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Porsche 914 Rotisserie

Introduction

This "How To" article covers the design and construction of a simple automotive rotisserie for a Porsche 914. The goals for this design are...

- Simple
- Easy to construct
- Inexpensive
- Full 360 degree rotation of a 914 that has GT flairs installed
- Ability to lock car at any designed rotation
- Ability to move entire rotisserie (casters)

This rotisserie as described does not have features such as...

- Ability to balance car (axis of rotation through center of gravity)
- Raise or lower the axis of rotation.

There are three extra things that need to be mentioned.

First, this design works for 1970 through 1974 model year Porsche 914s. The 1975 and 1976 model years utilized a different bumper and bumper attachment system than the earlier 914s. While adjustments to this design can be made to make this work with a1975 and 1976 914, this document does not go into how to make those changes.

Second, is some caution regarding the body structure of the Porsche 914. This design (and many others) relies upon the use of the stock bumper mount locations. The front bumper mount location is quite strong. However the rear is not as strong as the front. Two of the four mounts on the rear are in nothing more than holes in the thin body panel. Mounting to these locations works as long as you have a structurally sound body. Extensive rust (such as in the trunk area or the box section longitudinals in the middle of the car) or other damage that has weakened the body may result in the car tearing free from the rotisserie. This warning pretty much applies to any rotisserie design. In short, don't suspend your car if you think it is not strong enough to be suspended via whatever mounting points you use.

Third, this plan does not connect the two stands directly together other than via the car itself. The design is quite stable and works well without connecting the stands, however connecting the stands together at the bottom is a good thing. It is left up to the builder to find a good method for this. It can be accomplished in a number of ways, but in general you want to create some type of bracket on the end of the interior leg of each stand so that you can bolt a bar in place that ties them together. The stands have to be separate to allow mounting of the car, but once the car is on the rotisserie, you can bolt the tie bar into place. Having the two stands together allows any forces applied to the stands (such as if a caster gets stuck in a crack while moving) to move from one stand to the other via the tie bar and not via the car.

Design

The design consists of four main parts. The first two are identical "stands" that are positioned at the front and the rear of the car. Each stand has three casters each that allow the stands to move, a pipe that acts as a bearing for a rotating axel and a locking mechanism to keep the axel from freely rotating. The last two are mounts for the front and the rear of the car. Each mount is specific to the front or rear of the car due to the shape of the body. Each mount bolts directly to the body using the same mounting locations as the front and rear bumpers. Each mount also has a smaller pipe that acts as an axel. Some published rotisserie designs use engine stands in place of custom build stands. Before using this approach verify that the axis of rotation when using an engine stand will allow the car to rotate without hitting the bottom of the stand. Most engine stands will need to be extended to prevent this from happening.

To keep the design simple it is very much customized for a Porsche 914. For example as mentioned above there is no provision for adjusting the axis of rotation with respect to the center of gravity of the car. When completed and with a totally stripped 914 shell mounted the car will naturally want to rotate into a position with the car upside down. This is because the center of gravity is higher than the axis as described by the bumper mount points. However it is quite easy for a single person to rotate the entire car 360 degrees and lock the body into any position.

There are generally three safety features of this design that should be noted. The first is the locking mechanism that prevents the unintended rotation of the car. This consists of two bolts on each mount that are screwed into to lock the axis in place. In practice, by hand tightening two on one end, that you can lock the car into position. This will allow you to move to the other end and hand tighten the other two. With all four tightened, the car is very resistant to rotation. If you put enough load onto the outside (i.e. trying to climb into the car while on the rotisserie which is not a good idea anyhow) you should be able to overcome the locking mechanism. The second is a nut and bolt that acts as a pin on each axel. Once the axel is mounted on the bearing, insert the bolt and nut. This prevents the mount from slipping out of the bearing. The third also is to prevent this scenario and that is a bar that ties the two end mounts together to prevent them from moving apart.

The basic mounts and stands are built out of 2" x 2" x 1/8" and some 1" x 1" x 1/8" square metal tubing. Some commercial rotisseries are constructed by using 1/8" thick tubing and some using 3/16" tubing. Final thickness selection is up to you, however 1/8" thick tubing appears to be plenty strong for the lightweight 914 shell. It is conceivable that by using 3/16" tubing your completed rotisserie may outweigh a 914 shell! The "uprights" on the stands are actually two 2" x 2" tubes welded together. This 2" x 4" construction is probably overkill. Originally 2" x 3" tubing was considered for this part, but with many local steel supply yard not wanting to sell material in length less than 20', it was more economical to use more 2" x 2" than to mix use of 2" x 2" and a smaller amount of 2" x 3".

The axels and bearings are made out of seamless DOM steel tubing. The axel is thicker walled than the bearing. This was done because due to the way the locking mechanism works, it is conceivable that one of the two may deform and become less round over time. With the bearing being the thinner of the two, it should deform before the axel. This will allow the axel to continue to smoothly rotate even with a slightly deformed bearing. Additionally there is liberal clearance between the bearing an axel. An extremely tight fit may make it hard to rotate the car for many reasons. One reason in particular is that the actual axis of rotation for the front and rear of the car may not exactly match.

Material List

Qty	Item	Unit	Total	Source
2 x 20' (standard length)	2" x 2" x 1/8" mild steel square tubing	$60	$120	(1)
1 x 20' (standard length)	1" x 1" x 1/8" x 20' mild steel square tubing	$30	$30	(1)
1 x 13" cut to length	3" OD x 3/16" wall (2 5/8" ID) DOM Seamless Pipe	$34	$34	(2)
1 x 17" (cut to length)	2 1/2" OD x 1/4" wall (2" ID) DOM Seamless Pipe	$36	$36	(2)
1 x 4' (cut to length)	7/8 OD x 0.120 wall (0.635" ID) DOM Seamles Pipe	$21	$21	(2)
1 x 36" (or nearest easily found length)	1" x 1/4" mild steel bar	?	?	(3)
1	3" x 1/8" mild steel bar	?	?	(3)
6	500 lb swivel caster	?	?	(4)
24	M8 x 1.25mm x 25mm bolt (casters)	N/A	Pack of 50 for $9	(4)
34	M8 flat washer	N/A	Pack of 100 for $3	(4)
10	M8 spring lock washer	N/A	Pack of 100 for $3	(4)
8	M8 8.4mm ID x 30mm OD fender washer (or 11/32 ID x 1 1/4" OD)	N/A	Pack of 100 for $6	(4)
34	M8 x 1.25mm nut	N/A	Pack of 50 for $9	(4)
8	M8 x 1.25mm x 130mm partial thread bolt (bumper mounts)	N/A	Pack of 10 for $9	(4)
2	M8 x 1.25mm x 80mm partial thread bolt (safety pins)	N/A	Pack of 25 for $9	(4)
4	M10 x 1.50mm x 30 full thread bolt (locking mechanism)	N/A	Pack of 25 for $8	(4)
4	M10 x 1.50mm nut	N/A	Pack of 100 for $2	(4)

Source:

(1) Local industrial Steel supplier

(2) Specialty online Steel supplier that sells "cut to length" items.

(3) Local hardware store, aggricultural supply store, etc. (i.e. Lowes, Home Depot, etc.)

(4) Local hardware store, aggricultural supply store, etc. (i.e. Lowes, Home Depot, Harbor Freight, Northern Tools, McMaster-Carr, etc.)

Note:

Most local industrical Steel suppliers will give you the best price for things like square tubing. However they will also generally not "cut to length". They will charge you for the smallest length they sell which will be probably be 20'. So for shorter items like the pipes used for the bearing and axels, you should find a supplier who will see you "cut to length". You do not want to be buying this pipe in 20' lengths due to the cost of this size of DOM pipes. For short quantities (less than 20') of steel bar, etc. local places like Lowes and Home Depot are convenient.

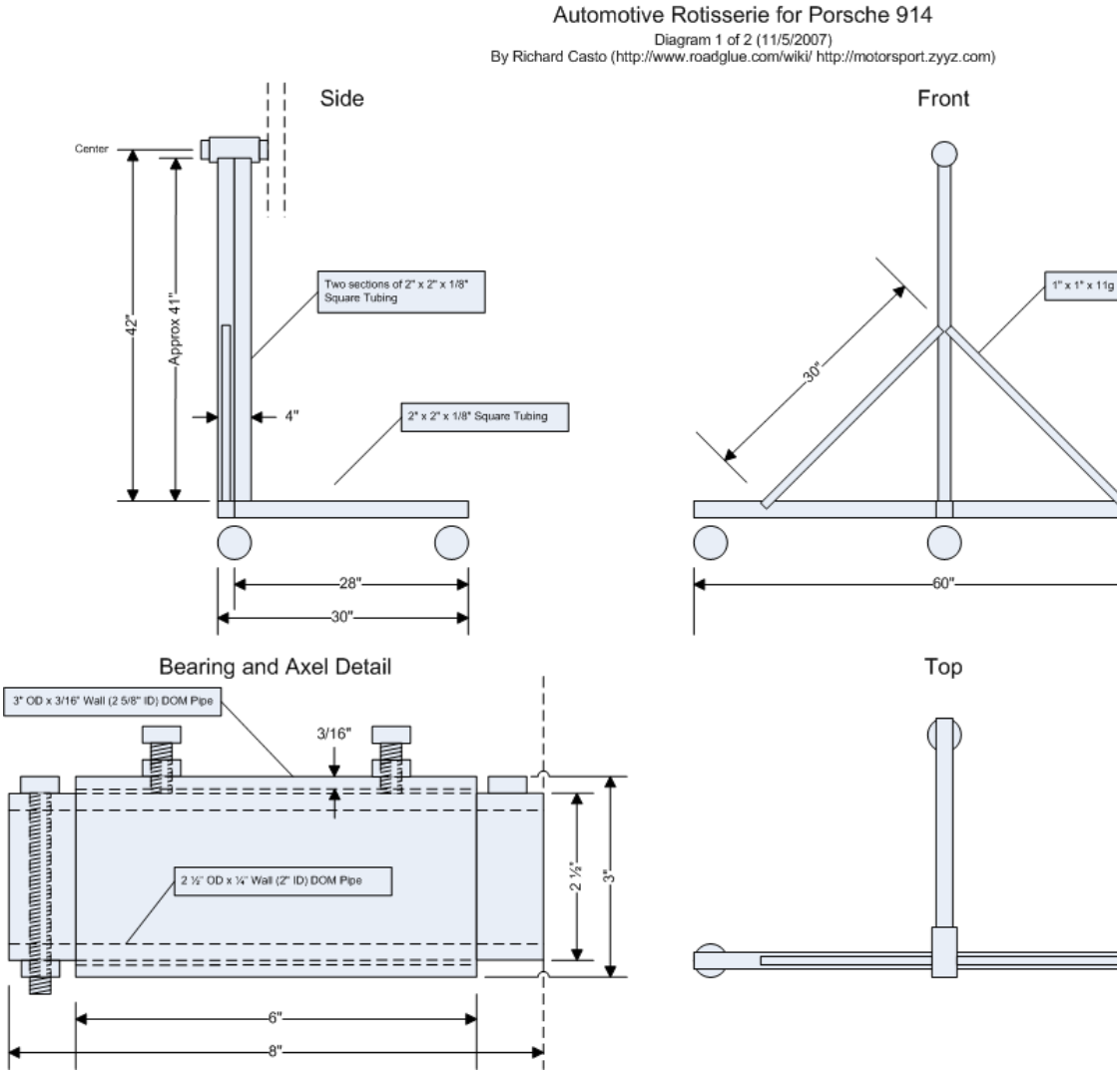
Have the Steel supplier to cut your 20' length exactly in half to make it easlier to get home. They may give you one free cut per item, or charge a minimal feed to make the cuts.

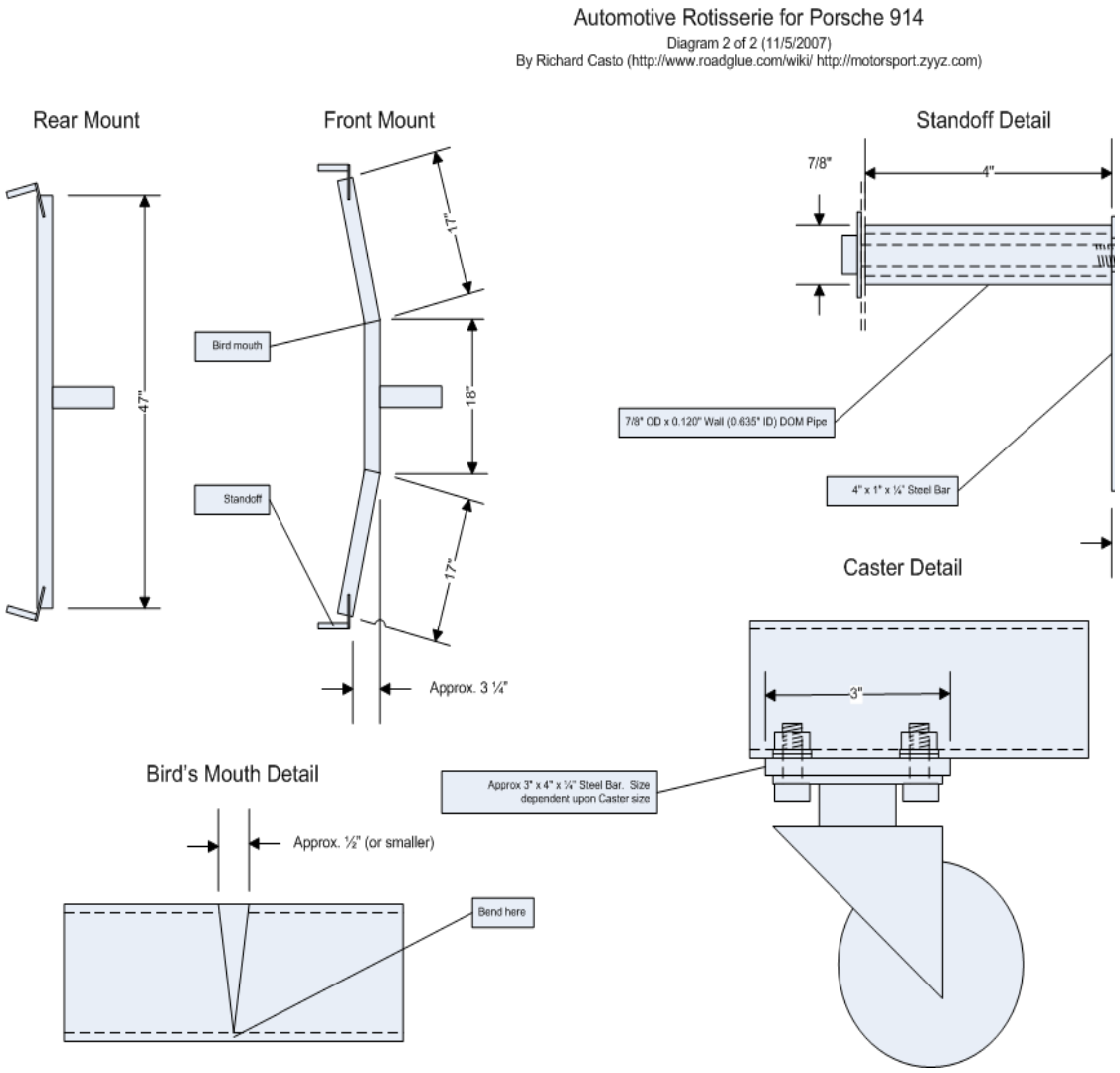
Cutting Plan

Qty	Length	Source Material	Usage
4	41"	2" x 2" x 1/8" square tubing	Vertical "uprights" for front and rear stands
2	28"	2" x 2" x 1/8" square tubing	Short leg on front and rear stands

2	60"	2" x 2" x 1/8" square tubing	Long leg on front and rear stands
1	47"	2" x 2" x 1/8" square tubing	Rear horizontal mount
1	52"	2" x 2" x 1/8" square tubing	Front horizontal mount
4	30"	1" x 1" x 1/8" square tubing	Diagonal braces for stands
2	6"	3" OD x 3/16" wall (2 5/8" ID) DOM Seamless Pipe	Bearing for front and rear stands
2	8"	2 1/2" OD x 1/4" wall (2" ID) DOM Seamless Pipe	Axels for front and rear mounts
8	4"	7/8 OD x 0.120 wall (0.635" ID) DOM Seamles Pipe	Standoffs for bumper mounts
8	4"	1" x 1/4" mild steel bar	Standoffs for bumper mounts
6	4"	3" x 1/8" mild steel bar	Mounts for casters on stands

Diagrams





Tools

You will need the following tools...

- Welder (MIG welder works well) and associated equipment
- Abrasive cut off saw
- Angle grinder with both an abrasive griding wheel and abrasive cut off wheel
- Drill (Drill press suggested, but hand power drill should work)
- Bits to drill holes large enough for M10 (i.e. 7/16")and M8 (i.e. 3/8") bolts to pass through
- Gloves
- Safety shield

Construction

As with any welding project, setting up your welder correctly is very important. After using the cutting instructions above, you will have a few very short peices left over. Use these for test beads so that you can make sure you have your welder setup properly and that you are getting proper penetration.

Safety Notes:

- Quality welding requires good technique. One way or another all of these welds will be holding up your precious 914. You don't want them to fail and damage your car or worse injure yourself. Due to the structural nature of this project, this may not be a good project to learn how to weld on.
- The M10 nuts used in the locking mechanism might be zinc plated. If you are a welder you should be aware of the danger of welding on zinc plated material. The gas that is produced can be deadly. If you want, you may be able to either grind off the zinc, burn it off with a torche (in a well ventilated area) or use some other method to remove the zinc.

Bearings

The bearing sit on top of the upright part of the stands and hold the axels.

1. Take the "cut to length" pipes used for the bearing and cut them to the final lengths. In the parts list, they are listed slightly longer than you need. This is done because you don't know how well your vendor may have trued up the edges. Re-cut the edges as needed and then cut the pipes to length.
2. Take the two bearing pipes and drill the two holes (7/16" bit) on each that is used by the locking mechanism. These holes should align along the same axis along the length of the pipe. Make sure that an M10 x 30mm bolt will slide through the hole easily. Later on, you will weld M10 nuts over these holes, so also make sure you don't make the holes so large you can't weld the nut in place.
3. Thread the M10 x 30mm bolts into the M10 nuts.
4. Place the nut/bolt combo onto the bearing with the bolt going through the holes you drilled previously. Threading the bolts on helps you center the nuts. Tack weld and then weld into place. Beware that excessive heat may deform the nuts. If this happens, remove the bolt and run a tap through the nut to reshape/cut the threads.

Axels

1. Take the "cut to length" pipes used for the axels and cut them to the final lengths. As with the bearing pipes they are source slightly longer than you need. Re-cut the edges as needed and then cut the pipes to length.
2. Take the two axel pipes and drill the two holes (3/8" bit) that is used by the safety pin on the end. Make sure that the holes are 180 degrees apart and that the M8 x 80mm bolt will slide in one hole and out the other hole easily.

Stands

The stands are identical front and rear. They consists of the legs, uprights, bearing and locking mechanism.

1. Cut the material needed to construct the two end stands from your 2" x 2" and 1" x 1" stock using the cutting plan listed above. You should be able to plan all of the cuts using 10' sections as your starting points. Plan out how you want to cut up the 10' sections before you start cutting. Use the abrasive cut off saw to make the cuts.

2. Take the four 41" square tubes an match them into pairs and make sure they are the same length and that the ends are flush. Clamp together, tack weld and then stich weld. Alternate sides as you stitch weld to prevent warping.
3. Take a bearing pipe that was finished earlier and mark out a saddle on the top of the upright. The using the angle grinder, grind out the unwanted metal. When done you should be able to sit the bearing pipe in the saddle and have a tight fit all around the perimeter of the saddle.
4. Measure to ensure you have the bearing with equal space front and rear as well as ensure that the welded on nutes for the locking mechanism are on the very top. Clamp into place (if possible), tack weld and then weld around the perimeter of the saddle.
5. Take your four 30" 1" x 1" braces that were previously cut and cut 45 degree edges on them. This is so that they will mount flush with the legs and upright. Make sure you cut the 45 degree cuts in the correct direction. You will use the abrasive cut off saw to make the cuts.
6. Rig up the long 60" leg, the short 28" leg and the upright pieces following the diagram. Tack weld, but don't do your final welds.
7. Rig up the 30" braces and tack weld.It is important to tack weld the entire stand portion before doing your final welds.
8. It is very easy to warp the 60" long section if the 30" braces are not already in place. Now weld up the stand.

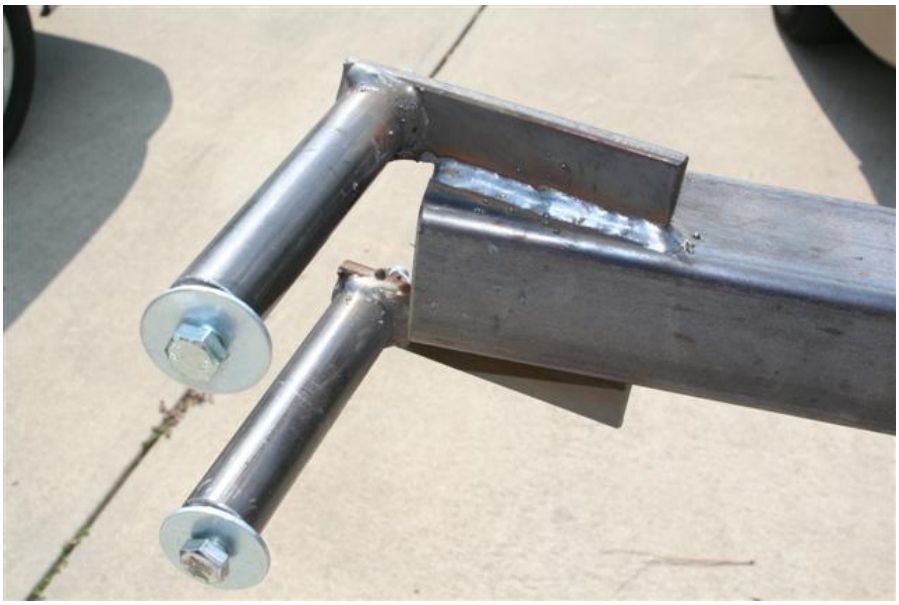
Casters

1. The size and bolt pattern for your caster will ultimately determine the size and drilled hold pattern of the mounting plate. You should ensure that the bolts for the caster will be clear of the 2" x 2" pipe. In this example a 3" x 4" plates are cut from a 3" bar.
2. Using your caster as a template, holes are drilled to match the bolt pattern of the caster.
3. Place a plate into postion on the stand. Clamp into place and test fit the caster and mounting hardware (M8 x 25mm bolt, M8 washer, M8 lock washer and M8 nut).
4. Once dry fit works, remove caster and hardware. Tack weld and then weld. Due potential interfearance between the hardware and your welds, you may want to weld on each end of the place and not along the side near the hardware. Repeat this process for each caster plate.
5. Once the caster plates are welded into place mount the casters to the stands.

Standoffs

The mounts attach to the body of the car in exactly the same way as the factory bumpers. This is via four large holes on each end of the car. These holes are pretty large (around 15mm) in diameter. The standoffs provide two functions. They move the mounts away from the body far enough that work can be performed in the area of the mounts as well as provide a way to mount to the large bumper mount holes.

1. Cut the material needed to construct the standoffs from your 1" x 1/4" bar and 7/8" OD pipe stock using the cutting plan listed above. Make sure the cuts for the pipe are true and smooth.
2. Position the pipes on the end of the bars according to the diagram and allow enough room around the perimeter of the pipe to weld to the bar. With the pipe in position, mark the center of the pipe on the bar and use this as a template to mark the other bars.
3. Drill a hole (3/8" bit) at the marked position on each bar. This should allow the M8 x 130mm bolt to slide through easily.
4. Center the pipe over the hold. Tack weld and then weld into place around the perimeter of the pipe.



Rear Mount

The rear mount consist of the mount bar, axel and stand offs.

1. Remove the rear bumper from the car.
2. Mount a standoff to the rear of the car in this order using the specified hardware. M8 x 130 bolt, Fender washer, body of the car, standoff with bar facing out, M8 washer, M8 lock washer and M8 nut. Hand tighten the nut to keep the standoff in place and repeat this for the other stand offs.
3. Using blocks and shims roughly position the 47" 2" x 2" bar into place. It should clear the rear tow hook mount on the body # Center left and right as well as make sure that the bar is level front to rear and left and right and equidistant from the car on both sides.
4. The bars on the standoffs should align above and below the bar. Once in place, tighten each standoff to lock them into place. Make sure that each standoff is also centered over the bumper mounting holes in the body of the car.
5. Double check that everything is in place and then tack weld each stand off.

6. Unbolt the mount/standoffs from the car.
7. Make the final welds that attach the standoffs to the mount.
8. Mark the center of the 47" 2" x 2" tube.
9. Align one of the axels to the center of the tube. Make sure that the safety pin holes are aligned straight up/down.
10. Tack weld and then weld into place. You most likely will have a very small gap between the mount and the axel at the top and bottom, but you should be able to fill this with mulitple passes.

Front mount

The front mount consist of the mount bar, axel and stand offs. The front mount is a bit more complicated due to the curvature of the front of the 914. A straight mount bar is possible, but it would require very long standoffs. The solution to this is to curve the mount bar. This is done by cutting two "bird mouths" in the mount, bending the mount bars and then welding the bird mounts shut. An exact amount of bend is not required. What is required is that both sides be bend as close to the same as possible. Also when cutting the bird mouths in the mounts, it is better to take a smaller amount than you think, bend and if you can't close the mouth, or the mouth closes, but you can't bend enough, grind the mouth out more.

1. Remove the rear bumper from the car.
2. Mount a standoff to the rear of the car in this order using the specified hardware. M8 x 130 bolt, Fender washer, body of the car, standoff with bar facing out, M8 washer, M8 lock washer and M8 nut. Hand tighten the nut to keep the standoff in place and repeat this for the other stand offs.
3. Take the 52" 2" x 2" bar and mark the center line as well a the 17", 18" and 17" segments.
4. Using blocks and shims roughly position the 52" 2" x 2" bar into place. This should give you an idea how much the bar needs to bend to meet the standoffs and maintain a roughly equal distance from the car along the length of the mount.
5. Using the angle grinder with the abrasive cut off wheel, cut the bird mounts based upon the diagrams above. The following are very important...

   You do not cut all the way through the mount.
   You do not cut the mouth too large.
   You make sure the top and bottom of the mouth are directly above each other as this impacts how straight the mount bends.

6. Test bend the bar. You should lay the bar flat on the floor as you bend it to ensure it does not twist. The bar should lie flat on when the bends are complete.
7. As mentioned above, the actual depth of the bend is not as important that both sides are bent the same. A depth of 3 1/4" should work well.
8. Once you have found the proper birds mouth side and both sides bend the same and close the birds mouth, tack weld one side into place.
9. Double check the depth of the side that was just tack welded. Replicate that depth on the other side and then tack weld into place.
10. Double check both depths, and if not correct, grind out one or both tack welds and correct. Once all is good weld into place.
11. Place the now curved mount back onto the blocks and shims.
12. Center left and right as well as make sure that the bar is level front to rear and left and right and equidistant from the car on both sides.
13. The bars on the standoffs should align above and below the bar. Once in place, tighten each standoff to lock them into place. Make sure that each standoff is also centered over the bumper mounting holes in the body of the car.
14. Double check that everything is in place and then tack weld each stand off.
15. Unbolt the mount/standoffs from the car.
16. Make the final welds that attach the standoffs to the mount.
17. Align one of the axels to the center of the tube. Make sure that the safety pin holes are aligned straight up/down.
18. Tack weld and then weld into place. You most likely will have a very small gap between the mount and the axel at the top and bottom, but you should be able to fill this with mulitple passes.

Builder Feedback

We have heard from a handful of people who have used these plans over the past few years as well as comments from others who have built their own rotisseries. If you have used these plans and would like to provide feedback, please email us at sales@blueskymotorsports.com

Disclaimer

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Revision

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