

Fuel Transfer Pumps Revisited

The following article is from Issue 56 of the Turbo Diesel Register. It was written in May of '07 by TDR Editor Robert Patton.

As the deadline for Issue 56 was fast approaching, I called TDR writer Jim Anderson. Jim is the point guy for miscellaneous e-mail and phone inquiries that come into the TDR. I asked, "Hey Jim, what's on the minds of those that you are corresponding with?" His response, "It seems that problems with the Third Generation trucks vary. There is not a common complaint that needs to be addressed." This is good news for the Third Generation crowd.

Jim continued, "However, with the used truck purchase of '98.5-'02 vehicles the education about fuel transfer pumps is an endless task." I responded, "Ouch, I know what you mean. Perhaps I should emulate the country music singer David Allen Coe's efforts to write the perfect country music song by writing the perfect transfer pump article." Jim responded, "Keep it simple, try the catch phrase from the Millionaire show 'Is that your final answer?'"

Thus, I present the final-answer, perfect transfer pump article. While the article focuses on the '98.5-'02 owners, this collection of TDR oldies also has tips for '94-'98 12-valve owners and '03-'07 HPCR owners. The information was pulled from our Issue 32, 48, and 50 magazines. Updates have been added to reflect the latest part number information.

Then, to add a final crescendo to the article, I'll share with you a story that will be of interest to 300,000+ owners of '03 and '04.5 HPCR owners.

Below is an outline of the topics that will be covered.

- '98.5-'02 trucks, correct fuel pressure
- '94-'98 12-valve, fuel transfer pump replacement
- '98.5-'02 24-valve, fuel transfer pump replacement
- Fuel pressure gauges and opinions
- '98.5-'02 24-valve, fuel transfer pump relocation kit
- '98.5-'02 24-valve, what to do
- '03-'04.5 HPCR, what to do
- '05 to current HPCR, what to do

Here we go...

CORRECT FUEL PRESSURE— '98.5-'02 TRUCKS

In May of 2001 there was a great deal of concern about fuel transfer pump delivery pressures. The problem first surfaced as a result of a production batch of inadequate transfer pumps and the resulting product recall. Hand-in-hand with the recall was the increasing number of warranty claims. (When the article was written the early '98.5 engines were 2.5 years old.) The problems were aggravated by those that hot-rod their trucks as well as purchase fuel system accessories that add restriction to the system. The bottom line is that the 24-valve's Bosch VP44 electronic fuel delivery pump needs to see at least 5-6psi of pressure from

the fuel transfer pump. Less than 5-6psi (more is better) and there is a danger of "overheating" the VP44 pump for it uses fuel to cool and lubricate its internal parts.

In the photo, note that the Editor's truck (a '99 model) is outfitted with two gauges—one is a mechanical, liquid-filled gauge and the other is a Westach electrical gauge with a pressure sending-unit mounted to the filter head assembly.

In order to install a gauge, the '98 and '99 24-valve engines have a filter head with easily accessible 1/8 NPT fittings. On the 2000 and up trucks the service design team at Cummins was mindful of the need to test the fuel transfer pump's delivery pressure. Thus, your truck is equipped with a "banjo adapter with a Schrader valve assembly." Say what? For clarification let's look at a photo and a description.

On the inside, the part with the rifled opening attaches the fuel line to the fuel pump. On the outside, the Schrader valve (think A/C valve or, better yet, a tire valve) has a press-for-pressure needle. Here is the catch, you can take the pressure needle out of the Schrader valve.

What Pressure Should I See?

The readings that I am seeing on the gauge:

- 13-14 psi at idle
- 12 psi @ 2000 rpm – no load
- 11 psi @ 3000 rpm – no load
- 10 psi @ 3500 rpm – no load
- 10 psi @ various rpm – 10 psi boost
- 8 psi @ various rpm – 20 psi boost
- 3 psi @ various rpm – 30 psi boost *

*From the readings at idle and at various rpm with a load (and a resulting boost reading that is at stock truck/20 psi or below levels), the gauge checks out okay. As I push the performance envelope with my hot-rodged engine (i.e. the 30 psi boost reading), the fuel pump is marginal.

Does the fuel pump meet the stock specifications? Yes. Is it ideal for my truck's hot-rodged performance? Good question.

In discussions with other hot-rod owners I find that the old adage, "I am my own warranty station" once again proves correct. As you increase the output power of the engine from its design, the hot-rodder has to look at upgrading other components. Discussions with other owners have uncovered various solutions to the low pressure at high performance blues: drilled out banjo bolts for better fuel flow, bigger fuel lines, different fuel pumps, different pump locations. The saga will continue.

FROM ISSUE 40: '94 to '98 12-VALVE FUEL TRANSFER PUMP REPLACEMENT

by Brandon Parks

I did not think fuel transfer pumps on 12-valve engines were a problem. I recall reading the "Backfire" column in Issue 39, where the editor states, "The old 12-valve engines used a mechanical fuel pump (the type driven off the engine's camshaft) which is essentially problem free." Nevertheless, as I started to read more about the transfer pump for 12-valve engines on the TDR website, it became obvious that there are many instances of pump failure. Is this something that we 12-valve owners should be watching out for?

Warning Signs

The first sign suggesting that my pump might be failing was very hard startups in the morning. Then I noticed that the idle rpm was slowly getting lower and when driving the truck it had lost its pep. Finally, the truck just wouldn't start. After running a fuel pressure test to determine the problem, I concluded that it was the fuel lift pump. You can purchase a new lift pump from a Cummins distributor for around \$170.00 (part number 3936316; gaskets, 3939258 at \$1.68).

Replacement

Following the procedure in the Service Manual, the first step is to disconnect the battery terminals. The instructions read to remove the starter motor (Remove the starter . . . there has to be a better way.), place a drain pan below the pump, remove the fuel line fittings at the top of the fuel pump, and fuel heater housing. Next, remove the fuel hose clamps and rubber fuel hose. (You can leave them connected and remove after you have removed the fuel pump and fuel heater.) Remove the two mounting bolts. Remove the fuel pump and fuel heater as one unit. Be careful not to allow the plunger to catch on the edge of the hole in the cylinder block and drop into the engine. As intimidating as this sounds, you would have to try to do this, as the plunger has to be pulled from its bore. Simple enough?



Carter lift pump with plunger removed.

Helpful Hints

Instead of removing the starter motor, I decided to get really acquainted with my engine and come in from the top of the engine compartment. This appeared easier than trying to work around the front differential to remove the heavy, bulky and greasy starter. The only problem is that when you try to reinstall your fuel pump and fuel heater unit you cannot push the pump back into place because your arms are not long enough to get any leverage to push the plunger against the camshaft. This is the voice of experience (and about an hour of labor and an evening in the easy-chair thinking about the problem) speaking to my fellow TDR members. Learn from my situation that there is a simple solution, thus making the top-removal a practical service technique.



Carter lift pump with regular mounting bolt and longer temporary bolt.

Here is the secret: When you remove the fuel lift pump, take one of the two mounting bolts and find a replacement that is the same metric thread size but about $\frac{3}{4}$ " longer. You probably have one in your parts box or you can borrow one from elsewhere on the engine. When reinstalling your lift pump use the longer bolt as your starter bolt. Once you get the lift pump and fuel heater partially tightened down, install one of the original bolts in the other hole. Once it is partially tightened, remove the longer bolt and replace it with the other original bolt. Tighten the two bolts to 18 ft-lbs torque. (Tighten the two bolts alternately to prevent damage to the fuel pump housing.) I thought this was the easier and less time consuming way than removing the starter and trying to be a contortionist by working my way around the front differential.

Next step, bleed air from the fuel system. Begin by loosening either (doesn't matter which) of the two 10mm bolts on top of the fuel filter housing. This will allow the air to escape as you prime the system. When priming the fuel system, begin by pushing the primer button a few hundred times and when you finally feel like your thumb is about to fall off, do it a few hundred more times. Seriously, don't use your finger to push the primer button. My favorite tool for this job is a jack handle (from one of those cheap automotive two-

ton jacks) that has a slot in the center of the open-ended pipe. Another method that's been used at Geno's Garage is using an old broom handle to push the primer button. I decided to make my broom handle a little easier to use by taking a $\frac{3}{4}$ " PVC coupling and sliding it on the end of the broom handle and drilling a hole about a $\frac{1}{8}$ " below the top ridge and installing a bolt in it. This is to help prevent the rubber boot from tearing. This will always come in handy when you have to prime the fuel system. When you hear the fuel hit the pump, try starting your truck.



Broom handle, $\frac{3}{4}$ " coupling with hole drilled and bolt.



Broom handle assembled.



Overall, it was a fairly easy installation. Skill level: give it a five on the 1 to 10 scale—make that a three, you know the shortcuts. Using the longer bolt and the broom handle made it much easier.

Brandon Parks
Geno's Garage

FROM ISSUE 34: '98.5 to '02, 24-VALVE FUEL TRANSFER PUMP REPLACEMENT

by Robert Patton

In two previous Issues of the TDR we've followed the editor's difficulties with his 24-valve engine (self-inflicted VP-44 fuel injection pump failure—Issue 30, page 36; marginal fuel transfer pump performance—Issue 32, page 39). In this issue we continue the saga with the replacement of the fuel transfer pump.

Hindsight is 20/20. With the marginal performance of the fuel transfer pump I should not have installed the performance module and then drag raced the truck. The Bosch VP44 fuel injection pump needs fuel for lubrication and for cooling. With its acknowledged marginal performance, would the VP44 fuel injection pump fail? "As you increase the power output of the engine from its intended design, the hot-rodder has to look at upgrading other components." This hot-rodder should have looked closely at this fuel transfer pump's performance, as I knew it wasn't up to par. The VP-44 bit the dust, leaving me stranded at the drag strip.

Fuel Transfer Pump Failure

After the installation of a Westach fuel pressure gauge, the fuel transfer pump on my truck would only give a reading of 3 psi. Having earned the degree of "shadetree mechanic," I first looked at my workmanship with the gauge for the cause of the problem. As a test bed for products sold at Geno's Garage, the truck is equipped with two fuel pressure gauges—one reading fuel pressure prior to the fuel filter, the other reading fuel pressure after the fuel filter. Yes, they both showed 3 psi. I swapped the sensor leads and even tried a replacement sensor to see if the problem was with my workmanship. The reading was still 3 psi.

Convinced that the transfer pump was the problem, I ordered a fuel transfer pump from Cummins. Likely this could have been covered under the engine's warranty, but I did not have time to spare. The latest Cummins part number is 3990082 (the part numbers have been changing with much frequency). The cost, \$160. The 3990082 kit includes a wiring pigtail to allow the pump to be used in all 24-valve applications. I also ordered four fuel line, banjo bolt gaskets, part number 3963983 at approximately \$1.00 each.

Before examining the illustrations of the transfer pump, let's refer to the Dodge Service Manual for their pump removal instructions. When I read Step (3): remove starter motor, I knew two things. One – I don't have a service bay with a hydraulic lift allowing access to the starter motor and transfer pump from underneath. Two – I would not be doing the job as outlined in the Service Manual.

Sounds like an opportunity to rewrite the manual. Can this job be accomplished from above? You bet, and it is not as difficult as one might imagine. Follow the pictorial for tips on how to do it.

Step (1): This step is not pictured, but it involves the common sense recommendation of disconnecting and pushing the oil dipstick tube and other related cables and wires out of the way of my access-from-above service location.

Step (2): Remove the fuel supply line from the transfer pump. From the bench-picture you can see the two, blue quick-connects that you push in to release the fuel supply line.



Pinch the blue disconnect and the fuel line will come loose.

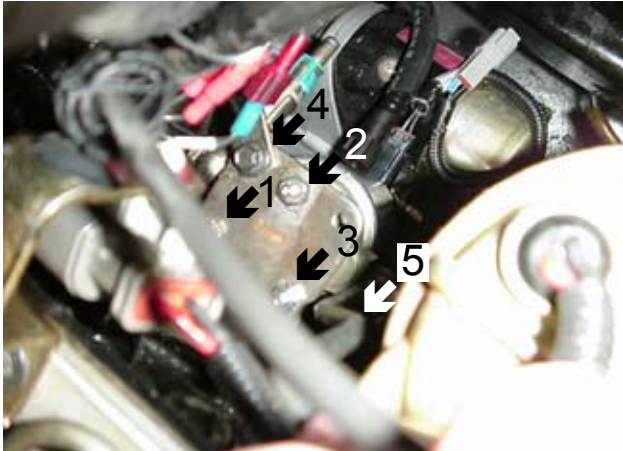


The fuel line to the transfer pump and the fuel line that goes to the fuel tank are pictured here.

Step (3): Disconnect the transfer pump's wiring harness.

Step (4): Disconnect the supply-to-filter assembly fuel line from the transfer pump. A 17 mm "stubby" wrench works wonders for the removal of the banjo bolt holding the fuel line to the transfer pump.

Step (5): Loosen the three 15mm nuts that hold the transfer pump to the bracket. Remove the 10mm bolt that positions the fuel line to the bracket. Remove the 15mm nuts that you previously loosened and remove the transfer pump.



The three 15mm nuts that hold the fuel transfer pump in place (1-3) and 10 mm bolt holding the fuel line (4). Arrow 5 points to a fuel line that you have to remove with a 17 mm stubby wrench.

Step (6): Remove the supply-from-tank fuel line from the old transfer pump and reinstall loosely on to the new transfer pump.

Step (7): Reinstall the new transfer pump. Reconnect wiring harness and the fuel lines—the torque specification for the banjo bolts is 18 ft-lbs. Reconnect the supply line from the tank by pushing the line into the quick connect fittings. Listen for the fittings to click.

Step (8): Purge air from the fuel system (easier said than done). This can be a long and arduous experience. Turn the key to start the engine (that is, briefly turn the engine over). Let the key come back to run. Leave the key in the run position and listen for the fuel pump to operate. It should run for 25 seconds. Repeat this procedure at least four times before trying to start the engine. Continue until the air is purged from the system. It is normal for the engine to sputter and cough.

Step (9): Engine cranks? You're finished.

Robert Patton
TDR Editor

FUEL PRESSURE GAUGES AND OPINIONS

by Robert Patton

Let's continue and discuss fuel pressure, fuel pressure gauges and opinions. To start let's look to Webster's dictionary for a definition.

Webster's: opinion *n.* 1. A brief, conclusion or judgment not substantiated by proof. 2. An evaluation based on special knowledge.

The TDR offices are only 20 steps away from the accessory business of Geno's Garage. The Geno's phone rings and the voice on the intercom asks for assistance, "Can someone help the customer on line one with a fuel pressure gauge question?" Should the Geno's staff offer an opinion based on Webster's first definition or Webster's second definition?

Future success in business dictates that definition 2 be used. As I've overheard the dialogue so many times, the exchange goes something like this:

GG: What year model truck do you own?

Customer: It's a truck (pick your year '98.5 to '02) with a 24-valve engine. I've heard opinions that I need a fuel pressure gauge. What do you think?

GG: Yours is a 24-valve engine—yes, you need to monitor the fuel pressure. We've got gauges and accessories in stock that will make installing the gauge an easy project.

Customer: Okay, what do you suggest and how do I install a gauge?

GG: Do you want the long story or the short story?

Customer: I've got time.

GG. Here goes... The 24-valve engine's VP-44 fuel injection pump relies on fuel from the transfer pump to keep the VP-44's internal parts lubricated and cool. A bad fuel transfer pump (and the transfer pump is known to be problematic) means a loss of fuel pressure to the VP-44 and often leads to the demise of the very expensive VP-44 injection pump. A fuel pressure gauge for a 24-valve engine is mandatory.

As for the installation, you will be dealing with fuel, albeit less volatile diesel fuel. Nonetheless, you want to minimize the possibility of fuel leakage. On the '98.5 and '99 trucks the filter is in a housing and the housing drops down from a horizontal filter bracket. On top of the bracket are two ports that are tapped and plugged with a 1/8 NPT plug. The innermost plug is the clean side of the filter. Remove the innermost plug and install an electric Westach fuel pressure sending unit. Because the Westach fuel pressure gauge does not always match other gauges that owners have installed, the gauge can be mounted at the bottom of the kick-panel in a rubber donut mounting kit. This keeps the gauge hidden and unnoticed. Because the Westach gauge is electric, the chance of fuel leakage is minimized. There are no fuel isolators to malfunction, and therefore no fluid

can leak into the cab. The Westach gauge is also the least expensive and least prone to give the customer a problem. Low cost and dependability—an unbeatable combination.

For the '00 to '02 trucks the fuel filter assembly was changed to make fuel filter changes easier to perform. To change the fuel filter one simply removes a plastic cap and the filter comes out of its housing. For those wanting to install a fuel pressure gauge this presents a problem, as tapping into the fuel system is no longer as easy as removing a 1/8 NPT plug. The first solution that we offered called for replacing one of the fuel system banjo bolts with a bolt that was drilled and tapped to accept a 1/8 NPT pressure sending unit. Unfortunately, none of the banjo fittings are located in a vertical position. Common sense dictated that mounting a 6-ounce sending unit that is on an angle into a fragile banjo bolt on an engine that vibrates is not a good idea.

At first we suggested that customers purchase a 1/8" NPT hydraulic "whip hose" for a grease gun and use the hose to plumb from a tapped banjo bolt to a mounting point for their Westach pressure sending unit.

As the technique evolved, TDR member John Holmes developed a hose that would screw onto the Schraeder-valve, test port and also screw onto the 1/8 NPT male Westach pressure sending unit. After several generations of hoses, the Geno's group now offers a universal hose kit to access the fuel system's pressure.

Customer: Wow, that's a story! It is now easy to understand the answer for 24-valve customers.

GG: For '98.5 and '99 owners all that is needed is the Westach electronic fuel pressure gauge and an acceptable gauge mount. The '00 to '02 owners should purchase a universal fuel line, a Westach gauge and an acceptable gauge mount.

Customer: Do you have any suggestions about transfer pump replacement for the '98.5 to '02 owners?

GG: Okay, this is another of our favorite topics. Many TDR members have added aftermarket fuel pumps to work in tandem with or in lieu of the existing factory pump. The drawback to any aftermarket accessory is that the owner is now responsible for installation of the product, special parts and tools to support the installation, and parts necessary should the new-and-improved accessory fail.

Admittedly, the original fuel transfer pump has been problematic. However, before I would recommend going the aftermarket route, I would suggest the keep-it-simple-stupid solution. Purchase a spare Cummins transfer pump. Yes, the part number has been superseded numerous times (the final kit number: 3990082). The current price at a Cummins distributor is \$160. Next, read (and copy?) and understand the previous article showing how to replace the fuel transfer pump. By using the factory parts you'll not have to worry about special aftermarket parts that may not be available to complete the repair when the truck breaks down.

Better yet, consider the '98.5-'02 transfer pump relocation kit from Vulcan Performance and Geno's Garage that allows you to change-out the transfer pump in five-minutes or less. (Read more about this kit on page 72.)

Customer: What should I tell my friend with the '03 and newer HPCR engine?

GG: The HPCR fuel system is entirely different. First and foremost, the fuel transfer pump is of a different design than the fuel transfer pump on the 24-valve engine. Although we are early in the '03 and '04 engine's life cycle, there are not reports of widespread problems with this newly-designed transfer pump. For '05, the transfer pump has been moved to a unit located in the fuel tank where the pump pushes fuel to the engine rather than pulling fuel from the tank. On the HPCR engine, the fuel is pressurized by a gear pump and loss of fuel pressure from the transfer pump does not equal an expensive fuel injection system failure. The gear pump is not fully capable of pulling fuel from the tank, so should a transfer pump fail, the worst scenario is that the truck does not start due to loss of fuel prime. Should you spend money on a gauge to tell you that the truck is not starting?

Customer: Is there enough pressure to support higher horsepower settings with the '03-'07's fuel transfer pump?

GG: In Issue 47, page 60, "Technical Topics" authors Doug Leno and Joe Donnelly had this to say about the HPCR fuel system: "It is not the purpose of this article to repeat the multitude of experiments showing the limitations of the stock lift pump and low pressure fuel system. This series of tests was done simply to validate that the stock fuel system is sufficient for power enhancements delivered by the boxes we tested (100 horsepower and below). We found no stumbling, hesitation, or other performance problems using any of the tested boxes; the power was smooth and predictable. As for actually measuring low-side fuel pressure, we hooked up the boost channel of the SPA Technique EGT/boost gauge to an SPA pressure sender on the Bosch CP3 fuel pump inlet. For the most aggressive power increase we tested, the low-side fuel pressure dipped to a value that is nominally equal to atmospheric pressure (gauge pressure read zero). This means that the low pressure fuel system is at the limit of its capacity, and from this we concluded that for the power levels tested, the low-pressure fuel system was sufficient, although barely so. Zero gauge pressure simply means that the CP3 inlet is not drawing (or pulling) fuel under vacuum."

Okay, should you spend money on a gauge to tell you that the truck is not starting? Will you be increasing the engine's output by a number larger than 100 horsepower? I can't answer these questions for you. I can suggest a combination of parts (a fuel cap and a Westach gauge) to make the installation on a '03 and newer truck easy to do.

Go forth and make an informed decision.

24-VALVE TRANSFER PUMP RELOCATION KIT

In August '05 TDR writer Andy Redmond wrote in to tell about a Mopar retrofit kit for the fuel transfer pump used on '98.5 to '04.5 Turbo Diesel pickup trucks. The following are the highlights from Andy's e-mail. At the conclusion of his discussion I'll offer my opinion of the kit.

Robert, here are the highlights on the Mopar fuel transfer pump retrofit kit (05175538AA) with instruction sheet K6855481.

- The kit retrofits all '98.5-'02 Turbo Diesels. These trucks were equipped with a Carter electric fuel transfer pump. The kit includes all parts necessary to convert to a tank module mounted pump, very similar to the design on '05-up Turbo Diesels. Major items include a new fuel tank module, electrical harness, fasteners and fuel connection hardware and supplies.

A similar kit is also available for the '03-'04.5 Turbo Diesels that currently use a fuel transfer pump mounted on the rear of the fuel filter housing.

- It's best to order by VIN because slightly different modules fit different size fuel tanks (which can vary about 1-2 gallons on some models).
- Reason for retrofit: As the readers are aware, the infamous electric transfer lift pump design has been problematic and unreliable at best. The controversy concerns a transfer lift pump that must lift fuel (Dodge-only application) much farther than on other ISB applications. The Dodge application requires that fuel be pulled in excess of five feet. Contrast this to a ISB-equipped Freightliner FL50 truck with a saddle tank less than three feet from the pump inlet. Additionally, many VP44 injection pumps would likely have not suffered catastrophic failure had the transfer lift pump not failed or partially failed, which starved the injection pump of fuel and fuel cooling (lubrication). The design specifications on the Carter lift pump are very close to, if not exceeding, manufacturer specifications. I guess now we know what happens when a part is pushed to its design limits!
- The kit lists for approximately \$400. It likely requires about 4-5 hours of shop rate labor to install the kit. DIY's should likely add more time.
- Reliability is unknown, but Dodge must believe the design on the '05-up Turbo Diesels to be superior to the previous design.
- A possible negative would be if a failure of the new transfer pump (now located in the tank) is experienced, the additional labor required to drain/drop the fuel tank and service the module/pump assembly could be more expensive.

I have personal experience with one retrofit so far. My friend that works in Mopar wholesale parts has a '00 model, which we diagnosed with an inoperable transfer pump. One of his

friends at the dealership, a technician, did the retrofit in a couple of hours. Another feature is greatly reduced pump operation noise before the engine is started. Unfortunately, I was unable to take photos while it was on the hoist at the dealership to show harness wiring, routing, etc.

Although I'm a proponent of the popular FASS fuel system, this would be a runner up. As long as it proves reliable, I tip my hat to Mopar!

**Andy Redmond
TDR Writer**

Now, my opinion: NO! Do not retrofit your truck. In the preceding pages we've covered the replacement of this troublesome part. My answer to the question, "Do you have any suggestion's about transfer pump replacement for the '98.5 to '02 owners?" has not changed with the announcement of the Mopar retrofit kit (05175538AA).

First let's review the prprevious correspondence from Issue 48. "Okay, this is another of my favorite topics. Many TDR members have added aftermarket fuel pumps to work in tandem with or in lieu of the existing factory pump. The drawback to any aftermarket accessory is that the owner is now responsible for installation of the product, special parts and tools to support the installation, and parts necessary should the new-and-improved accessory fail.

"Admittedly, the original fuel transfer pump has been problematic. However, before I would recommend going the aftermarket route, I would suggest the keep-it-simple-stupid solution. Purchase a spare Cummins transfer pump. Yes, the part number has been superseded numerous times (the final kit number: 3990082; a 4943048 pump and 4025182 harness). The current price at a Cummins distributor is \$180. Next, read (and copy?) and understand the previous article showing how to replace the fuel transfer pump. By using the factory parts you'll not have to worry about special aftermarket parts to complete the repair that may not be available when the truck breaks down.

"Additionally, my suggestion for all 24-valve owners is the purchase and installation of a fuel pressure gauge.

"The 24-valve engine's VP-44 fuel injection pump relies on fuel from the transfer pump to keep the VP-44's internal parts lubricated and cool. A bad fuel transfer pump (and the transfer pump is known to be problematic) means a loss of fuel pressure to the VP-44 and often leads to the demise of the very expensive VP-44 injection pump. A fuel pressure gauge for a 24-valve engine is mandatory."

Andy mentions that, "a possible negative would be if a failure of the new transfer pump, now located in the tank, is experienced the additional labor required to drain/drop the fuel tank and service the module/pump assembly could be more expensive." Change the words "could be more expensive" to "would most definitely be

more expensive.” Add to the cost factor the realization that an on-the-road failure (These failures do not happen as you’re pulling into a Dodge dealership, do they?) is now an expensive towing bill or a major time-waster even if you have the tools to swap a fuel transfer pump on the side of the road. (Yeah, right, change it on the side of the road.)

My keep-it-simple solution of having a spare lift pump will be complicated by misinformation in the field. Owners are being told that they can no longer purchase the lift pump at their Dodge dealership.

Regardless of the story from Mopar, there is good news for '98.5-'02 owners from the rest of the parts aftermarket. The staff at Geno's was solicited to purchase the “Carter (division of Federal Mogul) F74213” or “FP Diesel part number 3990105 fuel transfer pump assembly with wiring harness” from a diesel injection shop. (Interesting how the 3990105 number matches the number sold by Cummins.) Furthermore, Delphi is offering a fuel transfer pump, part number FP923 at other diesel injection shops. The Delphi, FP923 box was opened and there was not a wiring harness included in their kit. If my memory is correct, the wiring harness is needed on '98.5 to '99 trucks, as the early pumps had the harness pigtail protruding from the pump. Without the harness extension, the wires would be too short and not reach the replacement part.

So, it looks like availability of a transfer pump for '98.5-'02 will not be a problem. However, availability of a replacement pump for '03-'04.5 owners is a major problem. Page 74 has the details.

One last item to consider: the devil you know is preferable to the devil you don't know. None of the TDR audience knows how good or bad the '05 fuel transfer pump will be. There is not yet enough time on the clock. Nor do we know the symptoms of impending failure. Nor do we know the high, low, and mid-point performance (in psi) of the '05 pump. Enough said?

As a side note, Geno's Garage has chosen not to sell the fuel transfer pumps. Although it would be no fault of the retail outlet that you may purchase the pump from, the possibility of an unhappy customer was too ominous.

Robert Patton
TDR Staff

24-VALVE ('98.5-'02 OWNERS)—WHAT TO DO?

The First Step: Buy a Gauge

If you are the owner of a '98.5-'02 Dodge/Cummins Turbo Diesel truck, it is mandatory that you purchase a fuel pressure gauge. A gauge allows you to monitor the fuel transfer pump's performance and correct a small problem before it becomes a big and expensive problem—the replacement of the VP44 fuel injection pump.

Mandatory. Buy a gauge.

That is right, a gauge. Do not trust the low fuel pressure idiot lights. Your gauge will allow you to watch fuel pressure trends. A light tells you it is too late...

So, which fuel pressure gauge should you choose? From listening to the guys at Geno's Garage, they recommend the Westach fuel pressure gauge. It is an electrical gauge. It is inexpensive and easy to install. The price is about \$75 for a Westach gauge; \$200+ for Autometer. Owners of the '00-'02 trucks will need a \$19 fuel pressure line to allow you to marry a fuel pressure sending unit to the fuel system.

Alternately you can purchase a mechanical fuel pressure gauge. This design will have a pressure isolator that is mounted under the hood. The isolator is an interface that keeps diesel fuel in the engine compartment; a glycol fluid fills the capillary tube that goes through the firewall into the cab and to the back of the gauge. Mechanical gauges go from \$130 to over \$180. Because of their complexity the mechanical gauge is not recommended. Owners of the '00-'02 trucks would need a \$19 fuel pressure line to marry the fuel pressure sending capillary tube to the fuel system.

Step Two: Whose Fuel Transfer Pump

This is the \$150, \$210, \$400, or \$650 decision. Starting at \$150: Purchase a spare Cummins fuel transfer pump (part number 3990082). Monitor the fuel pressure with your gauge and become familiar with how to change the pump at its location on the engine.

Moving to \$210: Purchase a spare Cummins fuel transfer pump. Purchase a transfer pump relocation kit for \$59 (Vulcan Performance/Geno's Garage), and move the transfer pump to an easy-to-access location on the truck's frame rail.

The benefits of relocation: the transfer pump is not subjected to continual engine vibration; the transfer pump is closer to the fuel tank and operates more like a pusher pump. Should the pump fail, the pump is very easy to access.

Moving to \$400+: There are several vendors that sell performance-type fuel transfer pumps. If you've made changes to the engine that have pushed your horsepower to over 300 you've likely already added one of these pumps. TDR writer Joe Donnelly discussed the FASS system (www.dieselpmp.com) in his Issue 54 column. Other vendors: Pure Flow Technologies (www.pureflowtechnologies.com); Glacier Diesel Power (www.glaciardieselpower.com); and Vulcan Performance (www.vulcanperformance.com) offer similar pump-only kits for the '98.5-'02 trucks. Alternately you can become a fuel systems engineer and source a Holley, Carter, Walboro, etc., fuel transfer pump from a variety of automotive catalogs and retrofit a pump to your truck.

Moving to \$650+: The price tag moves to \$650+ when you take the performance-type fuel transfer pump kit as offered by the vendors above, and add to that kit a mounting block that holds one or two additional fuel filters. In the quest for clean fuel and reliable fuel pressure, this is the utmost solution.

'03-'04.5 WHAT TO DO

I have a '03 Turbo Diesel. Recently (45,000 miles) the filter-mounted fuel transfer pump stopped delivering fuel from the tank. After a lot of looking around the Dodge mechanic was able to get the replacement pump supplied by Mopar. These replacement pumps are in very short supply, which leads me to think I am not the only one with this original pump problem. Am I correct, and can you give me any information on this?

Larry Durkee

My response: Larry, wow! In Issue 50, page 108 (November '05) John Holmes reported that the '03-'04 transfer pump failures would have to be fixed using the in-tank designed fuel transfer pump. After much research I have concluded you were very lucky.

I, too, have an '03 Turbo Diesel. The warranty period has expired. Your correspondence prompted me to call my Dodge dealer to order a spare fuel transfer pump. Yes, we've all been told by Dodge and Cummins that the '03 transfer pump redesign is better than the old '98.5 to '02 pump, but I wanted to be prepared.

Guess what? John Holmes wasn't joking. You **cannot** buy the engine-mounted '03-'05 transfer pump from Dodge. The old inventory has been scrapped-out. (Believe me on this—I tried to purchase 1150 units through Geno's Garage and was told about the scrap decision just prior to press time. The part number (5093135AA) has been superseded to the "module in the fuel tank" kit 68003869AA or 68003870AA at a price of about \$375. Labor to remove the fuel tank and install the kit...I'm guessing \$400+.

No problem. With my engine serial number in hand I called my Cummins distributor. Long-story-short, same answer: you cannot purchase the engine-mounted fuel transfer pump from Cummins. Their part number 3957922 is superseded by a \$95 conversion kit that is simply the seals, washers, screws, fittings and hose that go with the relocation of a pump into the fuel tank.

The old 3957922 was priced fairly at about \$150.

Call me cheap. Call me apprehensive, but the claims that the '05 and newer pump-in-the-tank is the greatest thing since sliced bread have not been substantiated by Father Time. Call me lazy. Call me incompetent. I do not want to drop my fuel tank to install the in-tank kit.

So, where can I find the obsolete 3957922? If not the 395722, what other options do I have?

Four weeks worth of research and I was no better off than when I started. My quest was not clouded by the need for better transfer pump performance. I simply wanted a cost-effective solution to a problem that could arise. Solve the problem and provide others with a fairly priced alternative.

Sure, I could go the aftermarket transfer pump route at \$400+, or the aftermarket transfer pump with single or dual fuel filters as a part of the kit at \$650+. And, as you know, there is the factory answer that would cost about \$850.

I could recite the numerous parts supercessions. I could send you on the same wild goose chase for the transfer pump that is used in other non-Dodge B-series engine applications. But, I'll save you some time; the part is made by Airtex and the part number is 3968188. The price is \$140. At Geno's Garage we found some brackets and had it ready for release as an alternative to the aftermarket and factory answers.

Then I called Cummins to place an initial stock order. You guessed it...nationwide backorder.

At this point I was exasperated. So I called Eric at Vulcan Performance (www.vulcanperformance.com). We discussed the cheap, apprehensive, lazy and incompetent man's options to solve the '03-'04.5 transfer pump problem. We tried to formulate an answer.

We discussed an inexpensive kit to relocate the fuel pump onto the frame rail underneath the truck. We discussed many aftermarket pumps that could be used in the new frame rail location—the Cummins Airtex, the old Cummins/Federal Mogal '24-valve design, Walboro, Carter and Holley. Then we agreed that none of these fuel pumps offer the '03-'04.5 customer a proven record of performance.

As a plug-and-play option I understand that Delphi offer a replacement. The part number is FP943. Several TDR vendors offer this unit: Diesel Injection (www.dieselinjection.com) and Scheid Diesel (www.scheidiesel.com) are two locations that I am aware of. The retail price is about \$450.

I was pushed to consider the aftermarket. The installation requires hardware and fuel lines to relocate the transfer pump to the frame rail underneath the truck. Several TDR vendors and their dealers offer relocation kits and pumps in prices that range from \$400 and up depending on the pump's performance and whether or not you want additional filtration. Vendors that I am aware:

- Vulcan Performance (www.vulcanperformance.com)
- Diesel Performance Products (FASS system, www.dieselpp.com)
- Pureflow Technologies (AirDog system, www.pureflowtechnologies.com)
- Glacier Diesel Power (www.glacierdieselpower.com)

Also, there are many dealer outlets that offer these vendor kits. At this juncture the aftermarket is the cost-effective answer.

'05-'07 WHAT TO DO

Starting with the '05 model year the fuel transfer pump was relocated into the fuel tank. The overly simplistic answer to a fuel pump failure is to return to your dealership for a warranty repair.

Have you exceeded the 36,000 mile (or is it covered for 100,000 miles—I don't know) warranty period? Labor for an in-tank replacement will be expensive. the aftermarket vendors listed for your '03-'04.5 Third Generation brothers offer fuel transfer pump kits with "sippy straws" to bypass a failed in-tank unit. The price range is \$450 and up depending on the pumps performance and whether or not you want additional filtration.

Robert Patton
TDR Staff

5/2008 EPILOGUE—ATTENTION '03-'04.5 OWNERS

As you may have noted, I had hoped that the May 2007 fuel transfer pump article would be the final word on what owners would need to do to make the different year model engines bulletproof. Fortunately for the owners of '03-'04.5 trucks there is an update to their story. The article "The Ongoing Fuel Transfer pump Saga" is reprinted from TDR Issue 60, May 2008. So, '03-'04.5 owners (and there are about 300,000 of you out there) read-on.

FROM ISSUE 60: THE ONGOING FUEL TRANSFER PUMP SAGA (Or, Why Subscribe to the TDR?)

by Robert Patton

Why subscribe to the TDR? 'Cause the following can happen to you, your family, or your friends. In a time of unknown, you'll need a solution. Here is the story.

Brother-in-law purchases your used truck. Brother-in-law is in your big city and ventures downtown. Brother-in-law calls from the side of the expressway located in the less desirable side of town. The truck will not run. He has not read the TDR.

You have.

You start with the basics.

What happened? – It just quit running.

Did you just fuel-up? – Nope.

Will it restart or is it completely dead? – It will run for a few seconds then it shuts off.

Okay, open the hood and find the fuel filter. Next bump the engine over and bring the key back to the run position. Do you hear the buzz of the fuel transfer pump? – Ah, okay, I did that and no buzz noise, just some clicking noises. By-the-way, what's a fuel transfer pump?

Arrg... Obviously brother-in-law missed the 12-page article in Issue 56 about fuel transfer pumps. Since this part (which is the Achilles heel of a fine Cummins engine) can lead to a compromising and perhaps expensive engine-down situation, you'll want to have a plan of action.

Don't think that the fuel transfer pump problem won't happen to you or someone you know. As you read in the Issue 56 article, it is not likely to cause the '94-'98 owners too much trouble, as their fuel transfer pump is a mechanical unit that fails gradually.

The '98.5-'02 owners: you desperately need to have a plan of action. There were about 450,000 trucks made in this series of 4.5 years. For these owners nothing has changed in the past year. You'll want to read (reread) Issue 56.

The '03-'04.5 owners: Previously it was thought that the revised electric fuel transfer pump for these trucks was a better design than the '98.5-'02 pump. Well, brother-in-law's transfer pump lasted 115K miles.

Armed with information in the TDR (and a \$180 towing bill), the brother-in-law has some new-found options.

Postscript to the Issue 56 article, Page 74, "'03-'04.5 What to do?"

As you've previously read, the Mopar and Cummins parts networks have deleted the replacement fuel transfer pump from their inventories. Issue 56 was written in April '07. At that time the only plug-and-play option was a part number FP943 that was offered by Delphi at a retail price of about \$450.

Since that time we have found that the FP943 pump is made by one source—the same source that made the pump for Mopar and Cummins: Carter division of Federal-Mogul. I can only imagine their surprise when Mopar and Cummins scrapped-out their inventories last spring. Lots of extra inventory?

Perhaps so. The same part is not only showing up in a brown Delphi box, it is now available in a white Fel Pro box. We've closely inspected the pump and its contents. They are the same. And, available in stock.

More good news...the price has substantially dropped. How about less than \$200?

For those that want a plug-n-play option (or spare part), there is availability at several vendors. Diesel Injection, Scheid diesel and Geno's Garage are locations that I am aware of.

So, '03-'04.5 owners it is time to purchase a spare. Be ready for the inevitable!

'03-'04.5 Fuel Transfer Pump Installation

Following the well-written instructions that were in the Fel Pro "M4089602" box, the installation went on and off without a hitch. The following is a combination of the instruction sheet directive and some common-sense tips.

- Push the cables and wiring to the side of the fuel filter to make the transfer pump easier to access.
- Crawl underneath the truck and slip a heater hose (5/8" inside diameter) over the existing fuel filter drain hose.
- Open the fuel drain valve at the fuel filter housing. Drain the fuel and close the drain valve.



Extend the fuel filter drain hose to save the aggravation of having the fuel drain onto the frame which is caused by the existing short drain hose.

- Back under the truck: Locate the junction of the truck's hard fuel line-to-rubber fuel line. Pinch the tabs of the quick disconnect fitting and remove the fuel line.



Pinch the outer tangs of the fuel line quick-fitting to separate the rubber hose from the hard fuel line.

- Back up top: Disconnect the electrical connector from the fuel transfer pump (the pinch-to-release is on the bottom of the connector).



Unplug the water-in-fuel sensor. Note how the wires and cables have been pushed to the side of the fuel filter.

- Remove the four 5mm hex head bolts that hold the transfer pump to the filter housing.
- Remove the transfer pump and confirm that the sealing O-ring is also removed from the filter housing.



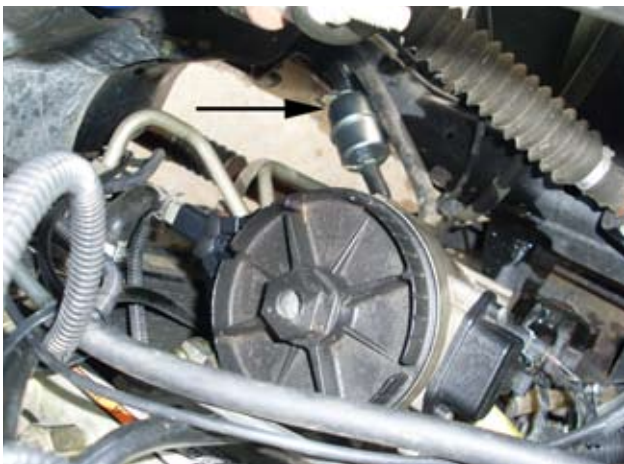
Do not forget to remove the old O-ring. An O-ring on top of an O-ring doesn't work too well. Ask me how I know.

- Assemble the new components to match the routing of the existing fuel pump and fuel line.



With the old transfer pump and fuel line removed you can see the orientation of the new fuel lines and primary fuel filter.

- Install the new O-ring to the fuel pump. Install the fuel pump into the filter housing. Position the fuel pump and push into place.
- Install the four 5mm hex head bolts (61 inch-lbs.).
- Connect the electrical connector to the fuel pump.
- Back under the truck: Check to be sure that the orientation of the new fuel line matches the route of the fuel line that was removed. Snap the fuel line quick-connect onto its fitting.



The installed orientation of the new fuel filter.

- Do a double check of your work. It is time to start the truck. Bump the starter, but do not attempt a complete start cycle. Return the key to the run position and listen for the fuel pump to operate. it will cycle for 15-20 seconds. Repeat the bump/return to run technique for 4-5 cycles to be sure that air has been purged out of the engine's self-priming fuel system.
- Crank the truck and check for leaks.

You're finished.

I am pleased to report the success of this project and that '03-'04.5 owners have a replacement part from the aftermarket. This plug-and-play option means you don't have to use the factory suggested repair technique—drop the fuel tank (labor estimate \$300-400) and add the '05-current fuel pump kit that goes into the fuel tank (parts estimate \$400).

This article updates the 56 article. Thus, we add another chapter to "The final Answer, Perfect Transfer Pump" article.

Robert Patton
TDR Staff

Related TDR articles: Issue 56, "Fuel Transfer Pumps Revisited." This 14 page article covers '94-'08 fuel transfer pump replacement options and service techniques.

08/2009 Epilogue—Attention '98.5-'02 Owners

Tired of reading about fuel transfer pumps?

No doubt that you are and, if I have done my job as a writer, there is no doubt that you understand the important role the fuel transfer pump plays in the well-being of your expensive Bosch VP-44 fuel injection pump. The VP-44 injection pump has to have fuel pressure from the fuel transfer pump or it will fail in short order.

In your readings you may have also noted my frugal recommendations:

- Purchase and install a cost-effective fuel pressure gauge (\approx \$100).
- Purchase a spare factory fuel transfer pump and keep the pump, your tools and the instructions on how-to-change handy (\approx \$150)

In the fall of 2008 the folks at Diesel Performance Products (the makers of the Fuel Air Separation System or FASS) introduced a mid-price fuel transfer pump option for the '98.5-'02 owner. The product is called the Dodge direct replacement pump (DDRP) and it sells for \approx \$285.

Advertised as a direct replacement the installation should be simple. To test out that belief, the following is a pictorial showing how TDR writer Andy Redmond installed the DDRP. The text and pictures are from TDR Issue 63, pages 108-109.

FASS DDRP FUEL TRANSFER PUMP

by Andy Redmond

The '98.5-'02 Turbo Diesel's most unreliable component is arguably the fuel transfer pump. If the fuel transfer pump fails, the demise of the expensive Bosch VP44 fuel injection pump is imminent due to inadequate fuel pressure, volume and lubrication qualities provided by the diesel fuel. The Bosch VP44 pump is actually quite reliable if the fuel transfer pump performs properly.

The OEM pump is manufactured by Carter, a Federal Mogul company. It has endured many supersessions and design changes. Delphi Diesel has recently remarketed the Carter pump. Another company, AirTex, offers a replacement variant. Dodge's latest solution for this woeful design is to offer a kit to place the fuel transfer pump inside the fuel tank/tank module, as they have discontinued their original design. The Cummins parts network still offers a replacement pump, if you provide the correct part number.

The well-known aftermarket company Diesel Performance Products (DPP) markets the FASS line of fuel transfer pumps. FASS is an acronym for Fuel Air Separation System. Only two offerings were available until recently—

the HPFP (remote frame-mounted replacement transfer pump) and the FASS (remote frame-mounted pump with water separator and fine micron fuel filters). Most of their customers purchased these items as a fix-it-for-good solution at a cost of \$450-\$800 dollars.

However, many enthusiasts with a stock or mildly modified engine wanted an OEM-type replacement with good reliability and a more affordable price point; thus the release of the Dodge Direct Replacement Pump (DDRP). It attaches in the factory location on the driver's side of the engine. The price point is \$269 versus Carter's at \$180-\$200. Is this the ultimate stock replacement pump?

The following is a pictorial installation of the DDRP on a '00-'02 model year truck. The lift pumps are the same for the '98.5-'99 model trucks, but there is a slightly different fuel transfer pump outlet, fuel line plumbing and fuel filter assembly.



Photo A

It is not necessary to remove the fuel filter housing to replace the lift pump. The arrow points to a 17mm wrench that is used to remove a banjo bolt that holds a fuel line from the fuel transfer pump to the fuel filter canister.



Photo B

For clarity I went ahead and removed the fuel filter housing. You can easily see the following: ①the pump outlet pipe; ②the Deutsch electrical connector disconnected; ③the fuel transfer pump inlet piping, with blue quick-disconnect fitting. The fuel transfer pump is attached to the support bracket with three nuts (13mm) and one inlet pipe bracket support fastener (10 mm head). Those that have changed a few of these fuel transfer pumps know how frustrating it is for the 13mm nuts to loosen the studs. If the stud spins with the 13mm nut you have to go underneath the support bracket with a thin 7/16 open wrench to hold the stud to keep it from rotating. Look at photo C, item ① and you'll see what I mean.



Photo C

The old and the new. The inlet and outlet pipes are moved over to the DDRP unit when it is installed. The DDRP comes with a female Deutsch connector to plug-n-play into the factory wiring.



Photo D

The installed DDRP unit. The kit contents provide an inlet screen (144 micron) for the inlet banjo bolt. The pump is primed easily with WD-40. The unit is quieter than the OEM unit.

Andy Redmond
TDR Writer

FROM ISSUE 60: HOW DO YOU CHANGE THE FUEL FILTER

If you are an experienced diesel owner feel free to skip this article. But, be forewarned, the convention of the TDR is to add information to an article that will make it worth reading for the seasoned professional. Let's see what can be added to this simple project to validate the worth of your TDR subscription.

FUEL FILTER BASICS

You can browse through your Dodge Owner's Manual, you can preach the virtues of maintenance to your friends and your offspring, but nothing makes a lasting impression like practicing what you preach. Maybe I should rephrase this to read that nothing makes a lasting impression like not practicing what you preach. Admittedly, I'll end up replacing an entire assembly because of my lack of maintenance to a component part of the assembly. Just like running out of fuel when you're the driver...it's my fault and I end up taking the long costly road to correcting the situation.

The most delicate part of a diesel engine is the fuel injection system. Because of the extremely close tolerances, the fuel injection system cannot tolerate contamination. Contamination can cause damage and, at a minimum, erratic performance.

The majority of low-mileage fuel injection pump failures seen by Cummins' warranty research department are caused by trash in the fuel system. Considering that trash is not a defect in material and workmanship, the resulting repair can be an expensive lesson in fuel system maintenance. Replace the assembly or perform maintenance on a component part, the choice is yours.

In this issue our back-to-the-basics article will show you how to change a fuel filter on a 2007.5 to current model year engine.

On a one-to-ten scale, this maintenance procedure ranks about a two in difficulty. However, fuel filter maintenance is often overlooked as new-to-diesel owners don't realize that fuel filter maintenance is called for every 15,000 miles. After all, when was the last time you changed your gasoline-powered vehicle's fuel filter? Why only 15,000 miles between fuel filter changes with a diesel? The obvious answer, diesel fuel is less refined than gasoline and is more susceptible to contamination by water and microbial activity.

Additionally, to the diesel novice the job of changing a fuel filter can be intimidating. Influenced by diesel folklore, the novice is concerned that the injectors and/or fuel system will have to be bled of trapped air, a task that he does not know how to perform. And, as recently as the '98 model year, air (and an accompanying squirt of diesel fuel) had to be vented using the manual fuel lift pump purging the air from a bleed screw. With the '98.5 24-valve engine's electric fuel lift pump and self-venting fuel system, the bleedscrew/squirt of diesel problem went away. However, the I-don't-know-how intimidation factor remains.

As with the '98.5-'02 and '03-'07 trucks, owners of 2007.5 and newer trucks have a fuel filter system that has an electric fuel lift pump and is self-venting. For '98.5 and '99 owners, the fuel filter how-to was covered in Issue 25, pages 84-86. For '00-'07 owners, the how-to was in Issue 45. Now that we have established the need for fuel filter maintenance. Let's get started on the how-to section of this article for the newer '07.5 audience.

2007.5 and Newer Fuel Filter Change

First, let's present three tips that will save you time and aggravation.

- Purchase your fuel filters in quantity. This prevents the excuse that you could not change the filter due to a not-in-stock situation. Additionally, a spare fuel filter should be in your box of emergency parts that you carry inside the truck. You cannot predict when or where you might receive a bad fill of fuel.
- Extend the fuel drain hose. The existing drain hose is about 18" long and hangs directly below the fuel filter housing. When fuel is drained, it is difficult to catch because the drain hose is not easily accessible. To correct this condition, I slipped a three-foot length of 5/8" heater hose over the existing drain hose (perfect inside-to-outside diameter interference fit). Extend and tie-wrap your longer drain hose to a convenient drain location.
- Purchase a one-gallon *plastic* fuel container. Keep it filled with quality diesel and use the fuel to pre-fill your filter. *Do not* store diesel fuel in metal, zinc-lined cans: the diesel fuel reacts with the zinc and forms a goo that can clog a filter and damage a fuel injection pump.

The advisability of pre-filling the filter was debated in Issue 43, on page 148. Caterpillar heavy equipment mechanic and TDR member Craig Hubachek maintains that this technique is a service no-no as it puts unfiltered liquids (fuel or oil) on the filtered side of the filter. The audience should use due caution if you use the pre-fill technique. Note that since the '98.5 model year, with the truck's electric fuel lift pump and self-venting fuel system, the self-priming nature of the fuel system make the pre-fill unnecessary.



Let's Begin the Fuel Filter Change

- First extend the drain hose.
- Position your newly-added drain hose in a location that is easy-to-reach and easy-to-catch. Open the drain valve and drain the fuel from the filter canister.

The drain handle is open. Unlike the '00-'07 trucks, when you open the fuel filter drain valve there is only a trickle of fuel. Instructions in the Mopar filter box will tell you to drain only about eight ounces. You'll be lucky if that much drains out.

Remove the water-in-fuel (WIF) sensor electrical connector from the bottom of the filter's plastic cartridge. The tang on the connector wires is pushed out and the connector wires and female socket can then be pulled downward. In shadetree fashion, I cut the tang so that the connector will be easier to remove in the future. I'll let you debate the merits of tang-cutting.

As I mentioned in Issue 59, page 42, the fuel filter is buried under a myriad of electrical wires, electrical relays and cables. The fuel filter is next to impossible to access.



I tried to access the filter from above—no way. An accepted field service practice on 4x4 trucks is to hug the front tire and come in from the side in between the gap in the plastic wheel-well liner and the frame. Two-wheel drive guys need to remove the 8mm screws that hold the fender wheel-well liner in place and drop the liner out of position.

For the truck's initial fuel filter service I chose the under-the-vehicle service technique and a strap wrench to remove the filter. I wish I had known about the Harvey Barlow technique (page 40).

Subsequent fuel filter changes can be done from above if you take the time to move the aforementioned electrical wires, relays and cables to the side. You will have to move the oil dipstick tube to the left and modify the bat wing to accept the new dipstick location.



Relocate the oil dipstick tube to the valve cover.



With one hand above and one hand below you can get to the fuel filter from above.



Modified "bat wing" with new dipstick location.

Once the fuel filter is removed, following the Mopar/Fleetguard directions is very easy. The next several steps are from the instruction sheet.

- A screwdriver blade and an upward pry will enable you to pop the fuel filter from its plastic cartridge. Remove the filter and inspect the filter and the cartridge for contaminants. Likely the filter is discolored and is black in color. No cause for alarm, the filter is doing its job.

There is cause for concern if you find lots-of-junk in the plastic cartridge. An accumulation of junk could indicate microbe activity in the fuel tank. Draining the tank and treating the fuel system would be the necessary service technique.

- Discard the old parts.
- Confirm that the used end seal is removed from inside the head.
- Wipe clean the sealing surfaces of the new O-ring and end seal inside the head.
- Install canister sealing O-ring and confirm the end seal is in place on the canister.
- Lubricate the canister O-ring with clean engine oil. Do *not* pre-fill the canister with fuel.
- Install to the point of first contact for canister-flange and head.
- Tighten the canister an additional 1/2-turn of rotation.
- Reconnect the WIF sensor electrical connection and ensure proper connection is made.
- Reinstall the drain hose.

It is now time to re-prime the fuel filter canister. With the key in the ignition, briefly bump the starter, but don't attempt to crank the engine. Let the key fall back to the run position. Listen for the electric fuel transfer pump to operate. It should hum for about 20 seconds. The transfer pump is located in the fuel tank so you'll have to either carefully listen or have someone crawl under the truck and listen. Repeat this bump-and-prime procedure four or five times. Now, the moment of truth...Crank the engine and let it run for 20-30 seconds. Check the filter area and confirm that no fuel leaks are present.

Restart your engine and you are good-to-go for another 15,000 miles.

Robert Patton
TDR Writer

THE HARVEY BARLOW METHOD

Those that frequent the TDR's web site are likely familiar with Harvey Barlow and his helpful post in the 6.7-liter area of the discussion forums. In early August Harvey discovered another (and perhaps easier?) way to change the 6.7-liter fuel filter. The following is Harvey's method.

Using this do-it-yourself tip it is not necessary to remove the left front tire or even the left front fender inner lining. As Patton suggests, you may want to spend some time from above and below tie-wrapping cables and wiring to make it easier to access the fuel filter.

From below the truck, reach up and disconnect the water-in-fuel sensor wiring plug from the base of the fuel filter canister. Again, as Patton suggests, you may want to de-tang the sensor wiring plug connector.

I like the idea of extending the fuel filter drain hose. Do so by slipping some 5/8" ID hose over the existing plastic hose, or remove the plastic hose and permanently replace it with a longer length of 3/8" ID hose. Loosen the drain valve on the bottom of the canister by twisting the 2" plastic "star wheel" counterclockwise and allow the canister to drain. As mentioned, you'll not be able to drain much fuel. Now for the tip-of-the-quarter: Using a 1/2" ratchet and a 1/2" extension long enough to reach the bottom of the canister, insert the 1/2" drive tip of the extension in the slot in the bottom center of the filter and back it out one turn. You can now remove the canister by hand from above or below, taking care not to spill the remaining fuel in the canister.



I'll bet you didn't know that there was a 1/2" drive indentation on the bottom of the filter canister.

The replacement canister contains a new filter element and the water-in-fuel sensor. Simply apply the supplied replacement O-ring to the male end of the canister and screw it in by hand. Hand tighten it. Reconnect the water-in-fuel sensor plug.

Cycle the key twice, just enough to bump the starter but do not turn the engine over. This will cycle the fuel transfer pump in the fuel tank to refill the canister.

Start the engine and test for leaks.

Record the date and mileage in your truck maintenance record book.

If your truck runs and doesn't leak fuel, you did good!
HBarlow

And the editor thought to himself, "Why didn't I discover the 1/2" drive indentation on the bottom of the canister?" As you inspect the canister you'll notice that is an off-only type indentation. Thanks, Harvey, for the tip.

THE SEARCH FOR A 6.7-LITER FUEL FILTER ONLY

Short answer: You cannot purchase a fuel filter only. The replacement kit is sold through Mopar (05183410AA), Fleetguard (FS43252) and Cummins (4936025) as a filter, gasket, O-ring and plastic cartridge assembly. Yes, you get the plastic cartridge whether you need it or not.

The plastic cartridge is reusable, right? Long Answer: To no avail, the Geno's Garage staff tried for 18 months to purchase the required gasket, O-ring and filter from Fleetguard. Fleetguard makes and packages the filter kit for Mopar. I've seen the notes from the e-mail and the telephone conversations and the words "dogged determination" describe their pursuit of the lower cost filter-only.

It is not to say that the Fleetguard FS43252 is outrageously expensive. At less than \$30 it is fairly priced. Be glad you're not a PowerStroke owner where the price for a 6.0-liter engine fuel filter package is \$55.

How about the Mopar-boxed fuel filter kit? In fact, the Mopar part is made by Fleetguard. However, would you believe the Geno's folks sell the kit for \$10? That is not a typo—the Geno's staff knows that their price from their Dodge dealership is too low and not correct. Being forthright, they advised the Dodge dealership and the dealership advised Mopar. Oh well... Owners of the 6.7-liter truck should take advantage of this pricing glitch while you can. The folks at Geno's will honor the price as long as possible. They have 500 filter kits in stock.

As a postscript, I received a follow-up phone call from Fleetguard. The response, "The plastic cartridge unit was not designed as a lifetime product. As such there has not been validation done to substantiate the cartridge's use long term."

So, the final answer: There is not much hope for a fuel filter only, so get 'em (the mis-priced Mopar fuel filter kit) while you can.

LOW PRESSURE FUEL SYSTEM PROBLEMS

by Andy Redmond

We all see much discussion on the TDR web forums and in the TDR publications regarding performance/drivability issues, which are often traced to a low pressure fuel delivery problem. Although the narrative that follows is specific to the 12-valve Turbo Diesel trucks, model year '94 to early '98 (pre 24-valve engine), the discussion on the components from the fuel tank (float and sending unit) to the fuel transfer pump apply to *all* Second Generation trucks.

The term low pressure fuel delivery system covers the components from the fuel tank up to the truck's fuel injection pump and from the injection pump back to the fuel tank. Common problems that will be discussed: fuel level sending unit; fuel heating element; fuel transfer pump; overflow valve; fuel return line.

Let's start at the beginning, the fuel tank. The fuel tank is approximately 34 gallons and made of an injection molded-type plastic material. The tank utilizes a fuel tank module with an integral fuel level sending unit. Carter (Federal-Mogul company) is typically the fuel tank module manufacturer; Walbro manufactures the sender. The module is installed vertically in the fuel tank and is retained by a large plastic nut and o-ring gasket to the threaded top of the fuel tank. The module has a lower half that can float up and down somewhat on a slide system. The purpose of the float is to prevent erratic fuel gauge readings due to fuel slosh when driving off-road. It also serves as a small basket, which will hold approximately one quart of fuel. This prevents air entrainment in the fuel system when the tank level is low and steep approach angles are tackled. The top of the module has ports for fuel supply (3/8") and fuel return (5/16"), a rollover valve/tank vent, an auxiliary fuel port and an electrical connector. The only serviceable parts on the module are the sending unit and the rollover valve and its grommet. The sending unit is notorious for the wiper contact area to wear out, which results in erratic fuel readings or fuel gauge malfunction. A sender-testing chart is shown should you desire to test your sender while the truck module is removed from the fuel tank.

Model Year of Truck	Sender Ohms at Full	Sender Ohms at Empty	Low fuel Indicator Lamp ohms
'94-'97	0 +/-	100 +/-	65 +/-
'98-'02	20 +/-	220 +/-	PCM Function

Sometimes the use of an old-school analog multimeter will catch a dead or bad spot as the sender is moved up and down. The needle will falter or jump at the contact failure. Digital multimeters (DMM) are great tools, but my old analog meter still gets plenty of use for tasks like this. The DMM is constantly auto-ranging for accuracy in a specific reading versus the analog meter holding a steady reading. Now you have an excuse to purchase both types of multimeters!

Looking back in my TDR index, I see that members have been bothered by this problem since Issue 16 in the Spring of '97 when member Russell Caya did a how-to on fuel tank removal. Other memorable articles: Issue 26 where Mel Lang took the sending unit apart in an attempt to understand why it was/is problematic.

My look back at these old sources of information did not reveal a shadetree repair procedure. Perhaps the labor and time involved to remove the unit dictates that one should install a new sending unit rather than hope a repair would work.

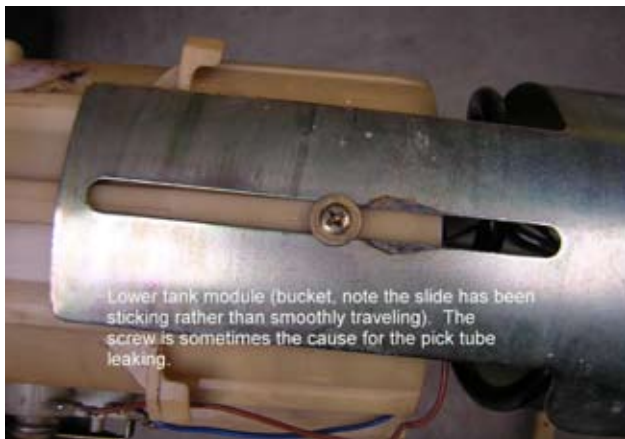
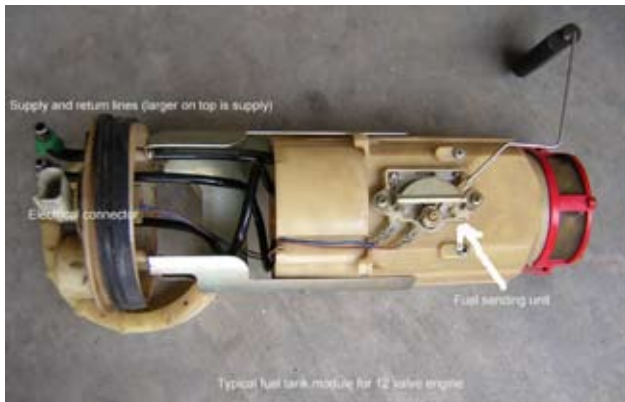
Oops . . . I've gotten a bit ahead of myself. I've got you diagnosing the fuel tank sending unit, but I haven't given you some tips on removing the fuel tank, much less the fuel tank module which houses the sending unit. I prefer to drop the tank from the truck rather than lifting the truck bed. A tank with a couple of gallons can be a circus to balance, even with a large floor jack and a four-foot section of 2x12 or similar sized plywood, so it's nice to drain the tank. My "Rube Goldberg tank drainer" idea was first presented by TDR writer Joe Donnelly in Issue 37, page 45. "Unfortunately many of us have bed-mounted fuel tanks, toolboxes, fifth-wheel hitches, etc., making the bed-lift method impractical. In that event, run the fuel low, and remove the filler neck (it has a check ball in it so the hose won't snake down in to the tank). Put a piece of 3/8" hose into the tank, cut a whistle near the end, and blow air through the whistle with compressed air. This will start fuel flow and if your catch can is lower than the tank, it will flow until the tank is virtually empty."

Hard plastic lines (supply and return) of a quick-connect variety connect to the module and run along the frame rail (this plastic line mates to a metal or braided line on some models). The lines then mount onto a bell-housing bracket. Then they bend around the bell housing where a short length of 3/8" rubber fuel line provides a fuel supply to the fuel heater line that extends behind the fuel filter. Due to the age of the 12-valve truck, careful inspection is necessary from the tank to the fuel heater/strainer, to ensure that there are no leaks in the fuel lines.

I recall a discussion (Issue 44, page 32) where Brandon Parks at Geno's Garage had a lengthy battle with a hard-to-start '97 12-valve truck. After weeks of troubleshooting he did a close inspection of the metal fuel supply line coming from the tank as it turned upward by the firewall. A pin hole caused by years of chafing was the problem.



The module has metal pipes exiting the top of the module (supply and return) and has hard plastic tubing coils that extend to the bottom of the module where a removable screen covers the pickup and return. Most of them that I've dissected have a one-way check valve in the fuel pickup to assist in holding fuel prime. Many members have noted that these lines sometimes chafe and develop a pinhole, which allows for fuel aeration, not a good thing! The perforated tubing seems to have rubbed on a sharp edge, or on the mounting hardware for the lower float we previously discussed. The return also returns fuel to the bottom of the module (above tank bottom about 1/4"). This is preferable, as it allows returned fuel to be released into the remaining fuel rather than spraying on the tank's upper surface introducing foam and air.



Permit me to further digress: I recently made a road call to visit a sick '95 model truck. The owner complained of a tapping noise and suspected connecting rod since the truck showed about 250,000 on the odometer. Over the phone when he held it near the source of the noise it sounded to me like a worn out lift pump tapping away on the cam lobe. The problem was missing fuel line routing brackets, which mount to the bell housing. It seems that the clutch had been recently changed and I assume the technician was speeding along attempting to "beat the book" (flat rate) and didn't see the need to attach the awkward brackets. The supply and return were chattering away on the bell housing which was driving its owner to near insanity. Some zip ties and split pieces of fuel line temporarily solved the problem while the replacement brackets were ordered.

Again, due to age, the fuel heater/pre-filter is a common repair area on 12-valve Turbo Diesels. TDR member Joe George showed us his method for finding a problematic air leaks at his fuel heater several issues ago (compressed air and a bucket of water). Joe's dilemma was much like Brandon's. Quoting from Issue 44, page 49, "I removed the fuel filter assembly (with the attached fuel heater and fuel pre-filter) from the truck. I applied 30psi of air to the assembly and lowered it into a bucket of water. Instantly, I observed a stream of bubbles rising from the fuel heater electrical connector. The connector had a crack in it, causing the lift pump to suck air into the fuel system. Without the removal of the assembly and the pressure test, I'm not sure I would have found this rare problem."

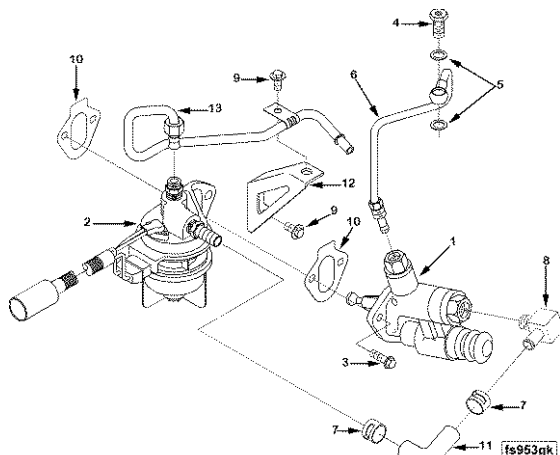
The fuel heater warms the fuel if the fuel temperature is below 40° and shuts off when the fuel temperature reaches 80°. The heater draws about 300 watts at 0°. This should help to prevent fuel gel in sub-zero climates. Should your fuel heater fail, it can be removed or eliminated. The pre-filter bowl is removed (using a short 17mm box combination wrench), and then a 8mm hex wrench is used to remove the shoulder bolt that retains it to the fuel heater casting. Once the fuel heater is removed the pre-filter bowl should spin onto the pre-filter base, the heater can be unplugged and you should be on your way.

The pre-filter assembly is attached to the engine block with the transfer lift pump cap screws. Fuel comes into the top of the unit via a short metal supply line, which attaches to the short length of 3/8" fuel line. It then passes through the

pre-filter screen, then the fuel heater then back out through a port and over to the transfer lift pump. This connection is made by a rubber supply line elbow that makes a sharp ninety-degree bend. I change this rubber elbow (item 11) when a transfer lift pump is serviced. Often this line is a major source of air leakage and subsequent fuel aeration.

As confirmation of my replace-the-elbow service technique, I had a discussion with a friend who is a competent technician. He had replaced a lift pump and now the truck would not restart. He stated that the lift pump would raise fuel up to the air bleed port on the fuel filter outlet, but with many bubbles rather than a clear stream of fuel. After we discussed probable causes, he called me back a short time later to report his findings. Sure enough, the rubber elbow was sucking air when the lift pump was manually primed. He also noted fuel weeping into the electrical connector on the fuel heater and a bad seal at the upper base and the upper heater "quad ring" (o-ring with square vs. round sides). Since he was short of parts, he removed the constant tension clamps and added gear-drive type clamps to the rubber line and removed the fuel heater and upper o-ring. After about twenty strokes on the primer and the truck started right up.

The next component, the heart of the low pressure fuel system for 12-valve owners, is the fuel transfer or lift pump. (Note to 24-valve owners: you can stop reading at this point. I don't want to discuss your electronic fuel transfer pump.) The lift pump is a piston style pump typically manufactured by Carter. It is designed to provide about 25psi to the fuel filter. It contains a manual primer and integral check valves that prevent prime loss and pressure delivery as fuel exits the pump. The pump is actuated by a plunger tappet, which rides on an eccentric engine camshaft lobe. Often as the pump ages the check valves wear and the plunger springs weaken. This can cause internal as well as external air and fuel leaks and a loss of fuel prime. Additionally, the fuel volume and/or pressure can diminish to a level which will cause sub-par engine performance. A healthy lift pump provides a volume of fuel far in excess of what the Bosch P7100 injection pump can use, with the exception being very high horsepower demands. At 400 rpm (starter motor cranking speed) for a thirty second cranking duration, the pump should deliver a volume of 20 oz. of fuel.



1998 12-valve illustration, part number 13 differs on 1994-1997 designs.

The fuel exits the lift pump through a metal tube to the fuel filter base inlet. It then is filtered and exits the outlet of the fuel filter assembly to travel to the injection pump. It is desirable to see 25psi at the fuel filter inlet. If you notice more than a 5psi drop across the filter (inlet to outlet) the filter is likely causing restriction. When testing the lift pump, should more than 4.0 inch Hg be shown on a vacuum gauge an inlet restriction exists somewhere back at the fuel tank. There are several things to watch for when servicing your fuel filter. The spin-on cartridge used in '94 to '96 vehicles (Fleetguard FS1253) has three o-rings that require attention when installing the filter: one on the re-usable water in fuel sensor, one that contacts the filter base and also one that fits onto the filter nipple. It's not a bad idea to check that the filter nipple is tight in the filter base with a hex wrench.

Fuel Filter	
1994-1996	1997-1998
Spin-on cartridge w/ removable fuel drain/WIF (water in fuel sensor).	Drop-in cartridge. Filter cartridge canister housing contains a fuel drain and WIF sensor.

On the drop-in style cartridge used in '97 and '98 vehicles (Fleetguard 19578), the o-ring on the canister housing's threaded shaft (just below the brass bushing) is sometimes omitted from a filter kit. Should that be the case it is an acceptable practice to reuse the existing o-ring.

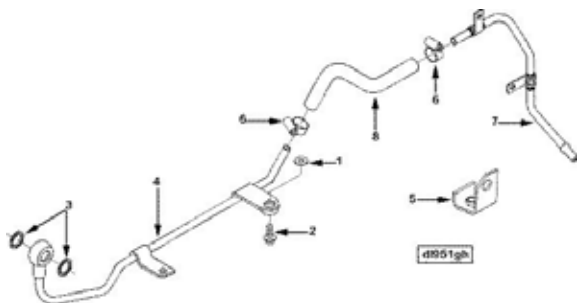
The fuel then travels from the filter outlet to the Bosch P-7100 fuel injection pump. This concludes the delivery portion of the tour of the low-pressure fuel system. However, several other items are worth mentioning on the return circuit of the fuel system. On the backside of the injection pump near the front corner of the pump is the location of the Bosch P7100 fuel pump overflow valve. This valve opens and allows fuel return to the fuel tank at approximately 22psi. When diagnosing fuel pressure problems, one can often determine if a lift pump or overflow valve problem exists by doing the following test. Let's assume we see a 12psi reading on our fuel pressure gauge. With the engine idling and a pressure gauge attached, slowly squeeze the rubber return line (this infamous rubber fuel return line is often



The Bosch P7100 over-flow valve.

problematic, but more on that subject in a minute) that runs behind the fuel filter. If the pressure gauge starts to rise, it means that the lift pump is making good pressure and that the overflow valve may be opening too soon. An overflow valve that opens at too low of a pressure will result in poor performance. Too much fuel will return to the fuel tank which robs the injection pump of fuel pressure that is necessary for proper operation. If the line pinch test makes little or no difference on the fuel pressure gauge, it would suggest that the lift pump is weak.

A drain manifold is available for excess fuel not injected by the six fuel injectors. The return path is sequential at each injector and returned to the fuel filter inlet. Usually these will leak fuel noticeably if a problem occurs, allowing the owner to quickly pinpoint the leak.



Notice the return line parts diagram: (illustration for 1998 12-valve). Part number 8, rubber fuel return line, is about three times as long on the earlier 12 valve applications. Also, part no. 7 is different as well.

Last, but not least (as evidenced by the numbers of problems that this hose has caused) is the rubber fuel return line. The illustration shows the rubber line used on a '98 12-valve. The '94-'97 trucks use a rubber line (5/16") that is about three times as long. The illustration is misleading. This hose is very difficult to see and access as it is tucked behind the fuel filter assembly.

Engine heat and age will cause this hose to develop cracks. It will leak air first, then fuel. Many owners report the use of a silicone grade marine fuel line as a permanent repair. I've had good luck as well with a Gates fuel injection hose, which seems to withstand the heat and elements far better than the factory-supplied SAE J 30R7, rubber fuel line. I find it helpful to remove the fuel filter base from the engine when changing the rubber return and/or supply lines. The lines can be gently slipped out of the brackets at the bell housing to provide better access. I also like to have a fresh razor blade handy to split the old lines where they are often stuck onto the metal fuel piping. Some fresh stainless steel clamps are smart too.

I will leave you with a list of part numbers that may help you in sourcing parts. Be advised that the part numbers may have been superseded.

Andy Redmond
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Common part numbers	Mopar	Cummins	Other
Lift pump	5012209AB	3936316	
Lift pump gaskets	5014230AB	3931059	
Injection pump overflow valve	4883838AB	3932096	2417413093, now ends in 101 (Bosch)
Gaskets for overflow valve	5015576AB	3935171 ?	
Metal return line (ov. flow to rubber line)	4746641	3923171	
Fuel filter to injection pump (metal line)		3936691	
Rubber elbow (fuel heater to lift pump)	4883978aa 4746638	Not handy	
Sending unit (fuel) 1994-1997	04797738 or 05013467AA	N/a	N/a
Sending unit (fuel) 1998-2002	4897669AB	N/a	N/a
Roll-over valve (fuel module)	52127666	N/a	
Roll-over valve grommet	4002149	N/a	
Pre filter screen kit	4762962		3845400S (Fleetguard)
Fuel heater to heater base (upper)			3834185S (Fleetguard)
Fuel heater element			3907766S (Fleetguard)
Fuel heater harness			3843722S (Fleetguard)
WIF (water in fuel sensor) 1994-1996 only.			3831852-S (Fleetguard)