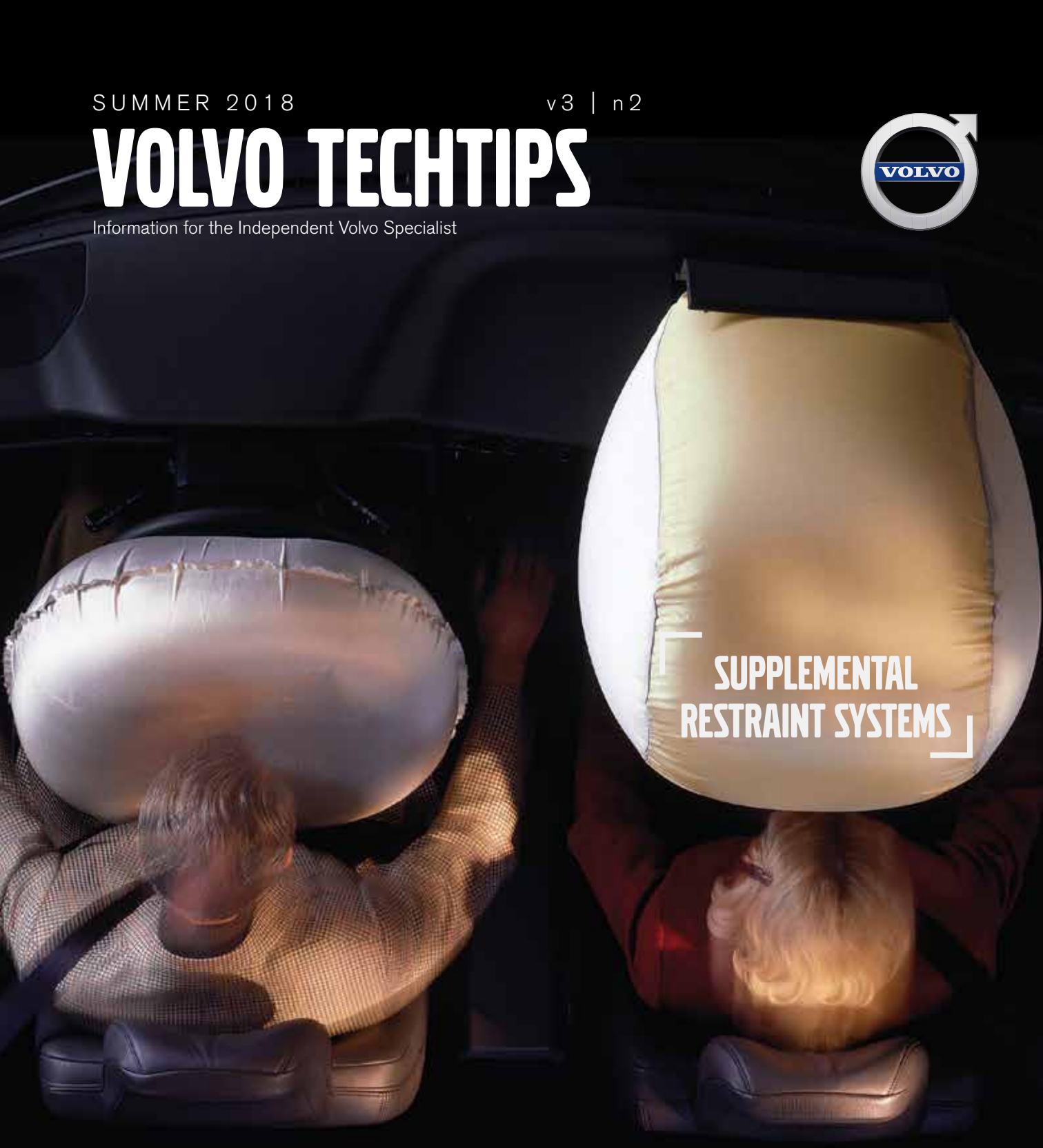
SUMMER 2018 v3 | n2

VOLVO TECHTIPS

Information for the Independent Volvo Specialist



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VOLVO TECHTIPS

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FEATURES

HIGH MILEAGE VOLVOS

OVER THE YEARS OF HOT AND COLD TEMPERATURES, USE, AND ABUSE, SOME OF THE AUTOMATIC TRANSMISSION PLASTIC SHIFTER PARTS CAN WEAR AND CRACK.

Broken shifter rocker arm on 2001-XC70/V70/ XC90/S60/S40/ V50/C30/C70 Volvo equipped with Geartronic automatic transmissions.

Over the years Volvo automatic transmission shifter assemblies and controls have tended to be reliable, tough and relatively problem-free, even when your customers let the dog, and sometimes the kids, abuse them.

But, of course, over the years of hot and cold temperatures, use, and abuse, some of the plastic shifter parts can wear and crack.

Sooner or later you will probably see one of these Volvos come into your shop, sometimes on a tow truck.

Your customer will complain about the shifter not staying in Park and slipping down into the manual (Geartronic) shifting mode.

Sometimes your customer will try to temporarily "fix" this condition themselves in some creative ways that will include duct tape or rope in an attempt to keep the car in Drive.

Of course driving like this can cause unsafe driving conditions and the issue needs to be fixed properly.

In most cases this condition is caused by a part of the shifter's rocker arm or claw assembly being cracked or broken.

If you have a customer bring a Volvo in with a rope tied to the shifter to keep it from popping out of Drive, your customer probably needs to have the shift rocker arm assembly replaced.

And in most cases the shifter can be repaired with an inexpensive parts kit that is available from your local Volvo dealer's parts department. The Volvo part number is 9463559.

Of course before you start ordering parts you should inspect the shift control components and functions to make sure that this is the only problem area.

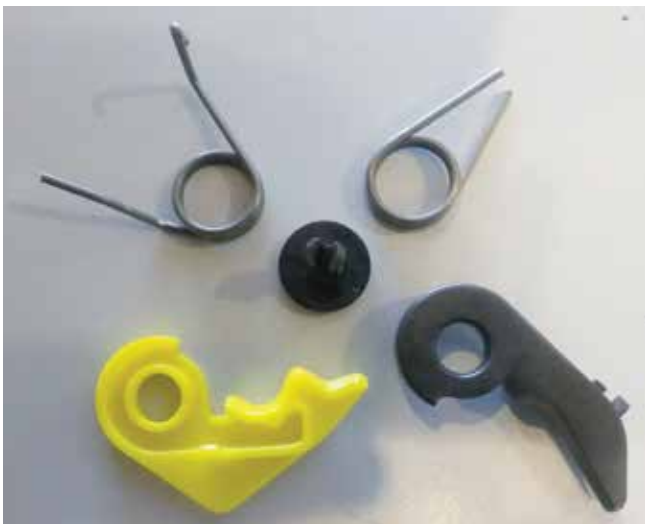
Start by parking the car on a flat surface and setting the parking brake and chocking the wheels to prevent the car from rolling while you inspect and repair the shifter mechanism. You will need to move the shifter through the gears and into Neutral while removing the shift knob, trim pieces and center console. You don't want the customer's car to start rolling down the driveway while you're working on it!

Some technicians prefer to remove the entire shift assembly to perform repairs but this is not necessary. If you do end up removing the entire shift control assembly, take extra care to mark and make note of the cable positions, and the wire harness routing. Make sure to move the front seats as far to the rear as possible to make it easier to access the panels around the shifter before you disconnect the battery.

Just like any repair that includes working around and removing electrical connections, the best practice is to always disconnect the battery at the negative post before you start.

BUT FIRST A WORD ABOUT DISCONNECTING THE BATTERY ON A MODERN VOLVO

Take extra care when replacing and disconnecting the battery on any networked Volvo. There are many reasons to do so besides having to reset the clock.



Volvo has a parts kit (No. 9463559) available that includes all the parts you will need to properly repair this condition.

HERE IS VOLVO'S OFFICIAL PROCEDURE

BATTERY, DISCONNECTING

Note before disconnecting Battery Cables

Warning! The SRS (Supplemental Restraint System) is active for a certain time after the power is cut. Therefore wait three minutes before starting work.

- If the malfunction indicator light in the combined instrument panel is illuminated, the diagnostic trouble codes for the management system must first be read out and remedied before battery power is cut off.
- The ignition should be off for at least five minutes before the battery is disconnected from the car to allow the control modules time to store information.
- If the vehicle is equipped with remote heating, the personal code is reset to the factory value (1-2-3-4) if the battery is disconnected or is discharged.

Caution! Always disconnect the negative battery cable before disconnecting any positive cables.

Note: Before connecting battery cables ensure that no live objects that can short-circuit the battery are under the battery's protective cover.

Warning! The key must be in position 2. No one must be in the car when the battery is reconnected. This is a safety precaution in case an air bag module activates when the power is connected.

Note after connecting battery cables you must do the following:

- Initiation of the Upper Electronic Module (UEM)
- Initiate the central locking system, interior lighting and sun roof by unlocking the car with the remote control, key or VIDA vehicle communication.

WINDOWS

- Initiate window positions.
- Calibrate the passenger compartment fan.
- If the car is equipped with Manual Climate Control (MCC) or standard climate control system, the fan speed must be recalibrated if the battery has been disconnected.
  - Ignition on.
  - Turn the fan control to Max.
  - Turn the fan control to Min.
  - The calibration is complete.

ENGINE

- If the battery was disconnected, the engine may need to run for a few minutes before it runs smoothly.

One thing that is not covered in this list of procedures is that, in some early Volvos (1999-2001) that have the "after blow" program software installed in the Climate Control module (CCM), these systems do not like the battery being disconnected while the CCM is running the "after blow" program.

The "after blow" software was developed to help dry out excess moisture from the car's evaporator, helping to prevent odors and possible mold growth.

It works by running the interior fan at half speed for 15 minutes, 50 minutes after the car has gone into sleep mode.

Some shops have reported damage to the climate control units by disconnecting the battery during the "after blow," so don't take any chances.

After you disconnect the battery, start disassembly by removing the shift knob.

This step is relatively easy, but can take a bit of brute strength.

Insert a small screwdriver between the boot and the gear selector lever knob to access the lock bracket. Carefully pry the screwdriver forward so that the lock bracket detaches from the gear selector lever knob.

Now grasp the gear selector lever knob with both hands and pull it straight upwards with a hard jerk. Try not to hit yourself in the face or damage that very expensive rear view mirror assembly or UEM.

Insert a small screwdriver between the boot and the gear selector lever knob to access the lock bracket.

Remove the panel (the pen holder) between the dashboard center console and the center console.

Pry out the panel at both ends. Use a “bone” or similar tool to pull the panel straight out.

Next, use a bone tool to carefully pop out the wood trim plate that surrounds the shift boot and display. There are four catches on the front and rear of the panel that should be depressed while you pull the panel up and out. Be careful not to crack that fake wood trim; it is brittle and is easily damaged.

Next, remove the lower panels on the left and right sides of the center console by removing the twist clips at the rear of the panels and pushing the panels forward to release them.

Remove the two T25 screws at the front of the center console.

Pry out the panel at both ends. Use a “bone” or similar tool to pull the panel straight out.

Open the arm rest and remove the contents and cover at the bottom that hides the two T25 screws, then remove them.

Next, open the arm rest and remove the contents and cover at the bottom that hides the two T25 screws, then remove them.

Now pull the panel that has the boot for the parking brake towards the driver’s seat and then pull the boot and cover over the parking brake handle to remove it.

Lift the center console from the rear and reach under it to disconnect the wire harness in the lower rear of the center console.

Carefully lift the center console assembly up and out towards the rear of the vehicle to remove it.

Now with all the panels and center console removed you have the access you need to inspect the shift control assembly.

Check for cracks in the plastic parts and check to see if any of the springs and clips are missing or loose.

Check to make sure that there is no dirt or debris, like loose change or paper clips, jamming the mechanism. Blow out the area with compressed air before disassembling the top of the shift control.

Use a panel tool or small screwdriver to carefully pry under the sides of the top cover at the back while pulling up at the rear. Once it releases, pull it up and over to the side; you can leave the wire harness connected.

Pull the panel that has the boot for the parking brake towards the driver’s seat and then pull the boot and cover over the parking brake handle to remove it.

Use a panel tool to pry under the sides of the top cover at the back while pulling up at the rear.

Now you will be able to see the rocker arm in all its broken or cracked glory.

At this point if nothing else is broken but the rocker claw parts (usually the yellow claw part), you can proceed to change out the parts that are included in the parts kit 9463559.

When the parts are removed make sure to blow out any broken bits of plastic and dust to prevent any sticking or jamming in the shift controls.

Reinstall all parts in reverse order and test the function and feel of the shift control.

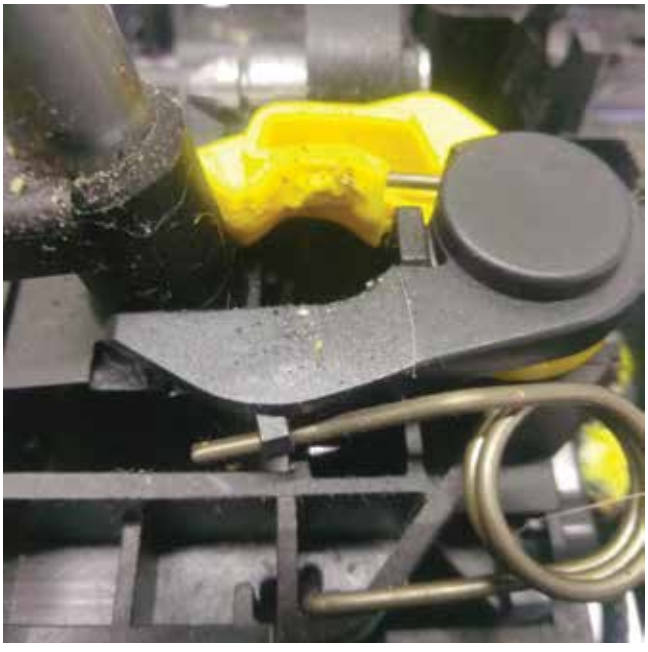
Reconnect the battery following Volvo's guidelines, then reset the clock and test drive.

STICKING IDLE AIR CONTROL (IAC) VALVE EARLY S/V40 2000-2004

There are still a fair amount of these first generation S/V 40 series Volvos on the road these days, and you probably still see them coming into your shop for service and repairs.

Volvo officially designated these models as the X40 platform. The first versions of the 40 series cars were seen in Europe starting in 1995. After a few years, and with improvements in the X40 platform cars, they were introduced to the U.S. market in 1999 and sold until 2004 when Volvo introduced the completely redesigned S40, released in 2005. This was part of the P1 platform cars which include the S40, C30, V50, and C70 Volvos.

View of the broken rocker arm



At this point if nothing else is broken but the rocker claw parts (usually the yellow claw part), you can proceed to change out the parts that are included in the parts kit 9463559.

These cars were manufactured at the Nedcar factory in the Netherlands as part of a joint venture between Volvo and Mitsubishi.

Introduced in the beginning of 2004, the second generation S40 (known as the 2004.5 Volvo S40) had a new design based on the Volvo P1 platform built at the Volvo Cars factory in Ghent, Belgium.

At the same time, the V40 was replaced by the V50, also based on the P1 platform and built in Ghent.

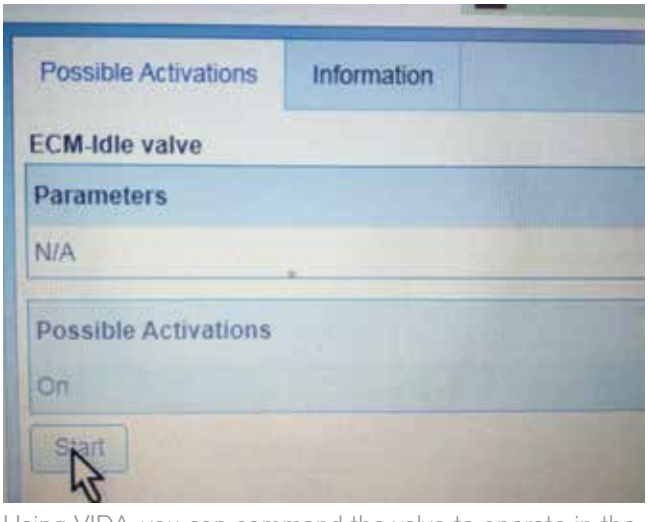
These early S/V 40s have some aging issues, such as deep cracks in the front brake hoses under the spring,

worn relays in the Central Electronic Module (CEM) that cause the low beams to lose power, and a few more we have covered in past issues.

The Idle Air Control (IAC) valves on these cars are built well and usually perform properly for a lot of miles.

But if you get one of these early S/V40 series cars in your shop with a stalling issue at idle, even if it's an intermittent issue, you may have a stuck or sticking idle air control motor.

As with any stalling issue, you should start by interviewing the customer about the symptoms, especially if the symptom is not presenting itself in your shop. Next check the ECU for any stored codes and freeze frame data. A lot of times these cars will not store a code for a sticking IAC.



Using VIDA, you can command the valve to operate in the Vehicle Communication tab.

Next, always make checking for intake air leaks part of your test procedure; using a smoke tester is a great way to do this. If there are no leaks in the intake and no other smoking guns, you should remove the IAC valve and test it. If you have VIDA you can command the valve to operate in the Vehicle Communication tab.

Or you can bench test the valve by applying power and ground directly to the pins on the valve.

But if you command the IAC with VIDA or a scan tool you will eliminate any issues in the wiring to the valve.

In most cases the valve will be full of carbon and will be stuck or sticking when you apply power. You could clean the valve and put it back on with a new gasket, but replacing the valve and gasket with new Volvo factory parts will make sure you have a repair you and your customer can count on.

NOT SO COMMON HIGH MILEAGE VOLVO ISSUE

Tailgate Open warning on all the time on 1999 - 2008 V70 / XC90.

How many times have you had a Volvo wagon come into your shop with the Tailgate Open message showing up on the DIM display, even when the tailgate is firmly closed and locked? Most Volvo shops will see these cars come in on a regular basis.

Over years of grocery shopping and taking the kids to the soccer game, these tailgates and their components take a lot of abuse. The door lock mechanism gets

Bench test the valve by applying power and ground to the pins on the valve.

locked, unlocked, opened, and slammed shut hundreds of thousands of times.

The door lock assemblies on these Volvos have a micro switch built into them that tells the Driver's Information Module (DIM) if the door is open or closed. These switches can wear out after years of use and cause a false Tailgate Open warning to come on intermittently or all the time. In the majority of cases, a new door lock assembly is the solution.

Of course in some cases a worn or broken tailgate wire harness is the cause of this issue.

But what happens when you have just replaced that worn old lock assembly with a brand new shiny one you just got delivered from your local Volvo dealer's parts department and the Tailgate Open warning is still coming on when the door is closed and locked?

The next logical step, unless you did this first, is to disconnect the tailgate wire harness connectors at both ends and use an ohmmeter to check for wires that are open or shorted.

(By the way, checking the wire harness for open or shorted wires should be done before you order that new lock assembly).

But what happens when you have that new part installed and you have checked the wire harness and it's good, but the Tailgate Open message is still stuck on?

The signal from the door's micro switch goes into the Rear Electronic Module (REM) and the Central Electronic Module (CEM) before it shows up on the driver's information module.

It is possible that poor or corroded connections at these modules could cause this issue, but it's unlikely.

The tailgate lock assembly's micro switch has two wires coming from it: one is the signal or powered side, and the other one is ground. What's interesting about the ground side wire is where it gets its ground.

The pink powered wire comes from the connector on the REM, the ground wire gets its ground for the connector on the left side of the rear window glass break detector. This is a thin wire that is part of the rear window defroster grid. The left side connector gets its ground from the other side of the defroster grid after it passes through the grid.

So we all know that the later Volvo rear window defroster grids are very tough and rarely have issues, but the fact that the tailgate open or closed status switch depends on the rear window defroster grid being intact and the rear window not being cracked or broken can't be overlooked.

The tailgate micro switch, that tells the driver if the tailgate is open or not, gets its ground from the connector on the right side of the defroster grid.

The ground wire for the rear window defroster grid/glass break detector comes from the right side of the grid and runs though the tailgate harness and down to a body ground point (31/72) behind the battery.

In most cases there will be a break in the ground wire inside the tailgate wire harness near the point where the harness bends inside the body near the roof. But in some rare cases a break in the grid in the rear window glass can be the culprit.

This issue is more common in wagons that are used as the "dog car" because a lot of larger dogs like to scratch at the back window to get their owner's attention. This scratching, of course, can cause breaks in the grid. The point is, check those wires for power and ground before replacing that part. ●

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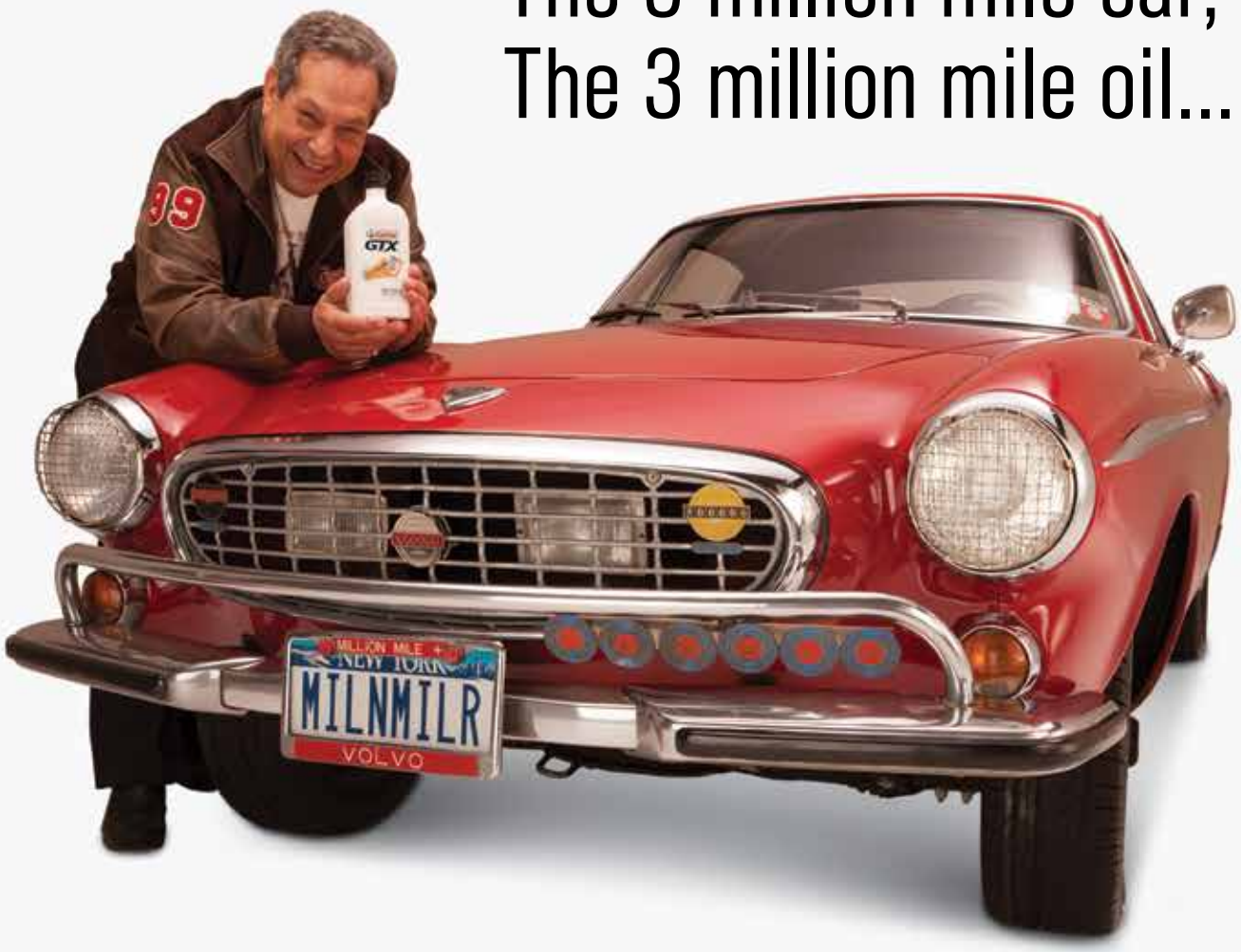

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SUPPLEMENTAL RESTRAINT SYSTEMS (SRS)

THE SUPPLEMENTAL RESTRAINT SYSTEM (SRS) FOR VOLVO STARTED WITH THE 1987 VOLVO. THIS SYSTEM CONSISTED OF SOME WITH DUAL AIR BAGS AND A CRASH SENSOR.

The Supplemental Restraint System (SRS) for Volvo started with the 1987 Volvo. This system consisted of some with dual air bags, on both driver's and passenger's sides, and some with just a single driver's side air bag. The system had a crash sensor and, if enough force was experienced, the air bag would deploy and the occupant would be secured for their safety. An air bag is an inflatable cushion designed to protect occupants from serious injuries.

The crash sensors or collision sensors were located near the front and rear bumpers. These sensors would send a signal at impact to deploy the air bags. Through the years more collision sensors were installed for better safety, eventually being located in the front and rear bumper area and on both sides B and C pillars.

Volvo worked with air bags and seat belts through the years to make the safest vehicle on the road. The three point seat belt was one of Volvo's innovations and they wanted to use both seat belts and air bag systems to help reduce fatalities in the world. At first people thought that air bags would take the place of seat belts, but Volvo wanted to use both seat belts and air bags to make the vehicle even more safe. Not wearing a seat belt is like believing it'll never happen to me. Volvo believes no child should sit in the front seat. Children should be in the back seat with a booster seat secured properly.

Volvo air bag is located in the steering wheel.

This shows Volvo's air bag module in the center console behind the parking brake.

Getting the air bag to deploy at the right time was the challenge early on. The first air bag technology started with many drawbacks including the use of pyrotechnical charges to inflate the air bag and the nature of the gas that would inflate the air bag. Another concern was the choice of material that would be used for the bag itself. Many aspects would be analyzed and tested many times.

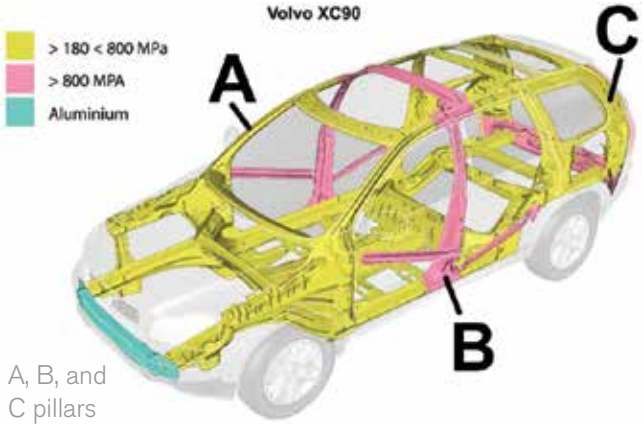
All of this evolved into technology in which a quantity of non-toxic nitrogen gas is produced, filling the air bag in a few hundredths of a second. Woven nylon is the material commonly used for the air bags.

By the 1990s air bags were standard equipment in the 850 and soon Volvo would introduce a side impact protection system. This system would help in protecting the passenger from a side impact.

The control module for the air bag system was located under the seat in the early years and moved to the center console behind the parking brake in 1993 with the Volvo 850.

The air bag module is designed to inflate extremely rapidly then quickly deflate during impact. It consists of the air bag cushion, a flexible fabric bag, inflation module, and impact sensor. The purpose of the air bag is to provide the occupants a soft cushioning and restraint during a crash to prevent or reduce injuries between the occupant and the interior of the vehicle.

The air bag provides an energy absorbing surface between the vehicle's occupants and the steering wheel, instrument panel, as well as A-B-C-pillars, headliner, and windshield.



A, B, and C pillars

The Volvo weight sensor is located in the seat to calculate body weight.

Volvo soon developed the IC Inflatable Curtain. The Inflatable Curtain would help protect against head injuries for both passengers front and back in case of a side impact. The system was introduced in the 1999 S80 Volvo. Volvo would be the first to introduce the inflatable curtain and many vehicle manufacturers would follow in their steps for safety.

The Volvo convertible in 1998 would have the curtain inside the door, and the curtain would deploy upward and stay deployed for safety in case of roll over. Through the years the curtain would be refined, making it longer to protect children in the rear seat. This application was in the Volvo V70 and XC70.

A new generation of air bags would follow and were known as smart bags and would add another level of safety. They would sense body weight, impact speed, and impact angle. These bags could sense the impact force and step down the force of the air bag deployment, reducing the risk to its cargo.

COMPONENTS AND THEIR FUNCTION IN TODAY'S VOLVOS

The wiring for the SRS system is orange and should never under any circumstances be checked with ohmmeters or any live measuring tool due to possible accidental deployment.

The SRS warning light should light up when ignition is in the number 2 position, and after start-up should go out within ten seconds. If it stays lit there is an issue with the system and should be diagnosed properly. If the light doesn't come on with the key in number 2 position the bulb is faulty or there is a wiring issue.

When removing air bags for storage always place the air bag metal side down or rear side down. This will help prevent the air bag from "popping up" in the event of an accidental deployment.

Air bags have three main parts: the air bag, the inflator, and the propellant. The air bag is made up of a woven nylon fabric and has different shapes and sizes. There is a heat shield coating to protect the fabric from scorching. Talcum powder is used to coat the air bag so the fabric doesn't stick together.

The inflator canister is made from stainless steel or cast aluminum. Inside the canister is a steel wire mesh with ceramic material sandwiched in between. When assembled, the inflator assembly is surrounded by metal foil to maintain a seal that prevents propellant contamination. The propellant is in the form of black pellets and is primarily sodium azide combined with an oxidizer, and is typically located inside the inflator canister between the filter assembly and the initiator.

Air bags are typically located in the steering wheel and in the dash above the glove compartment. They are designed to deploy during certain frontal or front-angular collisions, impacts, or decelerations, depending on the crash severity, speed, angle and object impacted. The complete process of deployment takes about two tenths of a second.

When an accident occurs and the air bags deploy, a small amount of powder appears that might look like smoke. Do not to be alarmed; this is normal.

The dual stage air bag, depending on the severity of the impact, will deploy at a less severe 70 percent of capacity, and full capacity at the most severe level.

Volvo front seat belt

The SIPS air bag is located in the back seat and inflates from side impact.

The front seat belts are equipped with pyrotechnical tensioners. If the vehicle is involved in an accident and the deceleration rate is high, the collision sensor will send a voltage charge to the seat belt tensioner. A gas charge will be set off and the seat belt will become tightened to hold the passenger against the seat back. On impact the seat belt will tension the passenger snugly into the seat so movement is limited and the passenger is secured in the seat. For the seat belt to work properly it must be worn correctly. Make sure the belt is not twisted and it should sit low on the hips.

Never have more then one person per belt. Never sit so far back that the belt doesn't touch your body. Never wear the belt under your shoulder. If the belt doesn't retract completely, replace it, and never try to repair a seat belt. Never put a child booster seat in the front seat; it should always be installed in the back seat.

Collision sensors or crash sensors send messages to the control unit to deploy air bags when the vehicle is in an accident. These sensors are located near the front and rear bumpers and B and C pillars of the vehicle. Collision sensors also function as diagnostic monitors. Collision sensors continuously monitor the SRS operation and record any faults in SRS system. The sensor is a piezoelectric sensor that detects deceleration and collision forces. To ensure correct operation of collision sensors the sensors must be secure and grounded properly.

The vehicle's passenger occupancy sensor detects whether a passenger is in the seat and decides whether or not to direct the air bag to deploy in the event of an accident. If the sensor determines that the weight on the seat is not a person, the air bag does not deploy. Volvo says any person under 4ft. 7in. should sit in back since the air bag might not otherwise provide full protection.

SIPS (Side ImPact Sensors) are located in the seats and, depending on the severity of a crash, speed, and angle, deploy when the vehicle is impacted on the side. Not all side impacts deploy air bags, depending on the severity of the crash. The bag will only deploy on side impact. These air bags are in the back rest of each seat on the side.

Seat track sensors (STS) are magnetic sensors that detect the position of the seat.

An inflatable curtain doesn't sound like a life saving component, but it is. Volvo's Inflatable Curtain is located in the headliner and stretches from the front windows to the rear windows. This air bag is designed to protect the heads of both front and rear passengers from side impacts. The inflatable curtains are not designed to inflate from a front or rear collision or a roll over.

The steering column has a pyrotechnical tensioner with a contact reel or clock spring. This single wire type contact reel design ensures the most reliable contact possible between air bag module and the crash sensor.

The SRS control module is located in the center console behind the parking brake. Volvo changed this location from under the seat in order to be centrally located.

The whiplash system is integrated into the front seats and is mechanical. This function reduces the risk of whiplash injuries in the event of a collision. The whiplash system includes specially designed hinges and brackets on the front seat back rests and head restraints designed to help absorb some of the energy generated in a collision from the rear. Any objects behind the seat could impede the function of the system.

On some Volvo models there is a rear compartment and child seats can be installed where children are between 50 and 88 lbs. and up to 55 inches tall. There are the three point seat belts and latches. There are also anchors on the back of the rear seat to strap down and hold booster seats or child seats.

Before touching the SRS system or any of its components, be sure you know what you are doing by reading the Volvo OEM SRS manual which is available from Volvo.

You should always switch the ignition off and disconnect the battery negative lead; then, before doing any work on the system, wait an additional ten minutes. Do not pound or hammer anywhere near the SRS crash sensor, for example, while under the car, if the ignition is on even if you are not working on the SRS system. Do not use an electrical welding unit on the car without disconnecting the battery negative lead. Not doing this could result in air bag deployment and possible injury. Do not under any circumstance use an ohmmeter or live electrical measurement instrument to measure resistance in the air bag seat tensioner or wiring while these components are connected, as this may cause them to activate.

If the SRS light stays on while driving, there is an issue with the system and the vehicle will need to be diagnosed. If the light is on the system will not work correctly and needs to be addressed sooner than later for occupants safety. This must be done by a qualified workshop due to the pyrotechnical SRS components.

Volvo's clock spring or contact reel is found in the steering wheel and is also referred to as the steering angle sensor.

The whiplash rod needs to be replaced due to the gap opening.

CHECKING MECHANICAL COMPONENTS SUCH AS SEAT BELT AND WHIPLASH UNIT IN SEAT

Check to see if the seat belt extends and retracts properly. Pull the belt out and hold, then jerk the belt repeatedly to make sure it locks correctly. Make sure the seat belt buckle opens and closes correctly.

Checking a seat for whiplash, move the seat forward and tilt back up with controls. Remove the side panel and press the catch for the seat belt end to remove the belt. Take off the protective panel. On the side of the seat check that the rod has no play. If there is play in the unit or visible space, both sides need to be replaced with new units.

PRECAUTIONS WHEN SERVICING SRS SYSTEM

Never apply power to SRS if the collision sensor is not mounted on the vehicle.

Never make any measurements on air bags or seat belt tensioners. A process of elimination will determine fault by using tool resistor 9988695.

Wiring repairs should never be done on the wire harness of an SRS system.

When handling air bags always have the trim cover facing away from your body.

Always wear safety goggles and gloves when handling a deployed bag or seat belt tensioner because it might have sodium hydroxide deposits that could irritate the skin.

Make sure to tighten all components and brackets to correct tightening specifications.

Never use a meter to check air bags or seat belt tensioners since the electrical stimulation might cause them to deploy. ●

Resistor tool 9988695 takes the place of the air bag when diagnosing issues.

CLIMATE CONTROL 850 AND S70 AND C70 EARLY

IN THE LATE 1990S THE VOLVO 850 ARRIVED WITH MANUAL MCC AND ECC ELECTRONIC CLIMATE CONTROL SYSTEMS.

In the late 1990s the Volvo 850 arrived with Manual MCC and ECC electronic climate control systems. Air conditioning and heat both would share a single heater box with manual control cables that connected to flaps for distribution of air for floor, defrost, and center outlet distribution. Electronic controls would be wired to small motors that actuate the flaps. Inside the box is a heater core and an A/C evaporator. Air conditioning electrically supported a compressor that was run by a fan belt. A button was located on the control panel to support the A/C system. Both passenger and driver have temperature controls for each side. A recirculation button is provided to shut off outside air.

The MCC manual controlled system used a fan resistor for adjusting speed control, along with a max speed relay and an A/C relay.

ECC used damper motors for adjusting air control and temperature. A power stage is used for blower speed and an A/C relay is used for powering up the A/C compressor.

Temperature controlled air is drawn in from outside or inside depending on the recirculation position. On the MCC cable controlled system both passenger and driver could each have their own temperature settings. ECC had a damper motor on both sides to control temperature depending on settings. The settings determine how much air flows through the heater.

Here is an illustration of the heater box with damper motors which control flaps and are electronically controlled for air distribution.

Shown on the opposite page are the Manual Climate Control (MCC) and Electronic Climate Control (ECC) modules.

ECC damper motors controlled the amount of air flow depending on various settings. Five damper motors controlled the system, with two temperature motors, one on each side of the heater box. Air distribution could be adjusted for windshield defroster, side defroster, center ventilation, side ventilation, rear floor, and front floor.

Volvo air conditioning systems control air temperature in vehicles to be at a comfortable level and to dehumidify the air coming into the vehicle. The air conditioning system is filled with refrigerant and functions like a refrigerator.

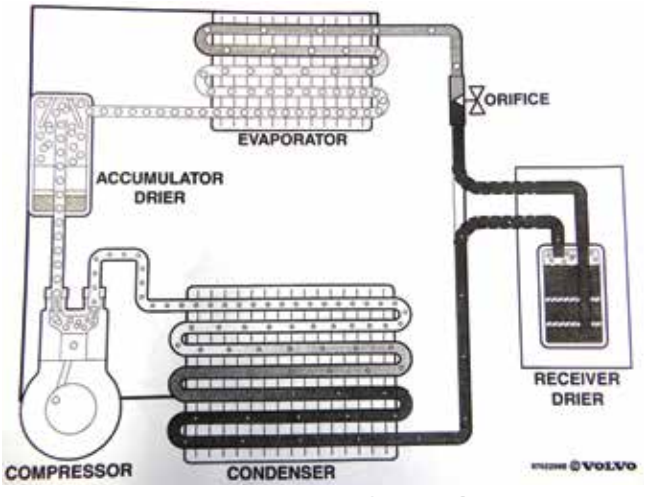
Dehumidified air feels cooler. When air comes into vehicle and passes through the evaporator, the humidity in the air condenses on the evaporator. The water that accumulates is drained through a tube to the outside of the vehicle. Often times customers will think they have a water leak but this is quite normal.

Main components in air conditioning system include:

- Evaporator
- Drier or accumulator
- Condenser
- Compressor
- Orifice

The system has a high and low side pressure that is separated in the compressor and the orifice. The air conditioning system will not work if outside temperature is below 42 degrees F. The compressor cannot engage at low pressure due to the temperature outside being too cool.

Let's talk about the components in the air conditioning system. The evaporator is located on the low side of the system. Heat is transferred from warm air to the cold refrigerant. The refrigerant boils and converts to a gas state. The blower motor will increase air flow through evaporator.



Here are the main components of the A/C system, showing the flow of refrigerant through the system.

The drier, or accumulator, could be located on either the high or low side depending on the system. The drier absorbs moisture and water in the system.

The condenser is located on the high side. The heat is transferred from high pressure vaporized refrigerant to cooler outside air, then condenses back to liquid form. The engine cooling fan is located near the condenser to increase the air flow to transfer heat from the refrigerant to outside air.

The A/C compressor sucks low pressure vaporized refrigerant from the evaporator. Refrigerant is compressed into high pressure and then the warm gases are pushed into the condenser.

The orifice separates the system's high pressure side from the low pressure side and controls the amount of refrigerant that flows into the evaporator. It is located in the evaporator inlet.

With this system it may be set for automatic or manual. Controlling the temperature, blower speed and air distribution make this system quite comfortable for both driver and passenger.

DIAGNOSING CLIMATE CONTROL SYSTEM 850 VOLVO

The ECC control module is capable of detecting faults and storing codes.

When ignition is switched on, the A/C off and Recirculation buttons flash a light for 20 seconds if there is an issue in the system.

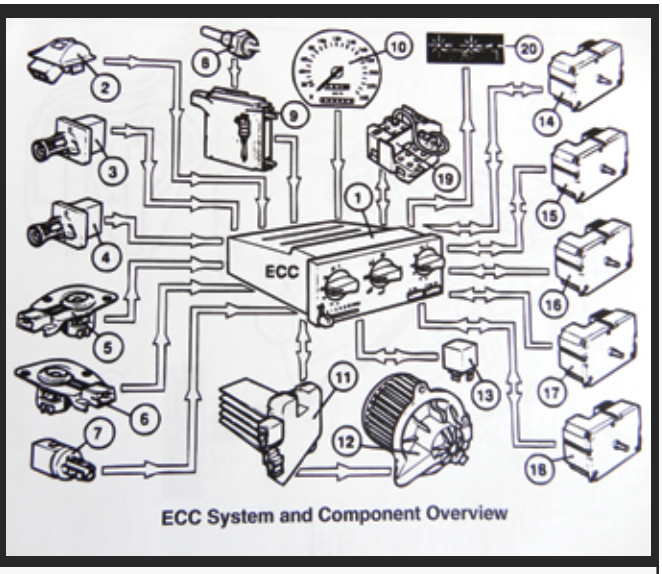
Test unit (9813190) and adapter (9813194) are used for diagnosis or self diagnosis.

Diagnostic units A and B are side by side with a connecting cable to insert in position depending on which control unit you are communicating with. In this case the connector cable will be inserted into B side number one for climate control. Turn the ignition to On position, push button and release; light will flash three digits then a short break and continue until all codes are read.

The orifice tube expansion valve is located in the high pressure hose and controls the amount of refrigerant going into the evaporator.

ECC SYSTEM AND COMPONENTS

The ECC control unit (1) receives information from the various components in the system.
Solar sensor (2)
Driver's duct side temp. sensor (3)
Passenger's duct side temp. sensor (4)
Driver's side interior temp. sensor (5)
Passenger's side interior temp. sensor (6)
Outside temp. sensor (7)
ECT/sensor, engine coolant temp. (8)
ECM/engine control module (9)
Speedometer (10)
Power stage (11)
Blower motor (12)
A/C relay (13)
Damper motors floor and defrost (14 and 15)



ECC System and Component Overview

Temp. control both sides (16 and 17)
Recirculation damper motor (18)
Data link for diagnosing (19)
Detected fault blinking on control module (20)

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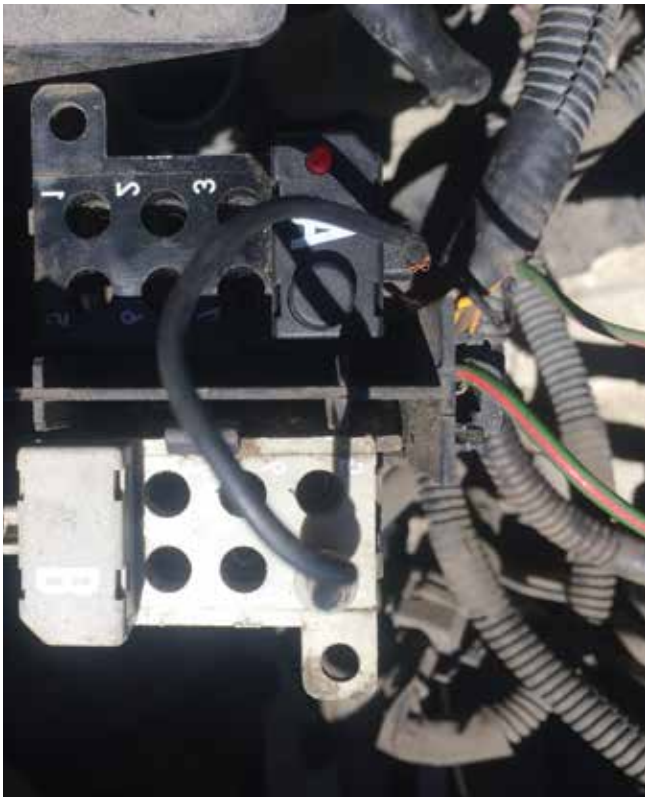
FAULT CODES

1-1-1	No Fault Found By Diagnostic System
1-2-1	Outside Temp. Sensor Circuit Shorted To Ground
1-2-2	Outside Temp. Sensor
CIRCUIT OPEN OR SHORTED TO POWER	
1-2-3	Driver's Side Temp. Sensor Circuit Shorted To Ground
1-2-4	Driver's Side Temp. Sensor
CIRCUIT OPEN OR SHORTED TO POWER	
1-2-5	Pass. Side Temp. Sensor Circuit Shorted To Ground
1-2-6	Pass. Side Temp. Sensor
CIRCUIT OPEN OR SHORTED TO POWER	
1-3-1	Driver's Side Duct Temp. Sensor Shorted To Ground
1-3-2	Driver's Side Duct Temp. Sensor
CIRCUIT OPEN OR SHORTED TO POWER	
1-3-3	Pass. Side Duct Temp. Sensor Shorted To Ground
1-3-4	Pass. Side Duct Temp. Sensor
CIRCUIT OPEN OR SHORTED TO POWER	
1-3-5	No Engine Temp. Frequency Signal
1-4-1	Driver's Side Temp. Switch Faulty Control Signal
1-4-3	Pass. Side Temp. Switch Faulty Control Signal
1-4-5	Air Distribution Switch Faulty Control Signal
1-5-1	Fan Speed Sensor Control Signal Missing Or Too High
1-5-2	Fan Speed Sensor Control Signal Shorted to Ground
2-1-1	Driver's Side Damper Motor Position Sensor
CIRCUIT OPEN OR SHORTED TO POWER	
2-1-2	Driver's Side Damper Motor Position Sensor
SHORTED TO GROUND	
2-2-1	Pass. Side Damper Motor Position Sensor
CIRCUIT OPEN OR SHORTED TO POWER	
2-2-2	Pass. Side Damper Motor Position Sensor
SHORTED TO GROUND	
2-3-1	Ventilation Damper Motor Position Sensor
CIRCUIT OPEN OR SHORTED TO POWER	
2-3-2	Ventilation Damper Motor Position Sensor
SHORTED TO GROUND	
2-3-3	Floor/Defrost Damper Motor Position Sensor
CIRCUIT OPEN OR SHORT TO POWER	
2-3-4	Floor/Defrost Damper Motor Position Sensor
SHORTED TO GROUND	
2-3-5	Recirculation Damper Motor Position Sensor
CIRCUIT OPEN OR SHORT TO POWER	
2-3-6	Recirculation Damper Motor Position
SENSOR SHORTED TO GROUND	
3-1-1	Driver's Side Damper Motor Shorted To Ground Or Power
3-1-2	Pass. Side Damper Motor Shorted To Ground Or Power
3-1-3	Ventilation Damper Motor Shorted To Ground Or Power
3-1-4	Floor/Defrost Damper Motor Shorted To Ground Or Power
3-1-5	Recirculation Damper Motor Shorted To Ground Or Power
3-2-1	Driver's Side Damper Motor Active Too Long
3-2-2	Pass. Side Damper Motor Active Too Long
3-2-3	Ventilation Damper Motor Active Too Long
3-2-4	Floor/Defrost Damper Motor Active Too Long
3-2-5	Recirculation Damper Motor Active Too Long
4-1-1	Pass. Compartment Fan Over Current or Seized Fan
4-1-2	Driver's Side Temp. Sensor
INTAKE FAN SHORTED TO GROUND	
4-1-3	Driver's Side Temp. Sensor
INTAKE FAN, NO CONTROL VOLTAGE	
4-1-4	Driver's Side Temp. Sensor Intake Fan Seized
4-1-5	Pass. Side Temp. Sensor Intake Fan Shorted To Ground
4-1-6	Pass. Side Temp. Sensor Intake Fan, No Control Voltage
4-1-7	Pass. Side Temp. Sensor Intake Fan Seized
4-1-8	No Control Signal To ECC Power Stage
4-1-9	ECC Power Stage Emitting Faulty Diagnostic Signal
4-2-0	ECC Control Module Fault, Program Memory
5-1-1	Self-Adjustment Of Damper Motor
Limit Positions Not Carried Out	



The data link is located under the hood for diagnostic purposes and for checking for fault codes in the system.

Here you can see the differences between the ECC and MCC front plate controls.

ERASING CODES

1. All codes must be displayed at least once before they can be erased. To erase codes, ensure selector cable is connected to terminal No. 1 of diagnostic unit B. Press and hold the diagnostic button for at least 5 seconds. The LED should illuminate 3 seconds after the button is released.

2. Press and hold the diagnostic button for a minimum of 5 seconds more. When the button is released, the LED should go out. Ensure codes have been erased by pressing the diagnostic button once. If display shows 1-1-1, codes have been erased/cleared. If a DTC will not erase/clear, perform that particular code's diagnosis again.

Diagnosis can be accomplished with the right tools and knowledge. Replacing a damper motor or recirculation motor on a 1996 850, for example, can be achieved by removing the passenger kick panel on bottom and removing the glove compartment. This will expose the blower motor, and above it is the recirculation motor. Start the vehicle and push the recirculation button and watch if the controls for the motor are moving and, if so, by how much. Remove the outside windshield wipers on both sides and the plastic cowling. Remove the cabin filter and flap so you can see if the recirculation flap can be seen open or closed. Remove the damper motor inside the cabin and replace with a Volvo Genuine part. Making sure the flap is closed to outside air when connecting.

When replacing the damper motor, any resetting of the end positions must be performed with a Volvo hand held scan tool or in position four on data link.

S/C/V70

Once the S/C/V70s came along everything was electronic and no cables were used. ECC has four damper motors to control air distribution, temperature left side and right side, and recirculation utilizing a separate A/C switch button and recirculation button, along with a blower motor speed adjustment button.

Sensors (temperature controlled sensors) calculate the temperature inside the cabin as well as outside ambient temperature. Adjustment settings are inside the cabin at the climate control face plate. This system includes self adjusting damper motors through hand-held VST (Volvo Scan Tool).

Functions on the face plate ECC and MCC include temperature dials for both driver and passenger. A function selector in the middle provides for desired air flow via upper, lower, or in-panel vents (middle).

The air conditioning system should be serviced and checked once a year. A drain tube from the heater box to under the vehicle should be checked to make sure it's not plugged. Running the vehicle with the A/C on, look for condensation dripping out under and around the passenger compartment. Refrigerant for this system is R134a and should never be mixed with any other type of refrigerant. The system is a sealed system and any type of leakage should be dealt with immediately. A system left open will accumulate moisture and dirt and not work as efficiently.

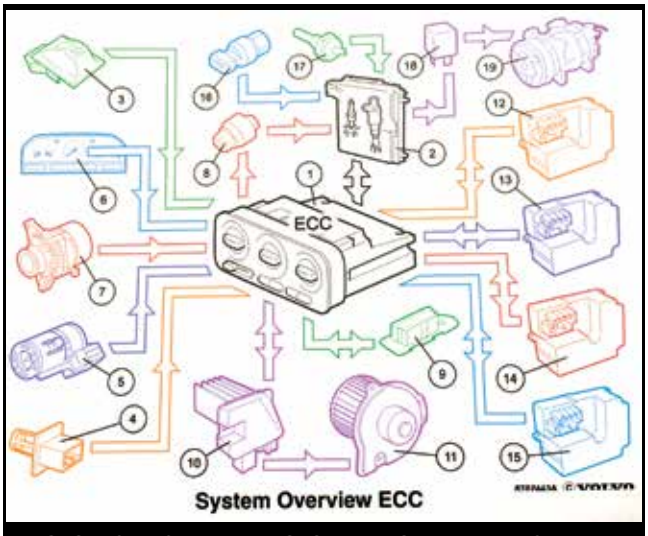
The air conditioning is disengaged when blower control is at zero and the speed of the vehicle is under 20 mph. The air conditioning system will only operate at temperatures above 32 degrees F. The recirculation button can close off outside air and help cool quicker and can be used to shut out exhaust gases or any outside air pollution. If the panel vents are open, a certain amount of air will always flow through, regardless of the position the function dial is in. To increase the flow of air to either the floor or the windows, close the panel vents and open the outer vents.

When working on the A/C system, replacing hoses or any component, cap open ends until a new hose or component is replaced. It's always a good idea to replace the drier or accumulator any time there is a major leak in the system. The system should be evacuated for a period of 20 minutes or longer and then checked for leaks. Make sure to add the correct amount of refrigerant and check to see how much and what kind of refrigerant oil is needed. Adding dye to the system will help in detecting future leaks. Make sure to test drive the vehicle to ensure the temperatures are right and that the system is cold enough.

A standard A/C service console can be used to evacuate and recover the refrigerant, and for recharging the system after service is complete.

If there are faults in the ECC system, the Recirculation On and A/C Off lights will flash for approximately 20 seconds. If this flashing happens the next time the system is switched on, the climate control unit should be checked. This can be done with Volvo scan tool. If the control unit detects an issue a DTC is stored.

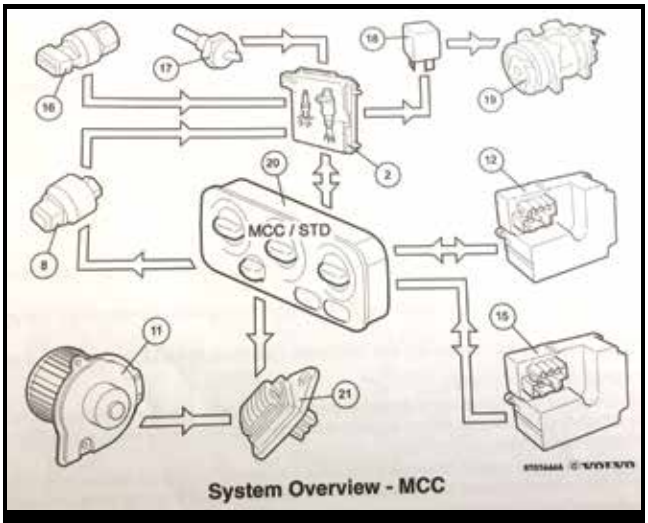
When replacing the damper motor or control unit, self adjusting will have to be initiated. Activating self adjustment can happen two ways. One, with a Volvo hand held tool, or driving vehicle above 20 mph for at least 15 seconds, during which the A/C LED flashes green. If self adjusting fails and the orange LED flashes, a DTC is stored and the system must be checked again.



System Overview ECC

ECC SYSTEM COMPONENTS AND LOCATION

1 ECC control module	11 Blower motor
2 Engine management system	12 Damper motor air distribution
3 Sun sensor	13 Damper motor temp. left side
4 Outside temp. sensor	14 Damper motor temp. right side
5 Interior temp. sensor	15 Damper motor recirculation
6 Speedometer	16 Pressure sensor
7 Alternator	17 ECT sensor
8 Low pressure switch	18 A/C relay
9 Data link connector	19 A/C compressor
10 Power stage	



System Overview - MCC

MCC SYSTEM COMPONENTS AND LOCATION

2 Engine management system	17 ECT sensor
8 Low pressure switch	18 A/C relay
11 Blower motor	19 A/C compressor
12 Damper motor air distribution	20 MCC control module
15 Damper motor recirculation	21 Fan speed resistor
16 Pressure sensor	

The MCC system has fewer components with only two damper motors, one for recirculation and one for air distribution. Cables control temperature settings. Here is a view of those components.

Diagnostics in this system are much simpler than with the ECC system and DTCs are obtained through a flashing signal at the control module. DTCs can be erased and damper motor self adjustment can be performed.

Here's how to fix a blower motor not working on a V70 or S70. You will need to remove the passenger kick panel and the glove compartment. The blower motor is now exposed and the power and ground wires can be seen. Check to see if there is power and ground with a volt meter. If power is there and the motor doesn't run, then the blower motor is bad.

Remove all wire connections. Remove the screws around the unit and remove the motor. Installation is performed in reverse order. Now the blower motor should work properly. Adjust blower motor speeds from low to high to make sure all settings work properly.

If by some chance the blower motor doesn't work in all positions, check the power stage or resistor. The glove compartment needs to be removed to access the motor. Use a volt meter connected at the power stage to control power, and connect the other lead to ground. Start at low speed on the control panel. Voltage will be low and increase as control goes to high. If at any time voltage is lost or doesn't increase evenly, the power stage is bad and needs to be replaced.

Using the right tools and VST Volvo Scan Tool will make diagnosing and programming perfect. Always use Volvo Genuine Parts for all Volvo vehicles. ●

The blower motor and power stage are located behind the glove compartment in Volvo S70 models.

VOLVO VALVE ADJUSTMENT P1 CARS

THOUGH YOU MAY RARELY PERFORM THIS JOB IN YOUR SHOP, IT'S IMPORTANT THAT YOU UNDERSTAND HOW TO CHECK AND ADJUST VALVE CLEARANCES. THIS KNOWLEDGE WILL SAVE YOU AND YOUR CUSTOMERS A LOT OF WASTED TIME AND MONEY.

This article is about a job that you may rarely perform in your shop, but it is very important that you understand how to check the valve clearances and how to adjust them if needed. This knowledge will save you and your customers a lot of wasted time and money.

But you're probably thinking to yourself, "Volvos don't need valve adjustments," and in most cases you would be right.

The fact is that Volvo has not had "valve adjustment" on their regular maintenance schedule since they used two digit engine numbers and cast iron engine blocks.

Some of you seasoned Volvo veterans have done these types of adjustments on the old B21 - B230 engines and probably still have the tools or maybe even a dusty box of assorted valve shims hiding somewhere in the shop.

If you have been in the automotive trade for a while, you might remember the old days when valve adjustments were a routine part of most car makers' regular maintenance schedules.

Yes kids, in the olden days, an average technician could check the valve clearances and adjust the valves on most engines in less than an hour with very few tools.

And in a lot of cases adjusting the valves made a noticeable improvement in the engine's performance, emissions output, and fuel economy.

That was the upside. The down side was that you had to adjust the valves a lot more often, and these older valve systems had a lot of limitations on how much efficiency and performance the car makers could squeeze out of the engines.

If you are a "seasoned" Volvo technician, or you still work on some of the classic Volvo vehicles, you may have some of the old valve tools and maybe a dusty set of valve shims laying around the shop.

With the advent of hydraulic valve lifters, computer-controlled variable valve timing and camshaft control systems, the need for mechanically adjustable valves has widely become a thing of the past.

But there are still some cases where you will need to check and possibly adjust the valves on some late model Volvos.

If you're relatively new to this line of work you probably have not had to perform many valve adjustments, unless you restore old classic cars or work on certain makes of Japanese cars.

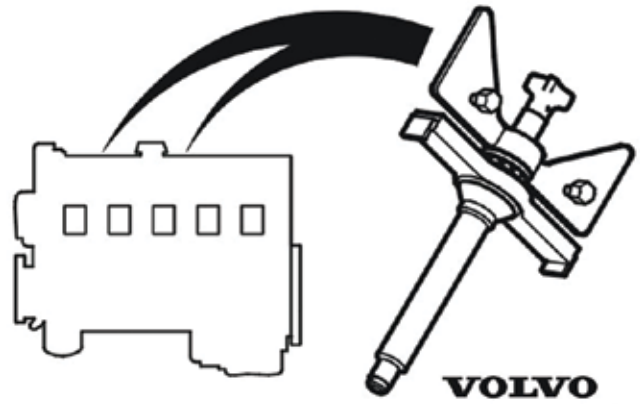
If you are replacing the head gasket or replacing damaged valves after a timing belt jumped on any of Volvo's 5 cylinder engines from 1995-2008, you should make it a habit to check the valve clearances when you have the camshafts removed for any reason, especially if the head has just been freshly overhauled at a machine shop.

Even if you have an outstanding machine shop perform the machine work on the head you should always take the time to double check the valve clearances before installing the camshafts, timing components, and camshaft cover.

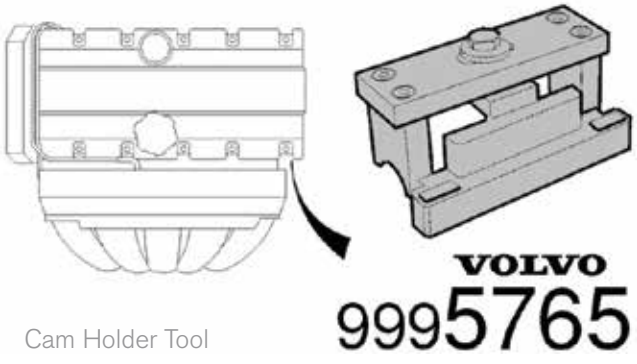
There are many reasons that the valve clearances could be off.

Probably the most common possibility is that some of the valve tappets could have been mixed up in some way and it only takes one set of two to screw up your whole day. You may find, when you go to start the car after the

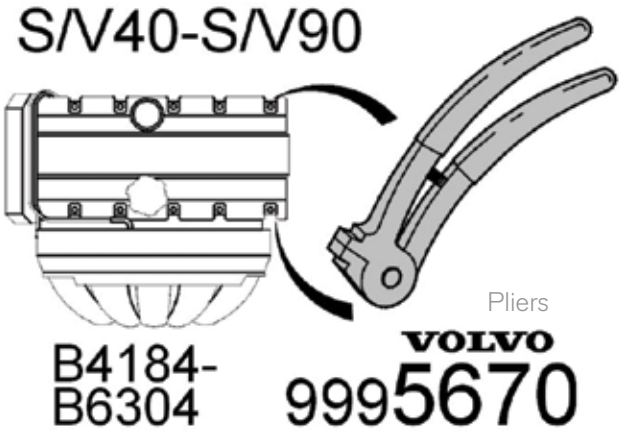
When checking the valve clearances on a Volvo, you can use your plain old feeler gauge set, or you can step up and order the Volvo factory feeler gauge tool (p/n 9814120) from your local dealer's parts department. This tool is made to work with Volvo engines and the tapered blades make it much easier to get an accurate reading the first time.



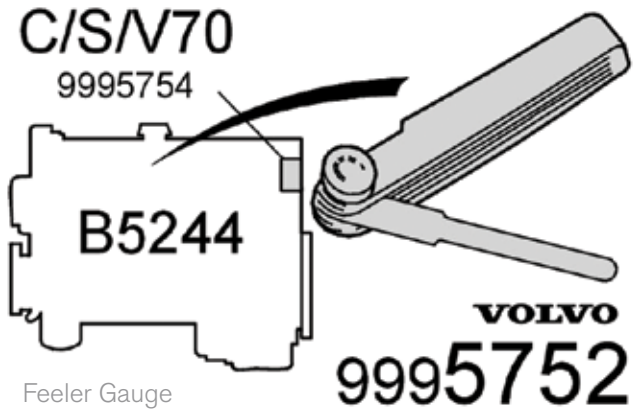
Press Wing Nut Tool



Cam Holder Tool



Pliers



Feeler Gauge

Roller

job, that you have a misfire because one or more of the valve clearances is too tight and the cylinder can't build enough compression.

And say, if for some reason, the valve tappets were not sent to the machine shop with the head and the machine shop lapped the valves. When you get your head back most likely all of the valve clearances will be too tight and in need of adjustment.

If this head is installed in this condition, the lack of valve clearance may cause some of the valves to not close fully, causing a loss of compression. This could cause low power or even a no start condition.

Don't be the person who put one of these heads back together and found out too late that the reason the engine would not start (after a lot of testing and head scratching) was caused by low compression because the valves were not sealing well during the compression stroke.

Of course the opposite happens with valve clearances that are too loose.

When you start the engine for the first time after the cylinder head replacement, you may hear an audible clicking noise from the valve train and think to yourself, "Oh, it's only the engine building up oil pressure. It will go away after the car warms up and it's taken for a long test drive." This statement could be true in some cases, but if any one of the valve clearances was too loose, no amount of "test driving" is going to fix that tapping noise.

You're going to have to disassemble and adjust those valves in either case.

The moral of the story is to check those valves if you have the camshaft cover off for any reason.

Here is the procedure to check and adjust the valve clearances on a 2007 S40 with a B5244 non turbo engine, but the tools and techniques can be used on most Volvo 5 cylinder engines from 1994-2008.

When you remove a tappet to check the size you may have to clean it and break out your reading glasses because the size markings are printed in fine tiny print on the bottom outer edge of the tappet.

Volvo special tool 999 5765 is used to hold down the camshafts and allow you to check valve clearances with the cam cover off the head.

CASE STUDY 2007 VOLVO S40 NON TURBO 2.4L (B5244 S7)

So let's talk about what tools you are going to need to do this job.

Here is the list of Volvo special tools that you will need to perform this job:

- 999 5454 Press tool
- 999 5670 Pliers
- 999 5765 Holder
- 999 5752 or 9814120 Feeler gauge or similar
- 951 2767 Roller or similar

If you need to purchase these or any other Volvo special tools, you can order them from your local Volvo dealer's parts department or log on to volvotechinfo.com for tool information and an online catalog.

Volvo uses solid tappets in all of the P1 cars. The tappets are marked on the underside in tiny print and you will probably have to clean them off before you can read the size markings.

The tappets can be ordered individually from your local Volvo dealer's parts department.

They come in 0.05 mm increments. Sometimes these tappets will need to be special ordered so make sure to double check your measurements before you order them because time is money and you don't want to play that game.

Volvo has a simple fixture (999 5765) that holds the camshaft down while the valve clearances are being checked.

Clearances are checked one cylinder at a time on each of the intake and exhaust sides.

If you already have the cylinder head removed you can still check and adjust the valve clearances on the bench using the camshaft holder fixture (999 5765).

If you are going to check or adjust the valve clearances you are going to have to get to the tappets first.

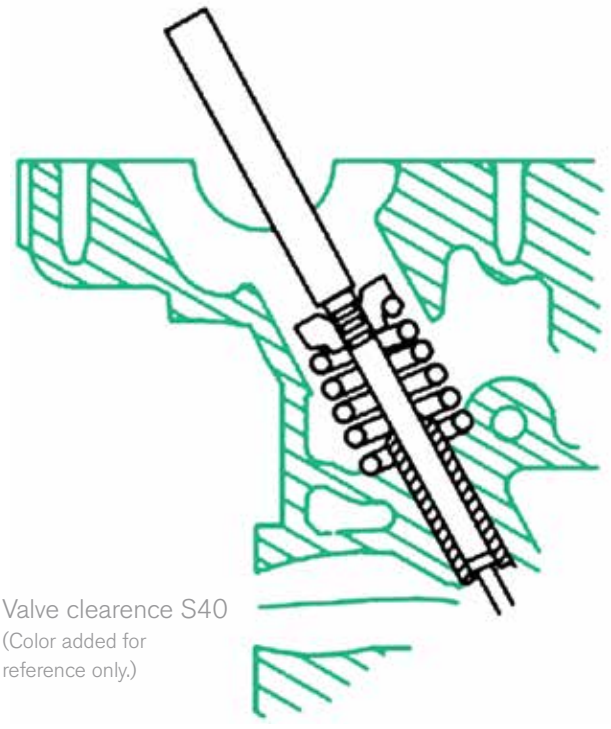
Start by disconnecting the battery at the negative post.

Next, you're going to have to remove the timing belt and variable valve timing unit or hub assembly or assemblies in some cases where the car has both intake and exhaust VVT.

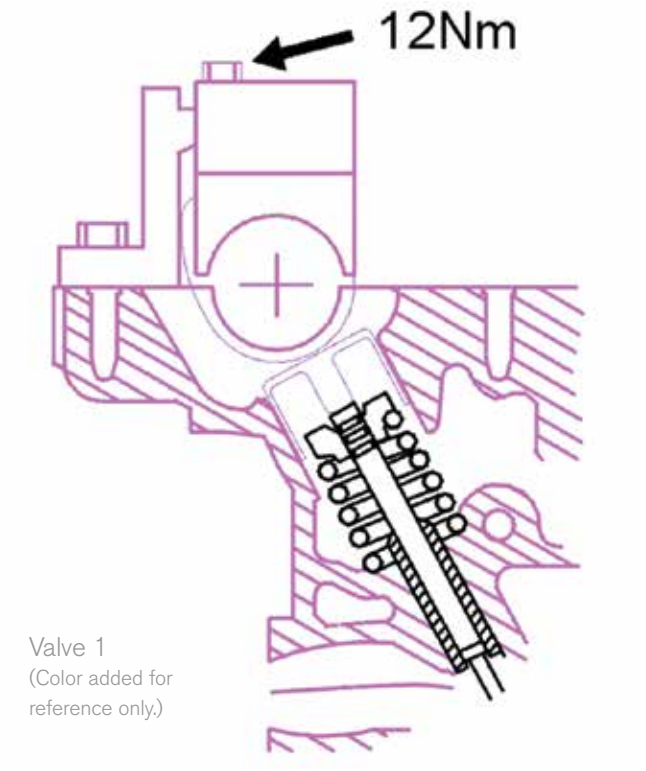
The next step is to remove the camshaft cover.

Start by carefully disconnecting the wire harness that is connected to the coils and VVT actuator and carefully move it to the side. These harnesses can have brittle insulation from years of heat, so when reassembling the head and hooking up coils be sure to look for any cracked wire insulation or loose connector pins.

Next, remove the ignition coils and spark plugs.



Valve clearence S40
(Color added for reference only.)



Valve 1
(Color added for reference only.)

Lubricate the threads and install the big wing nut tools into the cylinder number 1 and 5 spark plug holes (999 5454 PRESS TOOLS) with 2-3 mm gap to the camshaft cover.

Ensure that the screw in the spark plug well is fully tightened.

Next, remove all the bolts securing the camshaft cover to the cylinder head.

To get the cam cover to safely pop up off its dowel pins use pliers (999 5670) to help lift the cover from the cylinder head.

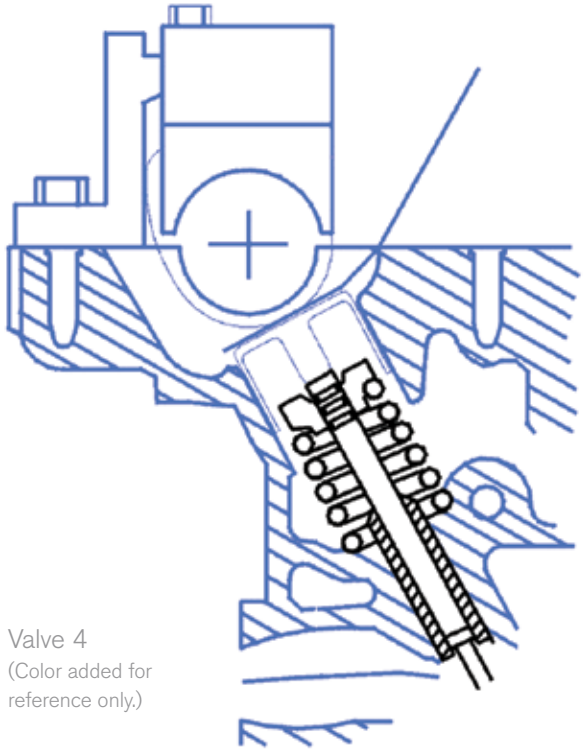
Install the pliers at the stop lugs in the corners and middle of the cam cover. Start with cylinder 1 and work alternately backward.

Slacken off the wing nuts approximately 2 turns. Repeat the procedure with the pliers.

Try not to use a screwdriver or pry bar to lever between the head and the cam cover as this may cause damage to the mating surfaces and may cause an oil leak or damage to the camshaft bearing surfaces.

When the cam cover is free, remove the wing nut tools and carefully lift the cam cover straight up and off the cylinder head. Pulling it up from one end could cause damage to the cam cover.

The camshafts may want to come with the cover when you remove it, so be careful not to let them hang from the cover and DO NOT pull the camshafts out of the cover



Valve 4
(Color added for reference only.)

from one side. This can break parts of the cover off and then you will have to replace it.

Now carefully push out the camshaft seals

Take care not to damage the sealing surfaces on the camshafts when removing them and storing them.

TORQUE SPECS	
Exhaust system (turbocharger/manifold)	24 Nm
Center nut/Vibration damper (crankshaft's front end)	180 Nm
Cylinder head **Note!** Tighten the screws in sequence from the center and outwards.	Step 1 ... 20 Nm Step 2 ... 60 Nm Step 3 angle tightening130°
Fuel pump, plastic nut	70 Nm
Fuel filter (D5244Tx)	35 Nm
Manifold (against cylinder head)	24 Nm
Stay (Manifold/Engine block)	M8x16 ... 20 Nm; M10x16 ... 40 Nm
Subframe front, front screw	120 Nm
Subframe front, rear screw	Step 1140 Nm; Step 2 angle tightening120°
Hollow screw M14x1 .5 (coolant pipe/turbo)	38 Nm
Hollow screw M12x1 .5 (water-heated crankcase ventilation)	26 Nm
Hollow screw M12x1 .5 (oil pressure pipe/turbo)	26 Nm
Hollow screw M14x1 .5 (oil pressure pipe/engine block)	38 Nm
Intake manifold (lower section, against cylinder head) (upper section)	19 Nm; 10 Nm
Camshaft bearing housing / valve cover	14 Nm
Knock sensor	Turned to the 8 o'clock position. Tighten to 20 Nm
Piston cooling valve (piston cooling oil channel, in block)	32 Nm
Piston ring nozzle	17 Nm
Timing belt gear (camshafts without variable valve timing)	20 Nm
Timing belt gear (camshafts with variable valve timing)	10 Nm
Heated oxygen sensor (HO2S)	45 Nm
Temperature and/or pressure sensor for intake air	2 Nm
Carrier plate	Step 1 45 Nm
Step 2 angle tightening 50°	
Intermediate section (**Note!** Tighten the screws in sequence from the center and outwards.)	M10 Step 1 ... 20 Nm; M10 Step 1 ... 20 Nm; MS Step 3 ... 24 Nm; M7 Step 4 ... 17 Nm; M10 Step 5 angle tightening 90°
Oscillating bracket, engine mounting (M1 0 for cylinder head)	Step 1 ... 35 Nm; Step 2 angle tightening 75°
Engine pad for the oscillating bracket right hand side (M 12)	Step 1 ... 70 Nm; Step 2 angle tightening 90°
Engine pad to cylinder block (M12)	Step 1 ... 70 Nm; Step 2 angle tightening 50°
Engine pad to frame member, right-hand, (M12). Applies to D5244Tx.	Step 1 ... 90 Nm
Engine pad, right side (2 screws in frame member M12)	90 Nm
Engine pad, right-hand side (2 nuts to the mounting in the engine M12)	65 Nm 90°
Engine pad, left side (screw M 12)	80 Nm
Engine pad, right-hand side (2 nuts to the mounting in the engine M14)	133 Nm
Engine pad, left side (screw M14)	Step 1 ... 60 Nm; Step 2 ... 50°
Engine pad, left side (4 nuts M10)	35 Nm 60°

Next, remove the wing nut type tools (999 5454), the camshaft cover and the camshafts.

Use a rag with some parts cleaner on it to clean off the tops of the tappets so you can use a felt tip marker to write the position on each one before you remove them.

Use a magnet tool to remove the tappets and keep them together in order in a box or on a magnetic parts tray.

Use a razor blade or a gasket scraper and gasket solvent on the camshaft cover to remove residual sealant.

Do the same on top of the cylinder head mating surface.

Do not use air tools with abrasive disks for cleanup. This can cause permanent damage to the delicate aluminum sealing surfaces.

Use an air gun to blow all surfaces clean.

Next, carefully tap the end of each valve stem to ensure that the valve is correctly located in the seat.

Use a plastic, aluminum, or brass drift to protect the valve and the surface of the tappet.

The sound made by tapping will let you know if the valve is correctly seated.

Now it's time to check those clearances.

Start by installing both the tappets for the inlet valves at cylinder number 1.

Note! Only install two tappets. The tappets should be placed at the same cylinder!

Intake valve: .0.20 ± 0.03 mm.

Exhaust valve: .0.40 ± 0.03 mm.

Position the intake camshaft so that the lobes at cylinder 1 point upwards.

Apply a little oil to the cam lobe and the upper side of the tappet to facilitate later measurement.

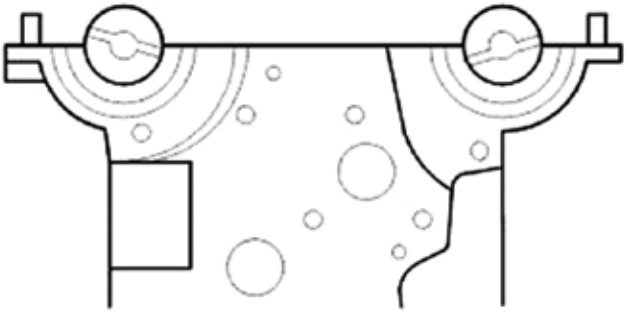
Install the lower section of camshaft press (999 5765 Holder camshaft) by the inlet valves for cylinder 1.

Tighten the tool against the cylinder head. Tighten to 17 Nm.

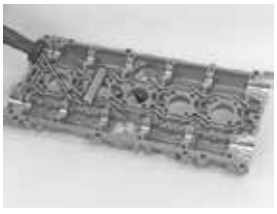
Turn the camshaft until it stops against the camshaft press.

Install the upper section of the camshaft press.

Tighten the screw which tensions the camshaft. Tighten to 12 Nm.



Cam center line



Applying Volvo sealant

Remember measurements must only be taken on a cold engine.

Use feeler gauge (999 5752) or similar feeler gauge and press with a finger so that the feeler gauge lies parallel to the upper side of the tappet (see illustration).

Move the feeler gauge sideways when taking the reading in order to obtain as accurate a measurement as possible.

The clearance specs on the B5244S are:

- Intake valves: .0.20 ± 0.03 mm.
- Exhaust valves: .0.40 ± 0.03 mm.

It's a good idea to draw a diagram with a map of the tappets so you can make notes about those that need to be adjusted.

Correcting measured clearance

Lift out the upper section of the press tool.

Lift out the camshaft.

Adjust the play by replacing the tappets with new ones that are smaller or larger to achieve the correct valve clearance.

Reinstall the camshaft and the upper section of the press tool. Tighten to 12 Nm.

Make a new valve clearance measurement.

When the correct valve clearance is achieved:

Remove:

- the press tool 999 5765
- the camshaft
- the tappets.

THERE'S NO SECOND CHANCE

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Get the replacement brake parts designed and engineered by Volvo. Contact your local Volvo dealer for a complete selection of Volvo Genuine Parts.

Note! Carefully mark the tappets with a marker before you remove them from the cylinder head so that they won't get mixed up and installed in the wrong order.

Installing tappets and camshafts

Lubricate the valve guide wells with engine oil.

Install all the tappets.

Lubricate the camshaft bearing seats and the upper sides of the tappets with oil or assembly lube.

Position the intake camshaft so that the groove at the rear edge of the camshaft is above an imaginary center line.

Position the exhaust camshaft so that the groove at the rear edge of the camshaft is below an imaginary center line.

Before applying the liquid sealant and installing the camshaft cover make sure that the mating faces are clean and free of foreign material.

Use a clean roller like Volvo tool 9512767 to apply the liquid gasket (Volvo p/n 1161059) to the camshaft cover.

Ensure that no liquid gasket gets into the oil galleries.

You can use a disposable paint tray or a clean piece of laminated cardboard to squirt some of the liquid sealant on so the sealant can be evenly spread across the roller's surface; this will ensure even application.

After rolling the liquid sealant evenly onto the camshaft cover install five new spark plug tube o-rings and place the cover back onto the cylinder head using the guide pins to line it up.

Reinstall the wing nut press tools (999 5454) and evenly tighten them down to press the cam cover close to the head.

Install and start all the cam cover bolts and begin to tighten the bolts from the middle and outwards.

Reassemble the rest of the cylinder head parts and timing components and give the car a good test drive.

Here is a list of the torque specs for this engine. ●

TORQUE SPECS	
Torque rod, lower (screw M12)	Step 1 ... 30 Nm; Step 2 ... 80 Nm
Torque rod, lower (screw M12)	80 Nm
Torque rod, lower (screw M10)	60 Nm
Torque rod, upper to frame member (screw M12)	130 Nm
Oil filter (environmental filter)	35 Nm
Oil trap	16 Nm
Oil plug	38 Nm
Oil pump (countersunk Allen, M6x20, holds the pump housing together)	6 Nm
Oil return line (turbocharger)	12 Nm
Stud (at exhaust port, manifold, turbocharger)	20 Nm
Plug (gauge hole/crankshaft adjustment)	38 Nm
Plug (Oil pressure line, engine block)	38 Nm
Belt tensioner (mechanical)	20 Nm
Belt tensioner accessory drive belt	42 Nm
Throttle body	Tighten the screws crosswise. Tighten to 8 Nm
Flywheel	Step 1 ... 45 Nm; Step 2 angle tightening 65°
Vibration damper (flange bolt M8x25)	Step 1 ... 25; Step 2 angle tightening 60°
Timing gear casing (rear)	2 X M7x20 ... 12 Nm; M8x30 ... 25 Nm
Timing gear casing (upper)	10 Nm
Timing gear casing (front)	8 Nm
Spark plugs	28 Nm
Connecting rod cap	Step 1 ... 15 Nm; Step 2 ... 25 Nm; Step 3 angle tightening 100°
VVT-module (center screw)	120 Nm
VVT-module (center plug)	35 Nm

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