Volvo TechTips

Information for the Independent Volvo Specialist

VolvoTechTips.com

Spring 2022

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MIL Codes and Faults

Also Inside:

- Injectors
- Four Common High Mileage Repairs
- Steering Lock Module
- Oil Separator Replacement

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Four Common High Mileage Repairs

Different terrain, temperatures, and road conditions affect vehicles differently. Here are some common problems found in high mileage Volvo vehicles.

Shown here: Leaking smoke from throttle body pipe flange

Like all cars, as Volvos get older and start to clock a lot of miles on the odometer, some common problems can start to arise.

If your shop is a Volvo specialist, or if you just take in a lot of them, you may start to see some of the same problems on the same models come your way.

Of course, if you ask five different Volvo technicians from around the country what common problems they see the most, you will probably get five different answers.

This can be due to the different terrain, temperatures, and road conditions that their customers encounter.

One example of this is when it come to direct injection cars that are driven in different states that have very different additives and octane levels in the fuel sold in those states.

In California, for example, the highly regulated clean emission fuel that is sold is much more likely to leave heavy carbon deposits on the valves over time than, say, in a state like Arizona, where the fuel is not as regulated. Of course, temperature has something to do with it too.

Axle assemblies on Volvo P1 chassis cars (including 2006–2013 C70, 2004–2012 S40, 2004–2012 V50, and 2006–2013 C30)

Axle shafts with constant velocity joints have been with us for a long time, in all makes of cars, but Volvo has been using them in almost all their models since 1992.

Over the years, the basic design of these axles has not changed much, with a few exceptions.

On all cars, the C-V boots will crack and leak out their lubricant over time, causing the joints to wear and eventually fail.

When the axles start to fail, the symptoms can be numerous and varied, depending on driving conditions and the condition of the C-V joints.

Volvos don't tend to display the same symptoms as Japanese cars when their C-V joints fail; most of them make a loud clicking sound when the cars are turning with the steering at full lock.

A more common symptom for a Volvo with worn C-V axles is a vibration on acceleration when at freeway speeds. This is especially true on the P1 chassis Volvos.

The Volvo P1 was developed during the Ford years at Volvo as part of the Ford global C-car platform series.

All the P1 Volvos are pretty much the same, from the A-pillar to the front bumper, and they all share a lot of parts and systems.

Including the front C-V axles, these axles are not unique among other C-V axles but, for some reason, the P1 chassis Volvos are very picky when it comes to the brand of replacement axles that are used.

The aftermarket parts manufacturers do make axles for these cars, but if you don't want the car to come back, you better use only Volvo OE axles from your local retailer.

Yes, aftermarket axles may be cheaper, and some may be well-made parts, but if you use any of these, you may be in for a disappointment, because the fact is that nine out of ten times, the use of anything but an OE Volvo axle will cause problems such as high speed vibrations. It may not happen right away, but there's a good chance that it won't last a year without a problem.

Volvo actually has issued a few Technical Journals (TJs) about various issues having to do with P1 Volvo axles.

Most of the TJs have to do with noise complaints.

If you are going to replace a front C-V axle on a P1 Volvo, you better use an OE Volvo replacement part from your local retailer because P1 Volvos don't get along well with aftermarket axles.

Do yourself and your customer a favor and only replace the C-V axles on these cars with factory Volvo replacement parts.

Late 2007–2012 XC70 with the 3.2L engine: Right hydraulic motor mount wear causing vibration and clunking noise on sharp U turns

This one can be hard to spot and can easily be mistaken for something else, like a worn C-V axle joint, or even a problem in the transmission or angle gear.

That's because the symptoms of one of these worn motor mounts can be intermittent because of the temperature of the engine and even the ambient temperature.

Top view of right mount bracket with torque mount removed.

Top view of mount bracket with torque mount removed. This motor mount is hard to inspect without removing the upper engine torque rod and moving the coolant expansion tank out of the way.

If the worn hydraulic motor mount has not completely failed, it may still have some fluid in it, causing it to partially do its job when the temperature is right, which makes the symptom hard to experience.

And, in most cases, you won't see any trace of hydraulic fluid leaking out, like the older Volvo hydraulic motor mounts that usually show when they are failing.

You should make checking the condition of all the motor mounts part of your standard inspection

It's easy to see that the engine mount shown on the left is worn out when compared side by side with a new one, but this may be hard to see when the mount is still installed.

To confirm that the right hydraulic motor mount is worn out you may need to remove the upper mount bracket from the engine.

procedure when you get one of these older Volvos in your shop.

It's not like the old days when you could just look at a motor mount and see that the rubber was cracked or even torn in half; these days you have to look a little closer.

If you suspect one of these right hydraulic mounts is bad, you may have to remove the upper bracket that holds it to the engine to confirm it.

Before you remove the mount's mounting bracket, you should support the engine from the bottom first.

Once you get the upper mounting bracket removed, you will see that the center of a worn mount has collapsed into the mount's housing.

When you compare a new factory Volvo mount to the old worn out one side by side, the problem is obvious.

Hard to find intake air leaks on early turbo cars

A lot of the Volvos that are coming into independent repair shops these days are older high mileage cars that still have a lot of life in them.

That being said, the problems with age and high mileage can sometimes be challenging to diagnose, because wear on older parts is not always easy to quantify.

If you are diagnosing an issue like a Check Engine light on an older Volvo and you see that a lot of the parts in the affected system are old or even original, you're not going to tell the customer that they will need to replace all the parts in that system just because they're old, are you?

Probably not. In a perfect world, that would be an option, but it's not a perfect world and, unless your customer wants to give you unlimited funds to do a complete restoration, you're going to have to do some testing.

One of the more common issues that you will see with older Volvo turbo models is intake air leaks. And sometimes these leaks can be small and hard to find.

Most of Volvo's turbo-equipped engines use a combination of plastic pipes and silicone hoses to move the intake vacuum and turbo pressure around.

When it comes to the silicone hoses, leaks are usually easy to spot, with age problems like cracks, breakage, and oil contamination causing the hoses to collapse.

Air leaks in the plastic pipes can be more difficult to pinpoint, especially when one or more of the silicone hoses is leaking too.

Smoke Machine

When trying to isolate an intake air leak on a Volvo or any car, the best tool is still a good diagnostic smoke machine. The newer models are very effective, and you can even get smoke oil for your machine that has an ultraviolet dye in it that can leave a trace residue at the site of the leakage that can be seen with a UV inspection light.

The best way to find an intake leak on a Volvo is to try to isolate the intake system that you want to test as much as possible before applying smoke to the intake.

In most cases, the best way to start is to disconnect the intake pipe from the air filter box and plug it with a tight-fitting cap or even a rubber glove.

The more you can isolate the area of the part of the engine that you will be testing, the better. If there was some way to close all the engine's intake valves at once, that would be great, but of course we can't do that. So you have to do what you can to keep the smoke machine's pressure and smoke in the right area.

Leaks in the soft hoses are usually easy to spot, but don't automatically assume that once you replace that soft silicone hose, you have fixed the entire intake air leak problem.


Air box pipe plugged for smoke testing

Even small false air leaks (any unmetered intake air leakage) can cause a whole array of problems, even if the Long Term Fuel Trim (LTFT) is keeping up and adjusting the fuel trims to compensate for the extra oxygen in the system.

Intake air leaks of any size can cause serious problems over time, not just poor fuel economy. If the engine is subject to extra oxygen (that is not regulated in open loop operation when the car is cold), the lean mixture can cause excess exhaust temperatures that can not only raise the NO_x emissions, but can also damage the catalytic converter and oxygen sensors.

The plastic pipe assemblies that Volvo uses for most of their turbocharged engines are very tough and are built to last. But, of course, with every part that is subjected to the harsh environment that exists under the hood of a car, there is a limit to how long they will last.

These plastic pipes are designed to handle high heat, high pressure, and high amounts of engine vacuum all at the same time.

As they age, they can start to develop leakage, usually at the area where the clamps hold them in place.

The clamps can also stretch and loosen up over time. That's why you should always order new clamps when you order a new intake pipe or hose from your local Volvo retailer.

Aftermarket vs. OE Volvo intake pipes and hoses—this one's a no brainer to anyone that has tried to replace one of these intake pipes with an aftermarket copy of a Volvo pipe assembly.

The aftermarket versions of these parts usually look something like the OE Volvo part, but they rarely fit the same, if they fit at all, without a lot of swearing and sometimes modification.

It's always a great idea to use your smoke machine to verify that you have fixed all the leaks before you deliver the car back to your customer.

It's also fun and educational to use a scan tool or Volvo's Service, Parts and Diagnostic Application VIDA (Vehicle Information and Diagnostics for Aftersales) to check out your Short Term Fuel Trim (STFT) numbers before and after you fix an intake air leak.

Early XC70 (2005–2007) wire harness problems

This is a common issue you may see on second generation XC70s and some V70s (2005–2007).

What happens is, part of the wire harness on the right side of the engine compartment behind the right headlight can come loose because the plastic tie downs that hold it in place deteriorate.

Over time, the loose wire harness tends to gravitate towards the pulley and belt on the power steering pump. Then the power steering pump pulley will make short work of the wire harness's insulation and then start to work on the wires themselves.

If you catch this early, the damage can be fixed easily by repairing the insulation on the affected wires with heat shrink tubing and a new zip tie to secure the harness out of the way.

Belt rub damage to wire harness.

If the wire harness behind the right headlamp assembly on an early XC70 or V70 (2005–2007) breaks its tie down, it can start to rub against the power steering pump pulley and cause damage to the harness.

If the damage to the wire harness is more severe, such as multiple broken wires, you are going to have to ask yourself, is the damage bad enough to warrant replacing the whole wire harness?

Well, that can be a tough question because on these older Volvos, a new replacement wire harness may not even be available anymore.

If there is no new harness available, you're going to have to repair it.

When it comes to automotive wiring repairs, there are a few right ways and a lot of wrong ways to do them. Of course, this can be a highly debated subject from one tech to the next.

Old-school technicians will tell you that soldering the wires together is the best way to fix a broken harness.

That may have been true in the olden days of car repair (pre-CAN networks). But soldered repairs can crack and even melt in some cases in the harsh environment that's under the hood of a car.

Constant engine vibrations and temperature variations can wreak havoc on soldered connections due to their inflexibility.

And it can be very hard to use a soldering iron to get a good connection in some tight places in the engine compartment.

Today's auto technicians have a lot of great options when it comes to wire connectors for splicing two wires together.

One of the best new options for effective splicing of wires is sort of an all-in-one connector. These repair connectors, commonly known as butt connectors, have an outer sleeve that is made out of a high-strength heat shrink material that, when properly installed, can be completely water tight.

When you have a Volvo in your shop that needs some wire harness repair, be sure to check with your local Volvo retailer parts department; Volvo offers a wide range of wire harness and terminal repair parts with which you may not be familiar. ●

If you find yourself splicing two wires together on a Volvo, you should use one of these all-in-one heat shrink connectors. When done right, the fix can be watertight.

MIL Codes and Faults

Codes or No Codes: That is the question. Here's how to deal with MIL codes and faults.

Fuel gauge attached to fuel rail at Schrader valve

In this article, we will go over MIL codes and faults and how to deal with them. We will also go over Volvo no-code diagnosis, and how to approach vehicles that come into your shop with no-code driveability problems.

Having a code in the system can sometimes be less daunting but not always. Not having a code and having an intermittent problem can sometimes be a problem. Let's say a customer comes in with an engine shut-off problem that doesn't happen all the time. So of course, you will test drive the vehicle to see if you can duplicate the problem.

The first thing to do is to attach a fuel pressure gauge to the fuel rail, usually a Schrader valve hookup. This way you will be able to check pressure while driving, sitting and idling.

If there is no fuel pressure, then, depending on the model and year of the Volvo you're working on, you will want to expose the fuel pump connector. Check for power and ground at the fuel pump. If power and ground are present, then the fuel pump is the problem. If no power is present, you will need to check a wiring diagram and also component location in Volvo's Service, Parts and Diagnostic Application VIDA (Vehicle Information and Diagnostics for Aftersales). The fuel pump relay could be a problem and is a good place to check next.

Check the ignition system for any worn or deteriorated parts like ignition wires, coils or maybe spark plugs. Check the connections at the coil or coils, and check the ignition wire connections. If the vehicle runs with no problem, leave the fuel gauges attached and run the vehicle while checking the fuel pressure gauge.

Alternator codes

Here we have a 2007 Volvo XC90 3.2 L. This vehicle has a couple of codes relating to the alternator. Codes ECM-P050B00 Generator Control Circuit General Electric failure; and ECM-P062074 Generator Control Circuit Mechanical Failure Actuator slipping.

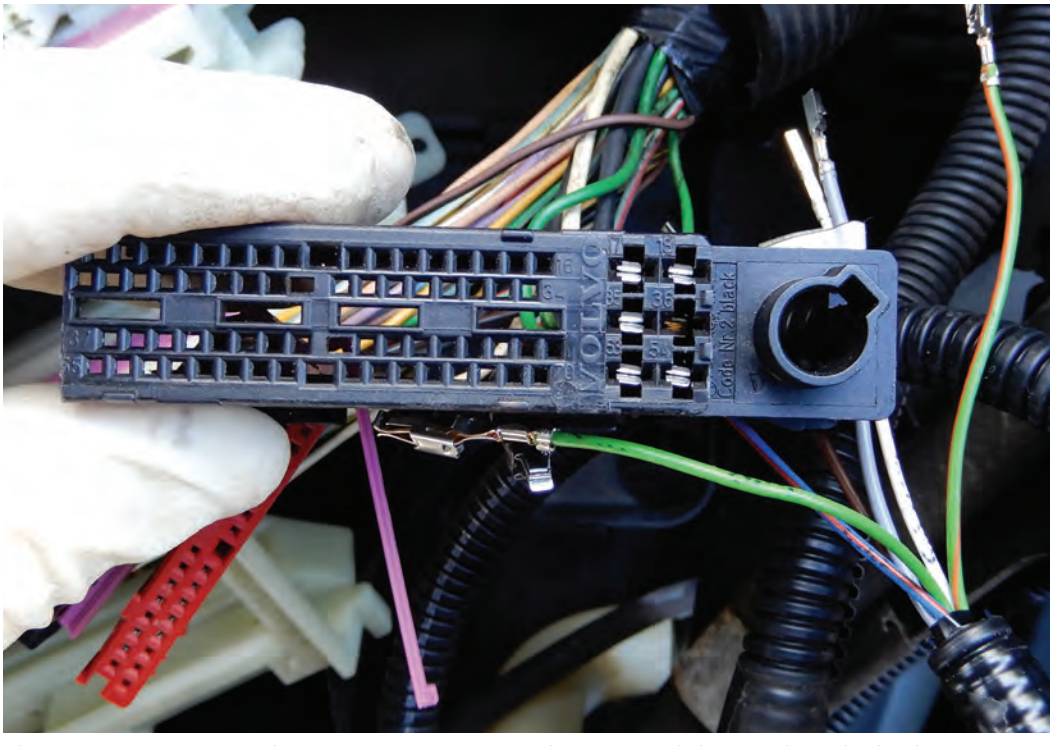
This vehicle has a charging problem; the battery keeps going dead. If the battery is bad, replace it, and if it needs charging, charge the battery.

Once the battery is charged up or replaced, let's check how much the alternator is putting out in voltage. Charging correctly should provide around 13.8 volts. This alternator is not charging, so it's a good idea to visually check the alternator connections and belt. If the connections look tight and there is nothing out of the ordinary, your problem is the alternator.

Air mass meter codes

These are codes that will show up from time to time, but it's not always an air mass meter problem. Many times this code points to something else. The air mass meter or sensor measures the flow of air drawn into the engine. Check for air leaks in the system; it would be a good idea to smoke test the vehicle for any leaks. A broken hose or another component could be the problem and setting an air mass sensor code.

On the Volvo five-cylinder engine, the plastic hose from the air mass sensor to the turbo can set this code. Smoke testing the vehicle can find the leak



The connector pins at the ECM connector can loosen, and the resulting lack of pin tension can cause the ECM to display throttle body codes. Installing harness 31409380 can correct this condition.

at this hose, or it could be the electrical valve sensor in the hose not operating correctly.

Make sure to always monitor the system while running using VIDA. Go to Vehicle Communications, ECM, and monitor the system at idle and under load, making sure all components are in spec. Air leaks are usually the problem for air mass sensor codes, so keep that in mind.

Correct alternator voltage using a volt meter

Volvo code with signal missing

Here we have a 2013 XC90 CEM Code 1A64, Communication with the Differential Electronic Module (DEM) signal missing. Use the wiring diagrams for support when taking readings. First, you will want to check the traffic load on the CAN cable. Information about CAN troubleshooting can be found in VIDA under Information/Product Specifications/ Design and Function/37/CAN.


Air mass sensor hose from air mass sensor to turbo

When faults occur on the CAN network, sometimes control modules send faulty messages that interfere with normal communication. When this happens, there is a considerable amount of traffic on the CAN network. Check the load voltage by measuring the average value on the CAN wires in relation to ground.

Measure voltage between connections at OBD II.

#6 and #4 ground: The voltage should be approximately 2.8 to 3.2 volts.

#14 and #4 ground: The voltage should be approximately 1.8 to 2.2 volts.

#6 and #14: The voltage should be approximately .55 to 1.4 volts. The voltage is normally between .55 and .90 volts. Higher voltage can mean there is increased traffic on the CAN network.

Using special tool 9513015 and plugging into OBD II will help in diagnosing your problem on the CAN Network.

After disconnecting the DEM, the voltage in the CAN system seems to register correctly. After replacing the DEM control module, adding software using VIDA, and going to Software Profile, the vehicle seems to be driving and operating correctly.

Finding a missing signal on the CAN network can take some time and tease your brain. If the fault cannot be detected through normal troubleshooting, you can diagnose possible interference on the CAN network using the tool DICE Error Frame Finder to register fault messages on the CAN network. Use Volvo tool 9513010 memory card and check out TJ 20402.3.4.

You can set up DICE to become the Error Frame Finder by installing the memory card 9513010 in the back of DICE. Make sure to go through TJ 20402.3.4 for more information.

With ignition on, plug in the DICE Error Frame Finder to the OBD II connection. The blue LED indicator flashes to show fault messages. So, if the blue LED light is flashing, there is a problem in a control module. Pulling and checking connections to modules might help in locating the problem. Keep an eye on the DICE blue light indicator.

Control modules can sometimes be difficult to troubleshoot. This could take some time, so let the vehicle sit with DICE connected for a period of time. Try to activate functions in the control module to provoke

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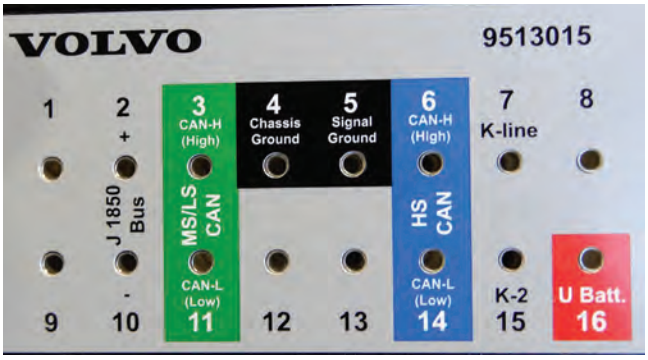
Cabin Filter

CLEAN AIR FOR EVERYONE

All Volvos are equipped with a cabin filter that cleans the incoming air to ensure a healthy in-car environment.

Replace the cabin filter every other maintenance visit, or more frequently if driving in high traffic areas or on dusty roads.

Contact your local Volvo retailer for a complete selection of Volvo Genuine Parts.



Special Volvo Tool number 9513015 hooked up to vehicle and checking voltage in the CAN System

a malfunction in the system. When the blue light on DICE starts to flash, remove the fuse for the control modules to see if you can locate which one is the problem child. When removing a fuse or power to the control module and the blue light goes away on DICE, this module is more than likely the problem module.

Misfire codes can sometimes be fixed as easily as replacing the spark plugs. It's a good idea to use Volvo Genuine Spark Plugs since many times an aftermarket spark plug causes misfires or other problems.

Here we have a 2008 Volvo XC70 with random misfire codes. The ECM trouble codes for each cylinder are as follows:

- ECM-P030100, cylinder one misfire
- ECM-P030200, cylinder two misfire
- ECM-P030300, cylinder three misfire
- ECM-P030400, cylinder four misfire
- ECM-P030500, cylinder five misfire
- ECM-P030600, cylinder six misfire

Here are the possible problems:

- Damaged spark plugs
- Damaged ignition coils
- Repeated cold starts when engine temperature does not reach proper operating temperature between starts
- Low fuel level
- Dirty or damaged valve depressor
- Dirty or damaged cam profile solenoid
- Contaminated fuel
- Air leakage
- Damaged VVT unit
- Clogged or leaking injector
- Faulty fuel pressure
- Bad or uneven cylinder compression

You will want to check if there are any other codes in the system that might generate a misfire code, like fuel-related codes, or maybe fuel pressure is too low. Fuel adaption codes may point to possible oxygen

Memory card inserted into DICE

sensor problems, faulty ignition coils, or injector codes. You might also find camshaft failures or misadjustment, or possible cam solenoid problems.

With the vehicle connected to VIDA under Vehicle Communications, ECM, you can monitor cylinder misfire and check all related codes in the system.

While monitoring the system, you see misfire in cylinders. The first thing to do would be remove the spark plugs and check for any damage or maybe different discolorations on the spark plugs. While plugs are out, take a compression check just to make sure the compression is correct and that cylinders are close in measurement. If compression is good, replace all spark plugs and check again.

If compression is correct and you have replaced spark plugs but still have a misfire, move coils around to see if the misfire changes to a different cylinder. If misfire changes, then you have an ignition coil problem. Replace the ignition coil or coils depending on which one misfires.

After replacing the spark plugs and/or ignition coils, monitor the engine using VIDA to make sure you have no lingering misfire codes.

Fuel pressure code

Here we have a 2016 Volvo Engine B4204T27 with diagnostic trouble code P018C00, low pressure sensor. With VIDA connected, go to Vehicle Communication and check your fuel pressure. If pressure looks correct, check to see if there are any Technical Journals (TJs) about this problem and you will find TJ 33794.2.0.

You will need to replace the low pressure sensor kit, the sensor and the feed line. If the vehicle is

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equipped with a Cooper LPS part number 31478293 or 31405791, it will need to be replaced with a new Sensata sensor part number 31432653 that is included in kit number 32242869. It's very important to replace the feed line that is in kit part number 31669066 when replacing the sensor.

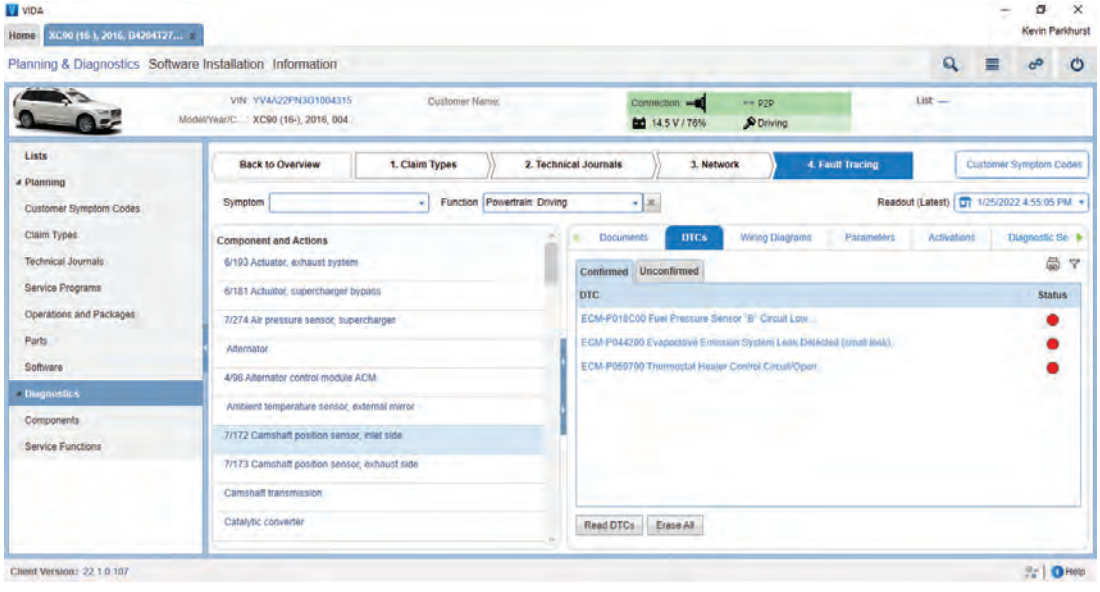
Now that the sensor and feed line have been replaced, clear codes in the ECM and test drive, monitoring the fuel pressure with VIDA.

Suppose you encounter convertible hardtops in which the electrical fold-down hardtop cannot be operated and there are no diagnostic trouble codes in the system. Using VIDA with the vehicle hooked up, read the vehicle, and in Fault Tracing, go to Symptom Related Diagnostic Procedures. Here you will see a procedure for checking the electrical convertible hardtop. Usually the reason for the electrical hardtop not operating is a Hall sensor or position sensor out of place.

Make sure the software is up to date, under Checking Software. Select the operation of sunroof tab. Here you can click on Flow Chart for Roof Operation and check the operation of the Hall sensors and position sensors. After finding the problem, be sure to restart the control module and check the system to make sure the convertible top works correctly.

No-code ETM problem

Electronic throttle modules can make a vehicle run poorly, might cause an uneven idle, or the vehicle might die coming to a stop and never set a diagnostic trouble code. You will want to hook up VIDA and, in Vehicle Communications, go to ECM and monitor the



Using VIDA to monitor misfire problem in vehicle

Taking a compression test on each cylinder to measure compression

Fuel sensor to be replaced per TJ 33794.2.0.

Flow chart for roof operation

Tables for roof opening

Note!
For a more detailed description of Hall sensor locations, see Location of components.

Opening the roof

	Side windows down	Releasing the trunk catch		Opening the trunk, releasing the front catch and the body catch		Extending the cover plate		Releasing teh rear catch and opening the front roof section	
		Before	After	Before	After	Before	After	Before	After
Position sensor 2, rear roof seciton		Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
Position sensor 17, front roof section		Closed	Closed	Closed	Closed	Closed	Closed	Closed	Activating the rear roof section
Hall sensor 1		Active	Active	Active	Passiv	Passive	Passive	Passive	Passive

Flow chart for hardtop convertible operation in VIDA

system while running. Check fuel pressure and oxygen sensors, and check for anything out of the ordinary.

Check the connections at the fuel sensor, air mass meter and related parts. Smoke test the vehicle to make sure there are no air leaks. It is possible an intake manifold leak could be a problem. After checking basic procedures and everything seems to be good, check the electrical connector at the ETM. Be careful with the connections; the terminals are gold plated and need to be handled with caution. Make sure to check for power and ground, which are probably there with no diagnostic trouble codes.

Remove the throttle housing to check for carbon buildup at the throttle plate. If the throttle plate is extremely dirty and the throttle plate has resistance, you might be able to clean the throttle plate and install it in the vehicle to see if there is a difference in the vehicle's driving performance.

You might be able to feel a difference in the performance, and, if the vehicle is running correctly at startup and after it gets warmed up, you probably touched on the problem. If the vehicle still has a performance problem, replacing the ETM might be necessary to solve your problem. Make sure to check VIDA to see if a software update is necessary for this vehicle.

Having a code in the system can definitely help in identifying and repairing the problem. When you have

Electronic Throttle Module (ETM) that has been removed from vehicle, and throttle plate build up has caused the throttle plate to have resistance.

no code in the system, it can make the problem a little harder to track down. Always start with the basics—power and ground checks, air leaks, fuel pressure and ignition spark. Using VIDA will help you with diagnosing problems in Volvo vehicles. ●

Volvo Fuel Injectors

If you end up replacing the fuel pressure sensor on one of these Volvos, make sure that you use the part number of the old one and pay attention to the color—different ones will fit but can cause driveability issues.

History

Volvo has been using fuel injection on their cars as long as we can remember. The designs have changed over the years, but the basic idea has remained the same.

Volvo first used fuel injection on the P1800 series cars in 1970. Volvo used a Bosch-designed system called D-Jetronic, the injectors were electrically controlled, and the system actually had an electronic control unit. Incidentally, the "D" comes from the German word for pressure, and the "D" was added later to the original "Jetronic" name to distinguish this system from later Bosch Jetronic versions.

There was no oxygen sensor, because it had not been invented yet, but the system did use a MAP sensor that looked like something that Captain Nemo might have designed.

Some of these cars are still on the road today.

These early fuel injection systems are, obviously, a far cry from the fuel injection systems that are used in today's cars, but some of the old designs still exist; they're just more refined.

The main difference between the older fuel injection systems and the modern ones is the way the fuel is regulated and delivered to the combustion chamber.

In the old days, the average technician would start their fuel injection system diagnosis by looking at fuel pressure, spray patterns, and maybe even hooking up a 4 or 5 gas analyzer to the tailpipe to check the tailpipe emissions in order to diagnose fuel system problems.

These days it's a little more complex, but we have a lot more data and tools to help us find any issues in the cars' fuel systems.

Fuel and smoke coming out of the tailpipes

Fuel injector problem case study: 2012 Volvo S60

This car was actually driven into a shop with a complaint of smoke coming from the exhaust and a flashing Check Engine light.

But that was only part of the story. When the customer was interviewed about the symptoms and asked how long the car had been smoking, they responded with the very common customer saying... "I'm not sure."

When the car was started and driven into the shop, the symptoms came on right away. Not only did a massive amount of smoke come out of the tailpipe, but there was a raw fuel smell and what looked like water dripping out of the tailpipes.

The technician immediately shut off the engine and, together with the other techs, pushed the car onto a lift.

The liquid that was dripping out of the tailpipes turned out to be raw unburned fuel (YIKES!).

That meant that a lot of fuel was in the exhaust system. Think about it; look at the average exhaust system and picture the internal volume—how much fuel could it hold?

This was a big problem, because with that much fuel in the exhaust, that meant that one or more of the cylinders was probably full of fuel too.

Can you say Hydrolock?

Damage can happen in an instant, so remove the spark plugs before you try to turn over the engine.

If you continue to crank over the engine that is filling with raw fuel, hydrolock can be a real possibility, so don't do it; you may end up bending some connecting rods.

If a car that you are working on comes into your shop dripping raw fuel out of the tailpipe, do not try to crank over the engine to clear the flooded spark plugs because one or more of the cylinders may be filled with fuel. It is very possible that you could cause permanent damage when the pistons try to compress all that fuel.

Well, luckily for the shop and the customer, this was not the case.

Before this Volvo was worked on any further, the car was put outside to dry out. The fuel pump relay was removed and the spark plugs were removed.

Of course, the plugs were fuel fouled and the cylinders were wet with fuel, some more than others.

After you figure out what the problem is and fix it, you should always replace the spark plugs, and change the engine oil and oil filter, because the engine bearings don't get much lubrication from gasoline.

Major bearing damage is uncommon, but you should inform your customer of the possibilities and write them up in detail on the work order, so if the engine has problems in the near future, you can cover your bases with a paper trail.

As far as the fuel in the exhaust system, after the car was parked outside for a couple of days, most of the fuel had drained out or evaporated.

The tech that was working on this Volvo started their diagnosis by using VIDA software and a laptop to connect to the car to read codes and check for any stored freeze-frame data.

The tech also hooked up a Midtronics battery support unit to make sure that the system voltage was maintained so the test data would be accurate.

If you are repairing a car that has been dumping raw gas into the combustion chamber and washing down the pistons, you should always recommend that your customer have the spark plugs, engine oil and oil filter replaced after the problem is solved because in most cases the engine oil will be saturated with fuel.

Volvo has issued a Technical Journal (TJ 16405) that explains the use and functions of the Midtronics battery support system.

But before the key was cycled to the On position, the tech took the precaution of removing the spark plugs

When you need to use a scan tool to diagnose a Volvo, the best choice is always VIDA.

When you are performing diagnosis and testing on a Volvo's fuel injection system, you should always hook up a battery voltage maintainer such as the Midtronics psc-550 or similar. This will ensure that your readings and testing won't be affected by low battery voltage.

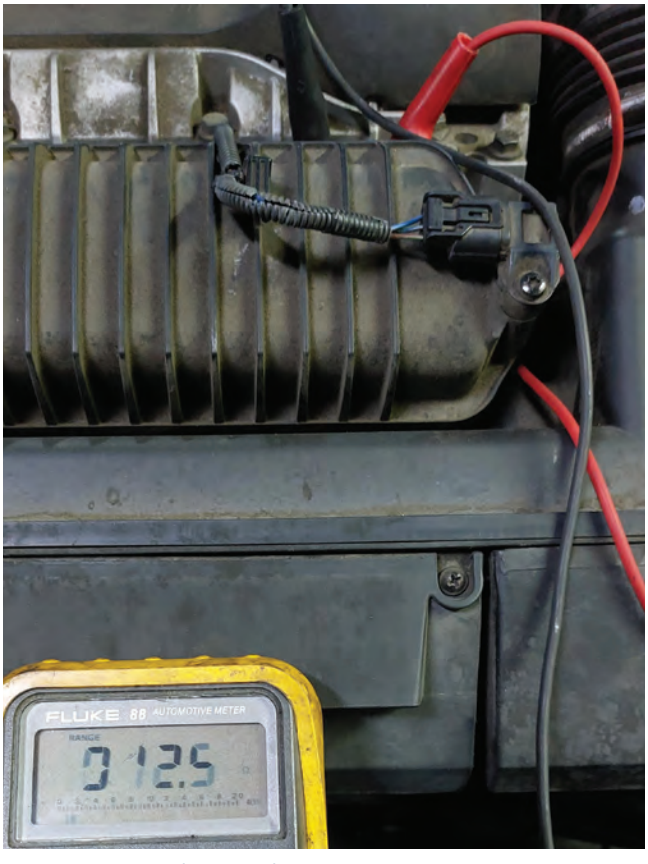
to see if injectors were spraying fuel when they were not supposed to.

After all, the tech did not know what was causing the large amount of fuel to be shot into the engine.

The tech hooked up a fuel pressure gauge to the fuel rail. The fuel pressure turned out to be in the normal range at first, but with the key on and the engine off, the tech started to smell raw fuel and saw that the fuel rail's test pressure was fluctuating and dropping.

The tech turned off the key and then used a flashlight to look into each cylinder. Cylinders 1 through 4 were dry, but cylinder number 5 had about a quarter inch of raw fuel on top of the piston.

Old injector Ohm reading



New injector Ohm reading

There was obviously a problem with the number 5 injector or the signal to that injector.

The only codes stored in the ECM were for misfires. That probably rules out a signal problem, because a short or open in one of the injector circuits is a one trip fault and should set a trouble code immediately.

You can check the resistance of the injector with an Ohmmeter; the normal resistance specification is 12 Ohms at about 68° F, or about 20° C. (View the Volvo 2012 S60 system specs online, at: bit.ly/2012S60Spec.)

In the case of this Volvo, the bad injector had the same resistance as the new one—around 12 Ohms.

The defective injector was mechanically broken internally, allowing the injector to act like a hose nozzle.

The shop recommended that all five injectors be replaced at the same time because all the injectors were the same age and had the same mileage on them. But the customer opted to only replace the one defective injector and the oil, filter, and spark plugs, because of budget constraints.

In the case of this car, it's important to document all findings and to explain to the customer that the over-fueling condition could have caused damage

Designation	Type	Supply voltage	Value	Other
Air conditioning (A/C) relay	Mechanical relay	12V (#1)	Approximately 70 Ω (coil)	
A/C pressure sensor	Absolute manifold absolute pressure (MAP) sensor	5 V (#3)	-	
A/C control valve	Electromagnetic valve	12 V (#2)	10.6 Ω at 20 °C (NOTE! large difference in resistance depending on the engine temperature).	The valve is controlled by a pulse width modulation (PWM) signal
Stop lamp switch	Position switch	12 V (#1)	The switch is closed when the pedal is depressed (terminals #1-#2)	
Fuel temperature sensor	NTC resistor	5V (#3)	5896 Ω at 0 °C 3792 Ω at 10 °C 2500Ω at 20 °C 1707Ω at 30 °C 1175 Ω at 40 °C (#1-#2)	Integrated in the fuel pressure sensor
Fuel pressure sensor	Piezo resistive pressure sensor	5V (#3)	-	
Engine cooling fan (FC) control module	-	12 V (#2)	-	
Evaporative emission system (EVAP) valve	Electromagnetic valve	12 V (#1)	17-24 Ω at 20 °C (#1-#2)	
Accelerator pedal (AP) position sensor	Electronic pedal sensor with two output signals, PWM and a linear analog signal	12 V (terminal #1) 5 V (terminal #6)	-	
Throttle unit	Electronic throttle module (ETM) with two integrated potentiometers and a throttle motor	5 V (#3)	1.2-3.5 Ω (terminals #1-#4 motor winding). 1000-1500 Ω (terminals #2-#3 Parallel connection of potentiometers 1 and 2). Approximately 820 Ω when the throttle is closed. Approximately 1580 Ω at wide open throttle (terminals #2-#6 potentiometer 1). Approximately 1480 Ω when the throttle is closed. Approximately 500 Ω at wide open throttle (terminals #2-#5 potentiometer 2)	
Injector	Electromagnetic injector valve	12 V (#1)	Approximately 12 Ω at 20 °C (terminal #1-#2)	
Camshaft sensor	Magneto-resistive sensor	5 V (#1)	-	
Knock sensor (KS)	Piezo electric component	-	Greater than 1 MΩ (terminal #1-#2 front knock sensor (KS)). Greater than 1 MΩ (terminals #3-#4 rear knock sensor (KS))	Separate signal ground for the knock sensors (KS)
Clutch pedal switch	Position switch	12 V (#1)	The switch is closed when the pedal is depressed (terminals #1-#2)	
Boost pressure sensor	Absolute manifold absolute pressure (MAP) sensor	5 V (#3)	-	
Preheating front heated oxygen sensor (HO2S)	PTC resistor	12 V (#3)	2.6-3.4 Ω at 20 °C (#3-#4)	

Volvo 2012 S60 system specs

to other parts like the catalytic converter and the oxygen sensors.

The usual suspects are fuel pressure regulator, fuel injector signal problems from the ECM, or one or more faulty fuel injectors.

Let's start with fuel pressure. The normal fuel pressure for this Volvo is 400–480 kPa.

You can use a scan tool or or Volvo's Service, Parts and Diagnostic Application VIDA (Vehicle Information and Diagnostics for Aftersales) to read live data and see what the ECM is reporting the fuel pressure to be. But in cases like this, it's always a good idea to verify the actual fuel pressure with a good fuel pressure gauge setup. Volvo sells a nice setup that's available from Volvotechinfo.com or from your local Volvo retailer's parts department.

Fuel pressure sensor

The fuel pressure data that the ECM sees is calculated by the fuel pressure sensor (or pressure control switch). This sensor is located on the end of the fuel injector common rail.

These sensors can fail over time, but they usually will cause mild symptoms like poor fuel mileage, and will usually set a specific trouble code.

If you have to replace the fuel pressure sensor, remember to relieve the line pressure before you pull off the sensor or you may get a face full of fuel.

Also, when ordering a new fuel pressure sensor, you should get the part number from the old part because there are multiple variations and all of them will fit, but not all of them will perform properly.

Pay attention to the color of the plastic on the top of the sensor; if the sensor has a black plastic top, don't install a sensor with a gray top. The car will start and run but there will be a lack of power and it will eventually set a trouble code.

How the system checks itself: The Volvo OEM fuel Pump Electronics control Module (PEM)

The Engine Control Module (ECM) controls the fuel pressure via the fuel pump control module using a Pulse Width Modulation (PWM) signal. The fuel pump control module then controls the fuel pump depending on the pressure requested by the ECM.

The diagnostic trouble code is stored if the actual pressure (measured pressure from the fuel pressure sensor) pulses too much.

General

The PEM, or fuel pump control module, has no functions for diagnostics. Instead, fuel pressure control components and functions are diagnosed by the ECM.

The following components and functions are diagnosed by the engine control module. Diagnostic trouble codes can be stored for each component and function:

- **Fuel pump control module or PEM:** A diagnostic procedure checks the power supply. A diagnostic trouble code will be stored and the fuel pump will not work if there is no power supply to the fuel pump control module. The fuel pressure sensor is equipped with an integrated fuel temperature sensor; a diagnostic procedure checks the pressure and temperature signals to see if they are outside the normal operating range of the sensor.

  If a fault in the fuel pressure sensor itself is detected, the fuel pump will run at a pre-defined power and the pressure is governed by the bypass valve in the fuel tank.

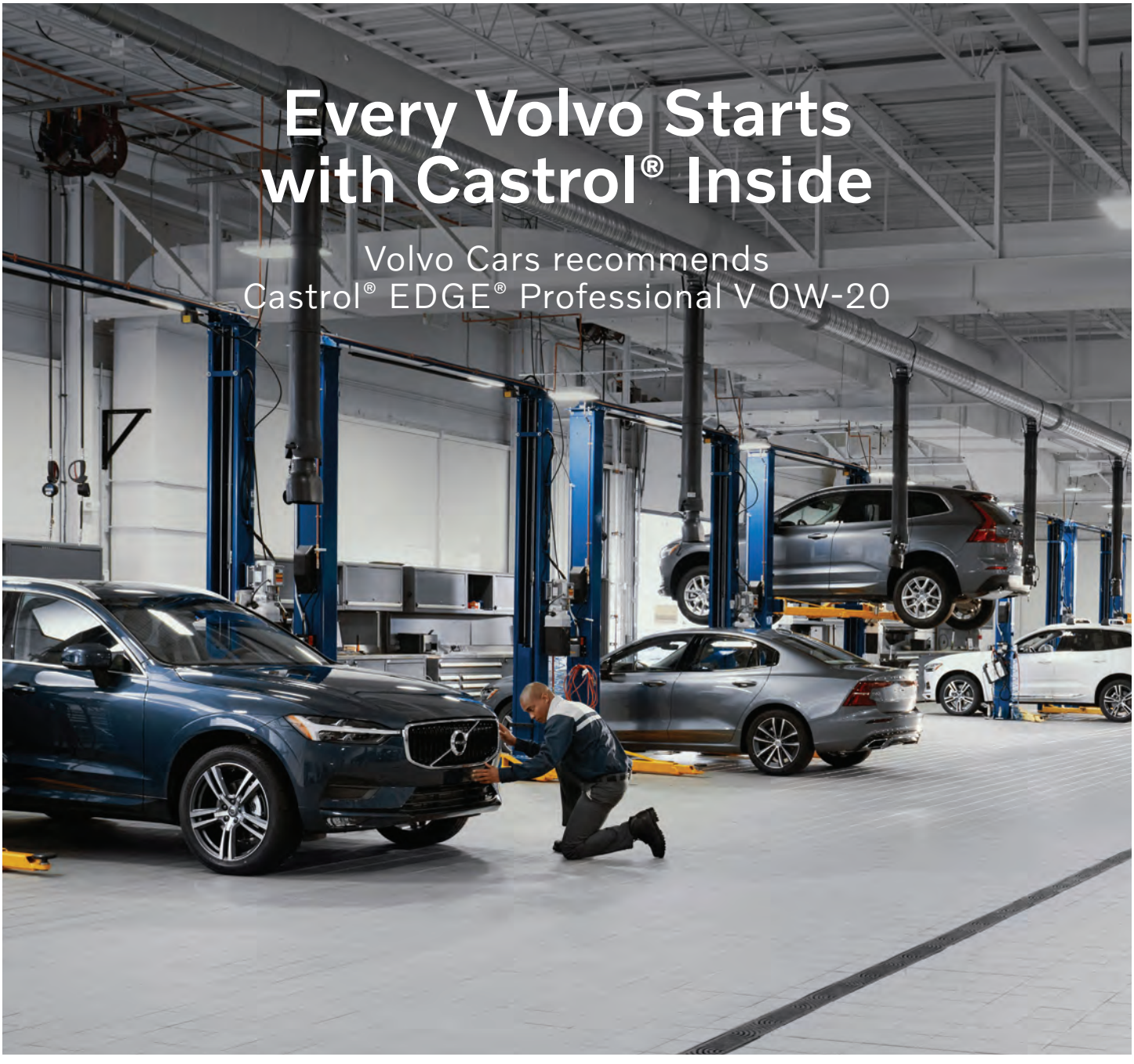
- **Fuel pressure**: The engine control module compares the requested pressure with the measured pressure (signal from the fuel pressure sensor). If the measured pressure deviates excessively from the requested pressure, or if the pressure pulses, a diagnostic trouble code will be stored for incorrect fuel pressure. The comparison is not active if a diagnostic trouble code for the fuel pressure sensor is stored. A DTC for fuel pressure will be stored if there is a fault in the fuel pump.

- **Communication cable**: The engine cannot be started if there is a fault in the communication cable between the engine control module and the fuel pump control module. A diagnostic trouble code will be stored for the fault.

Components and functions which cannot be diagnosed: If there is a fault in the bypass valve in the tank unit, the starting process of the engine will take longer if the valve is leaking fuel when the fuel pump is off. If the valve does not open when there are pressure peaks in the fuel system, engine operation will be affected negatively, especially after engine braking. The fault can also cause rough idling.

These units rarely go bad unless the connections become corroded or loose from accident damage or rust. This can happen especially in the snow and salt states.

If you work on some of these cars, you may have seen this. ●



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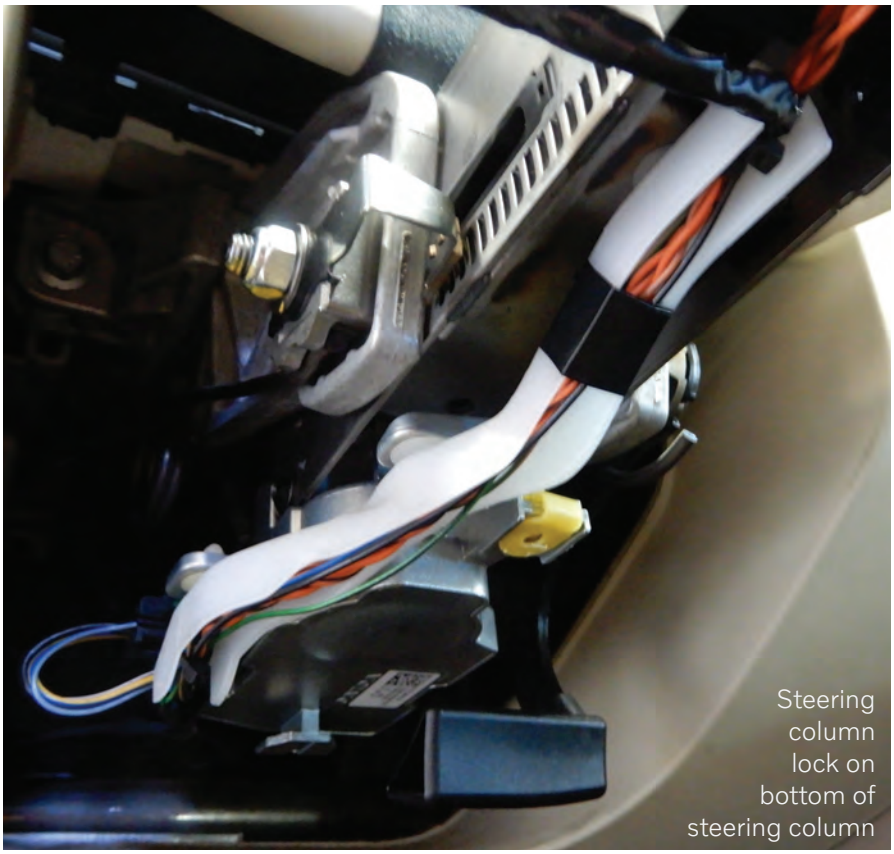
Steering Column Lock (SCL)

Shown here: Bottom of steering column, removing bolt and lift up steering shaft joint so that it releases from the steering gear

The steering column lock locks the steering wheel in place when the vehicle has been shut off and the key or fob is removed. Different from the conventional key and tumbler, the steering column lock is on the bottom of the steering column.

The steering column lock probably won't be a problem until it is. You will get a call from a customer and their vehicle won't start, or they'll report that the steering wheel is locked and won't turn. Sometimes, they will try to start the vehicle and it won't do anything, and they might get a message on the driver's information module saying there's a problem with the steering column lock module.

After the vehicle has been towed in, the first thing to do is check the vehicle for diagnostic codes. A common code is CEM B102649: steering column lock, system internal fault, internal electrical failure. Another common code is B102671: steering column lock, mechanical failure, actuator stuck.



Steering column lock on bottom of steering column

Steering Column Lock (SCL) module

For this diagnostic code B102671, the Steering Column Lock module (SCL) checks the operation of the steering column lock. The steering lock plunger's position is controlled through a switch and the information is sent to the Central Control Module (CEM). When the key remote or fob is removed from the ignition starting unit, the CEM sends a request to the steering column lock module to lock the steering column.

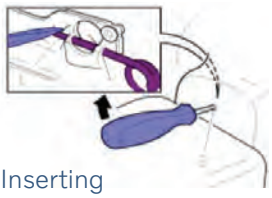
This code usually indicates that the steering column lock plunger is not in its lock position, so it could be broken or jammed. If for some reason you check diagnostic trouble codes in a vehicle and steering column lock codes are in the system, it would be a good idea to replace the steering column lock module sooner rather than later.

Here we have a 2008 XC70 that was towed in with a no start. After connecting Volvo's Service, Parts and Diagnostic Application VIDA (Vehicle Information and Diagnostics for Aftersales) and checking codes, we found that the steering column lock module was bad and needed to be replaced.

When replacing the steering column lock, you will first need to see if you can get the steering wheel straight as can be so you don't damage the steering angle sensor under the steering wheel.

Once the steering wheel is straight, make sure to leave the key in the switch. Disconnect the battery in the vehicle.

Remove the driver's air bag in the vehicle. Using a small screwdriver to release the air bag, turn the steering wheel to the side and insert the screwdriver at the back of the steering wheel to release the air bag. You will need to do both sides of the air bag.



Inserting screwdriver to release driver's air bag

Once the air bag is released, unplug the electrical connector at the back of the air bag, and set the air bag to the side out of the way. Center the steering wheel and insert the screw that is located in the steering wheel to hold the steering angle sensor in place. Remove the center bolt that holds the steering wheel onto the column. Remove the steering wheel from the vehicle.

Set the steering wheel out of the way. Remove the column panel trim, three screws on the bottom, and pop the top portion loose. Remove the three screws that hold the steering angle sensor in place, and disconnect the electrical connector. Remove the steering angle sensor.

Now remove the steering wheel control module, two 7 mm bolts on top. Disconnect the electrical connector from the module. You can leave the combination switches attached and take them off as one unit; just make sure to unplug the electrical connectors.

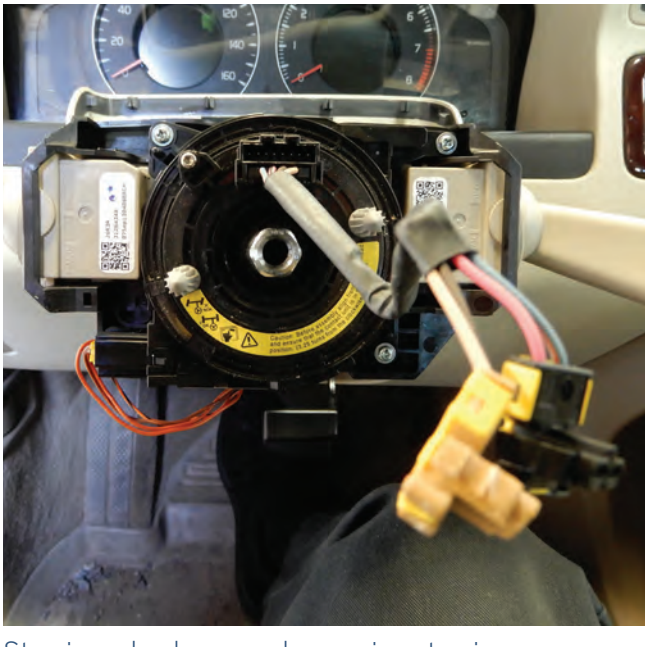
On certain models you will need to remove the driver's kick panel and knee bolsters. The knee bolster has four bolts in front to remove. Once they're removed, set the knee bolster to the side. The brackets that hold the knee bolster can be removed also to give you a little more room to get the steering column out of the vehicle.

Remove the bolt at the bottom of the steering column that connects the steering column to the steering rack. Mark the column and steering rack where they come apart and make sure the position of the wheels does not change. It's very important to put the steering column back together in the same position.

Remove the connection at the steering column lock module. Remove the cable harness from the steering column.

Remove the four bolts that hold the steering column in place, making sure not to break the ignition cable for the pyrotechnics sensor. Once the four bolts are removed, angle the steering column so you can get to the plate over the connection for the pyrotechnics sensor. Six T25 torx screws hold the plate in place. Once the plate is removed you can remove the complete sensor and disconnect the connector.

Now you will be able to remove the steering column from the vehicle.



Steering wheel removed, exposing steering angle sensor

Trim around steering column needs to be removed

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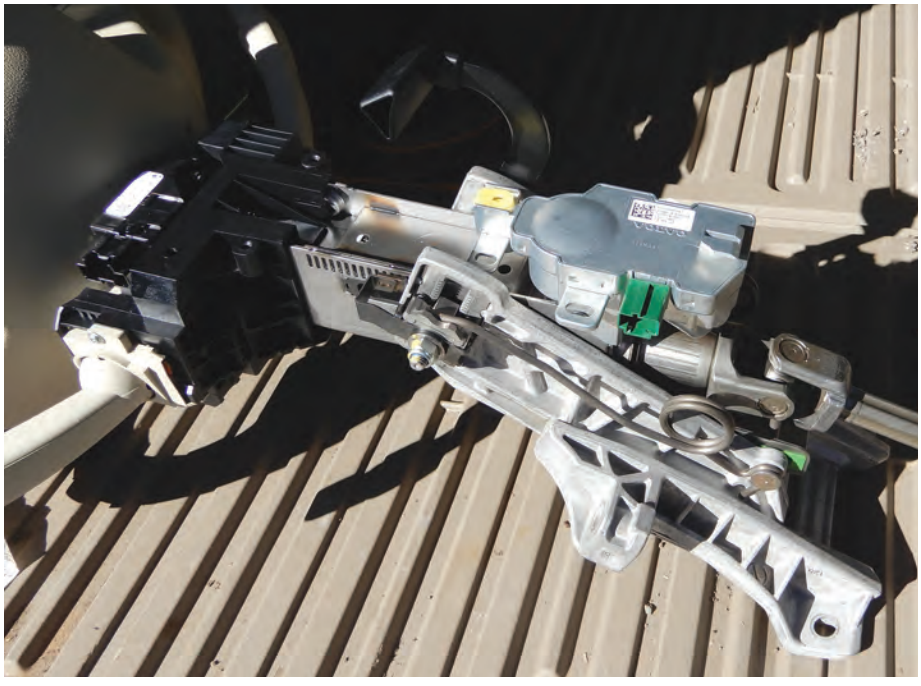
With the steering column removed and sitting on the bench, you will need to drill out the breakoff screws that hold the steering column lock in place. Using a 1/8 inch drill bit, drill into the bolt enough for an easy out to fit inside the drilled hole, and remove both bolts.

Now that the lock is removed, blow out the area with compressed air to get rid of metal shavings. Install the new steering column lock onto the steering column, making sure it sets in place. Install the two breakoff bolts and tighten until the heads break off.

Now that the steering lock module is connected to the steering column, install the column into the vehicle. You will need to angle the column into place and reconnect the pyrotechnics sensor, making sure not to stretch the wires so the connectors don't pull out of the connection. Install the metal plate over the pyrotechnics sensor, and tighten the six T25 torx screws that hold it in place.

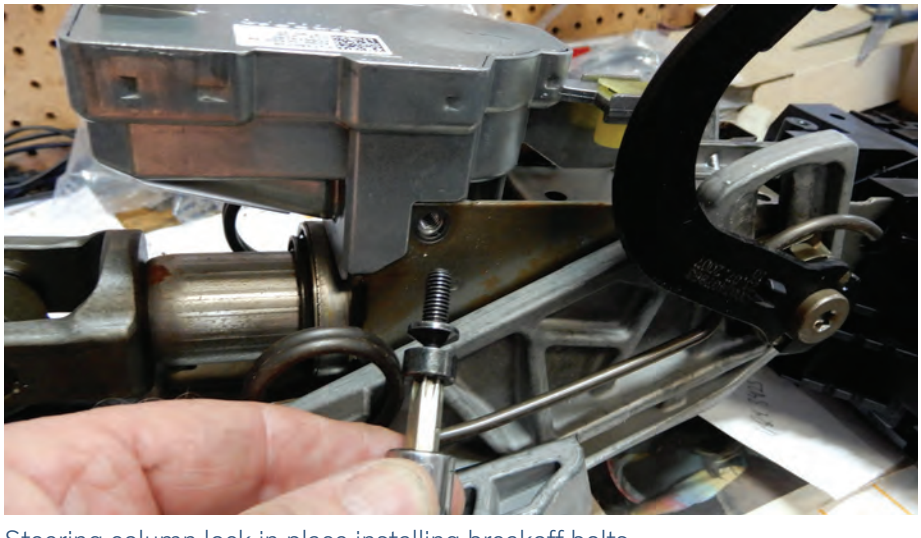
Set the steering column into place and install the four bolts that hold it in place. Tighten the bolts securely, making sure that the steering column has not moved. At the bottom of the column, install the steering wheel shaft to the steering rack and insert the bolt and tighten. If for some reason the shaft has play, replace the bolt that secures the shaft to the steering rack.

Set the electrical harness in place and attach the electrical connector at the steering column lock. Install the steering wheel module onto the steering column and tighten down the two 7 mm bolts at the top of the module.



Steering column removed from vehicle

Drilling out breakoff bolts on each side of steering column lock

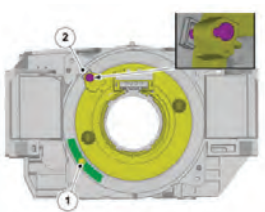


Steering column lock in place installing breakoff bolts

Steering Wheel Module (SWM) installed on steering column, the two bolts that hold it to column

If the vehicle is so equipped, install new bolster mounting brackets and knee bolster. Four bolts hold the bolster into place.

Install the steering angle sensor and secure with three screws. Attach the electrical connector to the combination switch and steering angle sensor. If for some reason the steering angle sensor comes out of position, make sure to adjust it properly. Secure the electrical harness at the bottom of the steering column.



Steering angle sensor in correct position

Install the panel trim at the top and bottom of the column with the three T25 torx screws at the bottom panel. Then snap in place the top trim panel. Install the steering wheel and remove the screw at the steering angle sensor that held the sensor from moving. Tighten the steering wheel. Connect the driver's air bag connectors and push the air bag into place.

Now that the steering column lock module has been installed, you will need to order software and download it into the vehicle. Make sure the vehicle starts OK and that there is no obstruction when turning the steering wheel. Test drive the vehicle.

Replacing the steering column lock module is pretty straightforward, and using VIDA to help diagnose it can come in handy. ●

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P1 Volvo Oil Separator (Oil Filter Housing) Replacement

Driving with the oil filter housing plugged causes the engine to break down oil seals. When this happens, the cam seal, rear main seal and valve cover can all start to leak.

Shown here: Two 8 mm bolts at bottom of oil filter housing that need to be removed

How will you know when to replace an oil filter separator or oil filter housing on a Volvo? Your customer will come in with a high-pitched sound from the engine. If you pop off the oil cap and the sound goes away, this is the problem.

Suction builds up inside the engine because the oil filter housing is plugged or it's failing. If your customer continues to drive with the oil filter housing plugged, the engine will start to break down oil seals, like the cam seal or the rear main seal, or the valve cover will start to leak oil. This is all because of high vacuum inside the Volvo engine.

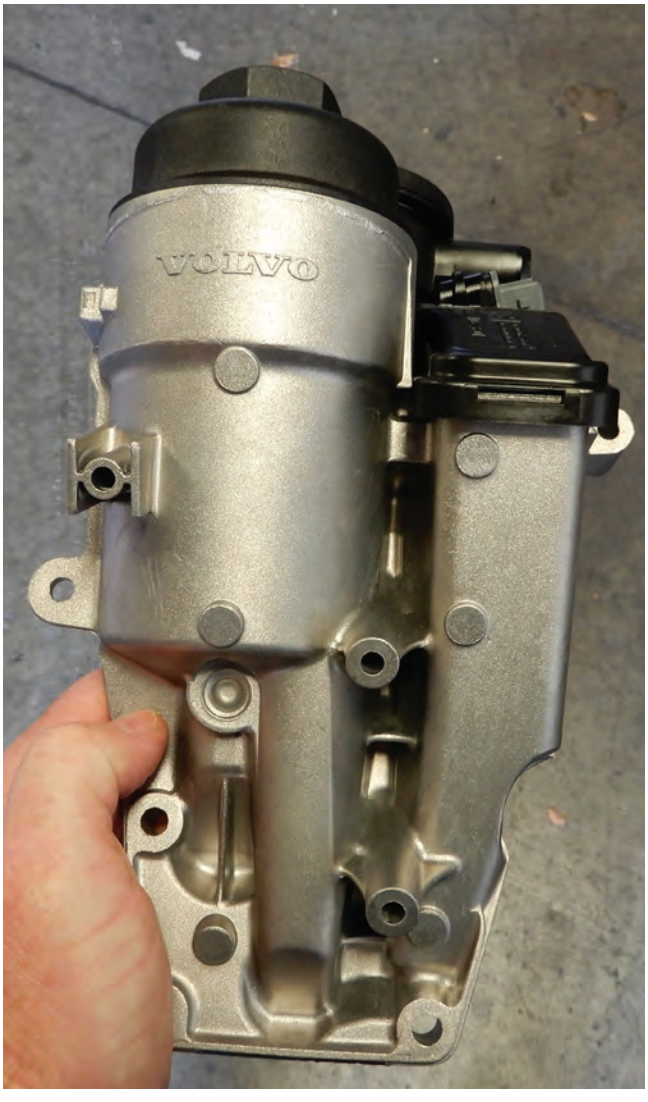
Sometimes when this oil filter housing becomes plugged and the engine creates a vacuum inside the crankcase, you might get some diagnostic codes, like long term fuel trim or an idle code. When the engine creates vacuum inside the crankcase, it's not happy and the idle could be a little rough.

The P1 Volvo platform involved includes the following vehicles. S40, V50, C30, and C70 with the five-cylinder engine.

So now you will want to drain the oil. First, unscrew the oil filter until the o-ring is exposed; this will allow the oil to completely drain from oil filter housing. Lift the vehicle up on a hoist and drain the oil using a 17 mm wrench. After the oil is completely drained, install a new oil drain plug washer and tighten back up.

The next thing to do will be to remove the pipe from the air mass meter to the turbo; a 7 mm clamp tool works well for these hose clamps. Remove the two 10 mm bolts that secure the pipe to the engine. One is at the back side of the pipe and one is on the back side of the cylinder head.

Remove the pipe from the vehicle. On certain models there will be vacuum hoses connected to it; disconnect hoses. Disconnect the hard plastic hose



Oil separator


7 mm hose clamp tool removing pipe from throttle housing to turbo

Hard pipe from air mass meter to turbo

from the intake manifold by pushing in on the red collar and pulling the hose loose. Remove the same connected hose from the brake booster and move it out of the way.

Now you will want to take off the cover over the spark plugs. Be sure to blow out or clean out the T30 torx bolts that hold the cover on. Remove the six T30 torx bolts from the cover and set aside. Remove the fresh air intake from the air cleaner box. Two 8 or 10 mm bolts secure the plastic intake. The top part should just turn and pull up to remove. For the bottom portion you will need to reach down at the bottom of the air filter housing and pull it back and forth to remove.

Remove the dipstick. Now you need to remove the air filter box that has the ECM attached to it. The best way to do this is to remove the engine mount at the front of the engine or on the right side of vehicle. Pull up on the coolant expansion tank until it's loose from its mounts. With the hoses still connected, place the expansion tank over the top of the engine and let it sit there.

With a 15 mm socket, pull out the two bolts that hold the top part of the mount. You will need to remove the plastic rock shield cover from underneath the vehicle. Support the engine under the front of the oil pan. Use a piece of wood and jack to support the engine, being careful not to damage the oil pan. Now remove the rest of the engine mount, two 15 mm bolts at front of the engine. Disconnect hose clamp at hose for the throttle housing. With the mount out of the way, you can now jack up the engine about four inches; this will help to remove the air filter housing.

The two bolts that secure fresh air intake

Front engine mount that needs to be removed

Electrical connectors at ECM that need to be removed carefully, not to break connectors

Disconnect the battery negative terminal and make sure that it doesn't touch the battery terminal. Now disconnect the air mass meter connector. With a T25 torx socket, remove the air mass meter from the air filter box, so as not to damage it. Remove the cover over the ECM, exposing the electrical connectors. These connectors sometimes get very difficult to remove, so it's a good idea to squirt a little penetrant on the connectors to help them slide better.

Push the little tab down and then slide the red handle down, being very careful not to break the connector. There are two connectors at the ECM. (See image bottom of page 32.)

Now pull the complete air filter box up and wiggle it out of the mounts it sits in. Once the air filter box becomes loose, you will need to disconnect the harness that is attached at the bottom of the air filter box on the ECM side. A T30 torx screw needs to be removed, along with any tie straps. Slide the harness from the air box so that it's not attached. Slide the air filter box to the right and wiggle it out of the vehicle.

Now that the air filter box is out of the way, you can now get to the oil filter housing. Remove the 8 mm bolt that holds the dipstick tube in place and remove it from the vehicle.

Remove the two 8 mm bolts at the bottom of the oil filter housing; you will need to move the electrical harness out of the way to get to the 8 mm bolts. (See image on page 30.)

Now lower the vehicle and remove the hose from the oil filter housing to the valve cover. You can use a screwdriver to remove the one-time clamps—just push down and release the clamp. You will need to replace these clamps when installing the new hose.

Unplug the electrical connector at the oil filter housing. Remove the top 10 mm bolts that hold the filter housing to the engine block. Remove the oil filter from the oil filter housing and set it aside. Now you can pull off complete oil filter housing unit.

With the oil filter housing removed, you will want to clean the engine block and make sure there are no restrictions inside the engine block.

Install the new filter housing, making sure not to get any electrical wires pinched behind the filter housing. Install the 10 mm bolts and tighten unit down to the engine block. Install the two hoses that connect to the valve cover, and the hose that

attaches at the cylinder head to the oil filter housing. Plug in the electrical connector at filter housing.

Install the dipstick tube using a new seal and make sure to clean the engine block before installing. Lubricate the seal so it will slide into place nicely. Secure the dipstick tube to the filter housing using the self tapping screw; make sure the screw goes straight in when threading.

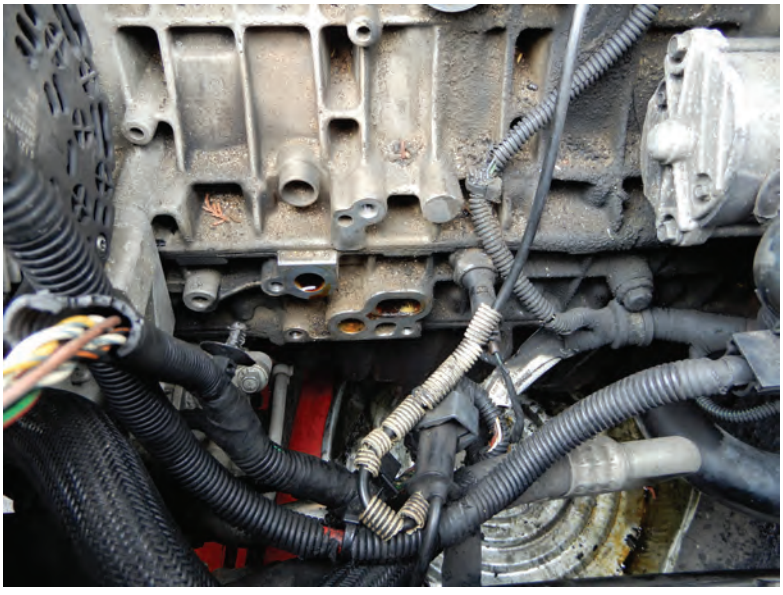
Now that the oil filter housing is installed, you can now install the air cleaner box. With the engine still jacked up, fit the air box back into place. Adjust the harness at the bottom of the air box back into place and secure with the T30 torx screw. Push down on the air filter box and secure into the rubber mounts.

Now install the electrical connectors at the ECM, making sure to align the connectors and slide into place and lock down. Install the air mass meter with the two screws that hold it to the air filter box.

With the air filter box back into place, lower the engine from the jack and install the front engine mount. First, install the mount to the block with 15 mm bolts, and then install the two 15 mm bolts at the chassis. Fit the coolant expansion tank back into place and push it down to secure.

Insert the cover over the ECM. Install the fresh air duct at the air filter housing and secure with two 8 mm bolts. Plug in the electrical connector at the air mass meter. Set the plastic cover over the spark plugs and tighten the T30 torx screws. Install the pipe from the air mass meter to the turbo and tighten the clamps. Connect the vacuum hoses to the pipe. Install the two 10 mm bolts that hold down the pipe from the air mass meter to the turbo, one at the back of the cylinder head and one at top of the valve cover.

With everything back together, add engine oil and start the vehicle. Bring it up to operating temperature and check all your work. Test drive the vehicle and reset any codes that might be in the system. ●



Oil filter housing removed from engine block and cleaned for new filter housing

Plugging in electrical connector at oil filter housing

Coolant expansion tank back into place

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What do independent repair facilities and authorized Volvo retailers have in common? Our shared commitment to make Volvo drivers happy through safe maintenance solutions. One way to achieve this is to only install Genuine Parts.

The advantages are clear. Today's sophisticated safety and performance features demand replacement parts that are manufactured to Volvo specifications. Thus, we always recommend Volvo Genuine Parts. Additionally, Volvo Genuine Parts also fit perfectly on the first try, which saves you time and money. Add to that a 2-year limited warranty* and you have a formula for satisfaction that's unmatched.

But there's more. Volvo can support your business on many levels. We cater to your needs with easy ordering, unrivaled availability, and you get access to technical information. Satisfied Volvo customers are the basis of a rewarding relationship.

Visit the Volvo Car Bookstore (volvotechinfo.com) for Technical Information, Special Tools and other important support links.

*Warranty excludes consumable "wear item" parts, labor and accessories.