

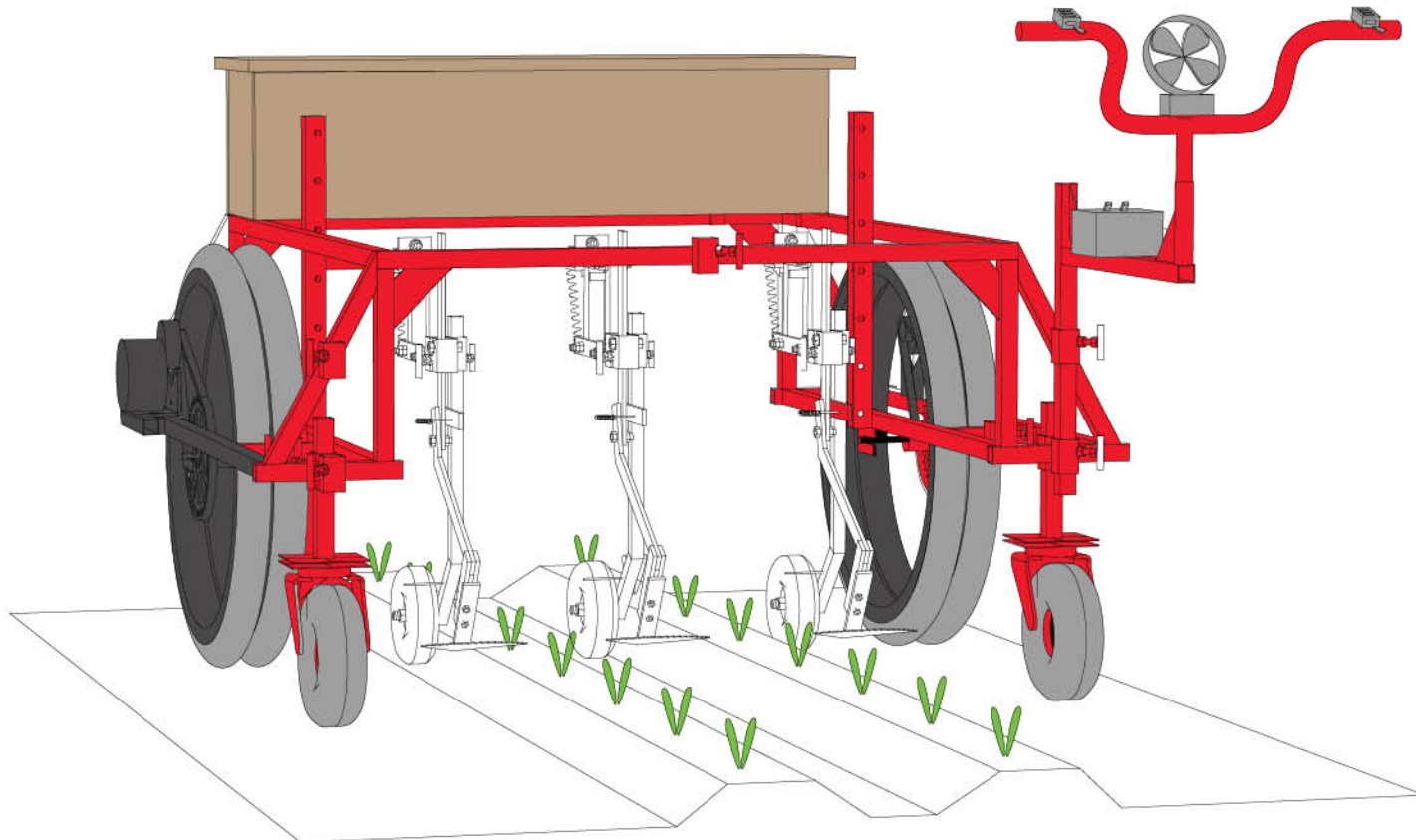
WEED WEASEL

The Weed Weasel is a light electric walking tractor for cultivating row crops. It has a centrally mounted tool bar for precision cultivating tools, an aft mounted tool bar for a blind cultivator (tine weeder), and wheel well sockets for wheel track cultivators. It is powered by two independently controlled 450 watt motors. The operator walks in the wheel track on one side and steers with handlebars and throttle levers. A 0.7 kwh battery bank provides up to 4 hours of cultivating between charges. The throttles include a hi-lo switch with a user-adjustable low power setting. The Weed Weasel fits in a niche between human powered cultivators such as wheel hoes, and cultivating tractors such as the Alis Chalmers G.

The Weed Weasel is built from standard steel square tubing, wood,

bicycle parts, and electric scooter parts. Prospective builders should study these free plans prior to building, and should be able to cut and weld thin metal, make electrical connections with solder and wire nuts, repair bikes, and do basic carpentry. The parts to construct one Weed Weasel cost about \$1,400 and build time is about 50 hours.

These free plans are available at www.farmhack.net and are entirely made possible thanks to a NE SARE grant. This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, through the Northeast Sustainable Agriculture Research and Education program under subaward number ONE18-324.



OVERVIEW OF STEPS



METAL



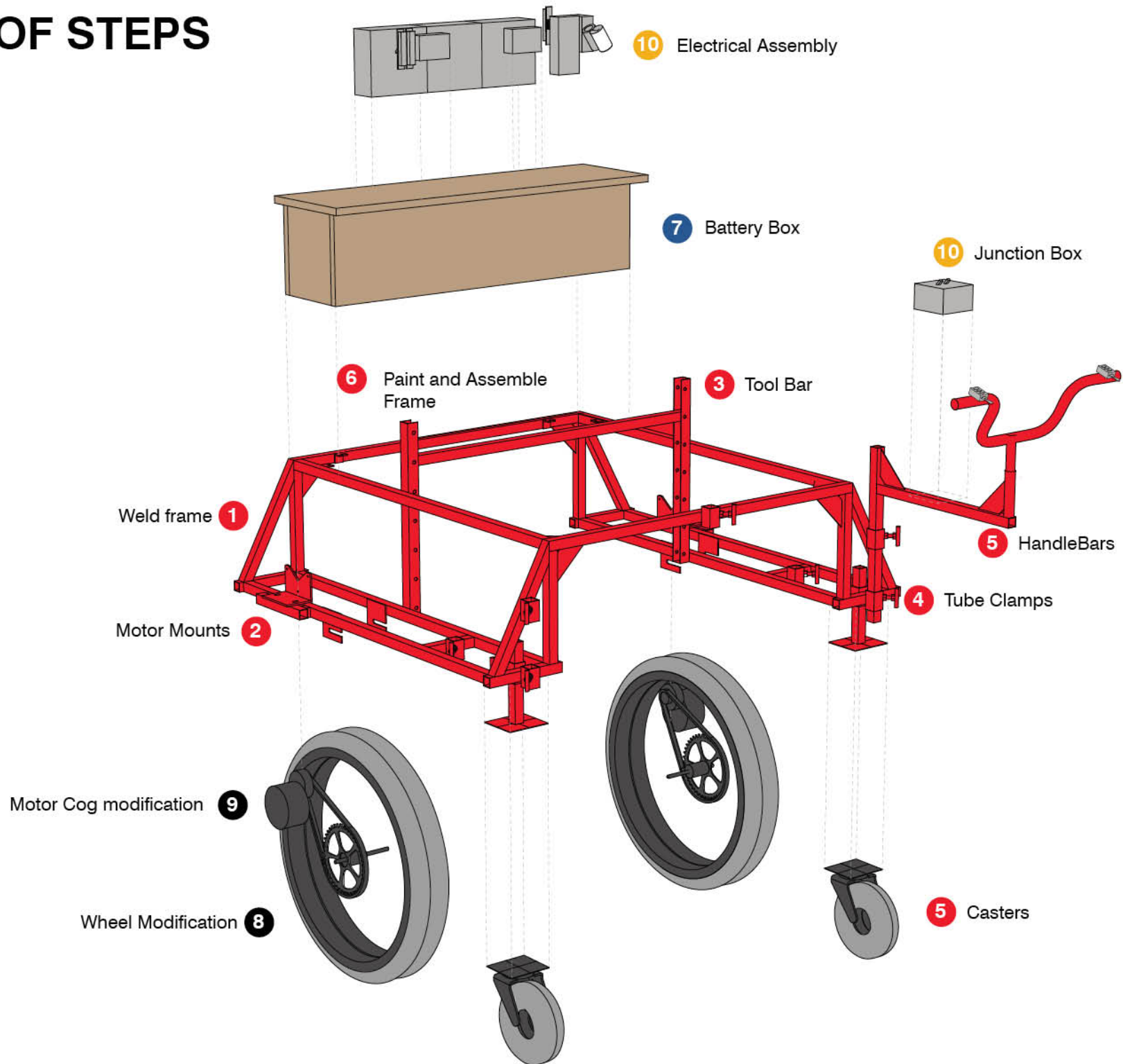
MECHANICAL



ELECTRICAL



WOOD



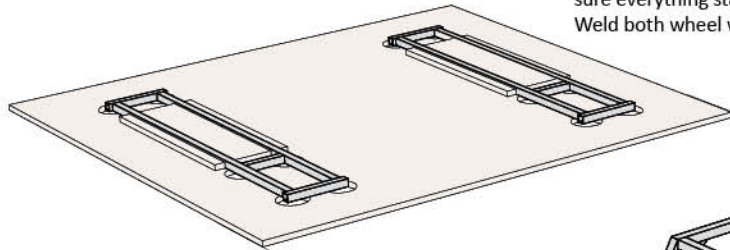
STEP 1

METAL FRAME

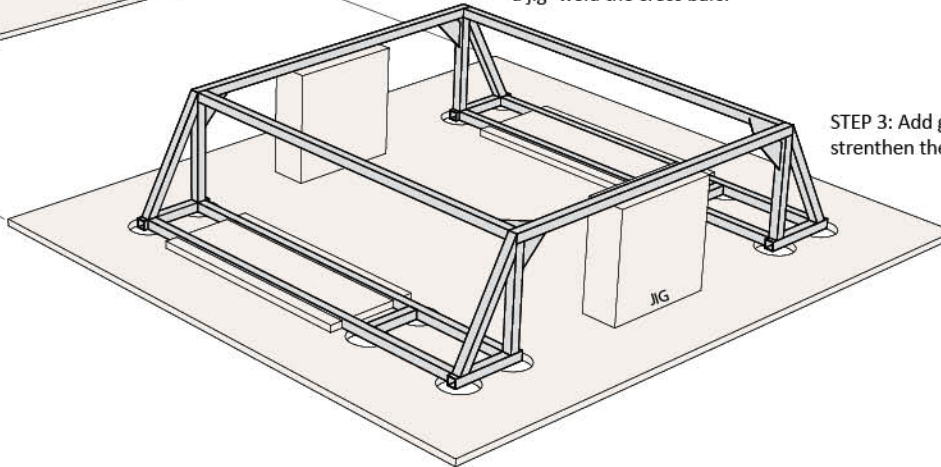


Fabricating the metal frame is most easily done with a mig welder, but the frame could also be stick welded, gas welded, or brazed. If a sturdy welding table is not available, a jig can be made using 3/4" plywood and scraps of 1x. The wheel wells need to be parallel so the machine tracks straight.

STEP 1: Using a jig to make sure everything stays parallel- Weld both wheel wells.



STEP 2: Weld the upright metal frame and then, using a jig-weld the cross bars.



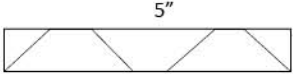
STEP 3: Add gussets to strengthen the corners

CUT SHEET:

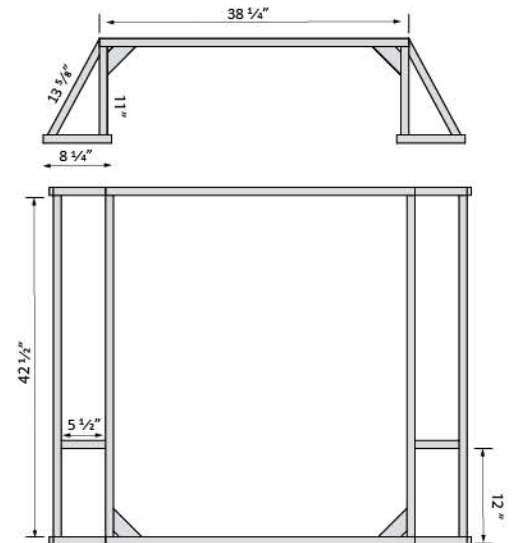
1x1x16g square tube :

- 6 @ 42 1/2"
- 2 @ 38 1/4"
- 4 @ 11"
- 4 @ 8.5"
- 2 @ 5 1/2"
- 4 @ 13 5/8" Cut at angles- take angles with bevel gauge

Gussets - 2"x 14g scrap cut at 5"



Gusset cut out pattern

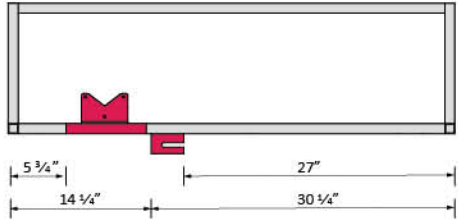
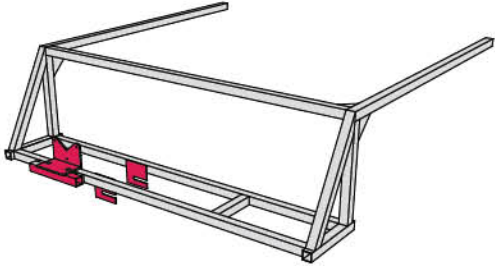
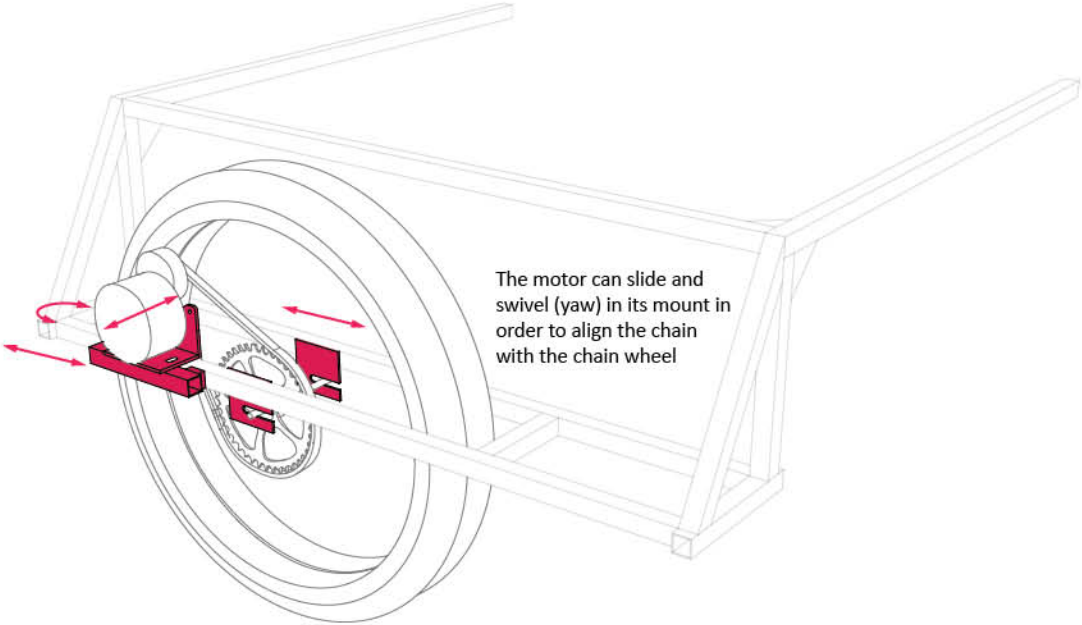


**STEP
2**

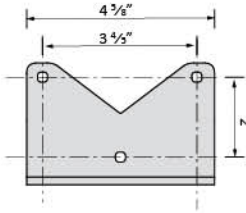
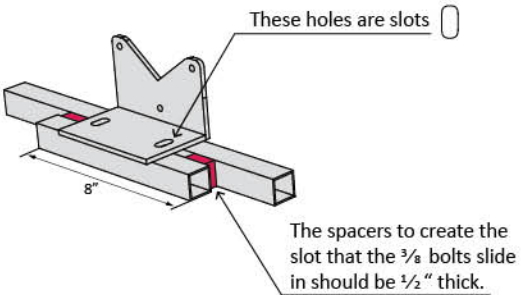
MOTOR MOUNTS + DROPOUTS + MOTOR ATTACHMENT

The motors first bolt to a hangar-bracket, and then each hangar-bracket-motor assembly bolts through a slot along the edge of the frame. The assembly allows the motor to adjust so that the alignment between the motor's cog and wheel's chainwheel can be precisely adjusted.

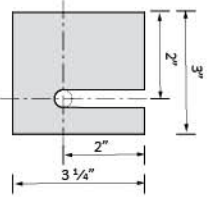
The holes in the hangar-bracket through which the motor bolts should be patterned off the motor itself. The dimensions given here are for the motor specified. The holes will need to be countersunk to insure the stainless machine screws have enough thread engagement in the aluminum motor case.



- CUT SHEET:**
 3" x 3" 1/8"
 angle: 2 @ 4 5/8"
 Mounting Bolts: 4 @ 3/8-16x2"
 Nuts: 4 @ 3/8-16
- 1"x1"x16g : 2 @ 8"
 spacers: 4 @ 1/2" or
 nuts or equivalent
- 3" x 1/8" flat bar: 2 @ 3 1/4"
- Motor: Ex.ElectricScooterParts.com
 PN# MOT- 36450G



These holes are patterned and sized using the motor. They will need to be countersunk so that the screws supplied with the motor have enough thread engagement.



**STEP
3**

TOOL BAR

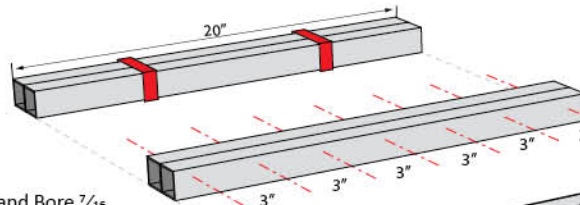


The central tool bar mounted on the Weed Weasel is just a piece of horizontal square tubing to which tool shanks can be clamped. If you already know what shank/sweep type you will be using, then change the tool bar plans to accommodate your tools. The tool bar can be raised and lowered on the frame using the indexed holes and some bolts or pins. If several heavy tools are mounted, it can become difficult for one person to raise and lower the bar alone. It may be worth considering a tool-bar hoist of some kind using either a crank or a lever.

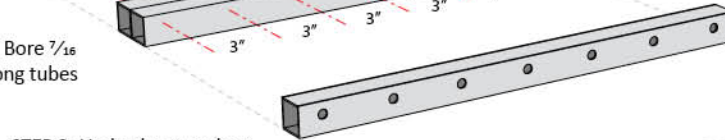
The central tool bar is located close to the axis of turning of the machine so that the precision cultivators don't "swerve" when the machine is steered. It is also just behind the turning axis so that lifting the rear end of the Weed Weasel lifts the tools clear of the soil for small maneuvers like turning around at the end of a row.

The width of the central tool bar, and thus the width of the whole machine, will depend on the bed-width in use which varies with each particular farm. The machine width and tool-bar width shown here is based on a 30" bed and a 36" tool bar. This width can be changed easily for a different bed width; simply go through the plans and change the relevant dimensions and cut sheets for each drawing.

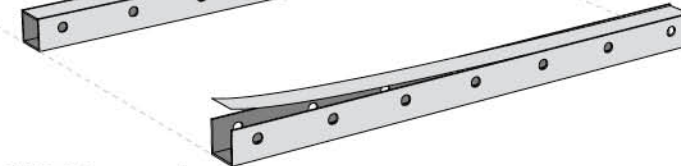
STEP 1: Clamp two 20" pieces of 1 1/4 x 1 1/4 x 16 g square tube together.



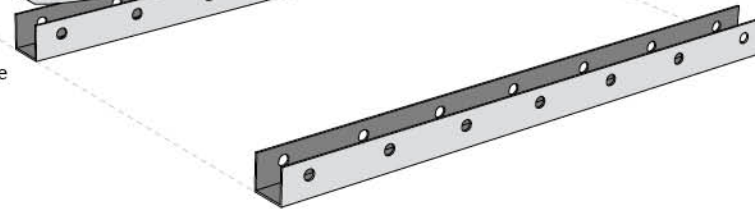
STEP 2: Mark and Bore 7/16 Holes 3" apart along tubes



STEP 3: Undo clamp and set aside one piece.



STEP 4: Cut open tube to remove top side



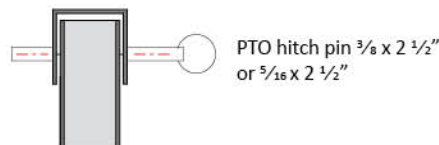
STEP 5: Clean up with grinder and repeat on other tube



STEP 6: Drill end holes in 1 x 1 x 16g square tube



STEP 7: Use Tool bar as jig to weld toolbar mounts to frame



PTO hitch pin 3/8 x 2 1/2" or 5/16 x 2 1/2"

CUT SHEET:

- 1 1/4 x 1 1/4 x 16g square tube: 2 @ 20"
- 1 x 1 x 16g square tube: 1 @ 35 3/4"
- Bolts or PTO Hitch Pins: 2 @ 3/8" x 2 1/2"

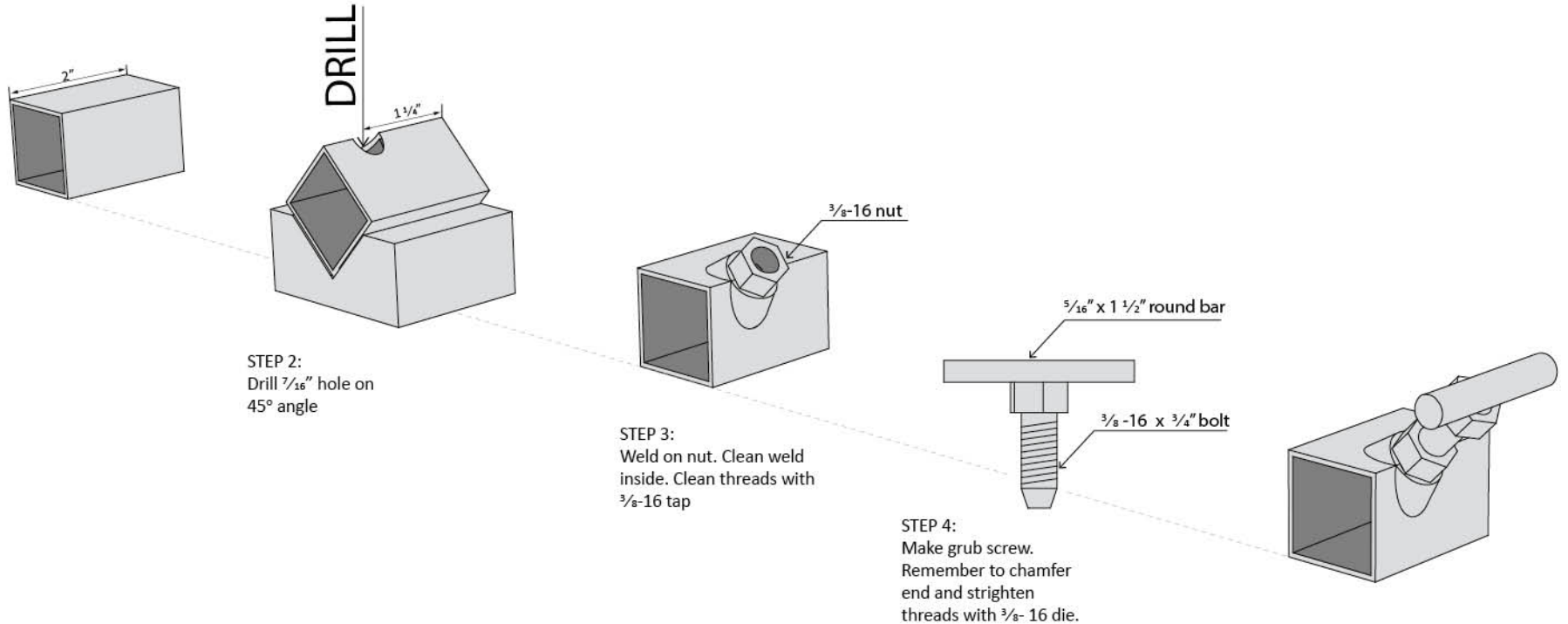
**STEP
4**

TUBE CLAMPS



The various sliding parts on the Weed Weasel all attach with tube clamps. Tube clamps work because the grub screw pinches the tube in it's corner. Shown here is one way to make a tube clamp. It can be tricky to weld the nut on to the edge of the tube clamp. Keeping the welded nut close to one end of the tube it is welded to makes cleaning

up the weld and de-burring the inside of the tube easier. It is essential to chamfer the working end of the grub screws! It is not, however, necessary to weld a t-handle on the grub screws, as long as you have a 9/16" wrench handy.



STEP 1:
Cut a 2" piece of 1 1/4 x 1 1/4 x 16g square tube

STEP 2:
Drill 7/16" hole on 45° angle

STEP 3:
Weld on nut. Clean weld inside. Clean threads with 3/8-16 tap

STEP 4:
Make grub screw. Remember to chamfer end and strighten threads with 3/8- 16 die.

STEP 5:
Repeat- You will need 9 tube clamps

CUT SHEET:

- 1 1/4 x 1 1/4 x 16g square tube:
9 @ 2"
- 5/16 round bar:
9 @ 1 1/2"
- Bolt: 3/8 -16 9 @ 3/4"
- Nots: 3/8-16 9

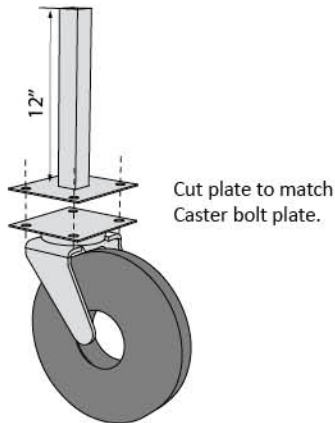
STEP 5

CASTERS + HANDLE BARS



CASTERS (2)

Pneumatic casters on the back of the Weed Weasel hold the tool bars at a constant height during use. That height is adjustable via a sliding shank which is shown here.



CUT SHEET (for both sides):

1 x 1 x 16g square tube:
2 @ 12"

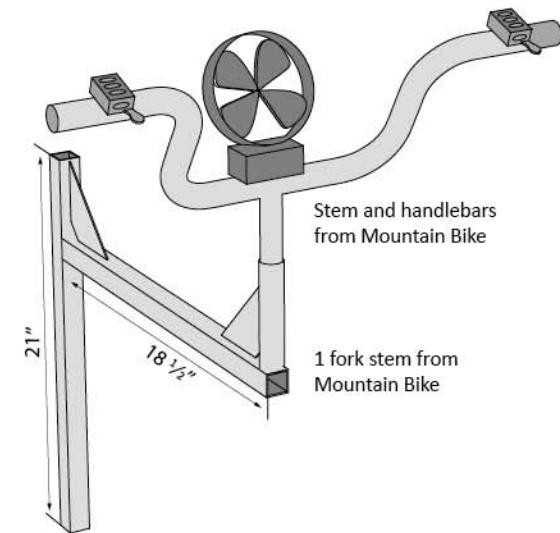
16g or 14g Sheet:
2 @ 4 1/2" x 4"

Bolts: 1/4-20 8 @ 1"
Nuts: 1/4-20 8 nylock

Castors: 8" pneumatic Swivel Castor
Ex. Harbor Freight PN# 60251

HANDLE BARS (1)

Handlebars mounted well aft of the Weasel frame give the operator's feet some clearance from the tine weeder, and also allow the operator greater steering torque. The stem and handlebars can be salvaged from a junk bicycle, along with the bike's fork-steerer into which the stem wedges. The handlebars can be adjusted up-and-down at the stem and at the forward shank that attaches them to the frame.



CUT SHEET:

1 x 1 x 16g square tube:
1 @ 21"
1 @ 18 1/2"

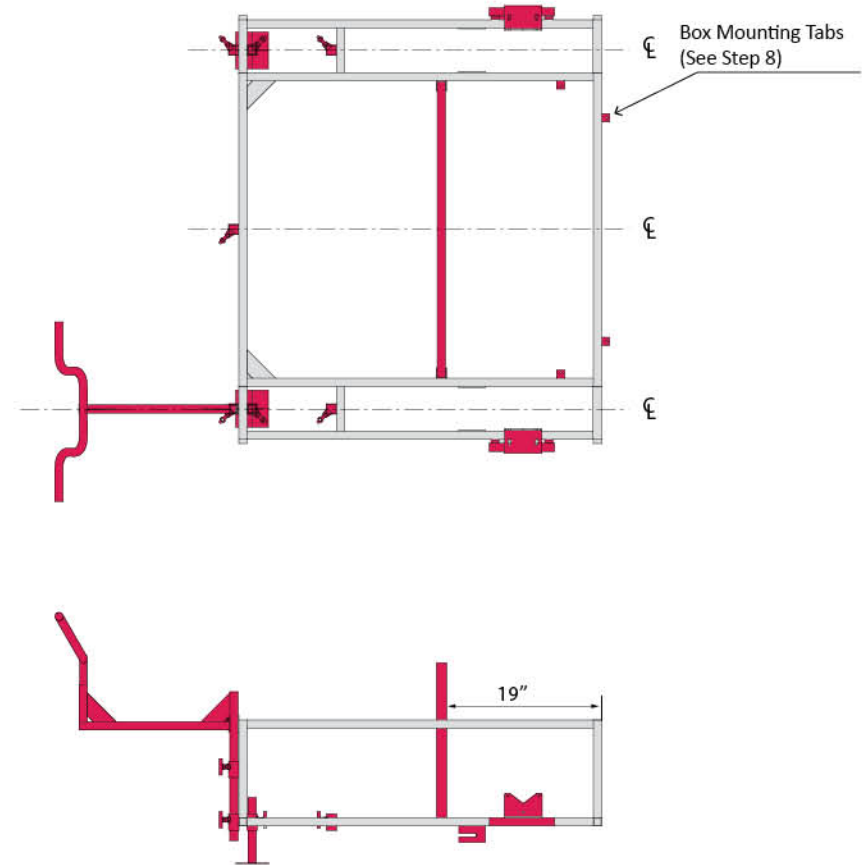
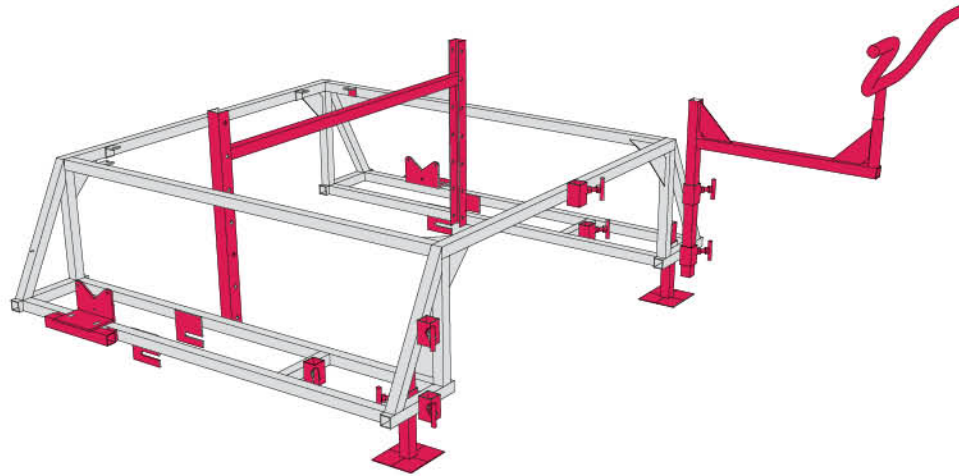
2 Gussets - 2"x 14g strap cut at 5" @ 45°
5"



STEP
6

COMPLETE FRAME + PAINT

The tubing clamps, tool bar holder, handlebars, caster shanks and battery box mounting tabs (see step 8) can now be welded to the frame. Once the parts are fitted and welded they can all be painted.



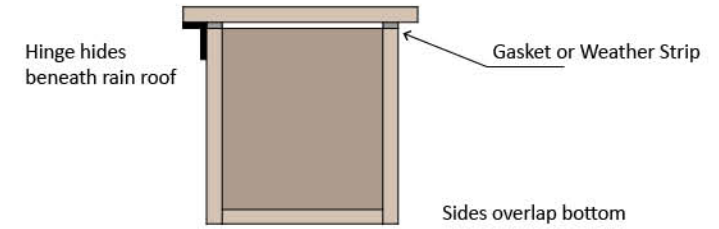
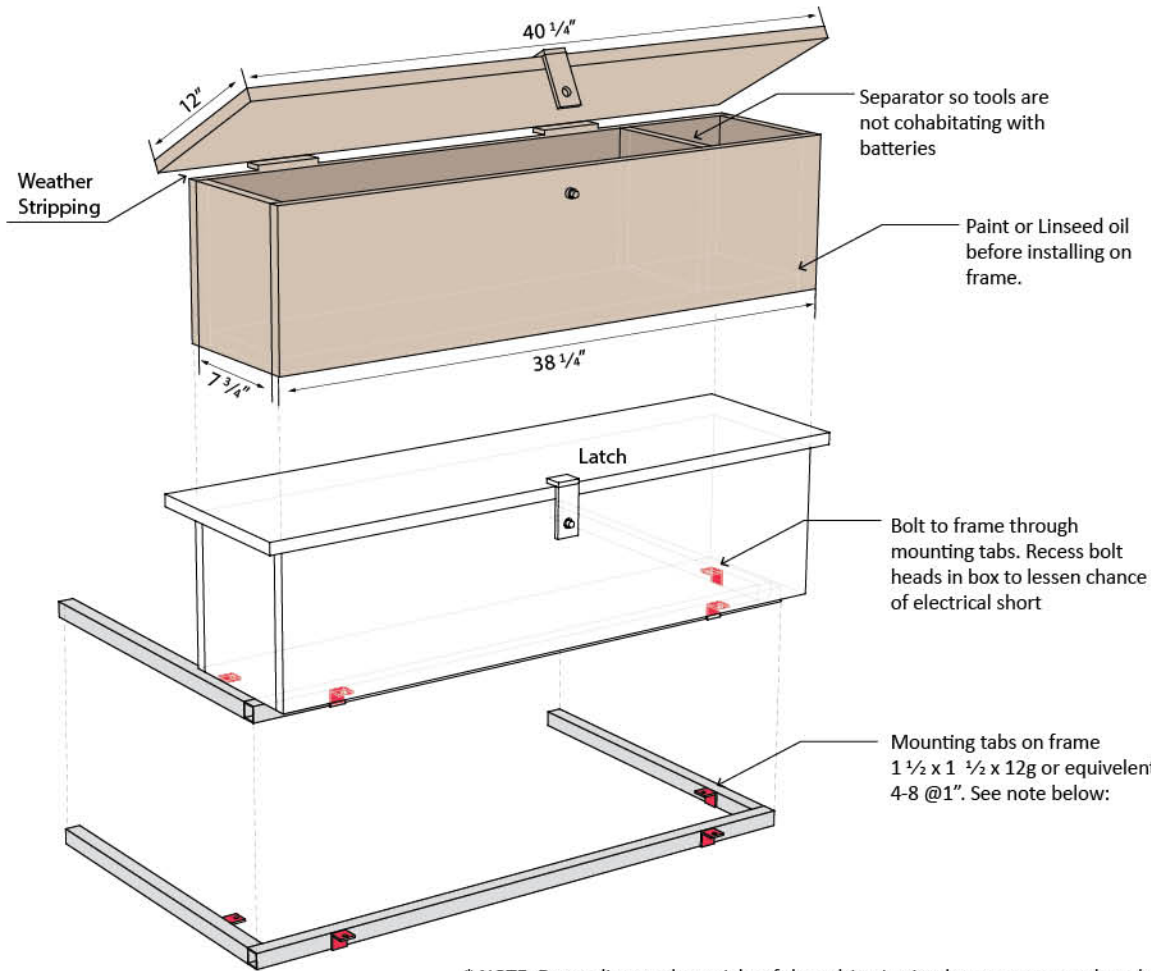
STEP 7



BATTERY BOX

Wood is cheap, biodegradable, and non-conductive, making it good material for a battery box. Some care is taken in the design to make sure no sharp screws protrude in to the wiring area of the box and to recess the mounting bolts so they aren't an easy path to ground. A partition divides the electrical area of the box from a separate area for storing metal tools and loose objects. Care must be taken when mounting objects on the outside of the box (such as the fire extinguisher or a

blue tooth speaker) not to screw through the box in to a battery or other live wire. The objects inside the box should be mounted with screws or bolts and strapped down so they can't shift. The holes made in the box for wire routing should, at the completion of the project, be filled with sealant to prevent bugs and dust from getting in. The lid of the box should be sealed with weather stripping. The battery box can be painted or oiled (boiled linseed oil).



CUT SHEET:

- 1 x 10 Finished Lumber
 - sides 2 @ 38 1/4"
 - ends 2 @ 7 3/4"
- 1 x 7.75" Finished Lumber
 - bottom 1 @ 36 3/4"
 - partition 1 @ 8"
- 1 x 12 Finished Lumber
 - lid 1 @ 40 1/4"

Screws: #8x1.625 deck screws or equivalent 36-48 count
 Hinges: 4"x1" or similar 2 count
 Latch: 2" x 1" or similar 1 count
 Hinge and latch screws: #10 x 3/4" 24 count
 3/8" weather-stripping: 96"
 Plastic hole-strap

* NOTE: Depending on the weight of the cultivating implements mounted on the Weed Weasel, it may be necessary to move the battery box forward or aft to properly balance the machine. Extra mounting tabs could be welded to the frame to give the operator some options. Or, a sliding mounting system could be contrived. A well-balanced Weed Weasel is back-heavy but can be rotated up from the rear with about 20lbs of force.

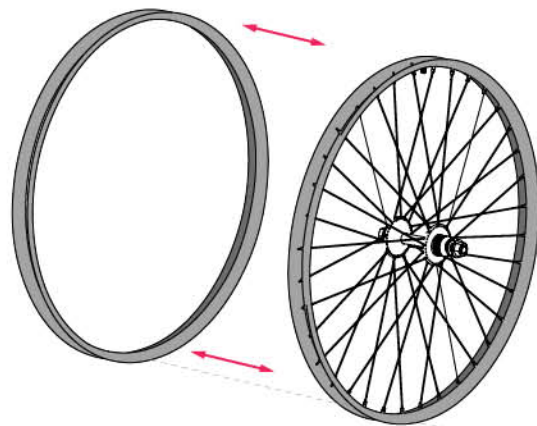
STEP 8



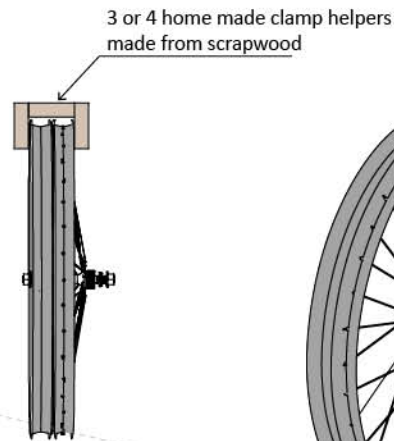
WHEEL MODIFICATION

The Weed Weasel has two 26" bicycle wheels as drive wheels. Each wheel consists of a complete rear wheel with an additional rim attached to the non-drive side. The "double tire" provides more traction and more flotation for the wheel. The easiest way to accomplish attaching the extra rim is to use steel rims and tack weld them together.

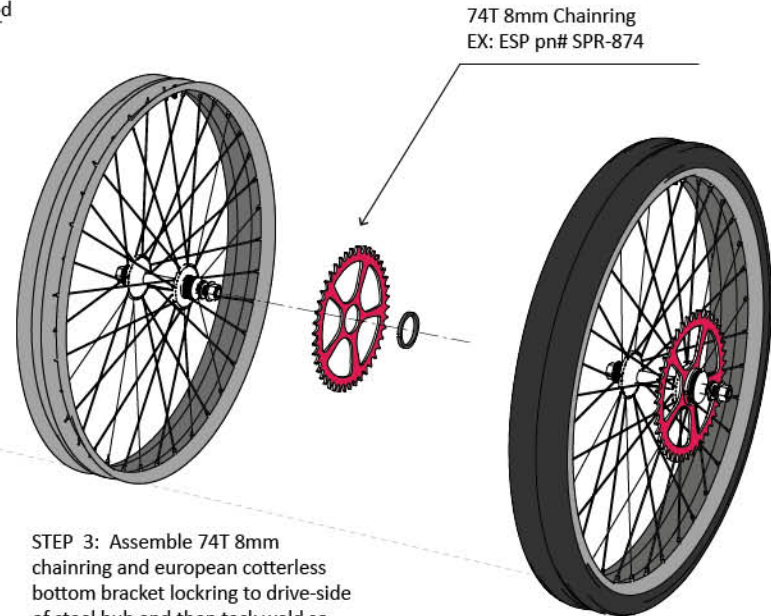
On to the drive-side threaded shoulder of each hub is mounted a 74 tooth 8mm scooter chainwheel. The chainwheel has to be mounted so that it can be torqued in both directions, so shown here is a method for using a lock ring from a bicycle bottom bracket to mount and square the chainwheel, and then a welder to tack the assembly so it can't unthread. Here again, the easiest method uses a steel hub so it can be conveniently welded.



STEP 1: One complete rear wheel: 26x1.5 steel rim, steel hub, non-cassette hub (threaded) + rim of same make



STEP 2: Use C-Clamp around home-made clamp helpers to clamp rim to non-drive side of wheel. Tack weld rims together every 4 inches.



STEP 3: Assemble 74T 8mm chainring and european cotterless bottom bracket locking to drive-side of steel hub and then tack weld so that the assembly can't loosen in either direction. Once welding is complete, spray paint welds.

STEP 4: Mount tires 26" x 2.125" knobby tires

MATERIALS LIST (for both sides):

- Two complete rear wheel:
 - 26x1.5 steel rim
 - Steel hub
 - Non-cassette hub (threaded)
- Two Rims of same make
- Two 74T 8mm Chainring
 - Ex. ElectricScooterParts.com PN# SPR-874
- Two bottom bracket lockrings - 1.375"x24 TPI

*NOTE - In order to center the tires in the wheel well of the Weasel frame, it may be necessary to loosen the bearing locknuts on the hub and move the spacer washers around.

STEP 9



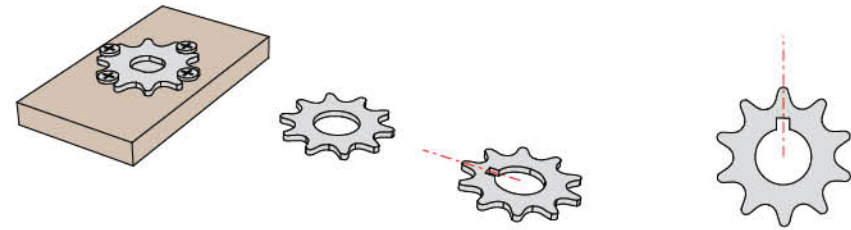
MOTOR COG MODIFICATION

The motors are supplied with a 9 tooth bicycle chain cog. The desired gear reduction to the drive wheel is about 1:7, which would require a 65 tooth chainring for the wheel. While a 65T steel chainring can be obtained, they are difficult to find. However, one option is to use 8mm

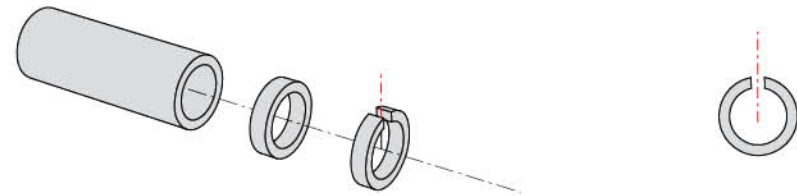
chain, for which small cogs and chainrings of many sizes are available. Here are the details for adapting an 8mm cog to the existing motor shaft. Because the cog is hardened steel, you will need a cobalt drill bit and cutting oil to drill it.



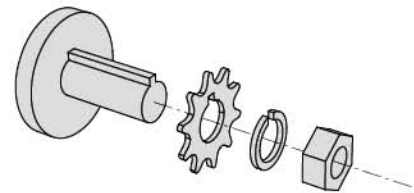
STEP 1:
Remove cog from motor using chain whip and 12 mm wrench



STEP 2:
Clamp new cog to scrap of wood (sheet rock screws work well) and overbore shaft-hole in cog to $\frac{7}{16}$ " ID using cobalt drillbit and cutting oil . With a small file, file a keyway (under tooth peak not valley) until cog fits on the shaft



STEP 3:
Make a $\frac{3}{16}$ " spacer. A piece of $\frac{3}{8}$ " schedule 40 or schedule 80 pipe can be used as spacer stock if it is first drilled out to $\frac{7}{16}$ ID and cut to accomodate key.



STEP 4:
Install new cog, spacer and nut onto shaft. Re-assemble with red loctite

MATERIALS LIST (for both sides):
Motors: Two 36 vdc 450 watt
Ex: Electric Scooter Parts PN# MOT - 36450G

Cogs: Two 8mm - 10 tooth
Ex: Electric Scooter Parts PN# SPR- 810

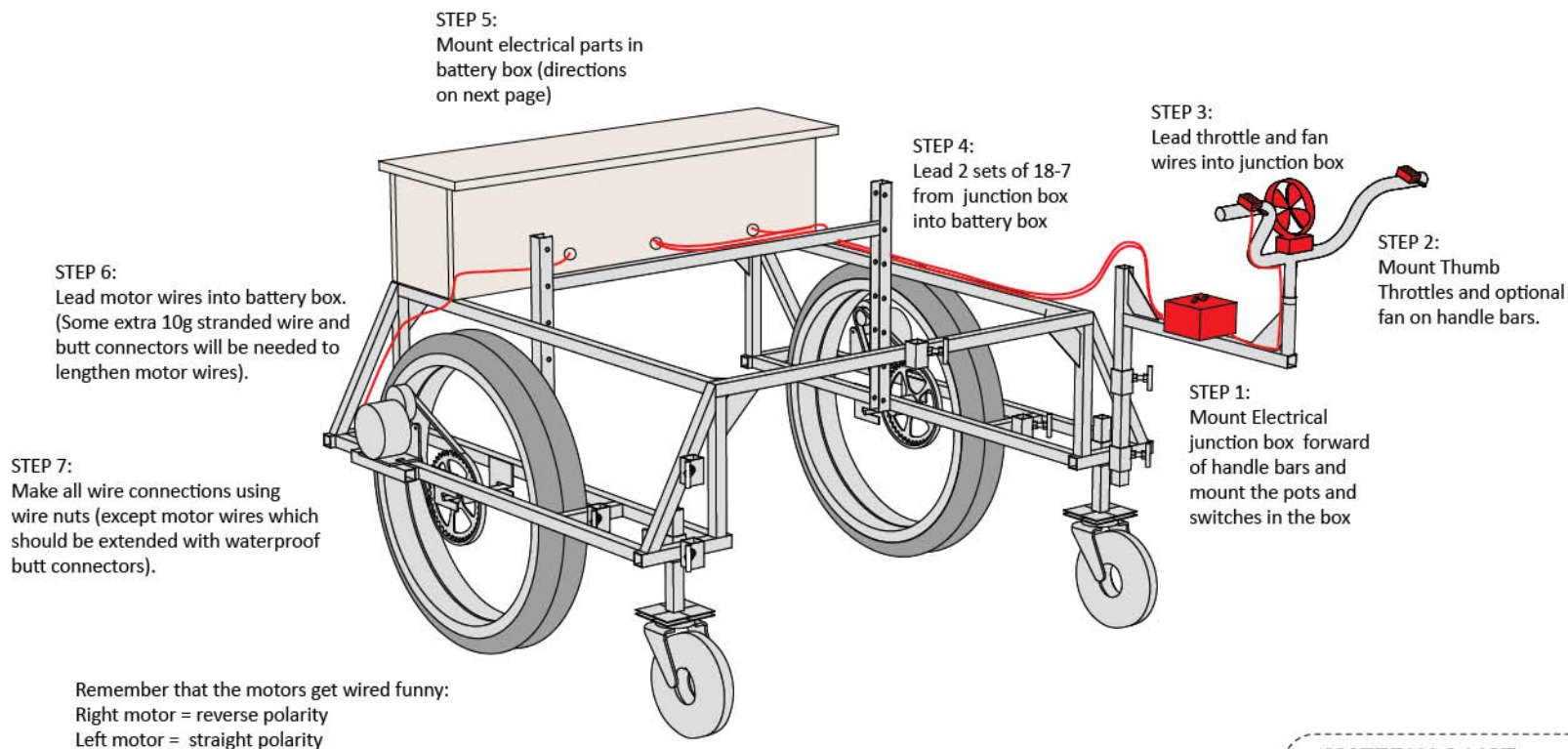
STEP 10



ELECTRICAL ASSEMBLY

The electric scooter controllers and throttles are supplied with plastic connectors from that industry. Unfortunately none of the wire harnesses are nearly long enough. So the stock connectors need to be cut off and the wire harnesses extended. To extend the control (low amperage) wires from the throttles to the motor-controllers, I use direct burial sprinkler wire which can be obtained locally (awg 18-7), and make the

wire connections inside a weather tight junction box. To extend the motor power wires (higher amperage) I used awg 12 stranded wire (primary type) and butt connectors with water resistant heat shrink. And to connect wires together inside the battery box and junction box I use wire nuts. Use zip-ties or string to provide cable strain-relief and route cables safely along frame. And leave a service loop to allow up-and-down adjustments of handlebars, and fore-and-aft adjustments of battery box.



MATERIALS LIST

16' AWG 18-7 Sprinkler Wire
(Ex Home Depot PN# 49273699)
10' AWG 12-2 Sunlight resistant
10' AWG 16-2 Misc wire for inside battery box
Junction box: Weathertight J-Box:PVC 6x6x4
Home Depot PN# E987RR

**STEP
10**



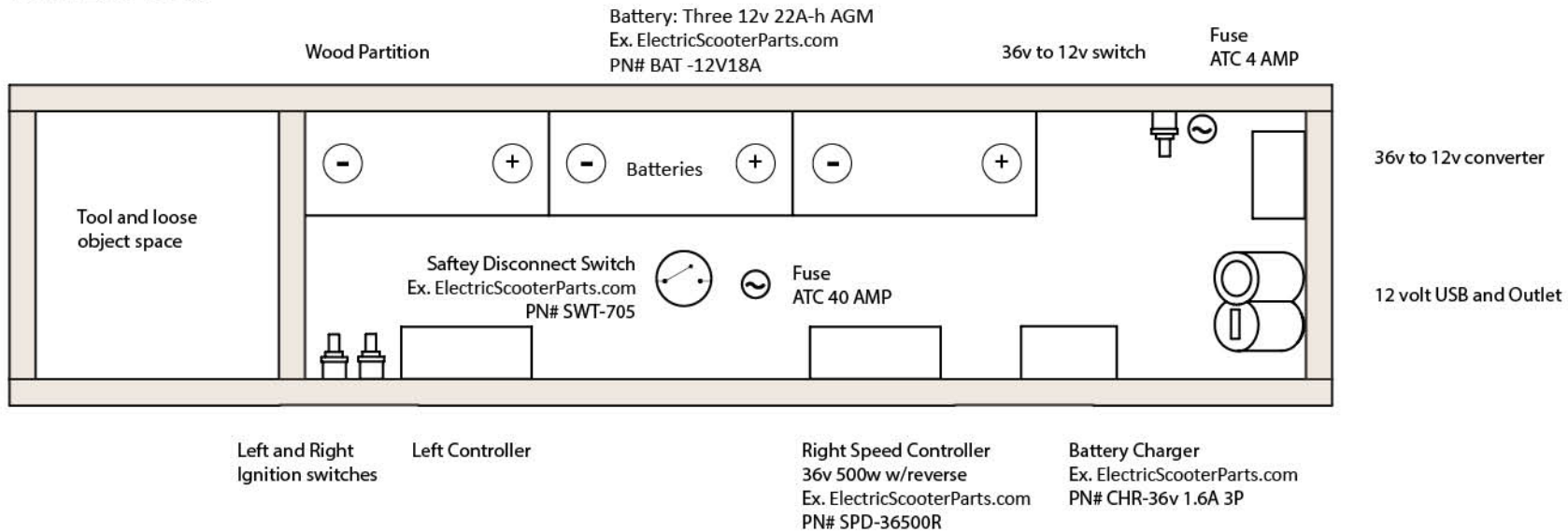
ELECTRICAL ASSEMBLY (CONT)

All of the electrical components need to be mounted and secured in the battery box. Most of the parts have mounting holes through which small screws (#8 x 1/2") can be driven into the wall of the battery box. For the batteries which are heavier, wooden chocks can be screwed to the battery box and then plastic hole strap or rope used to further restrain the batteries. Remember to be extra careful when screwing in to the battery box or when making holes for the wires to enter the battery box; don't screw or drill in to electrical wires or parts!

The junction box serves two purposes; it allows all the throttle wire extensions to be connected inside a box, and it houses the switches and

potentiometers that the operator needs access to while driving the Weed Weasel. The Weed Weasel has a HI-LO switch that in the HI position sends the unattenuated throttle signal to the motor controller, and in the LO position sends the throttle signal attenuated by a potentiometer which the operator can adjust. The typical way this is used is that the operator selects HI to move the Weed Weasel from the barn to the field. Then the LO position is selected and adjusted for a comfortable working speed in the field. The LO position allows independent adjustment of the left and right throttles, so they can be compensated for inclined beds or other special situations.

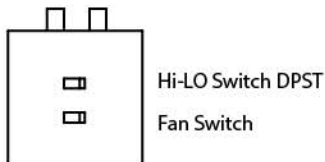
BATTERY BOX



JUNCTION BOX

J-Box:PVC 6x6x4
Home Depot PN # E987RR

Potentiometers to adjust low-power setting



STEP 11

WIRING DIAGRAM

Connections for throttle are shown for the right side only. The left side is identical.

Junction Box at Handle Bars

10K-ohm audio Potentiometers for left and right throttle low with speed adjustment
 Ex. Mouser electronics PN#313-1520E-10K
 Knurled knob: Ex. Mouser electronics PN#485-2048

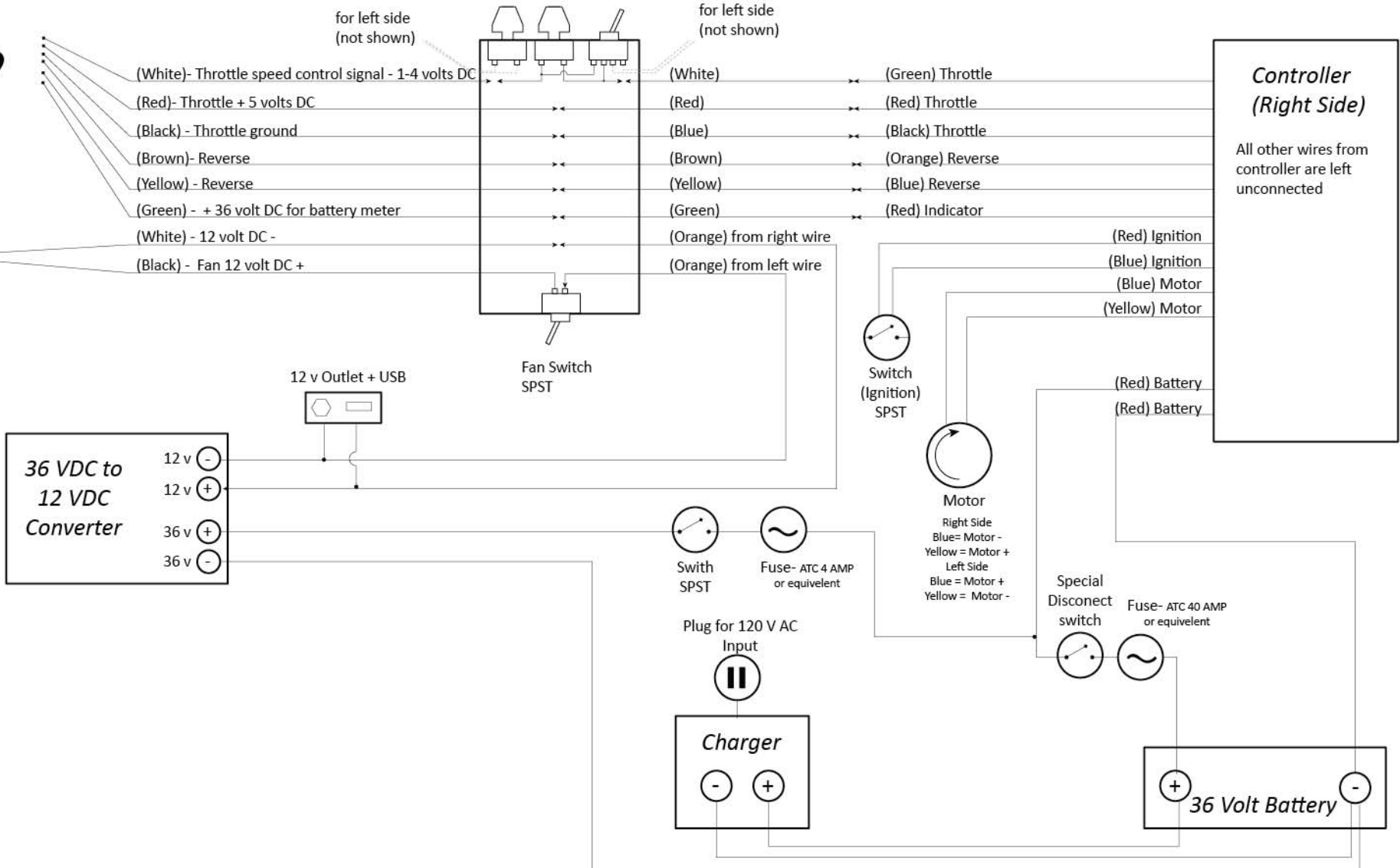
Potentiometer Bypass Switch for high speed DPST
 Ex. Home Depot PN# 41770

Right Side Throttle

Thumb throttle with Switch and Power Meter
 ElectricScooterParts.com
 PN# THR-138



12 volt DC Fan

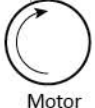


Controller (Right Side)

All other wires from controller are left unconnected

- (Green) Throttle
- (Red) Throttle
- (Blue) Throttle
- (Brown) Reverse
- (Orange) Reverse
- (Blue) Reverse
- (Red) Indicator
- (Red) Ignition
- (Blue) Ignition
- (Blue) Motor
- (Yellow) Motor
- (Red) Battery
- (Red) Battery

Switch (Ignition) SPST



Motor
 Right Side
 Blue = Motor -
 Yellow = Motor +
 Left Side
 Blue = Motor +
 Yellow = Motor -

Switch SPST

Fuse- ATC 4 AMP or equivalent

Plug for 120 V AC Input

Charger

Special Disconnect switch

Fuse- ATC 40 AMP or equivalent

36 Volt Battery

36 VDC to 12 VDC Converter

- 12 v (-)
- 12 v (+)
- 36 v (+)
- 36 v (-)

12 v Outlet + USB

Fan Switch SPST

OPERATIONS

Some people have trouble learning to drive the Weed Weasel. This trouble is common with any cultivating tractor. Here are some tips.

The bad news is that in order to use any mechanical cultivation on a farm, plenty of preparation and planning are needed. Bed width and row spacing must be uniform, rows must be planted parallel to within 1" or less, beds need to be groomed and flat, rocks and plant fibers need to be removed, and timing of cultivation has to be calculated (weeds can't be too big).

Learn to steer the Weed Weasel on one of the flatter less rocky beds, and learn on a bed with NO CROPS planted. Instead of a crop, start by "planting" popsicle sticks. Lay out your popsicle stick row with construction string so the rows in the bed are straight and parallel. Set up the tools on the Weed Weasel with a tape measure and chalk marks on a flat surface like a barn floor or piece of plywood, rather than at the beginning of the row (where plant spacing errors would get transferred to the tool spacing). On a flat, straight stretch of farm road, drive the

Weed Weasel with the tools raised up and adjust the potentiometers in the "LO" speed position until a comfortable working speed (a brisk walk) is obtained and the Weasel tracks straight with the throttles both floored.

Begin making cultivating passes in the popsicle stick bed. Proceed at your brisk walking pace and attempt to steer but don't worry about killing "popsicle stick plants" (perhaps a helper can go along and re-plant popsicle sticks for you). Instead, make several passes at your working speed and just keep your intention in mind--to steer accurately. Your eyes normally focus on one row in the bed, and you have to assume the row spacing and tool spacing will work correctly. Take a break for five hours or a day and come back to it; you will have magically improved while you rested!

In general, people who have played video games or operated high speed sewing machines will have a slight advantage over poetry writers, but everyone can learn to drive the Weed Weasel in a day or two of dedicated practice!



QUESTIONS + COMMENTS + DONATIONS

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