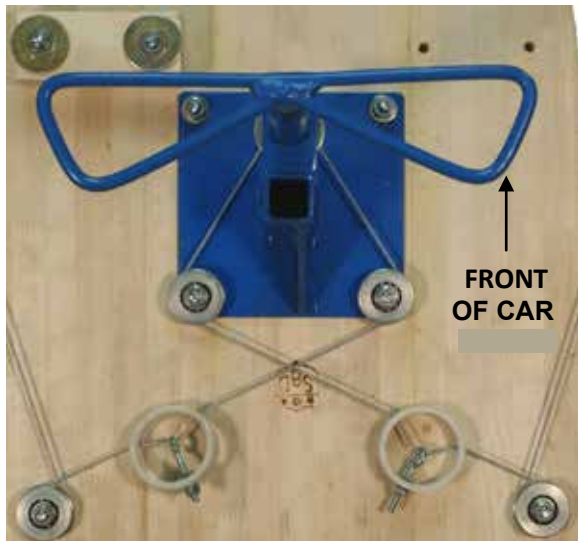


Photo #5.38(b)

- 5.38 Repeat steps 5.29 through 5.37 for the other cable. Refer to Photos # 5.38(a) and 5.38(b) for cable route.
- 5.39 Adjust steering cables by adjusting 8-32 x 1-5/8" eyebolts in cable adjuster assemblies.
- 5.40 Secure both cable adjusters by tightening both of the 8-32 nuts. Cable adjusters may be located anywhere along the cable. Remove temporary steering wheel clamp from Step 5.28.
- 5.41 Test by turning steering wheel to the right while seated facing the front of the car. The front axle must turn to the right.
- 5.42 Excess steering cable may extend past second 1/4" cable clamp and may be removed by cutting. To avoid cable fraying it is recommended that solder be applied to a 1/4" +/- on either side of the proposed cut prior to cutting.
- 5.43 Steering cable adjustment to occur in future Step 11.



# Step Six

Angle Iron Installation. Required Items: Stabilizer Bag, Angle Iron, Tools

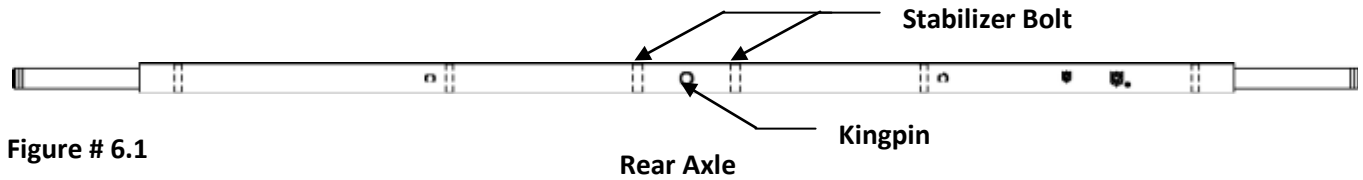
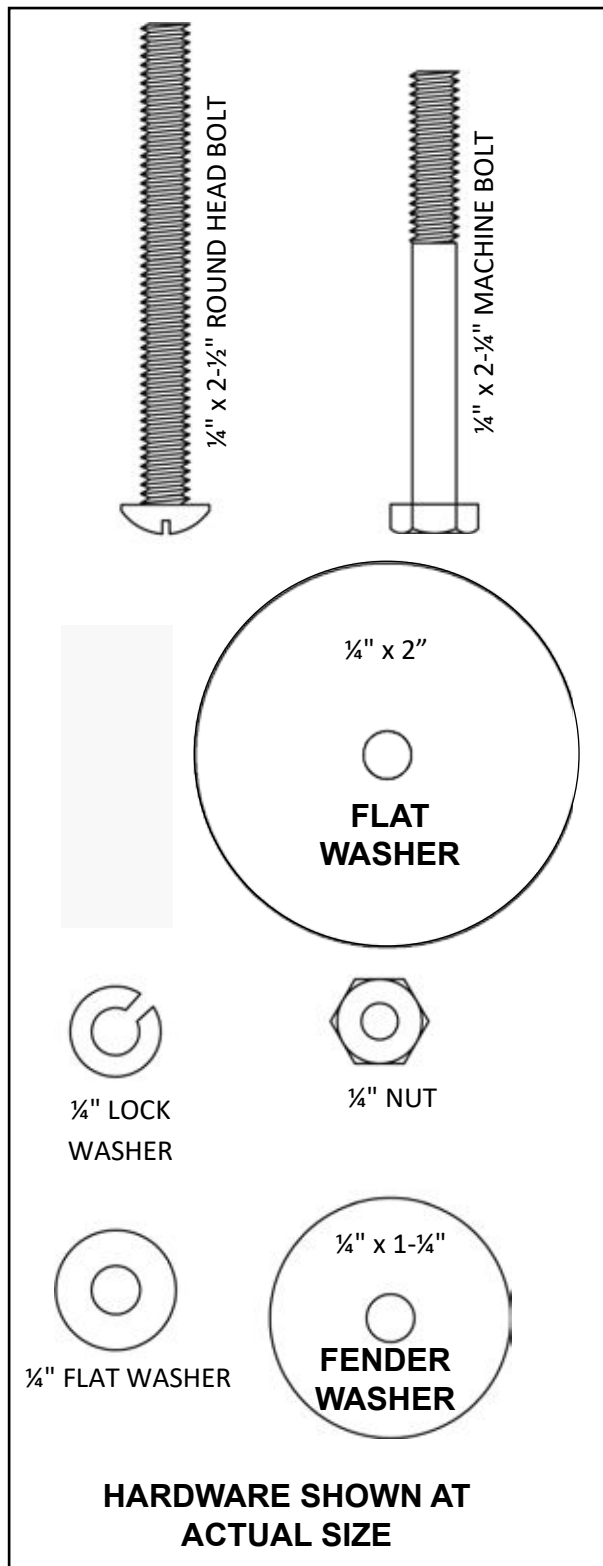


Figure # 6.1

## Angle Iron Sub-Assembly at Rear Axle

- 6.1 Insert  $\frac{1}{4}$ " x  $2\frac{1}{2}$ " round head bolt through back side of rear axle at a stabilizer bolt hole location. See Figure # 6.1 for stabilizer bolt hole locations. Round head bolt should be tight to the axle.
- 6.2 Place a  $\frac{1}{4}$ " lock washer on  $\frac{1}{4}$ " x  $2\frac{1}{2}$ " round head bolt.
- 6.3 Install  $\frac{1}{4}$ " nut on bolt. Tighten nut.
- 6.4 Repeat Steps 6.1 through 6.3 for the second stabilizer bolt hole.
- 6.5 Install a second  $\frac{1}{4}$ " nut on  $\frac{1}{4}$ " x  $2\frac{1}{2}$ " round head bolt leaving a 1" +/- gap between the axle and the second  $\frac{1}{4}$ " nut.
- 6.6 Place a  $\frac{1}{4}$ " flat washer against the second  $\frac{1}{4}$ " nut.
- 6.7 Repeat Steps 6.5 and 6.6 for second stabilizer bolt hole. See Photo # 6.7.
- 6.8 Slide the angle iron over the two bolts keeping the bottom leg flat against the SS rear axle plate. See Photo # 6.8
- 6.9 Place a  $\frac{1}{4}$ " flat washer on  $\frac{1}{4}$ " x  $2\frac{1}{2}$ " round head bolt.
- 6.10 Place  $\frac{1}{4}$ " lock washer on bolt.
- 6.11 Install  $\frac{1}{4}$ " nut on bolt. Do not completely tighten. See Photo # 6.11
- 6.12 Repeat Steps 6.9 through 6.11 for second stabilizer bolt hole.
- 6.13 The angle iron upright should be parallel with the rear axle. By maintaining the 1" +/- gap, the holes in the bottom leg of the angle iron should be aligned with those in the SS rear axle plate/floorboard.



# Step Six

Continued

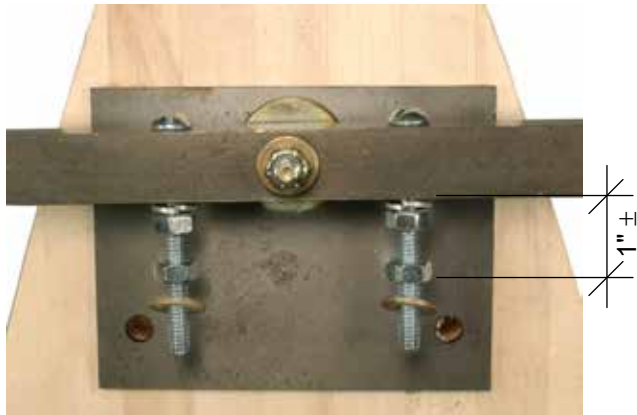


Photo #6.7

## Angle Iron Sub-Assembly at Rear Axle Continued

- 6.14 Tighten both sets of the  $\frac{1}{4}$ " nut assemblies on each side of the angle iron. See Photo # 6.14

## Angle Iron Sub-Assembly at Floorboard

- 6.15 Place  $\frac{1}{4}$ " x 2" flat washer on  $\frac{1}{4}$ " x 2- $\frac{1}{4}$ " machine bolt.
- 6.16 Insert bolt assembly through the bottom of floorboard at stabilizer/bushing location and press through the floorboard, SS rear axle plate and angle iron. See Photo # 6.16
- 6.17 Place  $\frac{1}{4}$ " flat washer on  $\frac{1}{4}$ " x 2- $\frac{1}{4}$ " machine bolt.
- 6.18 Place  $\frac{1}{4}$ " lock washer on machine bolt.
- 6.19 Install  $\frac{1}{4}$ " nut on machine bolt. See Photo #6.19
- 6.20 **Do not completely tighten.** Further adjustments to occur in future Step 11.
- 6.21 Repeat Steps 6.15 through 6.20 above for second stabilizer bolt hole.

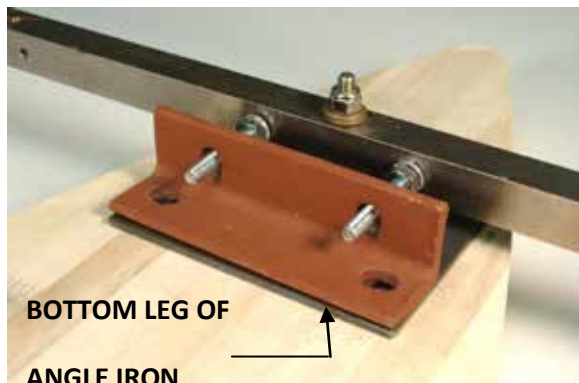


Photo #6.8



Photo #6.11



Photo #6.14



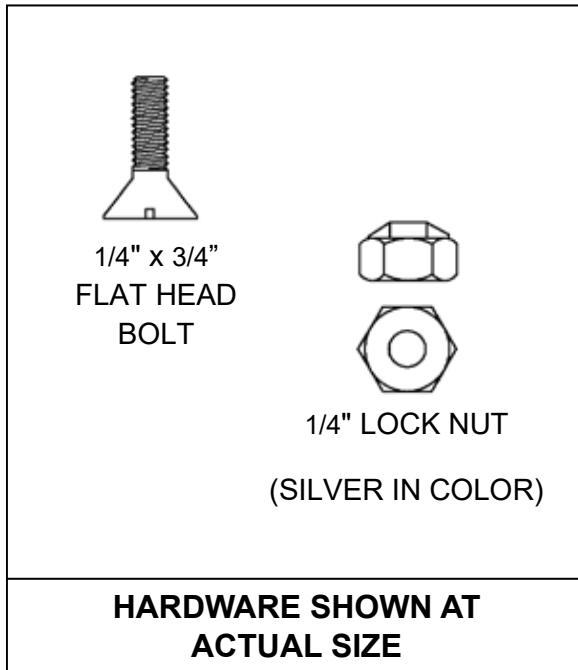
Photo #6.16



Photo #6.19

# Step Seven

Brake Pad Installation. Required Items: Brake Pad Bag, Plunger, Tools



## Brake Pad Installation

The brake pad may be installed to the plunger using both a 1/4" lock washer and 1/4" nut (provided by others) instead of the 1/4" lock nut.

- 7.1 Insert one 1/4" x 3/4" flat head bolt through each hole of the brake pad. Thick black side should be facing the ground. See Photo # 7.1
- 7.2 Align bolts in brake pad with holes in flat bottom of the plunger and insert.
- 7.3 Place a 1/4" lock nut (silver in color) on 1/4" x 3/4" flat head bolt (slotted or phillips head is acceptable).
- 7.4 Tighten assembly. It is recommended that approximately an eighth of the 1/4" x 3/4" flat head bolt (or three threads) is exposed. The 1/4" x 3/4" flat head bolt will be recessed in the bottom of the brake pad. See Photo # 7.4
- 7.5 Repeat Steps 7.1 through 7.4 for other three bolt locations.



Photo # 7.1

(Brake Pad)

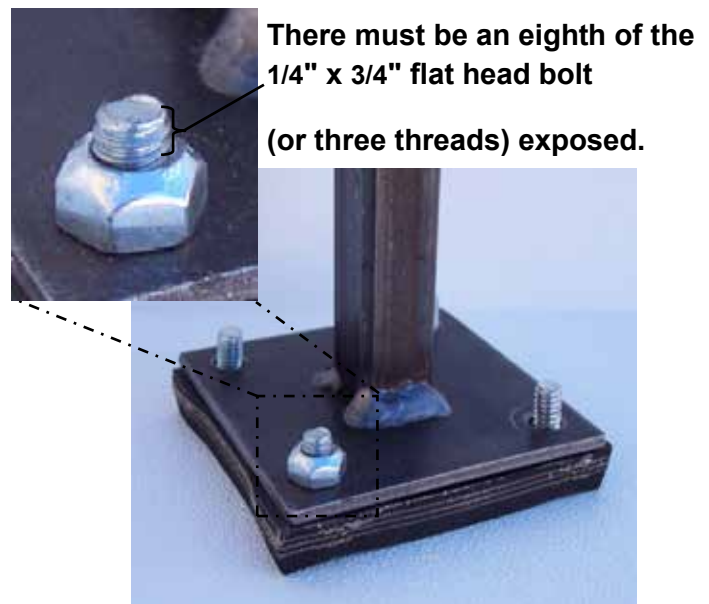
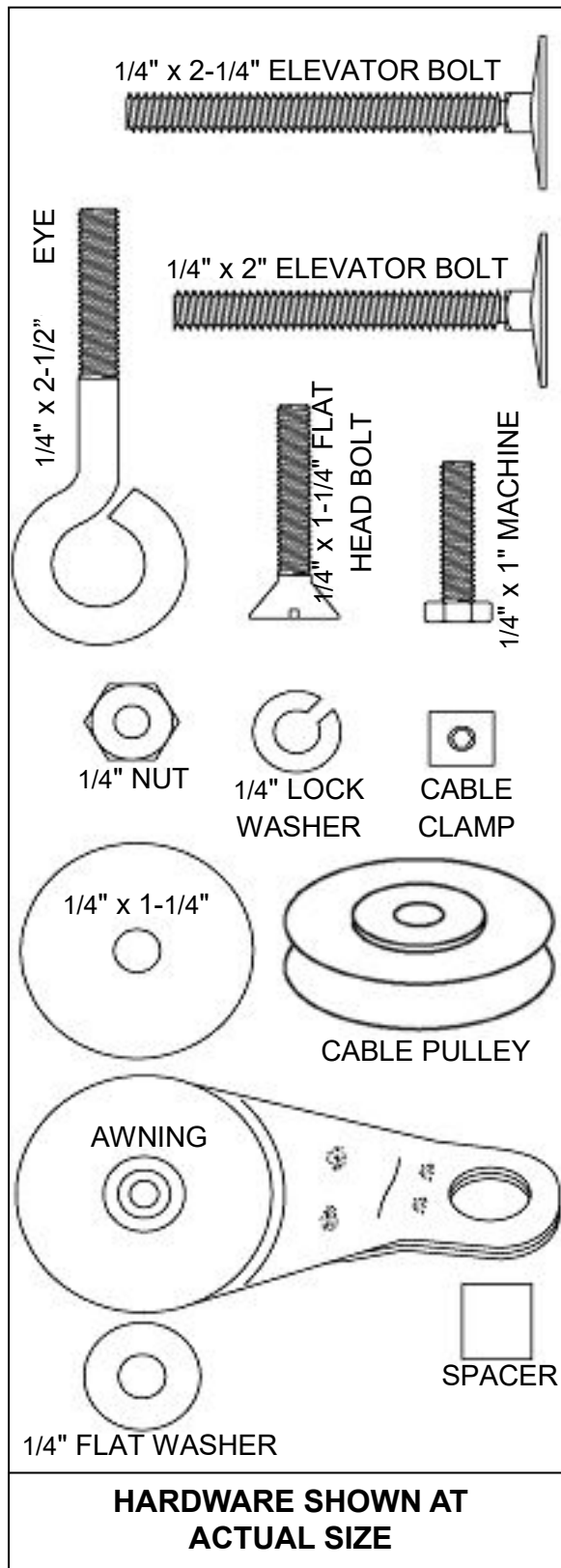


Photo # 7.4

**Brake Pad/Plunger Assembly**

# Step Eight

Brake Installation. Required Items: Brake Bag, Floorboard, Brake Pad/Plunger Assembly from Step Seven, Brake Spring, Tape (provided by others), Tools



## Brake Pedal Hinge Sub-Assembly

- 8.1 Align the four hinge holes with the brake pedal. Top of the wood brake pedal has rounded corners and the bottom is straight. The fifth hole located at the rounded corner is for brake pedal eyebolt installation.
- 8.2 Insert 1/4" x 1-1/4" flat head bolt through brake pedal and through one of the four hinge holes.
- 8.3 Install 1/4" lock washer on 1/4" x 1-1/4" flat head bolt.
- 8.4 Install 1/4" nut on 1/4" washer. **Do not completely tighten.** See Photo # 8.4
- 8.5 Repeat Steps 8.2 through 8.4 for other three bolts.
- 8.6 Tighten nuts until bolt heads are flush with face of brake pedal.



**Photo # 8.4**  
(Partial image shown for clarity)

# Step Eight

Continued



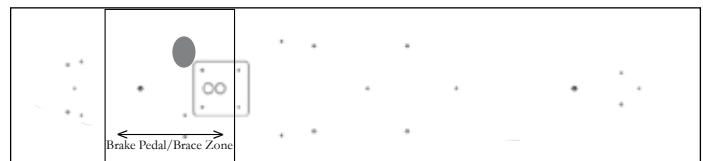
**Photo # 8.12**  
**(Eyebolt will face rear of car)**

Brake pedal may be moved forward or back in brake Pedal/Brace Zone to accommodate a driver.

**DO NOT ALTER THE BRAKE PEDAL**

## Brake Pedal Eyebolt Sub-Assembly

- 8.7 Install 1/4" nut on 1/4" x 2-1/2" eyebolt. Tighten nut to the end of threads on eyebolt.
- 8.8 Place 1/4" x 1-1/4" fender washer on the eyebolt.
- 8.9 Insert eyebolt assembly through the hole in the wood brake pedal on side opposite hinge.
- 8.10 Place 1/4" x 1-1/4" fender washer on the brake pedal eyebolt bolt assembly.
- 8.11 Install 1/4" lock washer on 1/4" x 1-1/4" fender washer.
- 8.12 Install 1/4" nut on bolt Tighten eyebolt assembly. See Photo # 8.12



## Brake Assembly Installation (Legend Area Highlighted)

### Brake Pedal Hinge Sub-Assembly at Floorboard



**Photo # 8.18**

- 8.13 Align the two outer holes of the brake pedal hinge with holes in floorboard at brake pedal location (center hole of hinge not used). See legend for location of holes.
- 8.14 Insert one 1/4" x 2" elevator bolt through the floorboard bottom at a brake pedal hole location and press through the floorboard and brake pedal hinge hole.
- 8.15 Place 1/4" lock washer on 1/4" x 2" elevator bolt.
- 8.16 Install 1/4" nut on 1/4" lock washer. Do not completely tighten.
- 8.17 Repeat Steps 8.13 through 8.16 for second bolt.
- 8.18 Tighten both nuts until bolts are drawn in flush with bottom of floorboard. See Photo # 8.18



# Step Eight

Continued

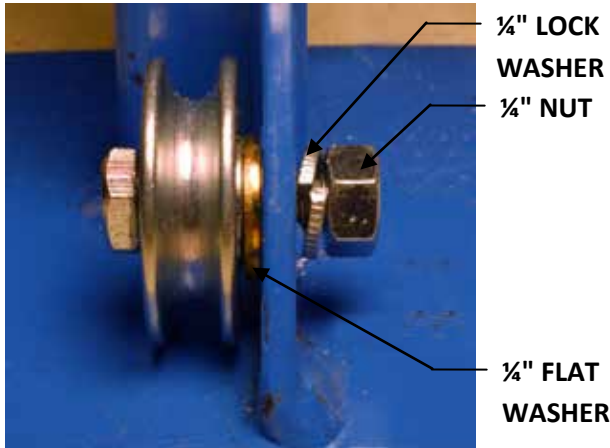


Photo #8.24

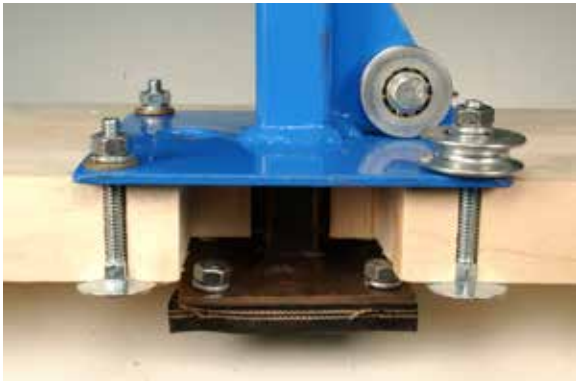


Photo #8.26

(Steering wheel and steering cables not shown for clarity)



Photo #8.30

## Cable Pulley Sub-Assembly at Brake/Steering Mount

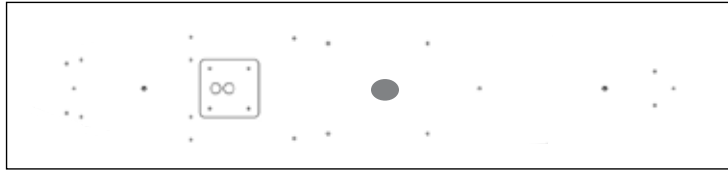
- 8.19 Insert 1/4" x 1" machine bolt through cable pulley.
- 8.20 Place 1/4" flat washer on 1/4" x 1" machine bolt.
- 8.21 Insert 1/4" x 1" machine bolt with cable pulley and flat washer through hole in the left side of the vertical plate of the brake/steering mount.
- 8.22 Place 1/4" lock washer on the machine bolt assembly.
- 8.23 Install 1/4" nut on 1/4" lock washer.
- 8.24 Tighten assembly. Cable pulley shall spin freely. See Photo # 8.24

## Plunger Sub-Assembly

- 8.25 Install 1/4" nut on 1/4" x 2-1/2" eyebolt. Tighten nut to end of threads on eyebolt.
- 8.26 Insert square tube end of brake plunger assembly through bottom of floorboard at large round hole of brake/steering mount and push through top of brake/steering mount. See Photo # 8.26
- 8.27 Place brake spring on brake plunger.
- 8.28 Compress brake spring coil and insert eyebolt assembly through hole of plunger (eyebolt faces rear of car).
- 8.29 Place 1/4" lock washer on the eyebolt assembly.
- 8.30 Install 1/4" nut on eyebolt. See Photo # 8.30
- 8.31 Tighten eyebolt assembly.
- 8.32 Push assembly down several times to ensure smooth operation.

# Step Eight

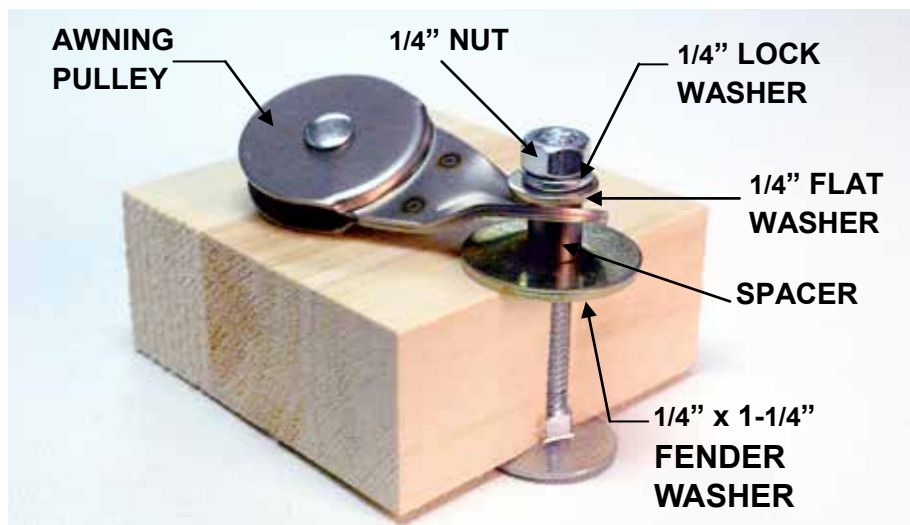
Continued



**Awning Pulley Installation  
(Legend Area Highlighted)**

## Awning Pulley Sub-Assembly

- 8.33 Insert one  $\frac{1}{4}$ " x 2- $\frac{1}{4}$ " elevator bolt through the floorboard bottom at awning pulley hole location. See legend for location of hole.
- 8.34 Place  $\frac{1}{4}$ " x 1- $\frac{1}{4}$ " fender washer on the elevator bolt on top of the floorboard.
- 8.35 Install  $\frac{1}{4}$ " nut. Tighten to draw elevator bolt flush with floorboard. Remove nut.
- 8.36 Place spacer on  $\frac{1}{4}$ " x 1- $\frac{1}{4}$ " fender washer.
- 8.37 Place awning pulley hole on spacer.
- 8.38 Place  $\frac{1}{4}$ " flat washer on awning pulley.
- 8.39 Place  $\frac{1}{4}$  lock washer on bolt.
- 8.40 Install  $\frac{1}{4}$ " nut on  $\frac{1}{4}$ " lock washer.
- 8.41 The awning pulley swings freely and should be pointed toward the front of the car. See Photo # 8.41
- 8.42 Tighten nut.



**Photo #8.41**

# Step Eight

Continued

Brake and steering cables may be double looped

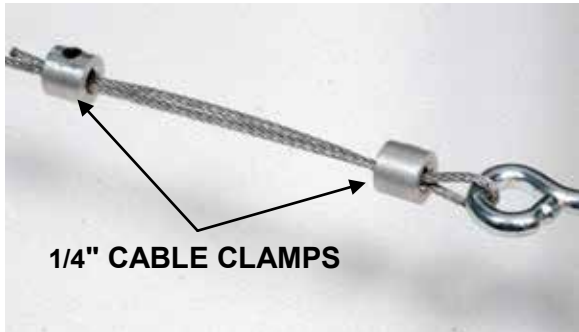


Photo #8.45



Photo #8.47

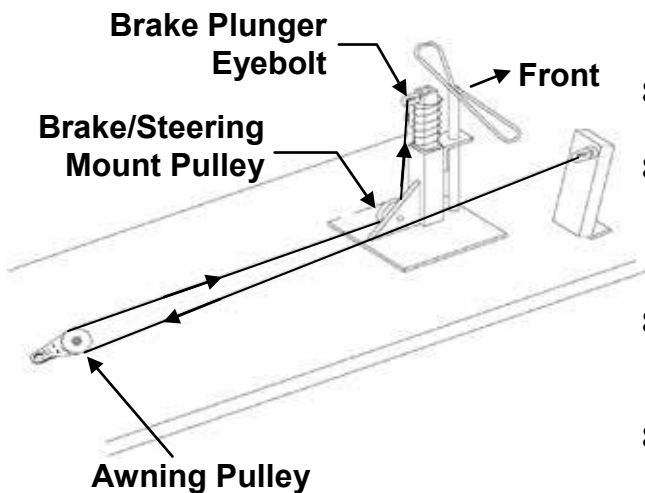


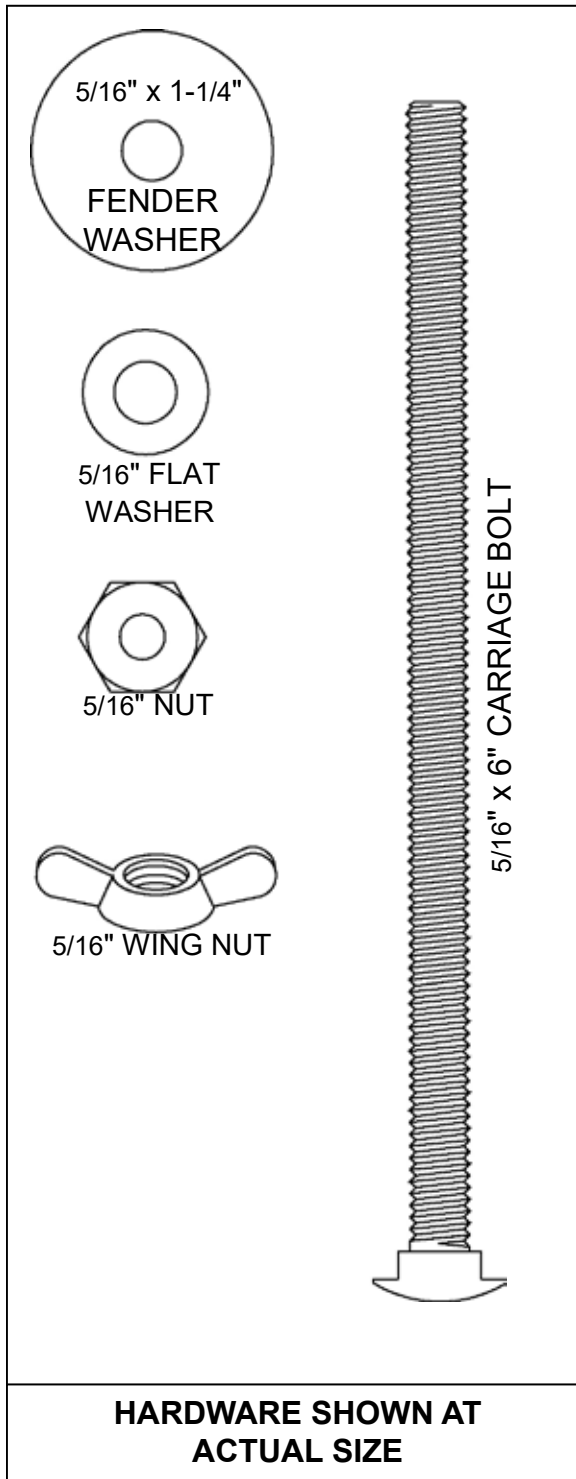
Figure #8.50

## Brake Cable Sub-Assembly

- 8.43 Slide two cable clamps on one end of the brake cable.
- 8.44 Thread end of brake cable (approximately six inches) through the brake pedal eyebolt creating a loop around eyebolt.
- 8.45 Thread cable back through the two cable clamps. See Photo # 8.45
- 8.46 Tighten cable clamps with a 5/64" Allen Wrench.
- 8.47 Thread other end of brake cable through awning pulley and continue through cable pulley at brake/steering mount. See Photo # 8.47
- 8.48 Slide two cable clamps on the cable and continue the cable up through brake plunger eyebolt.
- 8.49 Insert loose end of the cable back through both cable clamps creating a loop around the eyebolt.
- 8.50 Pull loose end of cable tight and tighten cable clamps with a 5/64" Allen Wrench. See Figure # 8.50
- 8.51 Apply pressure to brake pedal and check for smooth operation of brake plunger. Lubrication of the plunger shaft and adjustment of the brake cable may be required. When brake is applied, brake plunger should extend sufficiently to the ground surface to stop the car.
- 8.52 Tighten all cable clamps securely.
- 8.53 Excess cable length may be removed by cutting. To avoid cable fraying it is recommended that solder be applied to a 1/4" +/- on either side of the proposed cut prior to cutting.
- 8.54 It is permitted to secure the loose ends of the cable with tape (provided by others).
- 8.55 Push brake pedal several times to ensure proper operation.

## Step Nine

Weight Bolt Installation. Required Items: Weight Bolt Bag, Floorboard, Weights (provided by others), Tools



**Weight Bolt Installation  
(Legend Area Highlighted)**

- 9.1 Insert threaded end of 5/16" x 6" carriage bolt through the floorboard bottom at a weight hole location and press through the floorboard. See legend for location of holes.
- 9.2 Place a 5/16" flat washer on the 5/16" x 6" carriage bolt.
- 9.3 Install 5/16" nut on 5/16" flat washer.
- 9.4 Tighten bolt assembly.
- 9.5 Repeat Steps 9.1 through 9.4 for second bolt location.
- 9.6 These adjustable weight bolt assemblies are required.
- 9.7 See Tech Tip #1 – Optional Weights.



# Step Nine

Continued

- 9.8 Place owner provided weights as needed on either, or both, of the 5/16" x 6" carriage bolts.
- 9.9 Place 5/16" x 1-1/4" fender washer on owner provided adjustable weight on both bolts.
- 9.10 Install 5/16" wing nut on 5/16" x 1-1/4" fender washer of both bolts. See Photo # 9.10
- 9.11 Tighten wing nuts. Note that 5/16" x 1-1/4" fender washer and 5/16" wing nut must be installed even if weight is not used.
- 9.12 See Tech Tip #1 – Optional Weights.

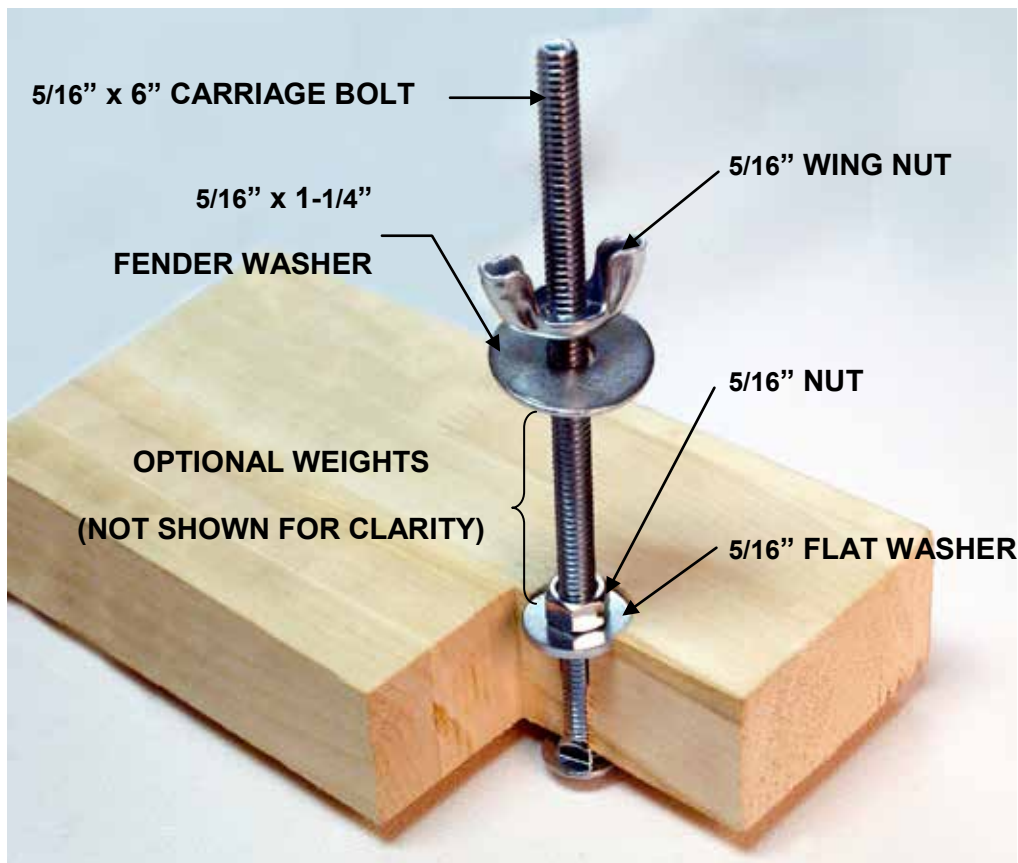


Photo # 9.10

# Step Ten

Axle Alignment & Triangulation. Required Items: Tape Measure or Triangulation Tool (provided by others), Tools

## Rear Axle Triangulation (Made easier by disconnecting brake pedal)



Photo #10.2

- 10.1 The rear axle will need to be aligned to ensure that the car tracks properly in a straight line. This is known as Triangulation. Contact your local Derby Director for other available methods and assistance.
- 10.2 Obtain a metal tape measure (other triangulation tools can be used in this step) to create a "Triangulation Tool." Drill a 1/4" hole near the end of the tape measure See Photo #10.2
- 10.3 Take off first nut only on front axle kingpin. Slide the 1/4" hole end of the tape measure over the front axle kingpin. Slide out the tape measure to establish Dimension B (PT#2 and PT#3) close to the end of the tape. Mark locations PT#2 and PT#3.
- 10.4 Semi-tighten the rear stabilizer assembly and adjust the rear axle until both dimensions are exactly the same between PT#1 and PT#2, and PT#1 and PT#3. See Photo # 10.4
- 10.5 When both dimensions are equal, tighten the rear stabilizer assembly.
- 10.6 Check the measurement to ensure that it is equal.

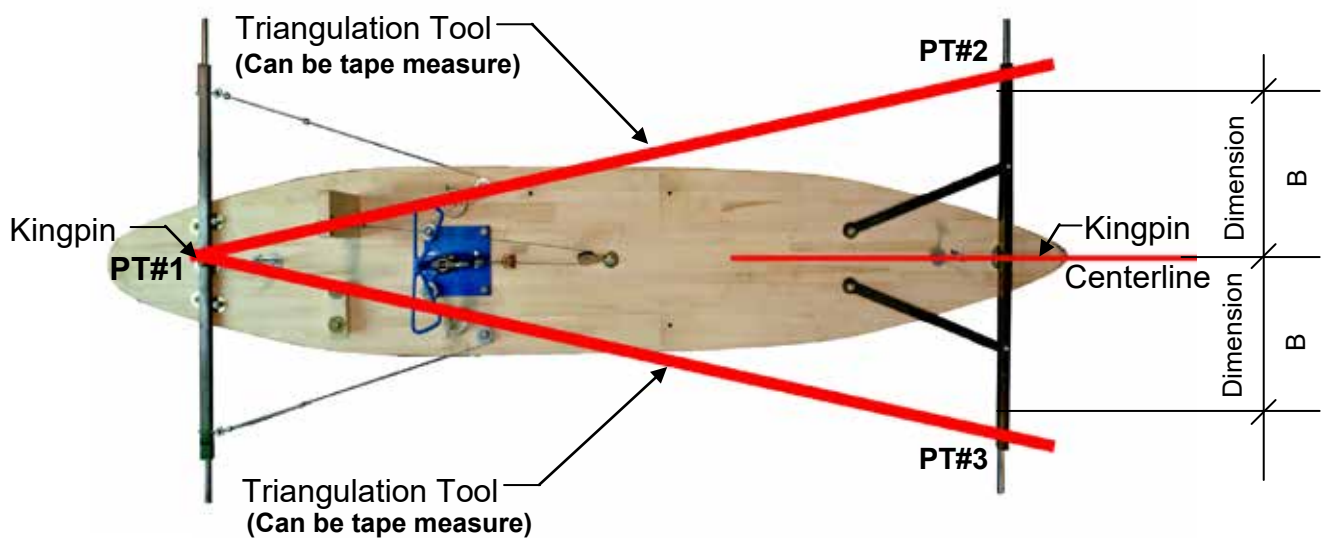
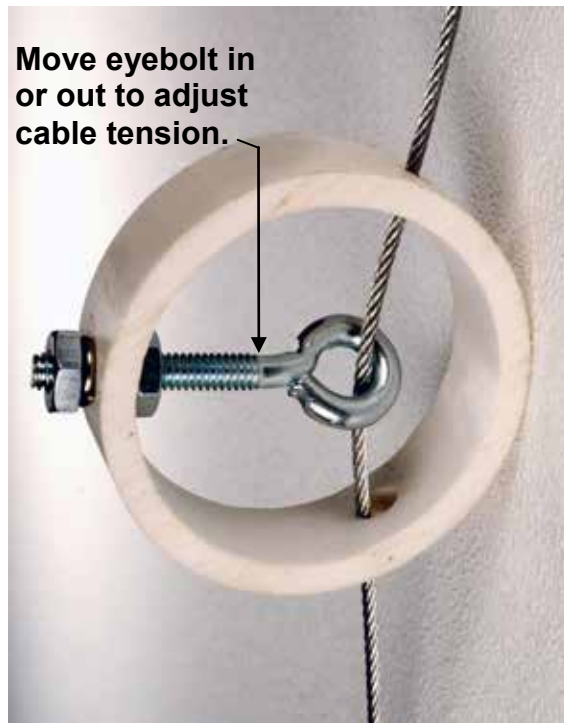


Photo #10.4

# Step Ten

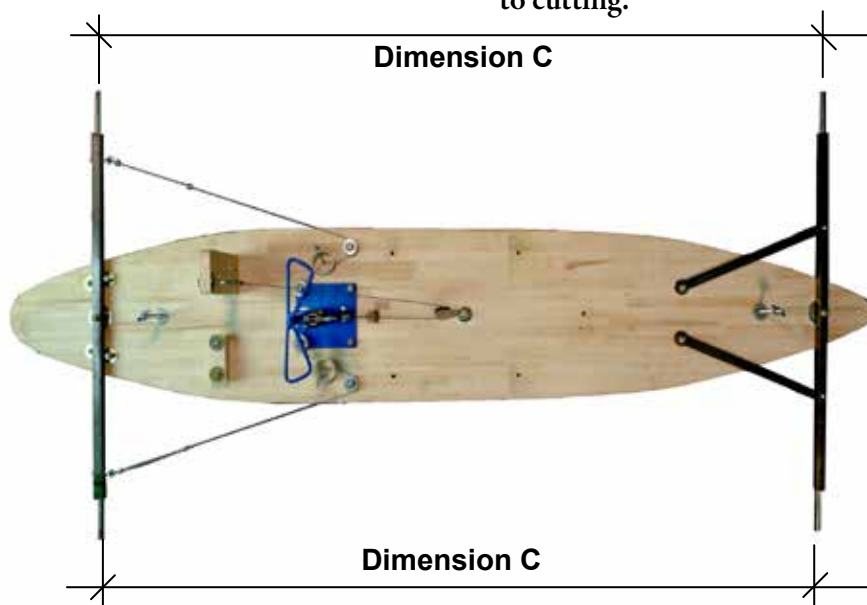
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**Photo #10.8(a)**  
**(Cable Adjuster Assembly)**

## Front Axle Alignment

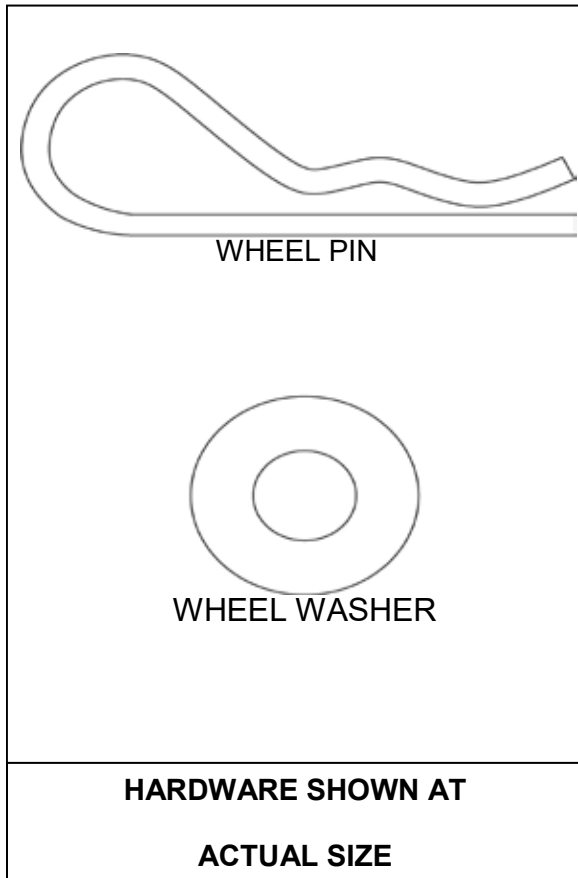
- 10.7 The front axle will need to be aligned to ensure that the steering wheel is properly centered to allow the car to properly track in a straight line. Contact your local Derby Director for other available methods and assistance.
- 10.8 Center the steering wheel. Measure from the back edge of the rear axle to the back edge of the front axle on both sides. Tighten or loosen the steering cables at the cable adjuster eyebolt until Dimension C is exactly the same on both sides. See Photo # 10.8(a) and Photo # 10.8(b)
- 10.9 Tighten nuts on both sides of the cable adjuster.
- 10.10 Check the measurement to ensure that it is equal. The steering cable should be tight; however, not so tight that it bows the front axle.
- 10.11 Make sure that the axle turns in the same direction as the steering wheel.
- 10.12 Tighten all parts of the steering assembly as shown in Step Five.
- 10.13 Steering cable excess length may be cut off past the cable clamps. To avoid cable fraying it is recommended that solder be applied a 1/4" +/- on each side of the proposed cut **prior to cutting.**



**Photo #10.8(b)**

# Step Eleven

Wheel Kit Installation. Required Items: Wheel Kit Bag, Wheels, Tools



## Wheel Kit Installation

- 11.1 Place a wheel (purchased separately) on an axle spindle.
- 11.1 Place a wheel washer on the axle spindle with the wheel.
- 11.3 Install wheel pin from front of axle through horizontal hole in axle spindle. See Photo # 12.3 Round portion of wheel pin shall face the front of the car.
- 11.4 Repeat Steps 12.1 through 12.3 for the other three wheels.
- 11.5 May use 0 to 2 washers per spindle.

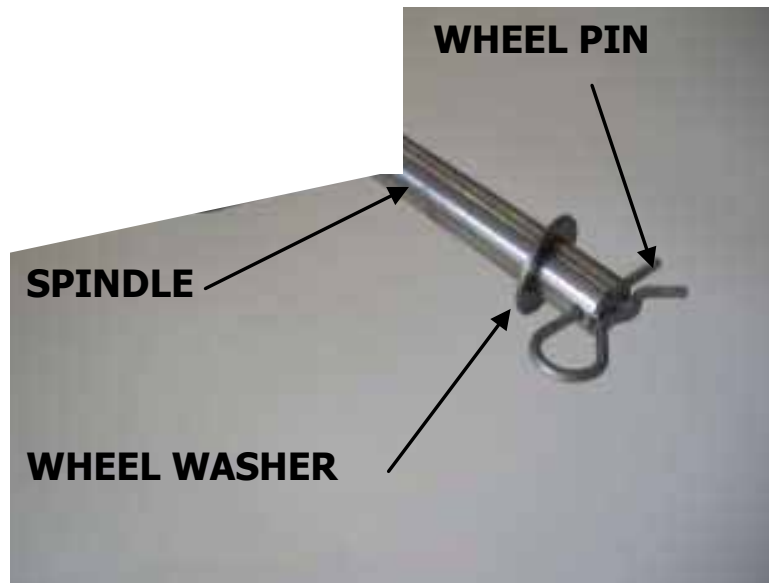


Photo #11.3

(Wheel not shown for clarity)



# Tech Tip #1

## Optional Weights (Provided by Others)

The information provided below is general in nature. Weight may be added to get the car/driver up to the maximum weight (275 lbs.) for better performance.

- 1.1 The car weight may be increased by the addition of weights. The additional weight should be securely bolted through the floorboard. There are two types of weight:
- 1) Adjustable Weight (located toward the front and rear of the car)
  - 2) Fixed Weight (located in the middle of the car)

- 1.2 Fixed and adjustable weights are available for purchase from the International Soap Box Derby, Inc.

- 1.3 Weight could consist of wood or metal materials. If bar bell type weights are used, the large center hole should be filled or a dowel rod should be used until the weight fits securely on the weight 5/16" bolt.

- 1.4 Weight should not be located between the original holes of the foot brace and the brake pedal back to the steering pulleys as shown in Photo #1.6.

- 1.5 A 1/8" clearance should be maintained between the weights, shell, axles, stabilizer assembly and the weight-free zone.

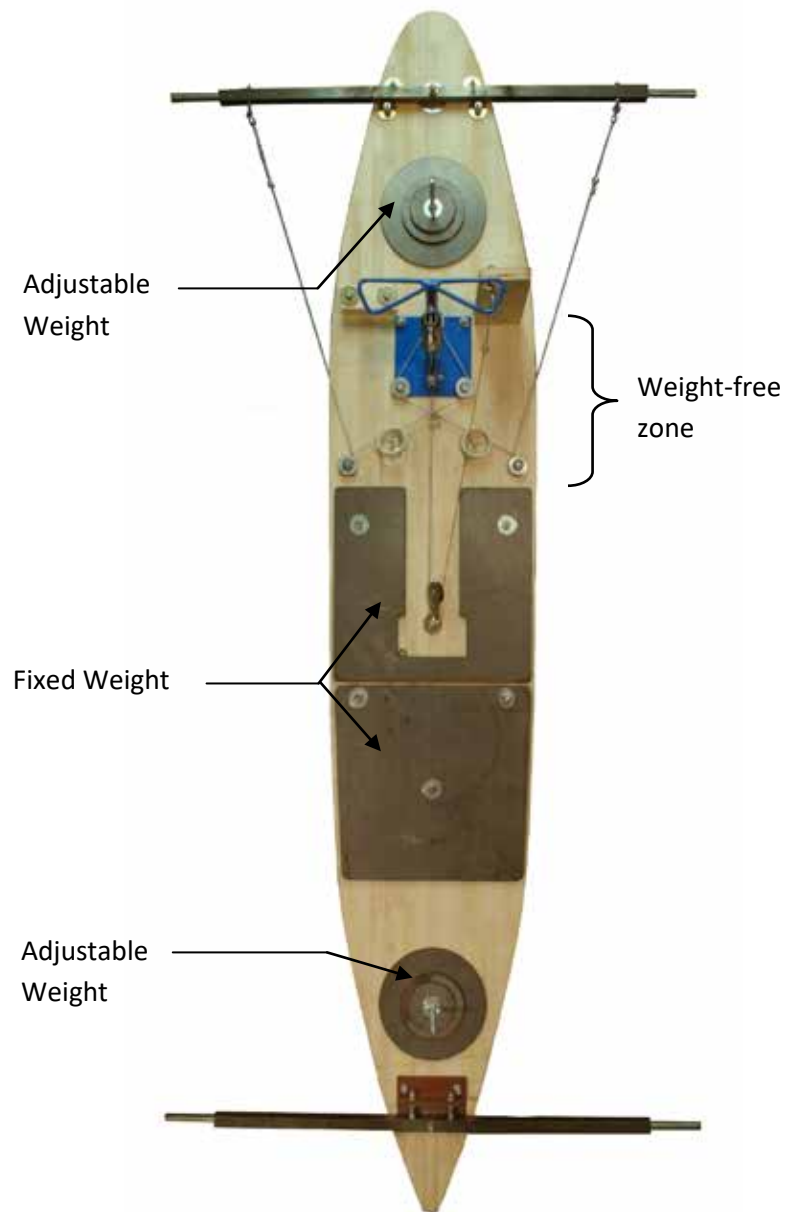


Photo #1.4

1.8 All weights should be easily removable with adequate bolt clearance. Weights should not:

- 1) Disconnect or remove any hardware components
- 2) Conceal any components
- 3) Be permanently attached to the car
- 4) Be threaded on the weight bolt
- 5) Be poured into the car
- 6) Touch the side or other components of the car
- 7) Be chained to the car

## Adjustable Weights

1.10 Two locations are dedicated for the adjustable weight. The bolts for these locations were installed in Step Nine. These two bolts are the only location that adjustable weight should be placed. See floorboard legend. Adjustable weight height is limited only by the length of the bolt. The size of the adjustable weight should be limited by the required 1/8" clearance to the shell, axles and stabilizer assembly and/or cannot exceed 12" lengthwise. See Photo #1.10

All weight should be placed inside the car on top of the floorboard

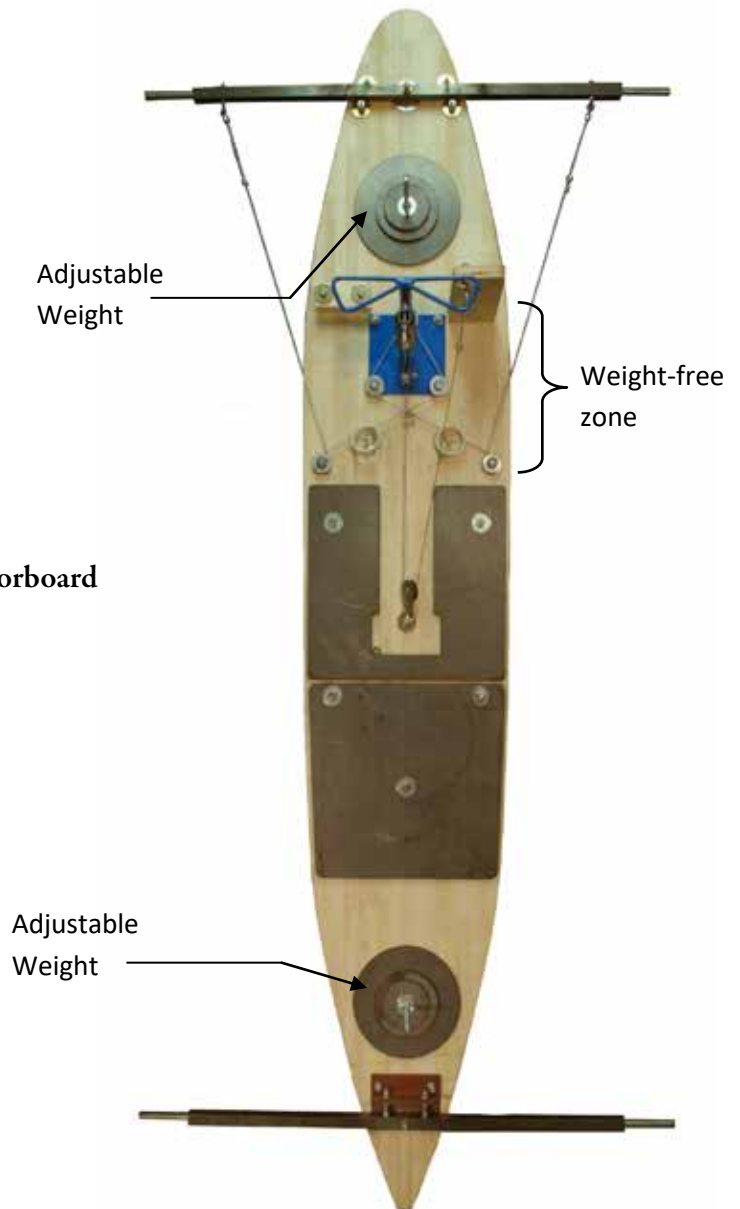
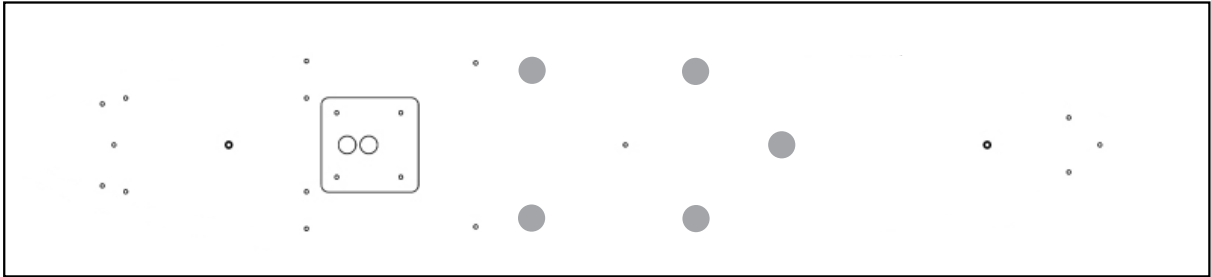


Photo #1.10

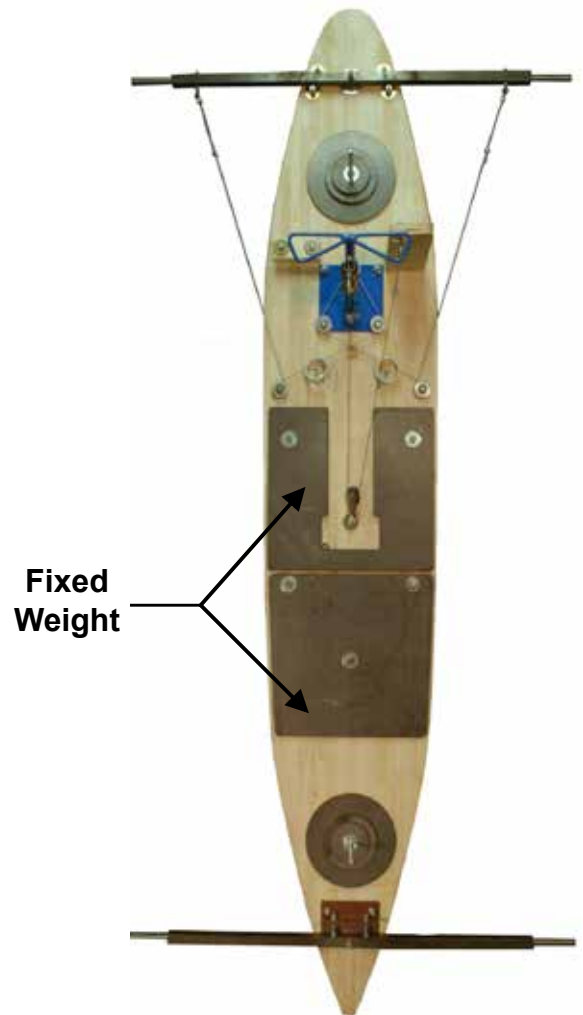


**Fixed Weight Bolt Installation  
(Legend Area Highlighted)**

- 1.11 Five bolt holes in the center/seat location of the floorboard are dedicated to fixed weight only. These five bolt areas are the location that fixed weight should be anchored. See legend above for location of holes. Any combination of bolt locations may be used, but each weight should be secured by a minimum of one bolt. See Photo #1.11. (**Weight bolt bag is included in kit**).
- 1.12 Fixed weight should not exceed a maximum height of 1-1/2" above the floorboard or exceed a 12" lengthwise dimension. Weight should be secured to prevent shifting or any type of movement.
- 1.13 Added weight in the form of bars, plates or flat shapes are permitted but should not exceed 12" lengthwise, should stack evenly on each other in the car, and should not exceed a total height of 1-1/2". A minimum horizontal clearance of 1/8" should occur between the weights in the fixed weight area. Bolts under the driver should be trimmed flush to the top of the nut.
- 1.14 See Photo #1.14 for examples of adjustable and fixed weight.



**Photo #1.14**



**Photo #1.11.**

## IMPORTANT

After fixed weights are installed the bolts **SHOULD** be cut flush with the top of the nut to insure that a driver will not get cut by the bolts.



# Tech Tip #2

## Alignment

### Axle Alignment – Cross Bind Adjustment

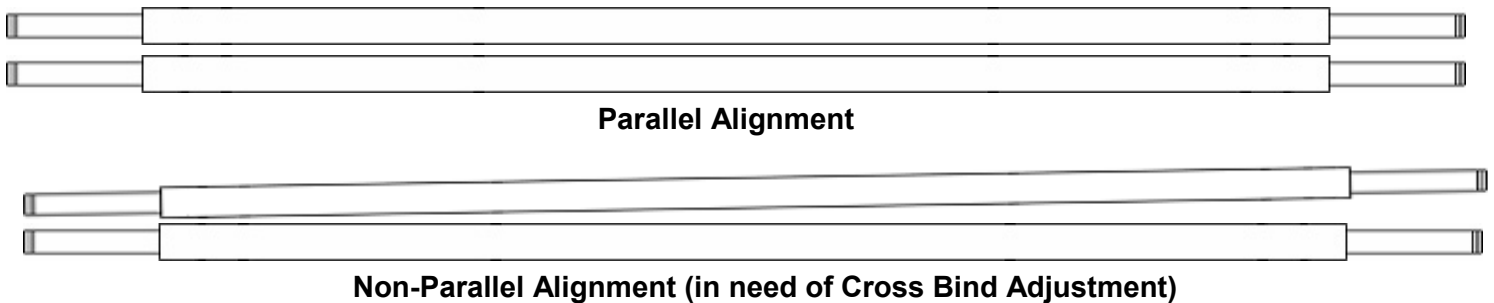
- 2.1 Cross bind adjustment is used to create a parallel horizontal plane between the front and rear axles. A single shim placement at either the front or the rear axle, not both, may be installed to eliminate cross bind between the two axles. This procedure is offered as guidance but is not the only method available. See Figure #2.1.
- 2.2 Elevate the floorboard and view the horizontal alignment of the front and rear axles from one end of the car. Determine if shimming is needed based on whether or not the axles are parallel.
- 2.3 The permitted shim should be a single, complete, uncut, feeler gauge (set available at any automotive store). Shims are available in thickness starting at one thousandth of an inch (.001). **Only one shim should be used in a car.** See Photo #2.3.
- 2.4 Install the single shim at the kingpin bolt assembly between floorboard and a washer or between two washers, all occurring below the axle bottom and at only one axle kingpin location. Small nails may be used to hold one or both ends of the feeler gauge in place. See Photo #2.4.
- 2.5 Tighten all parts of the kingpin assembly as shown in Step 3.



**Photo #2.3**  
**(Feeler Gauge Set)**



**Photo #2.4**



**Figure #2.1**

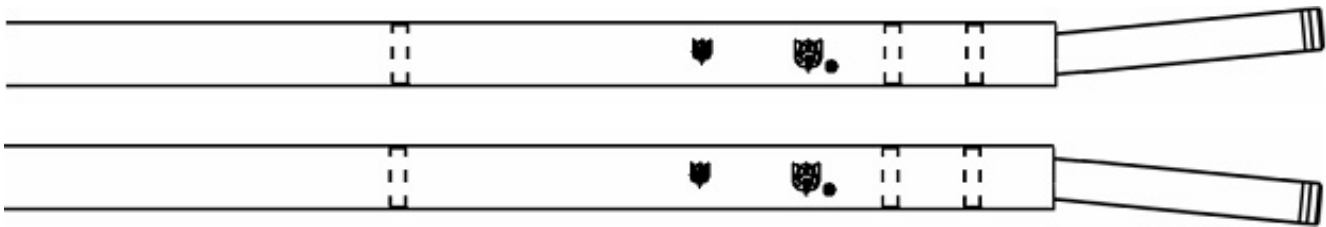


## Axle Alignment – Spindling

- 2.6 Spindling is an optional adjustment of the spindle (round portion) of the axle to gain Toe or Camber Alignment.

See Figure #2.2 and Figure #2.3.

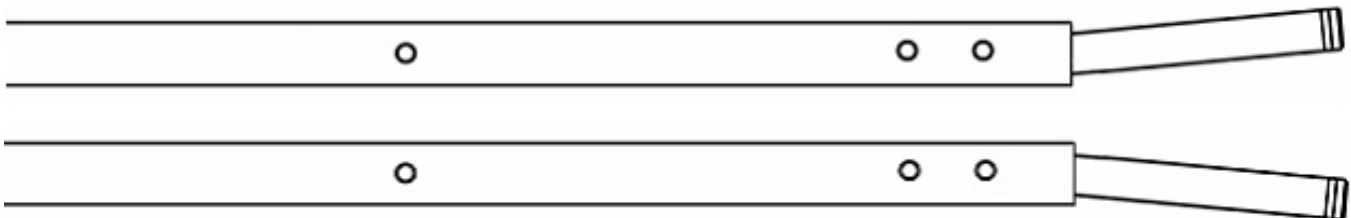
### Top View of Axle showing Toe Alignment (Distorted for Clarity)



**Figure #2.2**

(Partial Front Axle (with all hardware removed) shown as an example only.  
This figure can be used for both front and rear axles.)

### Side View of Axle showing Camber Alignment (Distorted for Clarity)



**Figure #2.3**

(Partial Front Axle (with all hardware removed) shown as an example only.  
This figure can be used for both front and rear axles.)

