

Replacing the Steering Rack on a 993

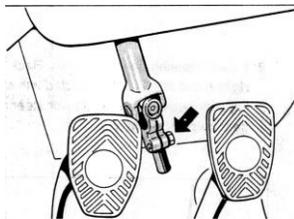
There are inherent dangers with working on cars. I am not a professional automotive technician so use my instructions below at your own risk.

Get a copy of the section of the Porsche 993 shop manual on how to do this procedure and read it. Key information in the shop manual covers the sequence and torque values when reinstalling the U Clamps.

- Loosen and lightly retighten the front wheels' nuts.
- On a level surface set the parking brake & block the rear wheels, jack the car up and set the front jack points on jack stands. Since you will be putting your entire body under the car make sure you do this in a safe way. To lift the car I used the rear jack points until I could slide the jacks under the front jack points as suggested in the 993 jacking procedure on p-car.com. I made adapters for my jack stands that include centering bolts that line up with the center holes in the car's jack points allowing for no possibility of the car slipping off the jack points. Safety! Safety! Safety is job one!

As the French say "to die for love" is a good thing however I think they are speaking of this while under something other than a car!

- Remove the floor board covering the peddle cluster in the driver side foot well. Getting to the bottom left hand floor board screw involves pulling back on the throttle peddle until it releases (pops) from its plunger shaft allowing you to fold it rearward gaining access to the last screw.
- Rotate the steering wheel so the split in the clamp that holds the steering rack to the steering column Slider joint is facing rearward and then shoot a little spray paint into the split onto the steering shaft spline to record the steering Slider joint orientation on the steering rack's spline shaft.
- Loosen the Slider joint's clamping bolt but do not remove it.

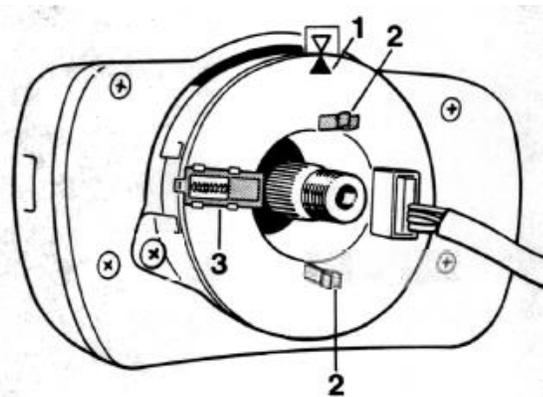


- Rotate the steering wheel to the center position with the wheels pointing straight forward and tie up the steering wheel loosely in this center position. I used bungee cord looped through the steering wheel spokes and tied it up to the above sun shade. No need for precision here as you are only trying to preserve the relative rotation center position to avoid clocking the steering wheel and with it the airbag electrical contact unit out of the center position. **Otherwise the airbag contact unit is easily broken.**

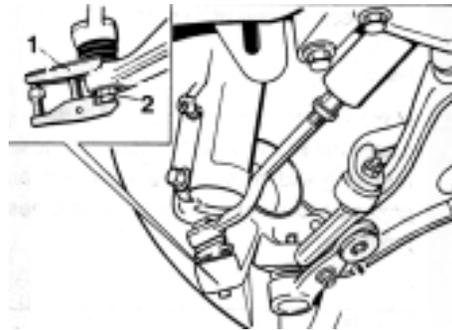
Now you get to learn from my folly of not tying up the steering wheel in the center position and having to remedy the results:

Warning: Before doing this procedure disconnect the negative terminal on the battery. When unplugging the steering wheel air bag unit from the steering wheel connection wire do not reattach the battery until you have reconnected the air bag unit otherwise you will cause an airbag fault (warning light) that will need to be cleared by using Durametric software or having the dealer do the same.

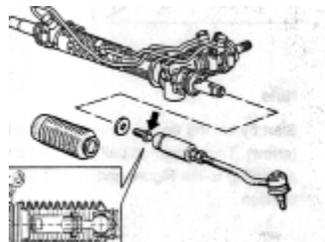
Flipping the steering wheel around past its extreme left or right turn clocking range I broke the airbag contact unit's pin (callout 2 in the image below) that engages the steering wheel and had to repair it. Before you loosen the steering wheel's hold down nut to get at the contact **unit don't forget to disconnect the negative terminal on the battery and mark the steering wheel's position to the top of the steering shaft so your steering wheel can be put back on strait.** Fixing the snapped off pin is relatively easy, just retrieve the snapped off pin's head and reattach it with a short piece of fish tank air hose filled with flexible car molding adhesive – better than new! Once repaired re-clock the airbag contact unit according to the directions printed on the unit or in the shop manual. If you do end up re-clocking the airbag contact unit a good trick is to remove the grossly over engineered small metal spring loaded "Rotation Lock" (call-out 3 in the image below). On my car it was bent and had broken free from the contact unit some time in the past. Instead just use a long piece of electrical tape to hold the contact unit in the proper position. Thread the tape through the steering wheel using the same hole the wires from the contact unit pass through. Once the steering wheel is placed over the correctly positioned contact unit and the airbag contact unit's pin is in its slot on the steering wheel at 12 o'clock just pull the tape out through the wheel. Extra steps, extra time, I just love this kind 'a work!



- Now completely remove the Slider joint's spline clamping bolt to release the rack from the Slider joint. Tie up the Slider joint with some wire. If you avoid sliding the Slider joint down off the steering shaft above you can avoid reinstalling it later. If you end up having to reinstall the slider joint it is rather strait forward to slip it back in the same position on the steering shaft as the spring pin in the joint lines up with a matching milled keyway (slot) on the splined end of the above steering shaft.
- As a precaution wrap the rack's now exposed steering shaft spline end in electrical tape to avoid dinging it in the removal process.
- Remove the front end plastic underbody cover, save the fasteners
- Unbolt and release the outside tie rod ends from the wheel carriers. Use a generic tie rod end removal tool, callout "1" below, if required. **Do not detach the outer tie rod ends from the inner tie rod ends. Leaving them in one unit preserves your car's alignment upon reassembly.**

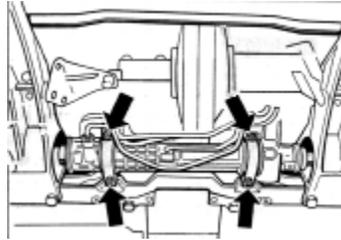


- Push back the boots and release the inside tie rod ends. Use two wrenches and use care not to put rotational force on the rack.
- Unscrew the inner tie rod ends from the rack by rotating the entire tie rod assembly and remove the inner/outer tie rod assembly in one piece. Note the orientation of the thick washers that are held to the rack ends by the inner tie rod end. Save these washers for reinstallation on the rebuilt rack later. Also **mark the assemblies as left and right so you can reinstall them on the same sides of the car as they were removed.** My car's tie rod ends were good (no play) but the outside rod end grease boots looked a little dried out so I cut the boots off and replaced the little booties with aftermarket ones and repacked them with wheel bearing grease.



- Under the car unbolt the socket head screws holding the U clamps in place and release the old rack, not too complex just involves spending quality time on your back under the car. You will not reuse the mounting bolts.

- Most 993s have a removable cross strut that comes off with the longer (80mm) rack hold down bolts. Note which positions the longer bolts were removed from to assist you in reassembly later. Save all the pieces parts. You will reuse the metal U clamps but not the rubber mounting bushings or the bolts. Also there is a sealing grommet about the size of a Dunk'in Donut pressed by the rack against the pass through hole into the driver side foot well. You can reuse this or replace it. It may be easier to just leave it stuck in place for when you reinstall the rack after it is rebuilt. Using the old donut you will avoid having to compress a new one when trying to bolt in the rebuilt rack.



Part numbers of 12.9 Bolts from Pelican Parts Catalog:

Socket head screw 8 x 60mm = 999 218 102 01

(4 on vehicles without cross strut, 2 on vehicles with cross strut)

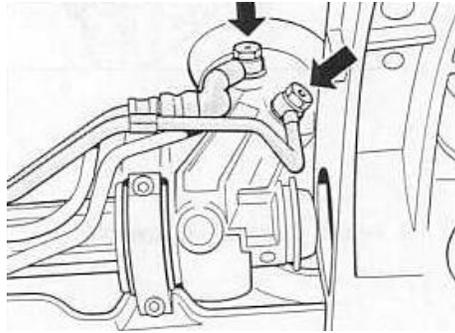
Socket head screw 8 x 80mm = 999 218 103 09

(2 on vehicles with cross strut)

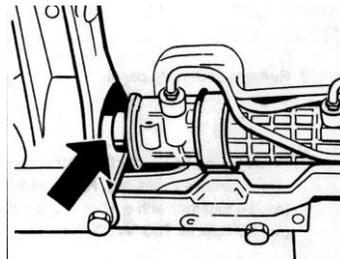
Washers 900 031 105 01

(Four screws above 4 on vehicle)

- Take a break, clean yourself off now replace the steering fluid reservoir in the engine compartment Pelican Number: 993-347-015-01-M103. It has an integrated power steering fluid filter and therefore should be replaced. I used a turkey baster to draw most of the fluid out of the reservoir before removing it. I stuffed lots of rags under it so when removing the old one I avoided spilling fluid all over the engine.
One of the clamps holding the hoses to the reservoir is not reusable. So you will need cut it off and get a substitution replacement at your local auto parts store. While you are there get three or four large cans of spray electrical motor or contact cleaner as you will need to clean up under the car at several points in the process, also call your local VW Dealer and have them order some steering rack grease VW part number AOF 063 000 04 for you.
- Now for the messy part! Go ahead and detach the hydraulic lines from the rack now that it is loosely held in place by the car's frame. Save all the pieces parts.



- At this point you should be able to push the rack's shaft ends in and out of the unit by hand -to the left and right as needed to clear the car's frame. I pulled off the boots before I did this step.



- You now have the removed rack in your hands. Remove the attached small hydraulic line bracket with clips and save it for reuse. Observe its placement and orientation.
- I sent my rack out to www.steeringgearsuperstore.com to have it rebuilt and returned, no core charge.

When sending out your rack add the following instructions on the packing slip:

- Asking the rebuilder to return the rebuilt rack made from your core, note the serial number, not from his stock of cores.

A rack freshly taken out of service such as the one from your car should likely just need soft parts switched out. One built from a salvage rack can result in a rebuild job with a much shorter service life because it may be made from a damaged rack or have welds done on its hard parts to fill corrosion pitting from sitting around. There are very few good 993 rack cores floating around as the rack for the 993 is a model unique configuration, not too many 993s were built and those built are mostly still on the road.

- Ask him to use care to not remove the paint alignment mark on the steering spline shaft and;
- Ask him to protect the spline shaft with a piece of rubber hose in return shipping. I would go as far as to provide the hose on your rack when you send it in so he has a hose on hand to use for the return.

Above are critical instructions as even a minor ding on the spline will not allow the steering Slider joint to slide over the rebuilt rack's steering shaft.

_My rack came back with two small dings I had to remove with a Moto-Tool to allow it to reinstall. Fixing a ding is easy however it also adds a trial fitting step

that requires that you remove and reinstall the steering Slider joint under the dash. The Slider joint slides off easy enough but to put it back on in the proper orientation involves pulling its shaft alignment spring pin out slightly and aligning the spring pin to its matching groove on the upper steering shaft. A task done way under the dash. Not fun at all.

- Put a pan under your car during the one week turn-around otherwise old steering fluid leaking out of the lines creates a mighty handsome puddle on your garage floor!
- Once the rack is returned to you clean any rebuilder applied paint from the original ZF/ Porsche part number/ serial number plate. Look at the part/serial number to ensure you have your original rack in your hands.
- Use extreme care not to scratch the hydraulic port faces when removing the rebuilder's dust plugs as leaks will result later. Use solvent to clean any rebuilder applied paint overspray from the hydraulic port faces and loosely reinstall the dust plugs to keep the ports clean as you position the rack under your car.
- Consider using solvent to clean any rebuilder applied paint from the ends of the rack cast body up to and including the rack end boot mounting grooves to avoid paint contamination of the rack end seals on the casting inside the boots potentially shortening the rack's life.
- Prepare the new rack with:
 - New dust boots, these usually come with the rebuilt rack;
 - New rubber rack mounts Pelican part number: 964-347-137-07-M136 and;
 - Special WV rack grease, VW part number AOF 063 000 04. Be sure to use only VW hydraulic rack grease to lubricate the inside tie rod ends and to coat the geared rack shafts to avoid contaminating the rack with incompatible chassis greases;
 - Make sure the centering observation port on the rack has the rubber plug in place, Pelican part number: 477-419-115-OEM;
 - Reinstall the small hydraulic line bracket to the rack removed earlier.

Use care not to punch any holes in the boots when mounting them to the rack or later on when pulling them over the inside tie rod ends. Pulling the boots onto the rack's casting is not easy. I rolled the boot ends back like rolling the cuffs on a dress shirt and then rolled them down over the racks boot mounting grooves.

- Before bolting up the rack reattach the two hydraulic lines each with two size 12 x 15.5 sealing washers, Pelican part number 12-X-16-X-1.5-CU-M131 one on each side of the hydraulic fitting where it mates to the port and under the banjo bolt's head. Take your time as you will drop the sealing washers several times before you sort this task out. Use care not to cross thread the ports with the Banjo Bolts. You will know when they are started in correctly and not cross threaded as they can be screwed in almost all the way by hand with a very light touch without binding. Avoid over tightening the Banjo Bolts. They only need to be tight enough to cause the soft copper sealing washers to mate snugly with the port and fitting faces.

- Bolting up the rack in the final position takes upper body flexibility and ingenuity. I used a scissors jack and a block of wood to gently force the u-clamps into position as the new rack mounting bushings and the rack to body sealing donut needed to be compressed slightly for the U clamp bolts to line-up and thread in.

Install the proper new bolts and washers, **with the washer face with the rounded off edges facing the bolt head.**

This is standard procedure with any washer used with a cap screw. Washers have sharp stamped edges on one face that can score the small fillet on the bottom of a cap screw head where it meets its shank significantly weakening the screw.

In the proper position reinstall the strut that came off with the bolts if your car came with one of these. The strut is placed across the two bolts closer to the front of the car with the part number facing away (down) from the car body installed in conjunction with the two longer 80mm cap screws and washers. Do not reuse the old cap screws and use care to observe that the U clamps are in contact with their mountings and torqued to the proper value as listed in the shop manual when the rack is fully in place. Read the shop manual instructions carefully on this:

Tighten fastening screws of rack as follows:

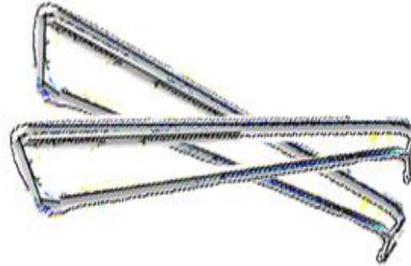
“First screw down the screws evenly until the fastening brackets almost touch the cross member. During final tightening, start with the screws for the short leg of the cross member and pull them tight, so these surfaces will be the first to fit tightly. Tightening torque: 45 Nm” or (33 ftlb).

Using a torque wrench to seat the bolts is very important as the OE fasteners’ threads have been treated with thread locking compound and this in conjunction with the elastic nature of the rack mounting bushings make it very hard to tell when the cap screws have fully seated in the u clamps by feel. Conversely the bolts are threaded into soft metal and using too much force can easily strip the mounting threads.

In my case one of the bolts made a galling (loud creaking) sound as I tightened it so I removed it and used a very small amount of ant-seize on the bolt. It seemed that the pre-applied thread locker still offered considerable resistance even with the anti-seize applied. For this reason I used anti-seize on the shafts and threads when installing the remaining bolts.

- Shift the rack steering position as needed to attach the inner and then the outer tie rod ends and pull the boots over the inner tie rod ends. When complete adjust the rack so the wheel hubs are in the position so if the wheels were attached they would point straight forward. Getting the boots over the inner tie rod ends was the hardest part of the entire job.

I learned from my friends on Rennlist.com that a pair of tools made from coat hanger wire with small hook shaped bends on the ends does the trick here to avoid poking a hole in a boot by using other tools during this installation process.



- With the wheel hubs pointing forward reattach the steering column Slider joint under the dash to the rack's spline shaft; be sure to line up the painted spline alignment mark you painted when you originally removed the rack and preserve the relative rotational position of the steering wheel as not to damage the airbag connection. You will probably need to turn the steering wheel a $\frac{1}{4}$ turn to the side to allow you to see the slot necessary to line up the spline paint mark. This is why the steering wheel should only be loosely tied up in the center position earlier in the process.
- Clean the rack, the underbody and the underbody cover of steering fluid with the contact/motor cleaner described above. Use care to clean off the hydraulic connections so they appear dry.
- Fill the reservoir then run the engine for a moment while rocking the steering back and forth.
- Check the reservoir and top it off again.
- Run the engine for 60 second or so and shut it off. Get under the car and look for leaks around the hydraulic line connections. If the copper sealing rings look wet with fluid tighten them up just a hair, clean them off again with the spray cleaner and run the test again until nothing leaks. In the unlikely event that you are using greater force or things are still leaking after three tests something else is at work. Never use high levels of force on the Banjo Bolts.
- Put the under body cover and wheels back on the car remove the jack stands and properly torque the wheel bolts. Reassemble the foot-well, and enjoy the mess on your garage floor.
- You might find that you need to add more fluid after test driving a short distance. If you hear the power steering pump whining immediately stop and top off the reservoir again.
- Think what you will do with the thousand if not thousands of dollars saved over having someone else do the job.
- If you're over 50, as I am, be sure to take two Tylenol before you go to bed or its going to really hurt in the morning! No pain no gain!

If you did not take your tie rods apart, you tied up the steering wheel in the center position and you reinserted the steering rack's spline in the paint marked position on the steering Slider joint when you remove it, your car's alignment will be preserved and your steering will be properly centered when you are done.

As in love – a good rack always improves the handling!

There are inherent dangers with working on cars. I am not a professional automotive technician so use my instructions above at your own risk.

Andy