

Fuel System: Pumps, Relays

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Abbreviations:

AMM	Air Mass Meter
ECT	Engine Coolant Temperature sensor
ECU	Engine Control Unit computer (either fuel injection or ignition)
FI	Fuel Injection
FPR	Fuel Pressure Regulator
IAC	Idle Air Control solenoid valve
TB	Throttle Body
TPS	Throttle Position Sensor
VSS	Vehicle Speed Sensor

Filter:

Fuel Filter Replacement. [Inquiry:] The time has come for the fuel filter to be replaced. Rather than pay the dealer an arm and a leg, I'd like to replace it myself. How do I do this? [Editor] The location, subject to salt spray and serious corrosion, makes this routine job a lot tougher. Bolts seize and are tough to remove. In this one instance, it is often worth your while to have a shop do the work. Ask them to reassemble everything using a good antiseize for ease of future removal.

Replacement Procedure:

[Response 1: John B/Tom Irwin/Neos/Philip] Here's how to do it safely:

- Pull the fuel pump fuse while engine is running, engine stops with no fuel pressure left in line.
 - (alternative 1: pull the fuses for the fuel pumps and crank the engine.)
 - (alternative 2: attach a vacuum pump to the FPR vacuum fitting and apply vacuum.)
- Shut off the engine and [remove the key](#) from the ignition.
- Raise the car (740) high enough, so that you have the best of angles (and room to work) to hold all in proper position. Spray the fuel filter fittings with penetrating oil.
- The filter and pump sit in a subframe or cradle under the driver's side of the car, mid-ship, held up by three 10mm bolts. The pump is held in place with a cushioned band clamp, one 10mm bolt, that can only be accessed with the tray lowered. The filter itself has two different sized fittings of 22mm and

27mm: each end uses a different size. Do not use an adjustable wrench: buy the proper size open-end box wrenches (Sears). The sizes of the banjo bolts are 18mm (mates into the 22mm or 7/8 inch filter side) and 19mm or 3/4 inch (mates into the 27mm or 1-1/16 inch filter side). These are easily accessed with a ratcheting socket. Everything will be corroded: soak in PBlastrer for a day or so in advance if you live in the salt belt.

- If you are doing this alone, loosen the carriage that holds the filter by ONLY REMOVING THE OUTSIDE NUT that holds it up, then bend the carriage down to work on the filter. The manuals say to take ALL of the nuts loose and drop the whole thing; loosening just one nut makes the job much easier and faster. Unplug the main fuel pump electric connections, disconnect the fuel tank line (plug this one) and disconnect the line to the engine.
- There should be wrench flats on the filter body to counterhold with a wrench as you use another to bust the banjo bolts free. While removing the lines, I almost broke the short line at the front of the filter that goes to the pump. It is real easy to start it bending to the point of having a kink if not careful. If badly corroded, try an impact wrench. You can get an impact wrench onto the front banjo fitting with an extension and knuckle. Place an open end wrench on the line on the back. Banjo bolt will spin out nicely. Then go to a bigger socket to fit the shoulder on the filter and use it to loosen the filter from the line on the back end. Your impact wrench can save the day on this.
- Instead of removing the filter from the bracket and then trying to disconnect the lines, now I try to leave the filter in place as much as possible, although I find that I do need to loosen the bolts to the cage a little to get my wrenches in there. After the lines are off, I loosen and push out the filter. When I put it back on, it is difficult to get the right angle of the rubber line around the cage unless it is one of the last things tightened.
- Once free of fuel lines, loosen the clamp around the middle and swap it out.
- Replace fuel filter and banjo gaskets. Use grease as anti-seize on the threads and washer flats of the fittings but don't get any in the fuel intakes. The new filter will come with 4 copper crush washers, two for each compression fitting -- note the location of the old ones as you remove the fittings. The BEST (most successful) way to reinstall the fuel lines is with an impact wrench, while gripping the filter body with a free hand or the rear flats with an open wrench. Just BRrrraapp! until it feels right. Using hand wrenches, you stand a good chance of twisting the lines under load, potentially causing a leak failure. Use a backup wrench. And be EXTREMELY careful.
- Cinch the clamp. Bend the cradle back up and tighten the bolts.
- Check for leaks when you are done and it is running.

Gasoline Spillage. [Tips from Patrick] Make SURE the negative cable on the batt is disconnected! (have your radio code available.) Be EXTREMELY careful as a significant volume of fuel may come out. Be ready to catch all the gas in the filter and the line between the filter and the engine. Some gas drips out of the main pump with the filter removed, but it won't be much as long as you keep the pump and tray assembly elevated as you replace the filter. If you remove all the carrier bolts, have an old box or something ready to support the weight of the tray -- don't let the tray hang by the fuel lines! An oil pan has more than enough volume to do this job. One last word of caution ... don't smoke when doing this job.

Copper Washers.

Whenever you change the fuel filter, make sure you have four new copper washers. The filter should come with them, or you can buy them from the dealer. Wagner Brake sells them as brake fitting copper washers, numbers F17 and F10775, at auto stores. There is a copper washer on each side of both banjo fittings. They really aren't designed to be re-used (the old ones work-harden and won't crush enough to make a seal) and four new washers should have come with your new filter. If they didn't, try annealing the old ones. First, dress both surfaces with a flat file, or fine sandpaper on a flat surface to remove ridges left from the banjo fittings. Second, heat the washers to bright cherry red with a propane torch and let cool. This step anneals the copper. Third, clean again with a file or fine sandpaper. When reinstalling, don't get crud or rust-proofing material stuck between the copper washer and the fitting (this crud usually isn't visible after installation).

Worst Case: Bolts Stuck; Fuel Line Breaks.



[Tip from Fisher] If you find that while working under the car, you absolutely cannot remove the corroded fuel filter bolts, you can remove the lines to the engine and to the tank which is easily done. Use flare wrenches and penetrating oil. You can then disconnect the fuel pump wires and the whole cradle, pump and lines will come right out. Now with the filter off the car, remove the lines at the filter. [Editor] If you break the small connecting fuel feed line, get another one from an online retailer (e.g., [FCPGroton](#)) for around \$30.

Airbag Deployment While Changing Fuel Filter

[Tip from Abe Crombie] There is a Volvo SB out on precautions when changing fuel filters. The SRS Airbag system is powered anytime the key is in position I or II. If you are listening to radio while changing fuel filter and you are using air impact tools there are real risks of deploying airbag as you re-install the fuel pump/fuel filter bracket. The hammering of air impact tool on bolts securing this bracket which is very near crash sensor location in floor pan on inside of car, can cause a deployment. This sounds like someone found out about this the hard and expensive way. The bulletin only mentions 700/900 series but the 240 crash sensor is not too far away from the same location. LEAVE KEY OFF WHEN CHANGING FUEL FILTER!! If you need tunes get your rhythm somewhere else besides the car radio.

[Comment: S. Ringlee] By extension, then, if I use impact tools on such things as suspension bolts or anything else likely to jolt the body while the ignition is on, the same result may occur. \$2500 lesson (bags, sensors, seat belts, glass, speakers, heaven knows what else.) This is great advice: listen to a boom box and NOT the car radio while banging on the car.

Carbon Vapor Canister. For notes on diagnosing and replacing this filter, see the [FAQ link](#).

Fuel Injection Relay:

Fuel Pump and FI Relay Diagnostic Tests.

Here is a procedure to test the operation of the fuel injection relay and the operation of both fuel pumps. The 3 main things to check in the fuel circuit are the fuel pump relay, and the 2 fuel pumps.

1. **Fuel Injection Relay Test.** There are 2 relays inside the fuel injection/pump relay. One of them should turn ON when the ignition is turned on (without turning over the engine), and the other relay (which actually turns the fuel pumps) should come ON when the engine turns over/runs. You can check the 1st relay by putting your fingers on the relay module and turning the ignition on and off repeatedly. You should feel the relay click on every time. If it doesn't, that relay isn't working. And you'll find the car doesn't start if the relay did not come on.
2. [Tips from Bob Dietz] Locate the main fuel injection relay, pop the cover and operate the contacts with your finger to operate the fuel pump when the key is on. If the pump operates then the problem is in the spark side of the equation. If the pump does not operate then replace the relay. If the pump then operates on its own when the key is switched to start, the problem is solved. If not, leave the new relay in place and check for current at the pump. If current exists, replace the pump. If the pump is defective, you'll want to replace the relay anyway because of an internal diode across the contact points that protects the fuel injection computer. High current loads from a failing main pump will cause extreme arcing across the point contacts on shut down and damage the diode protection circuit.
3. **Fuel Pump Diagnostic Tests.** On the 740, the fuse-box + relay box can be pulled out a little to facilitate inserting/removing relay modules. So pull it out as much as the wires will allow. Pull out the fuel injection/pump relay module. Now take a small piece of wire to jumper terminals 30 and 87/2 on the relay board (the terminals are identified on the relay module pins. The 2 terminals are the nearest left and middle right pins on the relay board). This should make the car act like the fuel pump relay is ON. Note: be careful that you insert the jumper ONLY in these pins, else you will damage the ECU.
4. Now turn the ignition ON (without turning the engine). You should hear a whirring sound right from where you are. That will be the main fuel pump. Now go to the gas tank and unscrew the cap. Put your ear to the hole and you should hear a smaller whirring sound. Or, listen with a piece of heater hose to the tank pump through the gas filler with car running. Should hear a humming. That will be the in-tank pump. If you hear both noises, the fuel pumps should be OK.
5. To check the pumps individually, you can pull out the in-tank fuel pump fuse after you do the above test, and repeat the test. You should not hear any whirring at the tank, but you should be able to hear the main pump. [Bruce Young] For cars using fuse 11 to power the in-tank pump or Regina main pump (NB: Regina and post-1994 cars have only one pump), you can test fuel pumps individually. Improvise a jumper wire with a flat male terminal on each end. Disconnect the fuel line at the injector rail and route it into a safe container with a helper watching.
6. For the 94/95 940 Single In-Tank Pump: [Eric Cordis] You can easily hear the pump in the trunk if it works. The 95 940 does not run a priming cycle when the key is turned; engine rotation on "start" is required to power up the

pump. A new pump will test at 1-2 ohms; my old, worn one was 20k-30k ohms.

To run or test the **In-Tank Pump**, remove fuse 1 and in-tank pump fuse 11 and apply battery voltage from the fuse 1 terminal **closest** to you to the Fuse 11 terminal that is **farthest** away from you, i.e., toward the engine. BE CAREFUL that you do not ground this jumper. The in-tank pump should push a good flow of fuel through the unpowered main pump all the way to the injector rail. To run/test the **Main Pump**, jumper voltage from F1 to the other F11 terminal—the **closest one**.

CAVEAT: The main fuel pump is not designed to be run without the in-tank pump on, so get the second part of this test over quickly. You should not need to keep it running in this condition for more than a few seconds to complete this part anyway.

Symptoms of Bad Pump Relay. [Symptoms:] 89 740 died & started 10 min. later. My '89 740 did the EXACT same thing for a while. When it acted up it did have spark. It seemed to be related to getting hot. It would die in motion, or when hot, it would also refuse to restart 'til it rested for 10 min. As far as driving it, not much you can do, just be prepared to pull over and give it a rest for 10 min. When it acts up, as the key is turned ON, listen, the fuel pump should normally be heard to come on for about 1.5 sec. If it's not coming on, I'd bet on the relay. [Diagnosis:] After replacing the fuel pump relay (\$38 at dealer), it's been 100% fine. [Editor's Note: See the note on Headlamp Circuits/Relay Won't Function in the Electrical: Lighting section for more relay information.]

Fuel Pumps:

Most 700/900 series four cylinder cars with Bosch injection systems have two fuel pumps: an intank pump which is low pressure and merely lifts the fuel from the tank and sends it to the main pump under the drivers seat. The latter is a high pressure pump capable of going to 80 psi or so, modulated by the fuel pressure regulator which keeps pressure around 35 psi by allowing excess fuel to circulate back to the tank. Of course, there are exceptions: the 1995 940 and all Regina-equipped cars have single in-tank main pumps.

Fuel Pump Noise. Fuel Pump Noise.

Cars With Pre-Pumps: [Inquiry:] My car is running perfectly but whenever the fuel-gauge drops to around 25%, noises coming out unexpectedly, but after refuelling the noise will suddenly disappear. Does anyone could tell me what's wrong with my car? [Response: Michael Pardee] Sounds like the hose on the in-tank fuel pump has a hole in it. That is very common, and if the hole gets much worse, it will not be able to run below 1/4 tank at all. Fortunately, it's an easy fix. [Response: Peter James] I would agree with that and/or the intank pump has failed and you are now stressing the main pump, which in turn can lead to premature failure of the main pump. [Response:] Are you sure it's the in-tank pump, not the main pump down by the rear wheel arch that is making the noise? Most commonly this pump makes this noise not because it is failing, but because the in tank pump is not supplying the fuel to it for some reason. It won't do it any good to operate in this condition,

and when the main pump fails, you're stuck at the roadside. The most common causes of in tank pump woes are not failure of the pump itself, but two other possibilities:

- The little sock filter on the in tank pump intake is blocked with debris
- The pipe from the in tank pump has split.

Both require the pump removed from the tank to rectify unfortunately.

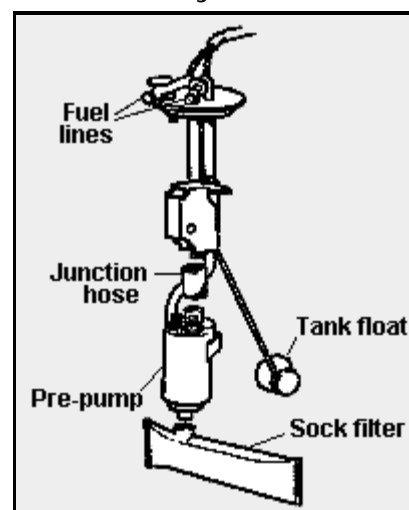
[Tip from Jeff] If you turn the ignition on to KPII ("on" but not started), the fuel pump should turn on then off after a short time as pressure increases. If the secondary, high pressure fuel pump runs continuously then the appropriate pressure is not building up. Check the fuel pressure regulator and the primary in-tank low pressure pump for faults.

Cars With Single In-Tank Pumps: If your pump makes noise, it is close to failure. The usual symptom is a strange buzzing sound, often intermittent. The usual failure mode is worn commutator and brushes.

Replace Rubber Bushings. [Tip] I replaced the three fuel pump cradle rubber bushings (Volvo p/n 1255018-2) three weeks ago and today I realized that I wasn't hearing the fuel pump anymore. Replacing all the rubber bushings in many places in the car has made a huge difference in the way it drives and handles.

Fuel Pre-Pump Problems & Diagnoses. Note: 94/95 940 and all 960 cars lack a pre-pump; they have one main in-tank pump instead. [From [RPR](#) ; illustration copyright and used by permission:] 7xx/9xx Volvos (except later 940s) are fitted with a fuel pump inside the fuel tank. This pre-pump, also called a primary or feed pump, moves the fuel out of the fuel tank to the main fuel pump under the driver's seat. This prevents fuel starvation problems that may occur when the tank is less than half full. If the main pump has failed, the car will not run. If the pre-pump is inoperative or if the junction hose has failed, you'll have fuel starvation symptoms. These may include hard starting, inexplicable poor idle, louder than normal main fuel pump noise and a loss of power under load. To check the operation of the pre-pump without removing it from the tank, locate the pre-pump fuse. Remove this fuse with the car idling. You should be able to detect increased noise from the main pump and decreased vibration of the fuel tank itself.

Diagnosis of pre-pump: Are there any short cuts to check to see if the in tank pump fuel pump is working? I opened the gas cap and did not hear any noise.] You should really be able to hear a buzzing sound in the fuel tank if the in-tank pump is running. Sometimes a length of heater hose inserted in the filler neck and placed against your ear will help isolate the sound. Try it with the fuse in place and removed and listen for a change in the sound. You might also find another Volvo owner who might let you probe their filler neck with your length of hose and listen to their in-tank pump . Assuming their in-tank pump is working you would be able to determine the sound



you are listening for. If you do [take it out](#) of the tank:

- Replace the short segment of rubber hose with a new section of fuel hose.
- Replace the sock that is on the end of the pickup tube (about \$15 from Volvo)
- DO NOT bench test the in-tank pump. When the pump is removed from the tank arcing will occur when powered up and can result in a fire due to the gasoline vapors present. Certainly don't remove the pump from the fuel level in the tank and give it a quick bump on the starter to check out its function- that can result in one hell of a fire (and explosion). The pumps are designed to run submerged in gasoline.

Symptoms of worn fuel pre-pump: My experience with a worn fuel pre-pump is that it will cause the engine to miss and lose power under conditions of high flow (high throttle and high rpm). The problem grew worse very gradually (over 10's of 1000's of kms). It certainly wasn't going to leave me stranded anywhere. [Another example:] My wife drives an '83 760, which I have maintained as needed. Recently, the car started to vapor-lock in warmer weather, and/or when the fuel level dropped to around a 1/4 tank or lower. Oddly enough, when I refill the tank, the problem seems to go away. [Test Tip:] As far as a definitive test goes, I guess it would be necessary to set up a pressure gauge and flow meter as well as a valve in the circuit that would allow a specified volume to flow while reading pressure, but see the above fuse and noise procedure for an alternative. [Editor] Hard starting and poor idle have been traced to a bad pre-pump, if other symptoms are also present such as main pump noise. **How Long Do They Last?** [John McPhail] I've junked a couple of 240s (severe rust problems) that had over 250K miles on the original pumps. The three cars that needed replacement in-tank pumps had between 150K and 200K on them when the pumps failed: 158K, 174K and 190K.

[Car Stalls During Turn: Fuel Prepump Failing.]

[Inquiry:] I bought a used '87 760t. It ran fine when I first got it but after a few months it started stalling when making a left turn. Not every time, but its worse (more likely to stall) if I'm decelerating, in fact I can usually avoid the stall if I slow down before the turn and then give it some gas during the turn. When it does stall it almost always starts right back up no problem.

[Response: MikeW] The stalling during turns is usually indicative of a problem with the in-tank fuel pump. Does it happen when you have a full tank of gas, or only when your down around 1/3 tank or less? Anyway, it sounds like your in-tank pump may be bad, or the rubber hose connecting it with the metal line running out of the tank may have deteriorated, or the filter sock on the bottom of the in-tank pump is plugged.

Changing Fuel Pre-Pump:

[Parts note from Editor] If you [change the pre-pump](#), have your parts guy supply two compatible nuts for the electrical connections (threads differ) and the OEM outlet hose. The OEM threads are 3.5mm x .75, available at electrical supply stores.

[Erik Smith] Before changing the

pump, make sure that the fuel pump ground connection is not the problem: if the connection to the body is not intact, the symptom will mimic that of a failed pre-pump

[John Sargent] There is a metal panel (about 6" X 6") under the carpet in the trunk, left of center, in front of the cargo/third seat compartment. [Remove that panel](#). You will see the top of the [fuel pre-pump/sending unit assembly](#). It is retained by a large plastic nut. Take the hoses off, remove the plastic nut, free the electrical wiring from any clamps and loosen both the connection in the trunk and the grommet through which the wiring passes. Mark the orientation of the round plate so you can reassemble it correctly. The fuel pump assembly can be manipulated through the hole. It is very easy to reverse the wires that attach directly to the pump, so make sure you locate "+ and -" on the pump and install the wires with correct polarity. When reassembling, don't overtorque the plastic nut and strip the threads. Access Tips: there is a black ground wire that needs to be either disconnected or cut and re-spliced. To remove the panel covering the fuel sender in the wagon, push the rear seats forward, pull back the front floor panel, remove the three nuts holding the panel in place, and pull the panel up and forward to remove. It is secured by adhesive or Velcro and two clips that clear once it is pulled forward.



Pre-pump Outlet Hose. Don't let those guys charge you \$200.00 for working on your pre-pump! Most likely the small piece of rubber fuel line between the in-tank electric pre-pump and the metal output tube has eroded and needs replacing. Remove the pre-pump from inside the trunk to get to this hose. The hose varies: about two inches long in earlier sedans (Volvo has a nice OEM bellows hose for this application) and about nine inches long in the later sedan and wagon (standard 5/16 inch fuel hose will work, but you are better off buying the \$10 OEM hose from a dealer since it is an exact fit AND is resistant to fuel degradation.)

Fuel Tank Line Clamp Recommendations. [Inquiry:] Which clamps work best on fuel lines inside tanks? What's their projected life span? [Response: Jim McDonald] Breeze Liner all-stainless clamps: about 250 years; somewhat less in plain steel. Buy [Breeze Liner](#) clamps from a truck dealer.

Fuel Sender and In-Tank Pump Replacement. *There are several FAQ files describing this generic procedure: the OEM [manual scan](#) (courtesy Volvo Car Corporation, copyright; all rights reserved; some browsers will not directly open a pdf plugin, so right-click to "save as" and save the file, then open it directly in [Adobe Reader](#))) and Art Benstein's illustrated [version](#). The latter in particular will guide you through this process.*

Fuel sender unit removal and replacement (see below for later [Bosch and](#)

[Regina one-pump systems](#) .

System Variants. [Dave Stevens] There are a number of fuel tank sender/pump variants for the North American market. To the best of my knowledge they appear to be:

- All 740s and 1992 16-valve 940s to 1992; B230F, B230FT, B234F w/Bosch FI and 60 litre tank; in-tank pre-pump (same pre-pump for turbo; main pump alongside fuel filter in undercarriage frame below left rear passenger area)
- 1992-1993 940s; B230F, B230FT w/Regina FI and 60 litre tank; quick-disconnect fuel line fittings (push-in plastic); in-tank main pump (different pump for turbo); otherwise similar assembly to 740s
- 1994 940s; B230F, B230FT w/Regina FI and larger 75 litre tank; quick-disconnect fuel line fittings (push-in plastic); in-tank main pump same as 1992-1993 Regina; longer fuel level sender barrel (also supports empty tank warning light); trickier to remove/install
- 1995 940s; B230FD, B230FT w/Bosch FI and larger 75 litre tank; in-tank main pump (different for turbo and both different from Regina); proper wiring connector for the fuel pump; otherwise similar assembly to 1994 940s
- 960 through 1992: sedan 80 litre; wagon 60 litre tanks with single in-tank pump and similar fitments as above
- 960 92-94: sedan 80 litre; wagon 75 litre
- 950 1995+: 80 litre

The sender/pump units for larger tanks are longer and somewhat more difficult to remove and reinstall. Sending units from 940s and 960s generally do not interchange, even if the pumps do, because the fuel tanks have different shapes.

Parts Needs. [Editor] In addition to the pump (specific to your model) and any associated in-tank hose or filter sock, you will in all likelihood need a new top gasket (p/n 1367623-4) and new hose clamps securing all the hoses on the top of the sender unit. These are almost always severely corroded. The large clamp holding the fill hose is Volvo p/n 943477-0; buy two of these. The smaller clamps are 943471-3; buy four of these. The spring clamps are 1321719-5; buy two of these. If you do not have to remove all the hoses or if a clamp is reused, you'll end up with an extra clamp or so. You should also buy a new 7.6mm ID in-tank pump hose (p/n 3514604-2): some pumps have been changed and the old hose is too short. Buy 14 inches. In a pinch, Gates 7.8mm submersible fluorelastomer fuel hose is a good substitute (p/n 27093 or 5/16 inch I.D.) but costs three times as much as OEM. If you need to replace the sender assembly because of rust, make sure you use a unit appropriate for your model and fuel tank size.

Tool Needs. [Editor] You will need an LED headlamp, a length of strong string, some Vaseline or light grease, and patience if you are working in the trunk of a sedan.

[Note: See [Removing Rear Floor Panels for Access to Fuel Tank and Pre-Pump](#) for instructions on wagon fuel tank hatch access.]

If the tank is brim full you will need to siphon some gas out. Ideally the tank should be 3/4 full or less. If the rear of the car is securely up on jacks or ramps then this is less of a problem.

First disconnect the hose coupling under the rear axle housing -it will be half-seized so apply penetrating oil, give it some time, use a proper flare wrench on the brass collar and an open end wrench as a counterhold to avoid twisting the metal line, work it back and forth with more penetrating oil once you get it started. Inspect the lines; you may need to replace the rubber hoses. NOTE: Volvo uses non-standard 1/2 inch pipes; most auto parts stores only carry up to 3/8 inch injector hose. Before you cut those lines have replacements ready. This applies to the rubber lines running to the main pump and from the fuel filter as well.

Then disconnect all the other clamped hoses on the sender housing: one is a vent hose from the fuel door supply tube; one is the feed hose to the fuel pump; one is the return hose. The clamps will usually be badly corroded. For any quick disconnect (clamp-free) connections, press in on the fitting with your thumb and pull the circular lock ring back toward the fitting with your first two fingers, using a little penetrant if needed. Be careful with the electrical connector on the sending housing: treat that connection as if it were made of gold because if it breaks, then you lose ground contact with the base of the sending unit and you might as well throw it away.

Remove the trunk trim panel on the left rear wheel, then disconnect the electrical connector in the left trunk well, cut the plastic ties, and feed it out of the chassis by pushing the rubber grommet out of the sheet metal and then pushing the wires through the body into the axle area. If you can't fit the plastic connector holder through the chassis hole, just record the wire colors and their locations in the plastic holder you just disconnected. Separate the plastic connector from the wires by inserting a jeweler's screwdriver into the slots inside, depressing the locking tang between the U-shaped side tangs on each wire (look into the back of the connector with a flashlight), then pulling the wire and metal connector out of the plastic holder. Undo the plastic knurled sender lock collar -you can tap around the lugs at an angle using a piece of wood to start the process. Now you're ready to perform the sender extraction.

Corroded Fuel Line Clamps. The line clamps WILL be corroded. Use P-Blaster liberally to loosen. A set of 1/4 inch drive metric sockets helps with access as does a pair of water pump or long angled needle nose pliers for the spring clamps. The narrow fuel line at the top of the sender emerging from the Y-filler hose is tough to access; you may have to drill a hole in the trunk deck to get to the clamp. The same is true of the large clamp at the intake side of the Y-hose. Before you drill this hole, buy a rubber grommet at the hardware store to fill the hole: drill to the size of the grommet. And treat the drilled hole edges with paint and rustproof before reassembling. Use stainless Breeze aero clamps on reassembly to prevent future corrosion. [Editor] While people have reported success using a Dremel cutoff wheel to remove corroded clamps, the shower of sparks near the fuel tank (regardless of how well it is sealed) is disconcerting at best. Perhaps it is better to use a diamond bit to cut through the clamp while minimizing sparking.

Unit Removal. Twist and pull the unit straight out until it is free of the collar. Now pull all the fuel hoses and wires out of the trunk opening. Once you get the rubber collar free there is no need to force anything. Now, starting from the six o'clock position turn the unit clockwise to about the ten o'clock position, tipping it up as you pull it out. Note the position of the filter sock (if it's missing you've knocked it

off and will have to fish it out of the bottom of the tank). Check the filter sock for damage or dirt -replace as needed. The rubber neck seal usually needs to be replaced: buy a new one before you start the job. The large plastic lock ring is made of some polymer that shrinks over time, so if you are not planning to complete the job within about half a day, reinstall it or buy a new one

Replace the pre-pump. That's the easiest part of the whole job.

Now is the time to remove rust from the sender top if it is metal, treat with Metal Ready deruster, and paint with POR-15. If the fuel outlet bases are cracked due to corrosion or if you have a holed area, repair with JBWeld epoxy, then apply POR-15 and repaint. While doing this, be very careful to not damage the three wires and the ground connection. If needed, get your old sender unit top plate, which may have rust and cracked pipes, rebuilt at a local radiator shop; they can clean off the rust and braze new outlet pipes into place. Much cheaper than replacing the whole assembly including pre-pump.

On re-installation, take a look in the tank with a flashlight and note the anti-splash bucket in the bottom. You've got to get the unit back into there without knocking off the filter sock -just follow the extraction gyrations in reverse without letting the sock go too far to the left or right so as to catch on the bucket. Also note that the bottom of the sender sleeve is spring loaded in a fully extended position. I find it makes the whole process much easier if you loop a string under the pre-pump so you can pull the sleeve back during initial installation (pull out the string once you get it vertical). During the final stages of re-installation you'll need to bump the sender unit up and down to get the unit to sit properly with the sender plate flush to the opening. Grease the sender unit top mating surface and the gasket with Vaseline. I found it best to install the rubber collar first about half way then push the assembly into it. What matters is that the rubber collar is seated properly all the way round the opening lip and that the sender unit face is completely seated flush to the rubber collar before you hand tighten the collar. If you smell gas fumes a few days later then you know you didn't get the sender seated properly. Do not overtighten the collar or the threads will slip. If you must tap the ring to tighten it then don't go much more than about 1/4 turn. I highly recommend putting a 5" stainless steel hose clamp (available at places like Home Depot) around the collar to prevent the collar from expanding and stripping threads (do this with the hose clamp lightly tightened). Fully tighten the hose clamp when done. Apply spray asphalt rustproofing after installation. Test for leaks by turning the engine on for a minute to pressurize the system.

Installation Tips

[Colin] The Bosch pump assembly is both telescopic and spring loaded against the cover plate and seats into a receptor in the base of the tank to ensure that the pick-up screen sits at the very bottom of the tank. Unless you disable this spring feature temporarily it will engage too soon and prevent you from rocking the assembly. To disable this function pass a thin cord or thread through the return fuel pipe of the assembly. Compress the telescopic portion, wedge it in this position with a cocktail stick or similar then tie the end of the thread to the end of the wedge. Fit the unit as previously described and then pull on the thread to remove both the wedge and the thread. If you lose the wedge from the end of the string it won't cause any problems as it will float on the surface of the fuel and cannot get

sucked into the pump. By far the easiest (possibly only) way to refit the assembly is to fit the gasket into the tank first, then push the assembly into it. A straight push may result in pushing the gasket into the tank, what is required is a relatively gentle push combined with slight rotary/rocking motion applied to the assembly

[Doug Bostrom] When replacing the tank pump/sender assembly, put a little vaseline on the surface of the pickup that mates with the wide gasket surface leading into the tank. By then positioning the gasket into the tank neck and inserting the pickup unit the job suddenly becomes much easier - the pickup practically dropped into place by itself. It is also helpful to put the gasket in place after getting the pickup unit prepositioned without the gasket being in the way. The gasket will stretch around the pickup, allowing it to be added to the stack quite easily.

Rust on Fuel Sender Top. [Editor] A frequent cause of fuel sending unit failure is rust. The design and placement encourages rust, which then loosens pipes and electrical connections and ruins the sending unit. The replacement cost is \$350 and up, so you may want to consider rustproofing the area when you open up the fuel tank to replace a prepump or sock. Normal spray-on tar rustproofing does not work if the sending unit top has already begun rusting. Instead, carefully wirebrush the top, including pipe connections, and clean it off using alcohol or brake cleaner. Let it dry, then apply POR-15 rustproof paint. Once this dries, apply spray-on tar rustproof such as 3M. If you have a plastic sender top, look carefully at the fuel pipes for rust especially as they penetrate the top.

Single Pump In-tank for Bendix/Regina/Later Bosch Systems/960 Cars:

[Procedure from Kuba] I have a one-pump-only Regina in-tank system on a '93 940 wagon. The access to the tank in the wagon makes life really easy. But first relieve the fuel system pressure *and* have your wife handy with a fire extinguisher. Make sure she knows how to use it (how to pull the pin and how to squeeze the trigger). **See Art Benstein's illustrated website procedure in the edited [FAQ file](#).**

1995 Replacement Pump. [Editor] This single in-tank fuel pump (note: NO pre-pump is fitted on '95 cars) is made by AC/Delco and may be obtained from aftermarket sources such as [FCPGroton](#) for far less than from Volvo. They reliably last about 150,000 miles: after that you are on borrowed time. [Jay Simkin] The Volvo fuel pump numbers for this 1995 specific application are:

- Non-turbo B230FD engine with Bosch injection: Volvo pump P/N 3507436
- B230FD engine with Rex-Regina fuel/ignition: Volvo pump P/N 9438001 (applies to 93+ as well)
- B230FT turbo engine with Bosch injection: Volvo pump P/N 9438756

Removal. First clean everything with PBBlaster before opening it up. You will need to disconnect the wiring, the top of the round cover of the sender assembly, and perhaps the large fuel filler hose. The fuel feed line (pressurized one) on newer Regina-equipped cars has a quick-disconnect which can be difficult to remove: pull the black plastic cylinder sleeve back with your two fingers while pushing on the 90 degree fitting with your thumb and then pull the hose off.

Most others have hose clamps. The clamp on the fuel return line is a spring type (although it may be equipped with a crimped-on hose clamp fitting, depending on the year), others are worm screw type. Just undo those and you're OK. The crimped clamp may require cutting. To reassemble the quick disconnect, just pull the cylinder sleeve, push the whole thing back on the metal pipe, and release the cylinder. The electrical wiring going to the sender is connected in left trunk well. Disconnect it there and pull it out working from under the car: do NOT attempt to disconnect it at the sending unit. You will need to see the slosh pan on the bottom of the tank to be able to clear the assembly when removing or installing it. Use a flashlight to see the pan, or remove the fuel. Either siphon the excess fuel out (NOT BY MOUTH!), or if your car runs just run it a little more till you go through most of the fuel. To get the assembly out, rotate it clockwise from 6 to 10 o'clock. You will likely need to peel out the tank seal and store it on the sender top, once clear of the tank, in order to withdraw the entire unit.

Reassembly Preparation. Don't even think of putting the rubber seal in yet. Just leave it out. You will be able to put it back later. If you insist on putting it in tank or on the assembly right now, you are making your life miserable. Get a piece of a cord. Make sure that it's won't dissolve in gasoline. A cotton knitting thread worked for me. Fold the cord in half to get a stronger version, push it through the vent fitting - the only uncommitted (as in nothing on the inside) fitting on the cover plate. Pass the cord under the *thicker* bracket (zinc-coated, not brass) that holds the fuel pump assembly together and back through the vent fitting. Pull the cord so that the movable part of the sender assembly goes against the stop in the topmost position. Tie the cord outside around the fuel feed line. That way you don't have to constantly pull on it while wiggling the assembly to make it fit.

Reassembly. Take a good look at the yellowish anti-slosh pan on the bottom of the tank. See the high side plates? You'll need to maneuver the assembly around them. Put the assembly in through the hole in the tank so that the bend in it points more-or-less at 3 o'clock. Push the assembly in some more while rotating it counterclockwise. Make sure you know when it's vertical. You'll need to clear the left-side edge of the anti-slosh pan on the bottom of the fuel tank. In order to achieve that, you don't want to push the assembly all the way into the tank - push it in only as far as you need to rotate it. To properly seat the bottom of the sender on the center of the slosh pan, you need to make the final 10-20 degrees of counterclockwise rotation with the assembly tilted up inside the tank so as to clear the edge of the pan. When the assembly has cleared the edge you'll be able to finally get it to vertical orientation (end of clockwise motion). Then push it in fully (2-3" deeper compared to where it should be right now). Make sure it seats properly. This is impossible with the rubber seal in the way.

[Tip from Philip] I discovered that the unit is spring loaded and collapses in itself about 5-6 inches as it rides up and down (like a telescope) within the larger part of the unit. Knowing this, I was able to install it by keeping it collapsed using a string and I was able to do this from the top (from inside the trunk). The UK Haynes manual suggests you compress the spring in order to install more easily: wedge full up with a match stick with a string attached and run out thru the vent pipe. Once installed, the string pulls the wedge free, letting the spring release properly into position.

Seal Installation. The rubber seal's purpose is essentially to keep the gas where it belongs - namely in the tank. To that end you'll notice that the side of the seal facing into the tank is split (bifurcated) - it looks like two concentric rings. Since the in-tank side of the seal has two concentric lips, it's next to impossible to get it to seat while the seal is on the sender/pump assembly cover. Pull the sender assembly out so that the cover with its rim clears the tank. It will get messy. Apply some Vaseline on the inside and outside of the seal, and onto the seal seating surfaces (cover and tank's rim). All four surfaces (inside/outside of seal and mating plastic surfaces of tank and cover) must be slippery. Don't overdo it -- spray at one point and then smear it nicely all over the seal and mating surfaces. Stretch the seal a tad and pull it over the sender assembly cover. Push the seal about halfway into the rim in the tank. With a rotating rocking motion (rock the sender in the seal slightly), slowly push the sender assembly's cover into the seal, and use it at the same time to fully seat the seal in the tank. After it's fully seated, pull the assembly out about 1/8". Feel the gap between the tank rim and the sender assy cover - make sure that the slight flange on the seal is present all around the cover. If you've pushed the seal improperly so that the flange made its way into the tank, pull the assembly out enough to be able to repeat pushing the seal halfway into the tank and following. With slight rocking, push the assembly back fully into the seal. It will obviously go only the same distance as you've pulled it out in step 8 above. Apply some grease to the large ring and [screw it in place](#) until it contacts the sender top, then slightly more to compress the seal. Not too much.

[Tips from C Weidner) I have the Regina style fuel system - one pump - and it's in the tank. Pump replacement seems like a pretty straightforward job, and for the most part is. Two obstacles - the pump assembly was wired straight into the wiring harness; there were no plugs. This required soldering. Nothing serious, just annoying and un-volvlike. The biggest hurdle was getting the pump assembly to fit back in the tank. There is a large plastic ring that threads onto the plastic fuel tank - this cap is what snugs the assembly to the tank. AROUND the assembly is a rubber seal (about 2" deep) that sits between the assembly and the tank opening wall. I hope this makes sense. It was a bear. It wasn't until my neighbor came over and got underneath the car, and I got out the vaseline (no funny stuff, I was crammed inside the trunk) to coat the seal, did we get the it to seat. IT took three hands. The secret was not to do the obvious/easier route and put the seal around the assembly, but to seat the seal in the opening and push the assembly through.



Gas More Than Empty But Can't Be Pumped Out. [Dan Ray] There are two marks on the edge of the tank stalk top, where all the hoses are clamped, that align with the weld seam in the gas tank. If for some reason the stalk is not in alignment, the pickup tube will be higher than the bottom of the tank and not allow for the use of a full tank: more gas will be left at the bottom that can't be sucked out. If you clean off the tank cap with all of the hoses, you will see a mark on each side, just within the plastic nut. Kind of like horizon marks, they follow the seam weld of the plastic tank. Align these for full use of the tank.

Fuel Gauge Failure: Fuel Level Sending Unit Repair

[Procedure From Nathan Babcook] Fuel Gauge failure seems to be rather common in 940 Volvos. I requested and received a lot of information before finally solving the problem. The Fuel Level Sending Unit and Tank Pump assembly is a fairly straightforward design. There are no a lot of moving parts to break, and if you are careful about your diagnosis you can avoid having to "crack anything open."

Diagnosis Procedure. Before you replace the sending unit, be sure that your much-easier-and-cheaper-to-replace gauge is working by using a 68-ohm resistor to simulate a working fuel sending unit. Buy a 1/2 watt 68 Ohm resistor (precisely 68!) at Radio Shack. The resistor will substitute for the coiled wires around the rods inside the send unit barrel. As the float unit moves along the rods within the send unit barrel, the float unit changes the resistance to the current flowing through the brown and grey-white wires. That change in resistance causes the gauge needle to move. The resistor substitutes for the send unit.

Be sure the car is turned off! Disconnect and isolate the negative (black) battery cable clamp using a zip-lock freezer bags). Have the radio-activation-code at hand.

Find the sending unit connector C93 in the left rear wheel housing in the trunk and disconnect it (in the 1995 940 wagon it is a 4-wire quick connector located in the driver's side hidden compartment at the rear). Inside are Black, Pink, Brown, and Grey/White wires. The pink wire provides +12V to the pump, the black is your ground and the grey/white and brown wires are your fuel level sending unit wires. Your wires may differ slightly in color depending on year: check the wiring diagram.

Bend the resistor leads into a "U" and insert them into the gauge side connectors - one side into the grey/white wire connector and the other side into the brown wire connector . If your wiring harness and gauge are fine, the gauge should read the [table values](#) after you reconnect the battery and turn the key to KPII. If you can't obtain a reading, suspect your gauge or your wiring from the gauge to the testedconnector is at fault. See the [gauge fault diagnosis](#) in the FAQ)

If the gauge and panel wiring harness are fine, then your fault lies in the sender or the wiring from the sender to the tested connector. To test the sender, use a multimeter One capable of reading small scales like 1-250 ohms is best. Measure the ohms between the two wire connectors (brown and grey/white) at the rear trunk connector . If the sending unit is working you should get a reading between 2 and 131. If you get no reading or infinity then there is a problem with the contacts inside the unit and you'll have to pull it.

Diagnosing and repairing the damaged nickle-plated contact in the sending unit is discussed below.

Pulling the Unit. [Pull](#) the whole sending unit. Once you have the unit pulled, drained of gasoline and dry, turn the unit over to be sure that the slide moves easily (you can hear the float inside the float canister sliding from top to bottom). If it doesn't then your problem is inside the canister (see "repairing the sending unit"). If it does move easily, you may not need to crack it open.

Break out your multimeter and measure the resistance again by touching your probes to the coils that stick out of the top of the float canister (hint: the two grey-white wires are soldered to them). Be sure you move the float up and down by

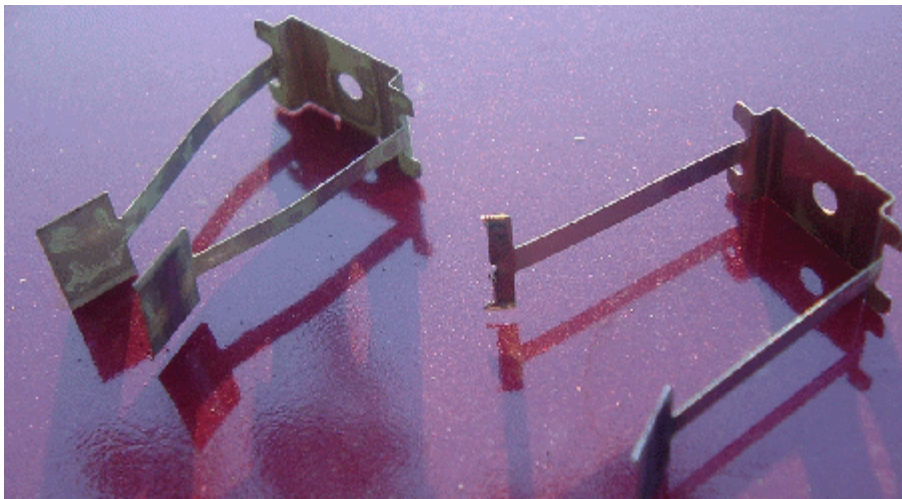
turning it over and measuring it with the float at EACH end of the canister! If the coils and resistor contacts are fine you should get a resistance reading of around 2 at the top (full) and around 100+ at the bottom (empty). If you get a reading here, then you can assume that your grey/white wires are the problem. To check these wires, de-solder (or cut) the wires free from the coils (I marked one with a sharpie so that I could put them back if needed). After they are free, connect them to each other (twist or clamp) and measure the resistance at the plug-end of the connector. If the wires are fine, you should get a 0 Ohm reading. If not, then you'll need to replace the wires (good luck).

If the wires are fine, and the sending unit float is giving you proper resistance, then you can be fairly sure that the fault lies at the solder point.

The Repair. Clean up the wires and re-solder them to the coils. Be sure that you can get resistance at the plug end of the wiring. This worked for me. Although I'm not sure if it will hold up, I went ahead and installed some shrink tubing over the connectors as an added level of protection. If you can now get the proper resistance from the sender apparatus at the plug, you are in good shape.

Float Sender Contact Repair. [Mike] You can have a problem with the windings that the float rides on where the rods that have the wire around are corroded inside the plastic shield and no continuity will be measured because of this. I managed to build one good sender from two 95 940 junkyard units and the one in my 94 940. The 95 940 sender is a little different than the 94 940 but can be modified as the 94 has the two pump system and the 95 has one. The lower picture below shows the usual suspect: the small nickel metal part that rides up and down with the float that contacts the rods with the wires spun around them. It just plain wears out. Time consuming but it appears I was





victorious.

Final Testing. Head back to your car and plug the sending unit into the harness (DO NOT put it in the fuel tank yet!!). Reconnect your battery and turn the key to KPII - BE CAREFUL!, when you turn the key, the pump should fire up and could make the unit jump, possibly falling and damaging it!!! It may take a few seconds for your gauge to respond to the repaired sender - particularly if it's been at "E" for a long time, but you should be able to turn the sender so that the float "falls" to the top, this should make your gauge rise to "Full" (eventually). Be sure you let it fall to bottom and be sure that your "low fuel" light comes on. Repeat to verify your repair. If all goes well, you may have just saved yourself \$500.00 in parts and more in labor!!! Hint: don't run the pump longer than necessary since it is cooled by gasoline in the tank.

Reinstall. [Replace](#) the sender unit/pump in your fuel tank (easier to get into the tank, but harder to get that rubber seal and locking ring on) It's not fun, but think of all the money you just saved!

Fuel Main Pump Problems and Replacement - Why Do Fuel Pumps Fail?

[Tips from Counterman Magazine, August 2001] What causes electric fuel pumps to fail? Electric fuel pumps can fail for any number of reasons:

- Loss of current or low voltage - The pump can't run without electricity, so anything that prevents current or voltage from reaching the pump will make it stop. This includes corroded, loose or broken wiring.
- Dirt - Dirt, sediment or other debris in the tank can clog the pickup strainer, accelerate pump wear, damage the pump and/or cause the pump's check valve to stick open (which can cause a hard starting condition due to loss of pressure when the engine is shut off). When dirt has caused a pump failure, or if there appears to be a lot of dirt or sediment in the tank, the tank should be thoroughly cleaned to prevent a repeat failure.
- Rust - Corrosion inside the tank produces rust, which can flake off and plug up the pickup strainer and have the same damaging effects on the pump as dirt. Rust is caused by condensation, which occurs during cool, humid weather when the fuel tank is low. Keeping the tank full will minimize the formation of condensation. If the tank is badly rusted or leaking, it should also be replaced.
- Wear - Most pumps are capable of going 100,000 miles or more, but depend

on lubrication and cooling provided by the fuel itself. Frequent driving with a low fuel level may occasionally starve the pump for lubrication and cooling, which can lead to accelerated wear or even pump damage. If a vehicle experiences a momentary hesitation when cornering, for example, it may be because the fuel is sloshing away from the pump and allowing it to suck air. Wear can also be caused by running at excessive pressure. A faulty regulator, check valve or crimped line can cause blockages that force the pump to run at a higher-than-normal pressure - so too can a clogged fuel filter. If the underlying problem is not diagnosed and corrected, it can cause the replacement pump to fail prematurely as well. Regina-equipped cars with the Bendix fuel system and the single AC in-tank fuel pump tend to fail before 100k miles.

- [Noise](#) may sometimes be an indication of excessive pump wear. Noise can also be caused by a failing fuel [pre-pump](#) inside the tank. For proper engine performance, the pump must be able to deliver the specified fuel pressure and volume of fuel for the application. If it can't, the pump needs to be replaced

Symptoms of failing main fuel pump.

Symptoms that may indicate low fuel pressure include hard starting, rough idle, hesitation, stumbling, loss of high-speed power, lean misfire (which may set an OBD trouble code) or pinging/knock due to low fuel pressure. These same symptoms, though, can also be caused by a defective [fuel pressure regulator](#), a plugged [fuel filter](#), [dirty fuel injectors](#), a restriction in the fuel supply line, a leaky pump [check valve](#), or a dirty [filter sock](#) in the tank. If the main pump runs continuously when your ignition is at KPII, then your fuel pressure regulator or in-tank pump has a fault since pressure is not building up.



[Fuel pressure](#) can be checked by connecting a gauge to the Schraeder valve service port on the fuel rail (later B230F) or teed into the fuel supply line at the fuel rail (earlier B230F). If an engine has no fuel pressure (cranks, but won't start), and there is no pump noise, the pump may not be receiving voltage from the [fuel injection relay](#). There may also be a problem in the wiring to the pump, the pump ground or an open inertia safety switch.

Diagnosis:

- Check for a spark using a spark plug wire and a paperclip near ground. If you have a spark, then your fuel injection system is a candidate for further investigation. If not, then your ignition system is at fault.
- Next, you could replace (or use a spare) the fuel pump relay. Normally, when you switch on the ignition, but just before you actually crank it over, you should hear the fuel pump working, (a faint whine) then it stops (i.e. it is priming the system to pressure) If you hear nothing at all, then the relay could be bad (it is a green bastard stuck in the row of relays (usually top left as you look at it) behind the ash tray. You should remove the little shelf panel to get at it.
- Another thing you can do is undo slightly one of the unions in the fuel distributor, using a 12 (or 13mm) mm ring spanner. Normally, undoing one of these, there will be a spurt of fuel. If there is nothing, you have no fuel

pressure.

- So far it could be the relay or the main pump. You could buy a new relay, slot it in and the car should go. If not, then it is your main fuel pump (or pump wiring, but that is less likely, as the connections to the pump are very solid and durable) You could disconnect the pump wires (you can do this without removing it completely) and get someone to crank while you test voltage across the connectors.
- You can also test current draw at the respective fuse using a DVM when the car is started. The main Bosch pump (all B23X engines) should draw around 6.5 amps; those engines equipped with Regina systems should draw 8.8 amps. The pre-pump should draw around 3-4 amps (non-turbo), 5.5 amps (turbo), 1.4 amps (auxiliary reserve tank only). B6300 engine fuel pumps should draw 6.5 amps through 1994; 8.5 amps thereafter. Too much draw indicates an overworked and about-to-fail pump, or a main pump operating without a pre-pump (which would have zero draw).
- If you have an old relay, you can remove the electricals and solder a large wire between terminals 30 and 87/2. As soon as you put it in (even without the ignition on) the main fuel pump should start to run and keep running and car should start. If nothing happens, then your main pump is well dead. Don't forget to remove the relay and chuck it, or mark on it what you did to it as it would be really dangerous to use otherwise. It is a strictly 'get you home' or diagnostic.
- So it's your main fuel pump. The tank pre-pump can be dead (or dying) and the motor will still run if you have more than half a tank of fuel. Get a new one if you can, or a scrap one from a yard, but test it before you buy it. Order the piece of fuel line from the accumulator to beginning or main engine line from Volvo.

Changing the Main Under-Car Fuel Pump (Bosch LH Systems):

- **Note: If you have a Regina fuel injection system or a later 940 with a single Bosch in-tank pump, then your [pump is inside the tank](#) mounted to the fuel sender unit.**
- See the instructions for [changing the fuel filter](#) above for tool needs. It helps in the future to use anti-seize on all bolts and a little dab on the banjo bolts entering the fuel filter.
- Disconnect battery negative.
- Clamp off the front and rear fuel lines using hose clamps. Disconnect both fuel lines to the pump. The tank-to-pump line has a screw clamp; the pump-to-filter line requires a 17mm wrench with a backup wrench. This short line is fragile, so don't bend or stress it. Disconnect the filter-to-engine line as above.
- Disconnect the electrical lines by squeezing the connector tangs.
- Drop the cradle holding the pump and filter.
- Remove the fuel filter. Note orientation of filter: flow is toward the rear.
- Turn it over and loosen the bolt securing the filter clamp to the cradle. Remove the filter clamp.
- Clean out the usually rusted Torx screw in the pump clamp and loosen the clamp.
- Replace the pump. The threaded end goes toward the front.
- Replace the filter clamp and filter.

- Reconnect the pump-to-filter short connector, being careful not to bend it. Use a backup wrench.
- Install cradle and reconnect the fuel lines.
- Reconnect the electrical lines. Black goes to the black pump terminal.
- Test for leakage.

If you have a one-pump later Bosch or Regina system, see [Fuel Sender and In-Tank Pump Replacement](#) above.

Gas Cap. [Editor] While aftermarket replacement caps from Stant et al may be had almost anywhere, the OEM cap can be purchased from [EEuroParts](#) for about \$8.

Fuel Tank Fill Hose Failure. If your car experiences gasoline smells after fillup and occasional leakage at the tank, see the [FAQ section](#) for information about fuel tank fill hose failures. This section deals with 960/90 cars but the advice applies to 740 and 940s as well.

B230K BiFuel Engine Ticking Sound: Fuel Pump. [Tips from Jaap Keyman] I posted on problems with my 740 estate 1987 B230K BiFuel (mainly LPG driven, carburettor type here in the Old World!): intermittent ticking noise, not from inside the engine, to be heard clearly inside the car, significantly less outside, fix relation to engine rpm, no difference when driving or static, no difference whether clutch depressed or not. The experiments done included replacing belts, checking exhaust shields and components and other extensive checks. Still the ticking noise remained intermittently present. I thought to have done everything, but finally after staring at the block..... I NOTICED THAT I FORGOT ABOUT THE MECHANICAL FUEL PUMP! This, together with the Pierburg carburettor is apparently not present in any US model 700, so does not show up in any publication on this board. Well, taking the pump away (I can drive on the second fuel) and putting a plate on the hole in the block, cleared the issue fully. Throughout its life this car may have driven only 1000mls on regular gas and the rest on Liquefied Petrol Gas, so the pump may have suffered in some way; or an issue may be in the fuel tank (hose rotten)causing standing waves in the fuel lines, which generate contact noise to the car body. Anyhow, long story, but hopeful interesting for those with mechanical pumps.

Fuel Tank. Replacement of Tank Straps: [Contributions added by Dave Mather] The 940 fuel tank sits ahead of the rear axle on two cradles that support it front and rear. The straps, or what Volvo refers to as 'tensioners', stretch length-wise, front-to-back, between the two cradles. One of my tensioners rusted and snapped (after 14 years and 350k miles) and I was alarmed the tank could fall while I drove. I guess there is always that risk, but when I examined the set-up while I replaced the tensioners I felt the engineers did an admiral job insuring the safety and integrity of the tank support. Now that I think about it, this is an integral part to the safety of the car. For 740 cars, the bracket is different: see note and photos below.

I ordered both tensioning straps from the dealer and they were US\$20 each. These are simple straps of metal that are

heavily painted in black. To replace the straps I used a 13mm extended socket and 6" extension off the ratchet, a set of sturdy ramps, a floor jack to support the tank and a 2" x 8" x 24" piece of lumber. It's a good idea to have some spray undercoating on hand to touch up the areas when you finish.



- Back the car up onto the ramps or use jack stands. Follow the utmost caution and take all precautions to insure your safety while you work under the car. Also remember you are working with gasoline. If you don't know what this means, don't start this project. The tank was relatively empty when I did this and this helps when you support the weight from below.
- Soak all exposed bolts with your favourite rust buster. (2 on the straps at the rear of the tank, and the four 10mm bolts on the plastic deflector strip at the front of the tank.)
- Begin by removing the four 10mm bolts holding the deflector strip at the front of the tank. This strip deflects debris away from the front of the tank, and shields the brake line and junction fitting running near the front of the tank. Volvo was not shy with undercoating, so this will likely have to be pried loose.
- The forward cradle or shelf holds the tensioners with 13mm bolts (under the

deflector strip) that go directly into the underside of the car. There are four bolts: two that receive the front end of the tensioner and another two that also secure the cradle to the car. There may be a brake line. Be very gentle and remove the brake line out of the way. Pry it off the plastic clips and try not to put any bends or stress on the line. The rear cradle has studs with washers and nuts. Mine were covered with undercoating and therefore not rusted badly, so easy to remove. The tensioners slip



through a slot in the forward cradle, while in the back they bolt directly to the car. The front cradle presents a problem because it's difficult to remove the old tensioner and feed in the new with the cradle attached to the car.

- While these mounting bolts are soaking, setup your support jacks, and associated lumber positioned in between the two long straps. Your goal is to support the centre of the tank, as much as possible. I used two pieces of 2x6. The front 2x6 fit as is, the rear one had to be trimmed for width, as these long straps run closer together at the back of the tank. Position the rear (narrowed to fit) 2x6 on a jack so that it projects just past the vertical edge of the tank, but not far enough that it will interfere with unbolting the straps at the rear. Position the front 2x6/jack in between the long straps, so that it

supports the remainder of the tank as far forward as practical – what you need to accommodate is that the front shelf bracket is being unbolted, and swung down to pull the ends of the old long straps out. Using 2 boards/jacks allows you to accommodate the curve of the tank, and deal with any uneven surface you are working on. Make sure that both boards are securely supporting the bottom of the tank – you can expect a SMALL amount of deflection on the front board, little or none on the rear board. Be careful not damage the tank. The tank is plastic: all you need to do is support it while the tensioners are released.



- I started in back. The nuts and washers came off, and what's left of the tensioner dropped down. The tank is firmly supported between the two cradles.
- Gently move the brake line out of the way. Double check the position and height of the front board/jack. Unbolt the 2 front straps, then the remaining 2 bolts securing the front shelf bracket. No noticeable movement of the tank should occur as these last 2 bolts are being removed.
- Remove the front shelf bracket, and pull the ends of the old straps out. Insert the correct end of the new straps into the front shelf bracket and re-install the 4 bolts, leaving them slightly loose to allow you to align the rear of the straps. Use Loctite Blue.
- Attach the new straps to the 2 bolts on the rear shelf [Note: the 740 rear strap connection is different than for the 940; see addendum below], and tighten up all 6 mounting bolts. Remove the 2 boards/jack stands.
- Install the plastic deflector strip, using the four 10mm bolts. Reapply undercoating where needed to bolts and straps.
- Do a final check that the straps and tank are aligned and sitting as they should, then lower the car and take a test drive.
- **740 Tips.** The rear strap setup is different for the 740. For the 940, the strap runs up the back side of the tank to bolt vertically to the understructure of the car. So the installation is easy: bolt up the front end, then do the back end. The bolt is long enough to get it started with ease. Tightening it up pulls the strap taut. The back setup on the 740 is different. The strap is shorter. But there is a L-bracket bolted to the understructure that runs down the side of the tank. At the end of that bracket is a horizontal bolt that faces rearward. Unless the L-bracket is loosened (ie lowered), there is no way to get the strap over that bolt when the front end of the strap is bolted. And there is no way to pull the strap forward with enough tension to bolt the front if the back is bolted first. Solution: lower the L-bracket first, bolt the front, bend the back end of the strap over the L-bracket bolt and tighten, then take up the slack by tightening (raising) the L-bracket.

Repairing Cracks in Plastic Tanks. See the [FAQ File](#) on this topic with illustrations.

Auxiliary Tank. See [Body: Accessories](#).

Fuel Pressure:

Fuel Pressure Regulator and System Pressure.

Operation of Fuel Pressure Regulator.

To provide the exact amount of fuel the engine needs under all conditions, the pressure inside the fuel lines that supply the injectors changes. When the driver steps on the gas and opens the throttle, intake vacuum drops. To deliver the same amount of fuel, pressure has to go up along with injector on time. Likewise, when the driver lets up on the gas and the vehicle decelerates, less fuel is needed to keep the engine running. Fuel pressure can drop along with injector on time. The device that makes all of this happen magically is not the fuel pump (which runs constantly and provides steady pressure to the engine), but the fuel pressure regulator. On most engines, a fuel pressure regulator is mounted on the fuel rail that supplies the injectors. Inside is a diaphragm valve connected by a rubber hose to intake vacuum. When vacuum goes up, the valve opens and allows excess pressure to vent through a return line back to the fuel tank.

Effects of FPR Failure. [Tips from Mike W.] When the fuel pressure regulator fails, it either provides full pump pressure to the injectors, resulting in an *overly rich condition* (I've had two cars do this), or *inadequate fuel pressure*, in which case the car will barely run and have no power. See Jason's note below. My experience with FPRs pressuring up and giving the engine too much fuel has been that spark plugs will be wet and/or carbon fouled, exhaust will be black and sooty, check engine light will come on, and the OBD will throw codes 113 (fault in fuel injectors) and/or 232 (fuel system compensating for rich or lean mixture at idle). Sometimes, the main fuel pump will even start squealing and get hot to the touch when running. A fairly easy test to see if the FPR is pressuring up too much requires disconnecting the fuel return line (back to the fuel tank) from the rear of the fuel rail. On my 940, this is a simple hose clamp. Be prepared for some fuel to spill. Now get several feet of rubber fuel line hose, slip it over the open end of the fuel rail, and aim it into a gasoline-safe container. Have an assistant start the car, and observe the fuel flow from the hose. You should get a strong stream of fuel, something on the order of 1/2 to 1 gallon per minute. If you get just a trickle or no fuel at all, the FPR is bad. [Tip from Mark Lundell] When you replace the FPR because of a rich burning problem, also replace the little vacuum tube and clean out the intake manifold nipple. [Jason R] If you have a Regina system and have to crank a long time on cold start to build fuel pressure, replace the FPR.



Pressure Test: Specifications.

[Jim Holst] The Volvo green manual states that the system fuel pressure for Bosch, Regina, non-turbo, and turbo 4-cylinder B2XX and 6-cylinder B6304 engines should be 43.5 +/- 1.5 psi (or 300 kPa) static pressure. The rail pressure should be 43.5 minus the vacuum tester vacuum at the regulator vacuum port. This tells if the regulator is working. Residual or shut-off pressure should drop below 29 psi

(200 kPa) in less than 20 minutes but not too quickly which could mean leaking injection and cold start valves. **Note that system components among Bosch, Regina, and Motronic are NOT the same: the part numbers and specifications differ.**

Bosch Systems:

- With engine at warm idle, FPR vac hose removed and plugged (simulating Wide Open Throttle/accelerating condition) pressure should be **43.5psi**.
- With FPR vac hose reconnected, idling fuel pressure should be about **36.5 psi**.

Regina Systems:

With engine off, the pump hot-wired at the fuel injection relay and FPR vac hose removed and plugged, pressure at the rail should be **43.5 psi**. That makes it the equivalent of Wide Open Throttle, but with the FPR feeling atmospheric pressure, rather than the normal vacuum of a running engine

Procedures, Tools, and Tips.

[Symptom: Car won't start] I hooked up a fuel pressure gauge (in-line fuel pressure gauge) it'll save you from guessing on your problem as to fuel pressure and clogged lines or filter. I've got mine from Summit part #SUM-800160 (60psi) \$19.95) and found that no more than 10 psi was generated while running the fuel pump continuously, and the trickle sound got worse. I removed the vacuum hose from the fuel pressure regulator, and found a couple of drops of gas. Just as a check, I turned the fuel pump on for one more second...YEOW!! I could have burned down the whole house with the stream that shot out the front of the regulator. Conclusion: No pressure to injectors, but plenty of raw gas supplied to the intake manifold, thence to the cylinders, and finally onto the ground under the exhaust manifold. No wonder the car wouldn't start. I have a new fuel pressure regulator now.

[Tip: Smitty] Be real careful removing the vacuum line off the FPR while the engine is running. If you suspect a failed diaphragm, use your nose and eyes first to check for raw gas on the vacuum side of the reg, with the engine off. Then maybe proceed with a helper available to crank/kill the engine in case gasoline should stream out the front.

[Art Benstein] Jumper the fuel relay to operate the pump continuously (listen for the pump in the tank) using an ammeter as the jumper around the fuel relay. When it was idling and would rev well, the pump would draw over 5A. Then place a cheap stick tire gauge on the fuel rail test port. The \$2.00 pressure gauge fits well if you bring it up between the #1 and #2 runners on the intake manifold. It does emit a little fuel shower as you press it on, so take readings with the fuel pump hot-wired rather than with the motor running. And keep a fire extinguisher handy if you do this.

[Al Stensby] I found a fitting to attach a test hose to the schrader valve on the fuel rail. It is a Number 705 made by Amflo. It should be available in any industrial supply store. I purchased mine at McFadden Dale in Anaheim, Calif for \$1.58. [Jim Holst] The Volvo green manual states that the Regina system fuel pressure should

be 43.5 +/- 1.5 psi static pressure. The rail pressure should be 43.5 minus the vacuum tester vacuum at the regulator vacuum port. This tells if the regulator is working.

[Relieving Fuel Pressure When Opening FI System](#). See the link for tips on relieving system fuel pressure safely when changing a component.

Changing the FPR. [Andy Jameson] [Relieve](#) the system fuel pressure and put a rag under the area to catch what does come out.

1. Use a screwdriver to loosen the clamp holding the fuel line to the FPR.
2. Remove the two bolts holding the FPR to the fuel rail.
3. Pull the FPR out of the fuel rail; straight out toward the driver's side fender. It is just held in by an o-ring which should come out with the FPR.
4. Then pull the FPR off the fuel line by pulling it toward the front of the car.
5. Installation is the reverse, except you will use the two bolts to force the O-ring and FPR into the fuel rail. Lubricate the O-ring with a little motor oil or vaseline. Be sure to keep it straight and turn each bolt a little at a time in turn. If it gets too crooked going in, the fuel rail can bend or the O-ring can tear.

Leaking FPR Seal. The seal between the FPR and the fuel rail can fail and leak. This seal is the same as those used on the fuel injectors which in turn are identical to the seals used on the injectors for a 92 Ford F-150 V-8. The latter seals are inexpensive and easy to find.

Noisy Fuel Pump: Bad FPR. [Tip from Chris Daunhauer] My fuel pump noise (both the old one and the new one I installed) turned out to be caused by a faulty pressure regulator up at the injector rail NOT by a bad pump. Parts counter man insisted that from my description of the problem I had a bad pump in the tank. He was wrong. Bad regulator was not letting excess pressure bleed off back into the fuel tank causing external pump have to work too hard. Thanks for the 2 suggestions, guys, they were both right. The electric pump delivers about 10 times as much gas to the injectors as they need. Excess is routed back to the tank. Could have been either a clogged return to tank line or faulty regulator. In my case it was the regulator. Here's what I learned.

If the external electric fuel pump is noisy, pull the return line off the pressure regulator. Install a spare length of hose on the barb and run the other end into a can on the ground. Start the engine. Fuel should be rushing out of the hose leading into your can, even at idle. If this excess fuel that the injectors aren't using is NOT (mine was not) rushin out, there's a good chance your fuel pressure

Volvo mech said he's put pressure gauges on cars w/ stuck regulators and the needle goes off the scale.

Noisy Fuel Pump: FPR Faulty. [Tip from Jeff] I have been fighting a noisy fuel pump, rough idling, and poor performance for the past 3 months and finally solved the problem. It may not be a faulty fuel pump. In my case it was not. I replaced pump and the new one was just as noisy. I checked the in-tank pump and it worked fine. Then I disconnected the outlet or return line from fuel pressure

regulator and attached a piece of fuel line to it and stuck it in a bucket. Nothing came out with engine running. The fuel should have been gushing out. I replaced the regulator and I have a totally new car. It runs like a top with no pump noise. So before ruling out pump problems check the regulator output first it is easy and takes about 3 minutes to test.

Fuel Pressure Test Tool. See the [FAQ file](#) for a description. See also the above [notes](#) from Art Benstein, who used a tire gauge to test his system.

Failed Check Valve. [Symptom:] My '84 244GLE is equipped with B23F engine and LH Jetronic 2 fuel injection, she doesn't want to start (read run) the first time -though cranks fine- when it has been sitting at least 6 hours. The car will start without hesitation on the second try. [Diagnosis:] It sounds like a classic case of failed fuel pump check valve, on the main pump under the car, left side, beneath the driver's seat (in LHD cars). The check valve keeps the fuel rail under pressure after shutting down. Under pressure the fuel cannot vaporize and cause a vapor lock.



This will usually only happen under very hot conditions. On fuel injected cars vapor in the line would only delay a start, not prevent it. The check valve also allows fuel pressure to build faster resulting in faster starts. They cost about \$14 at the dealer and are fairly easy to install. Just go buy one at the dealer and they'll show you in the parts book where it goes.

[Volvo Maintenance FAQ for 7xx/9xx/90 Cars](#)
