

VOLVO 850 1996-1998 RH DRIVE MODEL

POWER STEERING GEAR SERVICE INSTRUCTION

1.1 INTRODUCTION

Power assisted rack & pinion steering system is standard equipment on all models covered within the production year above, including earlier and later production. Typically the system used in my 855T5 is built by TRW, with markings; "34-010-752-RH ISSUE" on the right hand side of the rack housing and "34009946 RH" on the left hand side. These numbers could be referring to the manufacturing serial number.

Power assistance is delivered through in & out hoses that attached to a hydraulic pump that pumps hydraulic fluid (or ATF) driven by the drive belt from the crankshaft pulley. The pump is integrated with the reservoir located on the top-front, right hand side of the engine.

This manual is LOOOOOOOOOOOOONG but no nonsense. So don't feel irritated if you already know some part of the instructions. Hell ya, if you already know, you won't be reading this.



1.2 PREPARATION

The job requires certain basic DIY know-how and is not commonly done by a first timer. Be prepared for a lot of fluid spills, dirty hands (and body), frustration and to some extent, 1 hell of a day.

If you can service your brake calipers, or flushing the ATF, you could do this job.

1.3 TOOLS

Many special tools are used for the job, but you don't have to spend a whole day searching around town. You may as well DIY the tools. Below is the list of tools I used.

For removing steering gear from the car;

- 1 nice, wide, solid floor or with roof & air-condition if available.
- 2 or 3 ton jack stand x 2 units to support the car and 2 ton hydraulic jack x 1 unit to lift up the car & etc.
- 19mm socket & ratchet – to remove the 5 lugs for the wheels
- 3/4" (19mm) wrench – to remove the tie-rod end ball joint nut.
- 15mm socket & ratchet – to remove the 6 nuts from the steering gear to the engine sub frame.
- 14mm socket & ratchet – to loosen & remove sub frame rear mounting brackets
- 18mm socket & ratchet – to loosen & remove sub frame mounting bolts.

For servicing the steering gear;

- 1 wide and shallow bucket to work on your steering gear without spilling fluid or messing the floor.
- Locking pliers (or hand vice grip) – to remove the inner tie rod (ball end rod) from the rack.
- Rubber mallet – to knock the pinion out of gear housing
- 2-pronged bar (similar to the grinding disc locking device for angle grinder)
- C-clip remover pliers (flat & 45°)
- Bearing remover
- Long (800mm) stick with flat & angled head (like bended flat head screw driver)
- #400, #800, #1200 sand paper (abrasive paper) & bench grinder with buffing disk.
- New sets of packing & seals – obtainable new from Volvo at around USD150 or search for equivalent from hydraulics spare parts dealers. I got all at about USD40.
- 3.5mm pin remover & steel hammer (+ bench vice grip, if available)
- Marking punch

SEE LAST PAGE FOR PICTURE OF SOME OF THE TOOLS

2.1 REMOVING THE STEERING GEAR

If you have the Haynes Repair Manual, just flip over to Chapter 10, page 10-14. It's all written there. But they forgot to mention something just damn important. I wasted 2 hours figuring it out. But if you have no manuals and the repair shop people doesn't entertain you, let's go step by step.

1. Park the car with steering in straight-ahead position. Make sure the tires are also straight ahead because some cars have steering wheel off-aligned to the tires. Remove the ignition key and lock the steering that way.
2. For safety, detach the negative terminal of the battery, but I prefer removing the positive terminal, though.
3. Loosen the 5 lugs, jack up the car, secure with the jack stand on both sides and remove the tires.
4. Loosen the nut securing the tie-end rod to the hub. If you have ball joint separator, use it. Or if you don't, place the hydraulic jack in contact with the ball joint end and raise it off slowly until it disengage from the hub. Do not hit with hammer, unless you are replacing the tie-end rod with a new one.
5. Siphon out the fluid inside reservoir. Loosen the pipe fittings (that join to the pump) on the pinion housing. You may as well remove it. Place a large pan below the pinion area. Be ready to catch the fluids that drain out. Not much, but enough to wet your floor.
6. Remove the 6 nuts securing the steering gear to the sub frame, including one bolt securing the gear to the rear engine mounting (socket size 14mm). On LH drive model, only 5 nuts are available.
7. Remove the spring clip, the bolt & nut (size 13mm) on the universal joint connected to the pinion shaft. Working under the car, hit the universal clamp upwards with long steel rod. Hit slowly not to damage the clamp. On lucky case, you can just slide it off without hitting.
8. Remove 2 bolts (size 17mm) that secure the steering gear crash guard from rear & side of the steering gear.
9. This is the point that Haynes is missing. Inside manual it is specified to place the jack to support the rear portion of the sub frame in order to remove the steering gear. I tried and never been able to remove the gear for 2 hours!! So, my advice; place the hydraulic jack under the transmission housing. Make sure your jack doesn't have any sharp surface that may damage the transmission housing.
10. Remove the 2 bolts securing the sub frame rear mounting brackets on each side. Then remove the main bolt on each side or the rear sub frame. Take note that you must work from the correct position and using the correct wrench size. This is the main bolt. If the bolt head surface is damaged (blunt), you may call the day off.
11. Loosen the front main sub frame bolt (same as above). Do not loosen more than 3/4".
12. Slowly loosen the hydraulic jack pressure and let the sub frame to drop slightly at the rear by 2-3". Make sure that the steering gear is free from the sub frame. As for Haynes manual, the engine will drop together with the steering gear and the sub frame, thus making the rear engine mounting still sitting the steering gear. You won't be able to remove the steering gear at all.
13. Remove the steering gear from the right hand side. Just do whatever it takes to remove the steering gear from the car. It takes time and a lot of frustration. Be careful NOT to snap off the fuel lines and ABS sensor wiring or even the brake line when removing the steering gear.
14. Now place the steering gear on a big enough working tray or bench. Take your time off. Smoke or drink a can of cold beer. You are now full of dirt & stinks, but as well satisfied.



PIC 1: Support the car with 2 jack stand, with hydraulic jack supporting the transmission body

2.2 DISMANTLING THE STEERING GEAR



PIC 2: The gear. 10 years old and never been serviced since day one!

Haynes Repair Manual never mentioned anything about servicing the steering rack & pinion. Most workshops also refuse to do repairs since it is time consuming and complicated. They always suggest a whole new set (USD1200) or those used ones from the chop shop (scrap yard). That also costs you around USD200. As mentioned earlier, it takes as little as USD40 to get a new repair kit, why waste a grand? You can buy a new set of shocks with that kind of money, man.

Just a precaution, the steering gear housing is made from alloy and it is a very soft metal. Do not attempt to remove seals using sharp equipment and never apply excessive force to remove any parts. Once the alloy surface is scratched or cracks, it is more likely you can't repair it anymore.

1. Clean the outer surface of the steering gear with WD40 & wash off with water, just to make sure there is no more dirt, grease, fluids, sand



PIC 3: Main leaking points

of fluids that trapped inside the boot. This may indicate worn seals on the rack (LH side boot) or if the fluid is mixed with grease, it could be the seals on pinion shaft (RH side boot)

5. With the steering gear on a flat surface, look for the groove on each side of the steering rack. Most cases, the previous installer (or factory) punched the ball head surface on the mating area of the groove. This is to lock the position of the mating surface not to loose during moving. Using a hardened flat head screwdriver, hit the dented (punched) surface by the groove until the surface return to original position (see PIC 4)



PIC 4: Hitting the punch marking



PIC 5: Removing the inner rod

6. This is quite tricky. Most of the inner rods are factory fitted and it is very hard to remove it from the steering rack. One best bet is to secure the housing on a sturdy bench using the existing four mounting holes (on the housing) and unscrew the inner rod. But if you don't have a bench like that, take your steering gear to the left hand side of the tire well. Insert left hand side end to the opening (where the original location of the steering gear is). Secure the housing to the original mounting position (holes), lock it hand tight with the original bolts (see PIC 5)
7. Now you got the housing mounted to the frame. Using the hand vice grip, grip the ball head of the inner rod and remove it off the rack rod. Do it the



PIC 6: Marking the maximum right

same way with the right hand side. Afterwards, remove the rack housing from the car and place it back to the working tray. Check for loose play on the ball head. If play is obvious, get a replacement.

8. Now is the detail part. Turn the pinion anti-clockwise until the rack stops; you will see the rack rod moving towards the right hand side of the housing.
9. Using a marking punch, punch a mark at the second last groove of the rack, this will indicate the correct position of the maximum right turn (see PIC 6)
10. Likewise, punch a mark on starting point on the pinion housing and another at the pinion shaft. These markings must at the same spot (see PIC 7a & 7b)
11. Using a flat head screwdriver, pry off the cap at the lower part of the pinion housing. Take note of the accumulated fluids. If a lot of fluids are present, this indicates the lower seal on the pinion is torn.
12. Unscrew the nut that locking the pinion shaft to the bearing. To do this, grip the neck of the pinion with locking pliers and loosen the nut with size 14 mm wrenches. Make sure to use a new nylon nut when reassemble.
13. Using the same flat head, break open the top cap of the pinion shaft. You have to break it anyway, in order to get to the upper C-clip.
14. Using the C-clip remover, pry out the clip. Be careful not to damage the inner surface of the housing.
15. Using the rubber mallet, hit the pinion shaft from bottom (bearing area). The whole shaft will come of together with the inner seal and roller bearing. Put them aside. There are 3 integrated soft seals on the pinion valve drum, I don't know what the correct name is, but it is easily torn. Do not play



PIC 7a: Marking the starting point on the pinion housing



PIC 7b: Marking the starting point on the pinion

around or try to pry it out, unless you have the new unit.

16. Remove the lower C-clip. Carefully insert the bearing remover from the top of the pinion housing, until it reaches the lower bearing surface, or you may use 3/4" thick rod. Hit the rod with hammer slowly until the bearing comes off from bottom. Clean it up and inspect for damage.
17. With the pinion removed, now you can start removing the rack.



PIC 8: Opening filled with silicone



PIC 9: Removing the locking pin

18. On the left hand side end of the rack housing, there is an opening, covered with soft white silicon sealant (see PIC 8). Dig it out; you will see the tip of the stopper pin. Place the flat head screw driver at the tip, turn the side cover anti clockwise using the 2 pronged tools or the hand grinder locking tool. The pin will come out slowly, keep it aside (see PIC 9). Remove the cover. There is an oil seal on the cover, replace using the same thickness or slightly thicker.
19. With the cover off, now you can withdraw the rack off the housing. The rack will come off together with the outer seal. Take note of the direction of the seal for reassembling.
20. Clean the rack groove with WD40. Check the surface of the rack. Make sure the surface is even on all areas. Excessive worn or damage due to rubbing or lack of fluid can be obvious. You can sand it off with the abrasive paper, but do not use coarser than #400. Buff the surface to mirror finish. If surface is damage, or excessively uneven, start thinking of getting a new set or you can change it into a baseball bat...or towel hanger.
21. Using the long thin rod with 45° angled flat head, pry off the inner rack seal. It will come off together with a plastic packing. Take note of the direction of the seal & packing.
22. There is a black plastic plug on the rear lower part of the pinion, conjoined to the rack housing. To remove it, slot in the C-clip remover, grip it with the locking pliers and slowly and unscrew it out. Be careful not to damage it because this part is not sold separately. But I believe the plumbing or pipe spare parts shops have it. Anyway, try not to damage it.
23. Once the cover is off, you will see a short spring and a rack stabilizing block. Remove and check the surface. It must be smooth.
24. Using a small flat head screwdriver, pry off the lower seal inside the pinion housing from the top of the housing. The seal is glued to the housing; therefore certain amount of light punching and penetrating is necessary. Get a new one for reassembling. Anyway, do not scratch the inner surface.
25. Now all seals are already removed from the housing. Go to the nearest hydraulic shop or oil seals dealer to the get the same specification and shape. Make sure all seals are heat and oil resistant.



PIC 10: Removing the rear plug

2.2 SERVICING THE PINION VALVE

I mentioned above that there is valve drum with 3 soft seals. If you are obtaining the original repair kit from dealer, this item is also included. But it is not sold separately. Be careful not to tear the soft seal during dismantling or reassembling.



PIC 12: Serviced pinion vs. the stock

1. Using the C-clip remover, remove the clip just above the valve drum.
2. Locate the 3.5mm pin that locks pinion valve drum to the shaft. Mark the position of the pin on the shaft using the marking punch.
3. Using a bench vice grip, covered with rubber sheet, grip the valve drum. Using a 3.5mm pin remover, punch the locking pin of the valve drum with hammer. Once the pin has been removed, you can slide off the valve from the top. Replace with a new one. With the pin slot mating the previously marked position.
4. To ensure that the valve drum is properly inserted and aligned, slot the pinion with new valve drum into the pinion housing and turn it around. See if the pinion shaft is turning properly.
5. Do not attempt to remove any or the seals on the valve drum. They are not serviceable parts.

2.2 INSTALLATION

Most of the parts installations are just the reverse of the removal.

1. Install the rack housing inner seal, together with the plastic spacer (packing). Make sure the spacer is on the inner side. To get the correct alignment, just slide the seal (spring face facing out) and spacer into the rack, slot the rack into the housing and push towards the end of the housing. Once the rack stopped, means it already reached the maximum depth, pull it back. The seal should stay inside, if it draws out, just try again or use some hydraulic adhesive. If you are sure that the seal & spacer are sitting nicely, slot it the rack again. (See pic)
2. Install the rack housing outer seal (spring face facing in) by sliding it into the rack.
3. Replace the o-ring seal on the plastic cover and insert it into the housing. Make sure to lock the position with the pin by reversing the removal method.
4. Working on the other side of the rack, apply 0.2oz of moly grease into rack area. Put a lot of grease.
5. Install the pinion lower bearing with the marking facing up. Install the c-clip.
6. Slide the pinion lower seal into the lower part of the pinion and slot it into the pinion housing slowly. The edge on the inside of the pinion housing are quite sharp, be careful not tear the seals at the valve drum while slotting the pinion shaft. You may need to hit the top of the pinion with rubber mallet to get the bottom point for the seal to sit. Remove the pinion shaft. If the seal comes out, redo this step with hydraulic adhesive.
7. Push the rack towards the extreme right until you can see the teeth marking (see step 9 on removal)
8. Install all the remaining seals & bearing on the pinion. Apply some grease at the gear side (teeth) and some ATF on the valve (middle portion). Slowly slot in the pinion with the side marking at 4 o'clock position, (due to the design of the gear on the pinion shaft, the pinion will turn about 45° and it will match the starting point marked on the pinion housing). If it doesn't match, withdraw the pinion and do it again with some different angle. Make sure the marking on pinion and housing match after fully inserted. Lock the lower part of the pinion with a new nylon nut, install the c-clip on the top (inside) and close the top with the plastic cap. If the plastic cap is not available, you may as well use the same oil seal (as used on the top inner pinion seal)
9. Install the inner rod end (ball end) using the same way as the removal. Repack with grease and cover with the dust boot.
10. Install the side delivery pipes on the housing. Do not over tighten.
11. Install it onto the car; with the flat surface on the pinion shaft top to be parallel to the universal clamp joint opening. Install all the nuts. Install the delivery and return pipes.
12. Install the tie-end rods with the number of turns you recorded on step 2 of removal. Tighten the nut and install the tie-ends to the wheel hub. Fill up reservoir with fresh ATF and start the engine.
13. Turn the steering wheel to the full left and right for 10 times with stopping at each at 10 seconds. Top up if necessary. On certain cases, you will hear a loud whining noise from the pump. This is normal; it will go away once all the air trapped inside the system is cleared.
14. Install the tires and lower the car. Turn the steering wheel for about 10 times as step above. Top up if necessary.
15. Bring the car to the alignment center and have the toe checked.
16. Wash the area. You won't be able to see any leakage if the area is still covered with dirt and oils. Wait for a week, and check again. It should remain dry.
17. Congrats! You just saved some hundred bucks! Have another can of cold beer and puff some smoke.

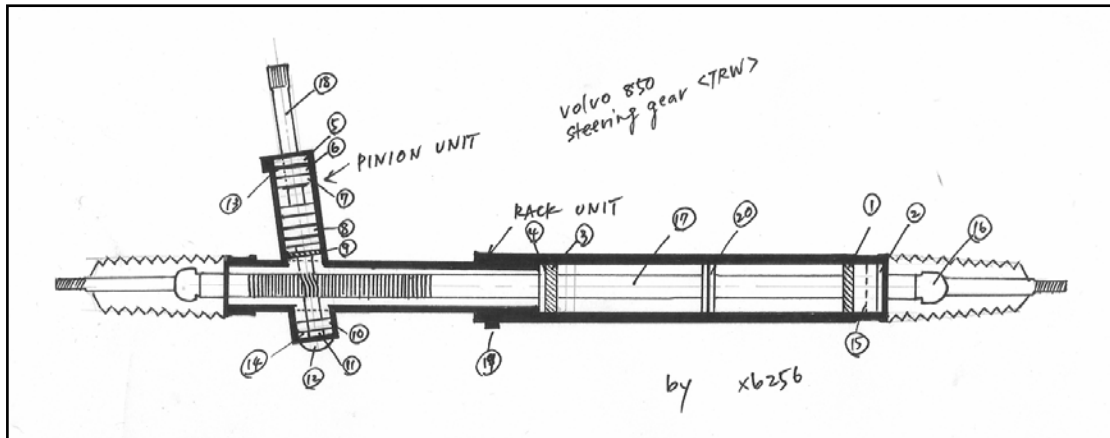


BE CAREFUL

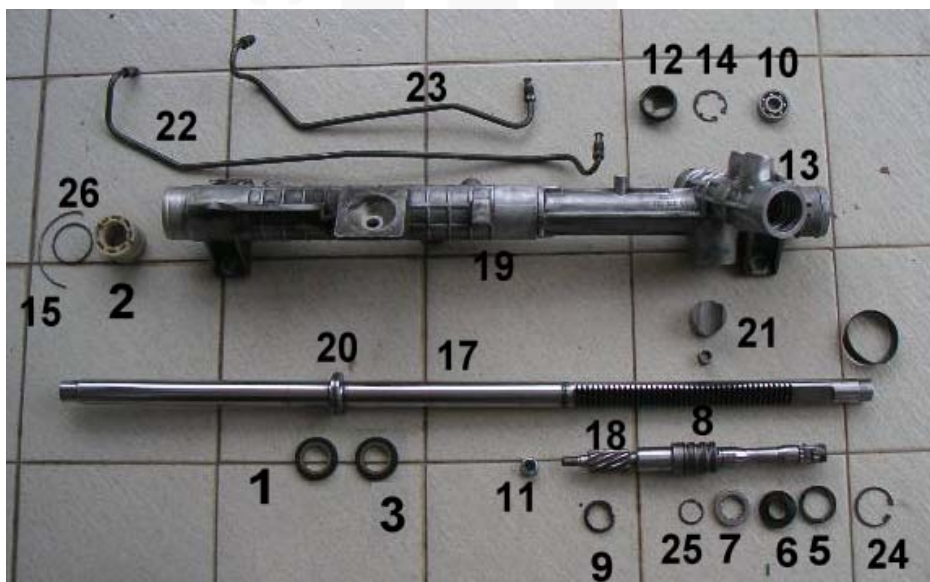
My steering gear was spoilt due to many reasons. Please take a great care of these points

- *Incorrect front tires inflation.* Volvo recommends front tires 205/50R16 to be filled at 230Kpa. Under inflation gives more rubber contact to the ground at low speed. It means more rubbing, thus giving more loads to the steering system. When excessive pressure builds up within the system to turn the tires, the oil seals give way quite fast rather than normal. I spoilt the system and 2 sets of tires for this mistake.
- *Contaminated fluids or burnt fluid in the system.* Make sure to have it flushed every 100,000km. Impure fluid invites corrosion and oxidization of the rack surface, especially when moisture or water is running within it. If the surface is deformed, the oil seals can't seal the system properly, thus introduces leaking.

2.3 LOCATION OF THE SEALS



1. Outer rack oil seal -LH side (rubber with rounded spring retainer)
2. LH rack housing plug (plastic)
3. Inner rack oil seal -RH side (rubber with rounded spring retainer)
4. Spacer / packing & locking pin (plastic)
5. Top cap (plastic) – replaceable with identical seal as #6
6. Pinion upper oil seal (rubber with rounded spring retainer)
7. Upper roller bearing (metal)
8. Pinion valve drum
9. Pinion lower oil seal (rubber with rounded spring retainer)
10. Lower ball bearing (metal)
11. Nylon nut
12. Cap (metal)
13. Pinion housing (Alloy)
14. Pinion lower C-clip
15. Locking pin
16. Inner ball end joint
17. Rack
18. Pinion shaft
19. Rack housing (Alloy)
20. Rack valve
21. Rack balancing block & spring (outer side is plastic plug – damaged)
22. LH delivery pipe
23. RH delivery pipe
24. Pinion upper C-clip
25. Pinion center C-clip (just above upper roller bearing position)
26. Rack housing plug oil seal



2.4 TOOLS

