Brakes: ABS

FAQ Home

Volvo Maintenance FAQ for 7xx/9xx/90 Cars

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Maintenance:

Pad and Rotor Identification and Replacement. See the detailed tables describing pads and rotors for ABS brakes at Brake Pad Identification and Brake Rotor Identification.

Brake Rotor Removal on 740 with ABS.

[Inquiry:] I have two new front rotors to install on my 1990 745T with ABS. My Chilton manual isn't very descriptive. From looking at the new rotors, it doesn't appear that I need to remove the wheel bearing. Is that correct? Are the ABS

sensors difficult to remove?. The manual mentions an internal toothed ring which has to be removed from the old rotors and installed in the new. The manual suggest that there may be some problems removing these and that a puller may be necessary. What size puller works best if necessary?

[Response:] If yours is like my '90 740 GLE, forget about Chilton. The disc and hub are separate on your car, not like the setup Chilton is describing. Once the caliper is removed, the disc simply lifts off (after removing the locater pin). The ABS sensor is on the hub not the disc, so you don't touch it at all. 2 bolts hold the caliper - support it after removing the bolts so the weight will not strain the flex lines.

Cleaning Sensor Rings.

[Tip from Tim:] While the rotor disc is removed, take the time to use a soft bristle brush and clean the ABS sensor area, and the toothed sensor ring that is part of the hub. It is usually pretty dirty with an accumulation of brake dust and magnetized sacrificial brake material. I did this with a fan blowing the ever toxic dust away from me, and out the garage door. Most of the stuff fell onto a newspaper for quick clean-up.

Brake Job Tips: Hose Clamp; ABS Sensors

Forcing Dirty Fluid Back into the ABS:

[From Motor Service Magazine] We believe the biggest brake bungle techs are making today is forcing caliper pistons back without clamping the hose and opening the bleeder. Since the line comes in near the bottom of the cylinder where the sediment is, this forces debris up into the ABS unit, and that will likely result in a comeback for a glowing anti-lock warning light. Just opening the bleeder as you may have done in the past isn't good enough anymore. You've got to choke off that hose. [Editor's note: you can buy inexpensive plastic pliers with rounded jaws designed to clamp rubber brake hoses without damage, just enough to keep most of the fluid from passing through. Check your auto parts store. And don't squash the hose, just clamp it] And note there is some **controversy** about this: Ford and GM do not recommend clamping because of the potential for damage to the hose.

Wheel Sensor Damage:

Another thing to remember about ABS is that it's easy to damage those delicate wheel speed sensors while doing brake work, or to cause metal particles to attach themselves to the magnet. Either is likely to put the system into default, or make it go permanently into anti-lock mode (called "false modulation"), and turn on the warning lamp. On ABS, speed sensors are at the top of the list of failures. As far as the ABS problems are concerned, the first is speed sensors with metallic particles sticking to the sensor nose. This may cause system default, or make it constantly

go into anti-lock mode called 'false modulation.' Make sure the air gaps are correct, and the sensors and tone wheels are clean with no iron filings or debris in the vanes, which can give an erratic speed signal, set a code, and put the system in default

Another problem on wheel speed sensors is an internal break in a wire. Be careful doing any wheel work because those sensors are delicate. The second thing is rust where the sensor mounts or in the wheel speed sensor bore, which makes the sensor hard to remove. As time goes on, we're going to see more and more corrosion in the electrical parts. Another problem is moisture infiltration into speed sensor electrical connectors, which causes intermittents.

Anti-Lock Brake System Service Precautions from Raybestos [Courtesy 1998 Brake Parts Inc. & Online Technologies Corporation, Raybestos, all rights reserved]

1. Always refer to the appropriate anti-lock service manual before attempting to service any portion of the brake system.
2. Warning: Some ABS systems store brake fluid in an accumulator under high pressure. Failure to depressurize these types of anti-lock systems before servicing can cause physical injury! The majority of these ABS systems can be depressurized by simply turning off the ignition and firmly depressing the brake pedal between 20 and 40 times. Check service manual for exact number. [Editor's Note: Not true for Volvo cars: see Abe Crombie tips on bleeding/flushing below.]
3. Use the proper DOT 3 or DOT 4 brake fluid specified by the vehicle manufacturer. This can be found on the master cylinder cap or reservoir body. DOT 5 (silicone) brake fluid can **not** be used in any ABS system. [See Brake Fluid Comparison for more information.]
4. Do not hammer or pry on wheel speed sensors and/or sensor rings to adjust the air gap. These components are delicate and can easily be damaged!
5. ABS and other on-board computer can be easily damaged by high electrical system voltage. Do not attempt to jump start an ABS equipped vehicle with a gasoline powered booster or 110 volt type battery charger on the fast charge/ boost setting. Slow charge the battery first before attempting to start. If this is impractical, disconnect the negative battery cable before fast charging the battery.
6. All four tires must be of the same size and type. Failure to observe this rule can cause the ABS and/or Traction Control system to disengage and the warning light to come on. Follow the vehicle manufactures recommendations before installing any optional tire sizes.
7. Never unplug or reconnect any electrical ABS component with the ignition on. This can cause a current surge and damage one or more of the system components.
8. When installing any "add on" electrical accessories' (CB's, Telephones, Stereos, etc.), it is important that any antennas or other wiring be located away from the ABS computer and sensor wiring. A magnetic field is generated as current flows through this additional wiring. The magnetic field that is created produces electro-magnetic interference (EMI) that can affect the signals from the wheel speed sensor to the ABS computer.
9. When electrical welding on a vehicle, it is recommended that all of the

computers be disconnected from the wiring harness to prevent possible damage. Care should be taken not to damage the connectors.

10. When replacing unitized wheel bearings, half shafts, steering knuckles, or any other component that could affect the air gap between the wheel speed sensor and sensor ring, then the air gap must be checked.
11. When servicing disc brakes, open the bleeder screws and vent the brake fluid, if it is necessary to push the caliper pistons in. There is sediment that naturally collects in calipers over a period of time. This sediment, if allowed to flow back into the master cylinder along wi

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Brake Fluid Bleeding/Flushing Procedures for Cars with ABS.

Depressurizing Fluid?

[Tip from Abe Crombie] The ABS doesn't need to be "de-pressurized" on a Volvo. There are a few cars out there that have the master cylinder/hydro-boost/ABS pump as a unit. These are the ones for that precaution. You never get the fluid completely changed on ABS cars as some fluid is in a storage accumulator that is not accessible. If you periodically change fluid this is never an issue as the fluid left in these areas will be circulated eventually through much of the system and it will be diluted by the clean fluid and will pose no problem.

[Editor's Note: Consider a pressure flush of fluid instead of a mere bleed; highly recommended both to remove air as well as to purge and renew the fluid, required every two years.]

Using Line Clamps When Flushing/Bleeding:

[Tip from Motor Magazine] Add the step of line-clamping the brake hose to the caliper when you retract caliper pistons. If you don't, you may be forcing brake fluid from the caliper bore (where rust and other debris may have collected) and sending this dirty fluid upstream.

It's long been standard practice to open the caliper bleeder screws to give brake fluid a place to go while retracting pistons. However, sometimes the bleeders are partially blocked. In these cases, they may not let out all of the fluid that you meant to let escape. Instead, the fluid may take the path of least resistance - upstream. Nowadays, that's likely to send it to sensitive ABS components.

If the vehicle you're servicing has a blocked bleeder, you may get around the problem by cracking open the fitting where the brakeline attaches to the caliper before retracting the piston. For added assurance, you may also want to line-clamp the hose feeding the caliper with genuine clamps designed for this purpose.

Troubleshooting:

ABS Diagnostic Code Retrieval.

1984-1991 Cars without ABS Self-Diagnostic Capability. Pre-1992 cars lack any self-diagnostic capability for the ABS system. Fault tracing is done with a multimeter, circuit by circuit and sensor by sensor, according to detailed

instructions in the Volvo OEM technical manual. A fault in the ABS unit will be indicated by an illuminated ABS lamp on the instrument panel and the ABS system (but not the normal brakes) will cease to function. The internal fault code may be cleared by disconnecting the battery.

1992+ Cars With Underhood Diagnostic Units. [Tip from Tom Irwin] To retrieve any ABS diagnostic codes which are stored and are noted by a lit "ABS" lamp, turn the ignition switch on to KPII and leave the engine off. Look under the hood to locate the Diagnostic Link Connector boxes. Your car can have one box ("A") or two ("A" and "B", 1992+). The "A" box has the diagnostic connector pigtail, the test button, and the LED readout lamp.

Put the Diagnostic Link Connector probe into Box A, Position 3. Push button on DLC for >1sec. and capture codes flashing in the red lamp.

To clear codes, place the DLC probe into position 3. Hold DLC button down for >5secs. Release for 3 secs, then press again for >5 secs. This will clear the codes.

The codes are shown in the table below. Note that these are generic; your car may not have two rear wheel sensors and thus the code will not apply. If you cannot pull any codes but the lamp still lights, see Diagnostic Unit Malfunction: Surge Protector Failure

Code	ABS System Diagnostic Information
Mode 1:	(40 km/h=25 mph)
1-1-1	No error code set
1-2-1	Left side front wheel sensor: faulty signal at speed less than 40km/h
1-2-2	Right side front wheel sensor: faulty signal at speed less than 40km/h
1-2-3	Left side rear wheel sensor: faulty signal at speed less than 40km/h
1-2-4	Right side rear wheel sensor: faulty signal at speed less than 40km/h
1-2-5	Signal faulty from at least one wheel sensor for a long period
1-3-5	Control Module (CM) faulty
1-4-1	Faulty pedal sensor: shorted to ground or supply
1-4-2	Faulty stop (brake) lamp switch: open circuit
1-4-3	Control Module (CM) faulty
1-4-4	Brake discs overheated
1-5-1	Left front wheel sensor: open circuit or short-circuit to battery voltage
1-5-2	Right front wheel sensor: open circuit or short-circuit to battery voltage
1-5-5	Rear axle sensor: open circuit or short-circuit to battery voltage
2-1-1	Left front wheel sensor: no signal on moving off
2-1-2	Right front wheel sensor: no signal on moving off
2-1-3	Left rear wheel sensor: no signal on moving off

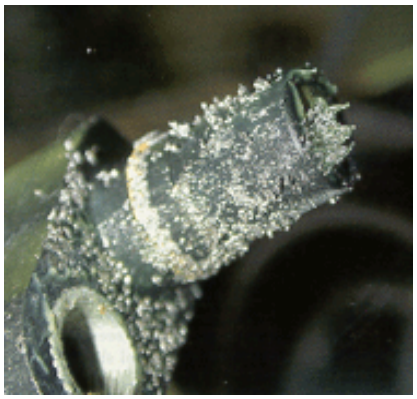
2-1-4	Right rear wheel sensor: no signal on moving off
2-1-5	Valve relay: open circuit or short-circuit
2-2-1	Left front wheel sensor: ABS operation signal missing
2-2-2	Right front wheel sensor: ABS operation signal missing
2-2-3	Left rear wheel sensor: ABS operation signal missing
2-2-4	Right rear wheel sensor: ABS operation signal missing
2-3-1	Left front wheel sensor: signal missing
2-3-2	Right front wheel sensor: signal missing
2-3-5	Rear axle sensor: signal missing
3-1-1	Left front wheel sensor: open circuit or short-circuit
3-1-2	Right front wheel sensor: open circuit or short-circuit
3-1-3	Left rear wheel sensor: open circuit or short-circuit
3-1-4	Right rear wheel sensor: open circuit or short-circuit
3-2-1	Left front wheel sensor: irregular interference at speeds over 40 km/h
3-2-2	Right front wheel sensor: irregular interference at speeds over 40 km/h
3-2-3	Left rear wheel sensor: irregular interference at speeds over 40 km/h
3-2-4	Right rear wheel sensor: irregular interference at speeds over 40 km/h
4-1-1	Left front wheel inlet valve: open circuit or short circuit
4-1-2	Left front return valve: open circuit or short circuit
4-1-3	Right front wheel inlet valve: open circuit or short circuit
4-1-4	Right front return valve: open circuit or short circuit
4-1-5	Rear valve: open circuit or short circuit
4-2-1	Rear wheel circuit inlet valve: open circuit or short circuit
4-2-2	Rear wheel circuit return valve: open circuit or short circuit
4-2-3	Traction control system (TRACS) valve: open circuit or short circuit
4-2-4	Pressure switch for TRACS: faulty or short circuit
4-4-1	Control Module (CM) faulty
4-4-2	Pump pressure low
4-4-3	Pump motor/relay: electrical or mechanical fault
4-4-4	No power supply to valves in hydraulic unit

Diagnostic Notes on ABS Systems by Larry Carley, Import Car Magazine, March 2002, [adapted for Volvo RWD]

All anti-lock brake systems control tire slip by monitoring the relative deceleration

rates of the wheels when the brakes are applied. If one wheel starts to slow at a faster rate than the others, it means the wheel is starting to slip and is in danger of losing its grip, locking up and skidding. The ABS system responds by momentarily isolating the brake circuit for that wheel, releasing hydraulic pressure and then reapplying the brake in rapid sequence until traction is regained or the vehicle comes to a halt.

Electrically operated solenoid valves in the ABS modulator hold, release and reapply hydraulic pressure to each brake circuit. This produces noise and a pulsating effect that can be felt in the brake pedal. All ABS systems keep track of wheel deceleration rates with wheel speed sensors. [Volvo RWD cars use]a common sensor in the differential . for both rear wheels (three-channel system). The common sensor for the rear wheels reads the combined or average speed of both rear wheels..



Wheel speed sensors consist of a magnetic pickup and a toothed sensor ring (sometimes called a "tone" ring). Wheel speed sensors generate an alternating current (AC) signal that increases in frequency and amplitude as wheel speed increases. Because the sensors are magnetic, they can attract metallic debris from semi-metallic brake linings and rotors that stick to the tip and interfere with the signal. If the ABS module doesn't see a clean WSS signal, it may think there's something wrong and set a wheel speed sensor code.

The distance or "air gap" between the end of a wheel speed sensor and its ring is also critical. A close gap is necessary to produce a strong, reliable signal. You don't want metal-to-metal contact between the sensor and its ring since this would damage both. But neither do you want too much clearance. An air gap that's too wide may produce a weak or erratic signal or, worse yet, no signal at all. [Per the Volvo shop manual, the required air gap is determined by an o-ring inside the sensor housing: make sure this is in place. If you need to measure gap,] insert a non-magnetic brass or plastic feeler gauge between the end of the sensor and ring... [Because wheel-speed sensors are magnetic, they attract metallic particles. If debris cast off from semi-metallic brake pads, rotors or drums ends up in the vicinity of the sensors and sticks to the tip, it will weaken the magnetic field and reduce the strength of the sensor signal. Gap and signal can be seriously distorted by steel particles picked up by the magnetic sensor: remove these at regular intervals.]

A good wheel speed sensor will generally produce an AC voltage reading of 50 to 700 MV when the wheel is spun at a speed of about one revolution per second. If the voltage reading is low or non-existent, check the sensor's resistance (with the key off). This can be done through a breakout box with a DVOM. Checking resistance through the breakout box will tell you if the sensor's wiring harness is okay. If you don't get the specified value [between 900 and 2,200 ohms for Volvo RWD front sensors and 600 and 1600 ohms for the rear sensor], disconnect the sensor from its wiring harness and check the sensor's resistance by attaching the DVOM test probes to the sensor leads. A resistance reading that's now within range tells you the problem is in the wiring, not the sensor. If the sensor has too much internal resistance (opens) or too little resistance (shorts), the sensor is defective

and needs to be replaced.

Damage to the teeth on the tone ring can also upset the WSS signal. If one or more teeth are damaged, even slightly, it may cause enough of a variation in signal strength to confuse the control module. We're talking a difference of only .050 inches in tooth height in some cases.

Grounds or shorts in the wheel speed sensor cables can be found by checking continuity between the wiring connectors. If a defect is found in the wires that run between the sensor and the chassis, replacing the wires with new ones is a better repair choice than trying to fix or splice them. These wires undergo a great deal of flexing every time the suspension encounters a bump, so new wires will hold up better than ones that have been soldered, spliced or taped.

The operation of the ABS system can often be affected by electrical problems in the vehicle, as well as the ABS system itself. Underlying conditions that may cause trouble include:

- Low battery charge - A low charge can interfere with the operation of the anti-lock control electronics.
- Blown fuses - Check the brake control module fuse, main relay fuse and pump motor fuse.
- Corroded/loose connectors - The main relay, ..., fluid level sensor and control module connectors all must be tight and correctly installed.
- Water intrusion - The most common causes of excessive harness resistance are water intrusion and corrosion at the sensor to main wiring harness connector. Water intrusion can occur at the sensor can or at the harness connector.
- Bad grounds - Check body grounds, especially on the modulator and ABS module.

[Your Volvo reports diagnostic scan codes through the OBD-I diagnostic connector.] Once you have a code, you have a place to start your diagnosis. Refer to the diagnostic chart or procedure for the code, and follow the steps to isolate the fault. This will usually involve measuring voltage or resistance within various wiring circuits or components. You'll need a multimeter and possibly a breakout box to make these checks. [Recommended: Volvo OEM "green manual" for brakes/ABS].

Diagnostic Unit Malfunction: Surge Protector Failure.

[Tip from IO333] This info pertains to Volvo 740/940 through 1993 model years. If your ABS light is on, and the DLC procedure for obtaining the codes from the ABS ECU produces no codes (no blinks after holding the button for >1sec with the DLC probe attached to #3 in the "A" unit, yet the DLC LED lights when the button is pushed), the transient surge or over-voltage protection relay may be defective. In later cars, this relay is located near the ABS control unit high under the kick-panel (you'll need to remove this), behind the instrument panel, to the left of the steering wheel. It is on the other side of metal bracket that holds the ABS computer (the large metal box with many wires going into it through a sturdy connector, very close to the left fender). In earlier cars, it is located in the well in the rear trunk that contains the ABS unit. The surge protector looks like a regular

relay, except that there is a 10amp fuse pushed into the top of it. If you follow the wires coming from it, you'll see they lead to the main ABS computer. The relay can be removed from the bracket by pushing up and twisting the bottom towards the footpedals. Now first remove the fuse and check that it is OK. If it is, put the fuse back in the relay and obtain a voltmeter. Leave the wiring connector on the relay and switch the ignition on, start the engine and leave it running. The pins are labled 1, 2, 3, 4 on the connector (as well as inside the relay, but the numbers are hard to see). Pin 1 (red wire) should show +12V. Pin 3 (black wire) should show continuity to ground. Pin 2 (yellow/red wire)is the switched circuit, and should show +12V with the engine running, and 0V with the car switched completely off. If you are not observing this behavior from Pin2, the relay is bad, and needs to be replaced. The relay is essentially impossible to dissasemble without destroying it, so a replacement unit will be required. My dealership charges $85 for the part, an

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Intermittent "Check ABS" Lamp.

[Inquiry:] I have a 1989 740GLE that sometimes has the anti-lock brake warning light on. The brakes are new so I know the're OK. Is there a connector somewhere that should be cleaned? [Response:] Check ABS sensors at front wheels, and clean them. Check B+ wires at the positive battery cable. Corroded positive terminal could be the problem.

[Another Inquiry about ABS Lamp On:] Found a 1990 760T in great shape; original owner with all the maintenance records. BUT: the ABS light stays permanently on. Am I facing a major repair, or just an adjustment / clean-up of the ABS sensors ?

[Response 1: Roy-Magne Mo] I had exactly the same problem with mine. Clean the connector at the front wheels, and check the wires going to the connectors. The wires were the problem with mine

[Response 2: John B] I agree with Roy.....but you won't know until you have the system checked out. Before I bought it I would pay the $80 or so to get the car and the system checked out by a Volvo dealer. You DON'T want to buy a new

[Response 3: RC] I should tell you that I had similar characteristic with my ABS. Luckily, a flush of the brake fluid did the trick. I can only hope that your fix is as simple; ABS repairs sound scary.

ABS Light "On": ABS Sensors/Wheels Dirty

ABS Sensor Basics.

[Inquiry:] During the snow here over last couple of weeks (UK) our 1992 Volvo 940 2litre turbo started flashing the ABS light up, and even now the snow's gone it came on once but brakes are all fine and the light hasn't come back on for week or so does anyone reckon we have anything to worry about, I reckon it may have just been the cold weather and snow, and surely if the ABS was faulty the light would have stayed on all the time? [Response: Paul Grimshaw/Bob Dietz] A common problem with ABS is that the sensors and reluctor wheels, used to measure and compare tire rotational speeds, can become fouled by dirt and brake carbon. This

typically occurs on the front axle where the sensors and reluctor wheels attract a considerable quantity of brake dust shed by the front calipers. As the wheel turns an analog signal is generated from each sensor and monitored by the control unit. If the amplitude of the signal decreases due to iron particles accumulating on the sensor the control unit cannot accurately compute the wheel speed and begins to modulate the brake pressure to the wheel whose signal has been lost. Since higher wheel speeds generate a higher voltage the problem does not occur at higher speeds since the differential value detected among the channels falls into an acceptable range. As accumulation of brake dust grows, heat fuses it into a carbon-like coating that attenuates the minute changes in reluctance measured by the sensors. This is interpreted by the car's ABS computer as a continuous difference in rotational speeds between one or more tires -- eventually exceeding a threshold value and triggering a "fault" light.

It is good practice to carefully clean the reluctor wheel and ABS sensors whenever the brake rotors are removed (usually during replacement of the rotors), as these parts lie inside the rotor "hat". Unfortunately (in this case), Volvo brake rotors last quite a long time. The result is considerable build-up -- and occasional fault light activation -- in otherwise functional systems.

Three-channel ABS systems employ a rear wheel sensor in the differential housing. These are very reliable and need not be removed nor cleaned unless a specific problem is encountered. A variety of Bosch and Teves systems are of the four-channel type employing reluctors and sensors at each wheel; these are not used on Volvo 200/700 or 940 cars.

Cleaning Sensors.

[Response: Paul Grimshaw/Bob Dietz] When cleaning the ABS sensors, it is best to avoid the urge to remove them from the dust shield as their plastic bodies can become brittle with age and crack if forced. A better cure would be to clean the wheel sensors by wiping them clean with a rag or soft brush. Another problem is the possibility of signal loss through non-waterproof connectors or cracks in the wiring or its insulation. I have seen cars where the rear wheel sensor anchor bolts were absent; with metal shavings on sensors that looked like a dead mouse (the sensor magnet is smaller than a pencil); or with broken wires inside intact insulation at the waterproof connectors both at the differential and shock towers. Most of the failures are very simple. The system isn't rocket science, which is probably why it works. But it needs to be maintained just as any high tech system needs to be maintained. [Chris Herbst] If you remove the sensors, make sure the o-rings are seated properly. I usually grease the O-rings a little bit on reinstallation.

Cleaning Reluctor Wheels.

[Tip from Chris Herbst] Usually there is a big buildup of garbage in the sensor reluctor wheels that obscures the sensor from reading it. The more junk that is on the wheel, the less defined the impulses will be. I scrape them out usually with a small drift pin and then blow compressed air at them. Some of the junk doesn't blow off of the wheels with compressed air and you will need to scrape it off.You could also use an appropriately sized dowel or something with an edge that will scrape the debris from the wheels. Try not to damage them by putting surface

scratches in them. If you use compressed air on brake parts, use appropriate precautions so as not to inhale the dust!

ABS Light "On": Rear Sensor?

[Inquiry] Is there a ABS sensor in the rear somewhere? I have cleaned the 2 up front and sprayed them well with contact cleaner. It seems to light up when braking and hitting a bump then it just stays lit.. The wires that lead to the sensors up front look in good condition.

[Response: Chris Herbst] There's a single rear sensor (single wire) that goes to the differential. The sensor sends the same signal to both speedometer and ABS units through one pair of wires leaves the sending unit. . The "over bumps" part is a good clue. That thing acts up over bumps first, and eventually breaks or becomes totally ineffective. Some days your system will work until you hit a bump and then BINGO- your ABS lite comes on and the speedometer fails! Play around with the sensor and connector and see if it might be your problem. It often is

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ABS Light "On" After Jump Start

[Inquiry:] On my 1993 940, I had to change the battery and after the car was started the ABS light was on and now doesn't go off. I checked all fuses at the fuse box, I read there's another one up by the ABS ECU? Please tell me there's another fuse to check, I fear this may be an expensive repair. What else can I check?

[Response 1: Jim Bowers] A possible source of system overvoltage is a loose battery cable. If the cable disconnects, even for a few thousands of a second, while the alternator is charging, the alternator output voltage will jump to a very high value, usually killing the alternator diodes also.

[Response: Abe Crombie] First, make sure the leads that attach to the bolt on the positive battery terminal are tight as one of these is the feed for the ABS modulator under hood. Second, there is a fuse on that year model (94 and later 900's don't have this fuse or the relay) on a relay under dash clipped to the bracket for ABS control unit. This control unit is high up on the left on 940 and over under the kick panel in right passenger's foot well forward of door on 960. It is a 10A push in fuse. The relay that the ABS fuse is located on blows the fuse if there is an over-voltage condition to protect from excessive voltage level to control unit. The usual reason that it blows is when you jump start vehicle

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ABS Sensor Replacement.

If suggestions of cleaning the front ABS senders (sensor and pulse wheel) and associated electrical connectors doesn't stop the intermittent ABS fault then you may need new sensors. I found the original old style sensors (rectangular tipped) on my '89 were over-sensitive, especially at low speeds on very smooth surfaces. Your car may or may not have received the in-warranty upgrade to the less sensitive new style sensor (diamond shaped tip). If not, it would be a relatively easy DIY upgrade.

[Tips on Removing ABS Sensors:] How do you safely remove the ABS sensors? After removing the 5mm Allen screw mine seem to be seized in place. I don't want to break them so I'm looking to some experienced people for some advice. My ABS is pulsing inappropriately at very slow speeds. I have reseated both electrical connections on the inside of the shock towers.

[Response: Abe Crombie] The sensors fit into the holes in the spindles with clearance to spare. Twist them as you pull on them and they should come right out. If they are the style constructed with two steel strips bonded to a magnet in the center to make the tip (made by VDO) then they will have a much greater tendency to have the low speed modulation as you have experienced. The other style (Bosch) have a diamond-shaped tip that is all steel.

ABS Pulses at Low Speeds

[Inquiry:] The ABS acts up when I'm driving at low speeds and applying hardly any pressure to the brake pedal of my 1990 740 GLE. The ABS lifts the brake pedal in the same way as if it was locking up.

[Response:] You should remove and clean the front wheel speed sensors. To do this turn wheel full lock to one side and then remove the sensor from wheel that is turned out by undoing a 5 mm Allen screw you will see adjacent to arm where tie rod for steering attaches. Then turn wheel to full lock the other way and do the same on other side. Also unplug and then reconnect the sensor connectors that are in the engine compartment near top of struts. This should effectively clean the connections. This can also cause low speed inappropriate ABS activation.

[Tip from Bob Dietz] Apparently when the waterproof connectors to the ABS sensors at the differential (rear) and shock towers (front) are molded on the sensor wire itself is under a lot of tension--I've found many of these with only one or two strands of wire left unbroken, even though the insulation looks fine. This can cause lost ABS signals. Volvo can supply replacement pigtails. It's a piece of white wire with the identical end molded on. I line splice and solder the joint, shrink tube over. Try to maintain the twist. All the signal cables for ABS are twisted pair. There is also the possibility of signal loss through non-waterproofed connectors.

[Tip from JSW] 1991 940 The symptoms started with just a groaning from the ABS under light braking at very low speeds. This progressed to the ABS warning light coming on at about 15 mph and staying on. I'd cleaned the sensors and reluctor rings, but this didn't cure it. But I discovered that it is possible to 'trick' the system into not showing a fault. I drove the car until the ABS light showed, then put it into neutral, switched off the engine and restarted. Continued driving, the ABS light stayed off. Then I slowed the car with the brakes. At about 5 mph the ABS cut in with the usual groaning noise, and the car briefly pulled to the right. This told me the left front sensor was detecting a lockup and therefore releasing brake pressure to that wheel. This explains the car pulling to the right. I replaced the left front sensor and all is well.

Noise from 960 ABS System

[Inquiry: My 960's ABS system makes a strange noise on stops.]

[Response:] The ABS does do a self test if you come to a complete stop for over a couple of seconds. This is in addition to the initial test that occurs on the first roll over 4-6 MPH. To verfiy that this is the noise, pull out the fuse for the ABS and drive (carefully so as to not need the now nonfunctioning ABS) in the conditions to see if the noise is gone. Putting in the fuse and switching ignition off and then restarting and driving again will turn off ABS warning lamp.

ABS Lamp Lights After Start-up.

[Inquiry 1:] The Anti-lock light illuminates on my 1990 760 a while after I start driving, before that ABS seems to work OK. The light seems to become lit when I exceed 25 mph, but lately it seems like the speed has been higher, yesterday I had as much as 75 mph before it became lit. Can a slight shiver in the front wheel bearing cause this?

[Response 1:] If the light comes on as you gain speed through 3-5 MPH then you might have a faulty pump motor relay. The pump is tested as you gain speed the first time after starting car. If it comes on after you have driven a distance and hit a bump then a problem with wheel speed sensor wiring is likely. The ABS system on that year model doesn't have fault diagnosis code feature. If it's a wagon with solid rear axle the wire from car to axle is subject to motion with every bump and will fatigue and break inside insulation. This usually is no sooner than 100 K miles unless the car is driven on poor roads a lot. If it were the cable it would predictably do it on bumps. If there is a severe build up of metallic particles on front sensors that can make light come on. If your wheel bearing has expelled grease that may have built up on sensor and made it retain the metal pad wear particles. That might be the place to look first. A bent pulse wheel (part of hub and runs next to sensor to create the signal , looks like a gear) can do the same. The system is designed to be a little forgiving when the signals from wheels are not equal as this could be due to normal things like having the mini-spare on car. If the signal is too different then the ABS lamp will light . The wheel bearing is a ball, not tapered, roller type that is not adjustable and must be replaced if it is loose.

[Inquiry 2:] The ABS light on my '90 740T Wagon came on as soon as I started the car after lunch today (very hot, very humid). And it stayed on after I drove it and after restarting the engine a couple of times.

[Response 2:]If the light is on at start and doesn't go off then you likely have a problem with the surge relay next to ABS ecm or the solenoid valve relay on ABS modulator under hood. The fuse on the surge relay can come lose or relay can fail. The solenoid valve relay (the smaller of the two on ABS modulator under black cover) gets eroded contacts and will need replacement if that is in fact failed. Turn on key, start engine, check to see that ABS light is on and then tap on AS modulator, if light goes off then sol. valve relay is at fault. Otherwise check surge relay next to ABS ecm for loose fuse. See also Speedometer Relay and ABS Lamp

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Replacing a Failed ABS Module. [Randy Duke] After my 94 940's BS modulator seized and would not allow brake fluid to pass on to the caliper, I got a used ABS

hydraulic modulator for $125. I was able to get most of the air out of the replacement modulator by placing the assembly flat on the ground with the open connections pointing straight up. It turns out the old brake lines I cut off the car fit those connections so used them and a syringe to force fluid into the part. Lots of bubbles came out. I left the hoses on the bottom two connections so the fluid would not drain out when I was installing it. After that I attached the top brake lines first so the fluid did not drain much when I removed the temporary hoses that were in the bottom hole. I attached the bottom two lines last. The brakes are working just fine now.

Removing and Replacing a Toothed ABS Sensor Ring. [Jay Simkin]

If your car has ABS brakes, the "toothed sensor wheel" on the hub (rotation of which wheel feeds the ABS sensor) can be removed, to ease stud removal/installation.

To remove the toothed wheel, you'll need a workbench vise with 6"-wide jaws (or wider), a wide-blade (minimum 1.5") pry bar (e.g., a Stanley Wonder-Bar), a block of wood (0.75" (20mm) thick; 1.5" wide, and 8" long), and a hammer.

NOTE. DO NOT EVER hit the toothed sensor wheel with the hammer!!! While the toothed sensor wheel is wide, it is hollow underneath. If hit directly with a hammer, it will dent readily and so become useless. You will then need to replace it. It is part #3530983. It costs about US$50.

Clamp the hub in vise, with the toothed sensor wheel upwards. Position the hub, such that the top edge of the hub's flange is level with the top of the vise jaw. Tighten the vise as much as you can.

Use a length of thin wire, to hold in place the bearing retainers, which are inside the hub opening. Run the wire through the hub opening for the stub axle, and twist the wire a few times, until it snug. You'll need to loosen it, in steps, as the toothed sensor wheel comes off. Using a magic marker or white-out, make a mark on the toothed sensor wheel and on the hub body, so you can re-install the toothed sensor wheel, exactly where it was.

Position the block of wood, so that it within 1/8" (3 mm) of the edge of the toothed sensor wheel. Set the block, so most of it is on top of the vise jaw, and thus over the edge of the hub flange. So positioned, the wood block will help to hold down the hub.

Rest the flat side of the pry bar on the block of wood. Slide the edge of the pry bar under the toothed sensor wheel, until the end of the pry bar is against the hub body.

Hold the pry bar with one hand. Using the other hand, take the hammer and strike flat of the prybar, about four inches from the end closest to the hub. Remove the hub and turn it 45 degrees. Re-set it in the vise, and repeat the procedure.

Depending on the extent to which the toothed sensor wheel is corroded (my test hub was pretty corroded), it may take several cycles to loosen the toothed

sensor wheel. As the toothed sensor wheel rises along the hub core, loosen the wire holding in place the bearing races, and re-snug the wire.

The process requires moving in one direction around the edge of the toothed sensor wheel, lifting it a fraction of an inch with each cycle. Do not shift to a point opposite your starting point, as if you were tightening wheel lugs.

Once you have removed the toothed sensor wheel, you can replace damaged wheel lugs. Once you have done that, you can replace the toothed sensor wheel on the hub. Before you do that, use a brass wire brush, to remove rust/dirt from the area of the hub, onto which you will re-seat the toothed wheel. Do not remove your placement mark.

To re-seat the toothed sensor wheel, set it atop the hub core, and align your placement marks.

Lay the block of wood across the center of the toothed sensor wheel. With the hammer, strike the block of wood gently, in the center of the block. The toothed sensor wheel should start to slide down the hub core, to its original place on the hub.

After each blow, check to see that the toothed sensor wheel is not skewed, i.e., that its top edge is the same distance from the hub base, at all points on its circumference. If one edge is higher, move the block of wood, so it is atop the "high point", and tap the block of wood, until the top edge of the toothed sensor wheel is level. Move the block of wood back to the center and continue tapping, until the toothed sensor wheel's top edge is even with the top edge of the hub opening.

Re-install the hub, and all other removed parts. If, in a road test, the ABS light does not come on, you should not have any problems. To test the ABS system, go into a completely empty parking lot - or find a road on which there's no traffic (e.g., very early in the morning). Attempt an emergency stop. If you hear the "growl" of the ABS system, then all's well. If the ABS System does not work, consult a Volvo Master Tech.

Volvo Maintenance FAQ for 7xx/9xx/90 Cars
