1993–95 900 Series Diagnostic Trouble Code Chart

C	Fault detected	ABS light	ABS syste
-1)	No fault detected	-	-
5	Faulty signal from at least one wheel sensor	on	off
5	Fault in control module	on	off
2	Brake light switch, open circuit	off	on
1	L/H front wheel sensor, open or short-circ. to supply	on	off
2	R/H front wheel sensor, open or short-circ. to supply	on	off
5	Rear axle sensor, open or short-circ. to supply	on	off
5	Valve relay, open-circuit or short-circuit	on	off
1	L/H front wheel sensor, signal absent	on	off
2	R/H front wheel sensor, signal absent	on	off
5	Rear axle sensor, signal absent	on	off
1	L/H front wheel valve, open or short-circ.	on	off
3	R/H front wheel valve, open or short-circ.	on	off
5	Rear valve open or short-circ.	on	off
3	Pump motor/relay electrical or mechanical fault	on	off

1993–95 850 Series ABS Diagnostic Trouble Code Chart

DTC	Fault text	Notes
1-1-1	No faults detected by diagnostic system	
1-2-1	LH front wheel sensor, faulty signal at speed less than 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
1-2-2	RH front wheel sensor, faulty signal at speed less than 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
1-2-3	LH rear wheel sensor, faulty signal at speed less than 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
1-2-4	RH rear wheel sensor, faulty signal at speed less than 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
1-4-1	Faulty pedal sensor, shorted to ground or supply	Switches ABS warning indicator on Switches TRACS warning indicator on
1-4-2	Faulty brake light switch, open circuit or short circuit	
1-4-3	Fault in control module	
1-4-4	Brake discs overheated	Cars with TRACS only Switches TRACS warning indicator on
2-1-1	LH front wheel sensor, no signal on moving off	Switches ABS warning indicator on Switches TRACS warning indicator on
2-1-2	RH front wheel sensor, no signal on moving off	Switches ABS warning indicator on Switches TRACS warning indicator on
2-1-3	LH rear wheel sensor, no signal on moving off	Switches ABS warning indicator on Switches TRACS warning indicator on
2-1-4	RH rear wheel sensor, no signal on moving off	Switches ABS warning indicator on Switches TRACS warning indicator on
2-2-1	LH front wheel sensor, no signal from ABS system	Switches ABS warning indicator on Switches TRACS warning indicator on
2-2-2	RH front wheel sensor, no signal from ABS system	Switches ABS warning indicator on Switches TRACS warning indicator on
2-2-3	LH rear wheel sensor, no signal from ABS system	Switches ABS warning indicator on Switches TRACS warning indicator on
2-2-4	RH rear wheel sensor, no signal from ABS system	Switches ABS warning indicator on Switches TRACS warning indicator on
3-1-1	LH front wheel sensor, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
3-1-2	RH front wheel sensor, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
3-1-3	LH rear wheel sensor, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
3-1-4	RH rear wheel sensor, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on

1993–95 850 Series ABS Diagnostic Trouble Code Chart

DTC	Fault text	Notes
3-2-1	LH front wheel sensor, intermittent signal problems at speeds over 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
3-2-2	RH front wheel sensor, intermittent signal problems at speeds over 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
3-2-3	LH rear wheel sensor, intermittent signal problems at speeds over 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
3-2-4	RH rear wheel sensor, intermittent signal problems at speeds over 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
4-1-1	Inlet valve for LH front wheel, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
4-1-2	Return valve, LH front wheel, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
4-1-3	Inlet valve, RH front wheel, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
4-1-4	Return valve, RH front wheel, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
4-2-1	Inlet valve, rear wheel circuit, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
4-2-2	Return valve, rear wheel circuit, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
4-2-3	TRACS valve, open circuit or short circuit	Cars with TRACS only Switches ABS warning indicator on Switches TRACS warning indicator on
4-2-4	TRACS pressure sensor, faulty or short circuit	Cars with TRACS only Switches TRACS warning indicator on
4-4-1	Faulty control module	Switches ABS warning indicator on Switches TRACS warning indicator on
4-4-2	Pump pressure low	Switches ABS warning indicator on Switches TRACS warning indicator on
4-4-3	Pump motor, electrical or mechanical fault	Switches ABS warning indicator on Switches TRACS warning indicator on
4-4-4	No power supply to valves in hydraulic unit	Switches ABS warning indicator on Switches TRACS warning indicator on

1996 and Later ABS Diagnostic Trouble Code Chart

DTC	Fault text	Note
ABS–141	EBD–pressure sensor signal, circuit fault	Switches on warning light ABS Switches on warning light TRACS
ABS–142	Brake light switch signal	
ABS–143	Road speed signal, circuit fault	
ABS–144	Brake discs on front wheels overheating	Cars with TRACS only Switches on TRACS warning light Only while temperature is still high
ABS–211	Wheel sensor signal LH front wheel wheel speed incorrect	Switches on ABS warning light Switches on TRACS warning light
ABS–212	Wheel sensor signal RH front wheel wheel speed incorrect	Switches on ABS warning light Switches on TRACS warning light
ABS–213	Wheel sensor signal LH rear wheel wheel speed incorrect	Switches on ABS warning light Switches on TRACS warning light
ABS–214	Wheel sensor signal RH rear wheel wheel speed incorrect	Switches on ABS warning light Switches on TRACS warning light
ABS–221	Wheel sensor signal LH front wheel ABS control phase too long	Switches on ABS warning light Switches on TRACS warning light
ABS–222	Wheel sensor signal RH front wheel ABS control phase too long	Switches on ABS warning light Switches on TRACS warning light
ABS–223	Wheel sensor signal LH rear wheel ABS control phase too long	Switches on ABS warning light Switches on TRACS warning light
ABS–224	Wheel sensor signal RH rear wheel ABS control phase too long	Switches on ABS warning light Switches on TRACS warning light
ABS–311	Wheel sensor signal LH front wheel circuit fault	Switches on ABS warning light Switches on TRACS warning light
ABS–312	Wheel sensor signal RH front wheel circuit fault	Switches on ABS warning light Switches on TRACS warning light
ABS–313	Wheel sensor signal LH rear wheel circuit fault	Switches on ABS warning light Switches on TRACS warning light
ABS–314	Wheel sensor signal RH rear wheel circuit fault	Switches on ABS warning light Switches on TRACS warning light
ABS–321	Wheel sensor signal LH front wheel extrapolation counter	Switches on ABS warning light Switches on TRACS warning light
ABS–322	Wheel sensor signal RH front wheel extrapolation counter	Switches on ABS warning light Switches on TRACS warning light
ABS–323	Wheel sensor signal LH rear wheel extrapolation counter	Switches on ABS warning light Switches on TRACS warning light
ABS–324	Wheel sensor signal RH rear wheel extrapolation counter	Switches on ABS warning light Switches on TRACS warning light

1996 and Later ABS Diagnostic Trouble Code Chart

DTC	Fault text	Note
ABS–411	Inlet valve LH front wheel, fault in valve terminal circuit	Switches on ABS warning light Switches on TRACS warning light
ABS–412	Outlet valve LH front wheel, fault in valve terminal circuit	Switches on ABS warning light Switches on TRACS warning light
ABS–413	Inlet valve RH front wheel, fault in valve terminal circuit	Switches on ABS warning light Switches on TRACS warning light
ABS–414	Outlet valve HR front wheel, fault in valve terminal circuit	Switches on ABS warning light Switches on TRACS warning light
ABS–421	Inlet valve rear wheel,fault in valve terminal circuit	Switches on ABS warning light Switches on TRACS warning light
ABS–422	Outlet valve rear wheel, fault in valve terminal circuit	Switches on ABS warning light Switches on TRACS warning light
ABS-423	Inlet valve TRACS, fault in valve terminal circuit	Cars with TRACS only
ABS–431	Control module - general hardware fault	Switches on ABS warning light Switches on TRACS warning light
ABS–432	Control module - general interference fault	Switches on ABS warning light Switches on TRACS warning light
ABS–433	Battery voltage too high	Switches on ABS warning light Switches on TRACS warning light
ABS–441	Main control module relay	Switches on ABS warning light Switches on TRACS warning light
ABS–442	Control module - creeping powers	Switches on ABS warning light Switches on TRACS warning light
ABS–443	Pump motor electrical or mechanical fault	Switches on ABS warning light Switches on TRACS warning light
ABS–444	Control module - valve reference power	Switches on ABS warning light Switches on TRACS warning light
ABS–445	Control module - general valve fault	Switches on ABS warning light Switches on TRACS warning light

The ABS system is bled the same way as a conventional system; refer to Bleeding the Brake System, earlier in this section.

Brake Specifications

BRAKE SPECIFICATIONS

All measurements in inches unless noted

Model	Master Cylinder Bore	Front Brake Disc			Rear Brake Disc			T
		Original Thickness	Minimum Thickness	Maximum Run-out	Original Thickness	Minimum Thickness	Maximum Run-out	Fro
240 Series	0.880	0.870	0.790	0.0024	0.393	0.314	0.003	0.12
740 Series	0.937	0.870	0.790	0.0024	0.378	0.330	0.003	0.12
760 Series	0.937	0.870	0.790	0.0024	0.393	0.314	0.003	0.12
780 Series	0.937	0.870	0.790	0.0024	0.393	0.314	0.003	0.12
240 Series	0.880	0.870	0.790	0.0024	0.393	0.314	0.003	0.12
740 Series	0.937	0.870	0.790	0.0024	0.378	0.330	0.003	0.12
940 Series	0.937	①	②	0.0024	③	④	0.003	0.12
Coupe	0.937	0.870	0.790	0.0024	0.378	0.330	0.003	0.12
240 Series	0.880	0.870	0.790	0.0024	0.393	0.314	0.003	0.12
740 Series	0.937	0.870	0.790	0.0024	0.378	0.330	0.003	0.12
940 Series	0.937	①	②	0.0024	③	④	0.003	0.12
960 Series	0.937	①	②	0.0024	③	④	0.003	0.12
240 Series	0.880	0.870	0.790	0.0024	0.393	0.314	0.003	0.12
850 Series	0.937	1.024	0.906	0.0024	0.378	0.330	0.003	0.12
940 Series	0.937	①	②	0.0024	③	④	0.003	0.12
960 Series	0.937	①	②	0.0024	③	④	0.003	0.12
850 Series	0.937	1.024	0.906	0.0024	0.378	0.330	0.003	0.12
940 Series	0.937	①	②	0.0024	③	④	0.003	0.12
960 Series	0.937	①	②	0.0024	③	④	0.003	0.12
850 Series	0.937	1.024	0.906	0.0024	0.378	0.330	0.003	0.12
940 Series	0.937	①	②	0.0024	③	④	0.003	0.12
960 Series	0.937	①	②	0.0024	③	④	0.003	0.12
850 Series	0.937	1.024	0.906	0.0024	0.378	0.330	0.003	0.12
960 Series	0.937	①	②	0.0024	③	④	0.003	0.12
850 Series	0.937	1.024	0.906	0.0024	0.378	0.330	0.003	0.12
960 Series	0.937	①	②	0.0024	③	④	0.003	0.12
C70 Series	0.937	1.024	0.906	0.0024	0.378	0.330	0.003	0.12
S70 Series	0.937	1.024	0.906	0.0024	0.378	0.330	0.003	0.12
V70 Series	0.937	1.024	0.906	0.0024	0.378	0.330	0.003	0.12
S90 Series	0.937	①	②	0.0024	③	④	0.003	0.12
V90	0.937	①	②	0.0024	③	④	0.003	0.12

vented rotor: 0.870

y rotor: 1.024

vented rotor: 0.790

y rotor 0.906

③ With standard rear axle: 0.378

With multi-link rear axle: 0.393

④ With standard rear axle: 0.330

With multi link rear axle: 0.314

1992 Volvo 940

Submodel: | **Engine Type:** L4 | **Liters:** 2.3
Fuel Delivery: FI | **Fuel:** GAS

1990–93 Vehicles

The Control Unit (CU) contains a monitoring circuit to detect any internal faults within the control unit, as well as electrical faults in the sensors, solenoids, modulator unit, etc.

If the monitoring circuit detects a fault, the control unit will disable the ABS system and light the warning lamp on the dashboard. If the light comes on during vehicle operation, perform the following checks. All tests must be performed, in order.

1. Remove the soundproofing under the left side of the dashboard. Inspect the 10 amp fuse on the transient surge protector, located adjacent to the ABS control unit.
2. Check all connectors, wires and ground connections for the ABS system. Inspect the connectors at each component.
3. Insure that the ignition is switched **OFF**.
    A. At the CU under the dashboard, depress the lock spring and swing out the connector, disconnecting it from the CU.
    B. Remove the cover from the connector. Remove the white protective moldings from the sides of the connector.
    C. Use an ohmmeter to check ground circuits. Terminal numbers are stamped into the side of the connector. The ABS wiring grounds at the left A-pillar. Test between ground and terminals 10, 20, 32 and 34.

    NOTE: Never check connectors from the front or terminal side; damage may be caused. Always check through the holes in the side of the connector without using excessive force to make contact.

    D. Resistance should be 0 ohms in all cases. If any other reading is encountered, check for damaged wiring or improper connections. Wires are grounded on the left A-post.
    E. If a fault is found at terminal 32, replace the solenoid relay on the hydraulic modulator and retest.
4. Check the transient surge protector:
    A. Turn the ignition switch **ON**.
    B. Connect a voltmeter between ground and terminal 1 on the control unit connector; 12 volts should be present.
    C. If no voltage is present, measure voltage directly at the transient surge protector connector. Terminals 1, 2 and 4 should be energized and terminal 3 should be grounded.
    D. If only terminal 1 and 4 are energized when terminal 3 is grounded, the transient surge protector has failed and must be replaced.
5. Check the power supply to the control unit connector:
    A. Connect the voltmeter to a known good ground. Depress the brake pedal and at the same time, connect the meter to terminals 25, 27, 28 and 29.
    B. The voltmeter should read 12 volts at all terminals, except terminal 29.
    C. Voltage should read 0.5 — 1.0 volt at terminal 29.
6. Start the engine. The voltmeter should read 12 volts at terminal 25.
7. If no voltage or incorrect voltage is found in the above tests, proceed as follows. For a problem at:
    A. Terminal 25: Check brake lamp switch and replace if needed. Inspect brake light bulbs and replace as needed.
    B. Terminal 27: Replace defective solenoid relay.
    C. Terminal 28: Replace defective pump relay.
    D. Terminal 29: If reading at 27 is correct, voltage at 29 should be 0.5–1.0 volts. If not, replace solenoid relay.
8. Turn the ignition switch **OFF**.
9. Check voltage to the hydraulic modulator:
    A. Remove the cover from the hydraulic modulator. Detach the connector from the hydraulic modulator.
    B. Switch the ignition **ON**.
    C. Connect the voltmeter to a know good ground and to terminals 6, 7, 10 and 12. Voltage in all cases should be 12 volts.
10. If there is no voltage or improper voltage to any terminal, proceed as follows. For a problem at:
    A. Terminal 6: Inspect wiring for shorts and/or poor connections.
    B. Terminal 7: Attach the connector to the hydraulic modulator with the ignition **OFF**. Turn the ignition **ON** when connected; the ABS warning lamp on the dashboard should come on. If not, replace the warning lamp bulb.
    C. Terminal 10: Transient surge protector failed.
    D. Terminal 12: Inspect wiring for shorts and/or poor connections.
11. Turn the ignition **OFF**; attach the connector to the hydraulic modulator.
12. At the control unit connector, use an ohmmeter to measure the resistance of each wheel speed sensor.
    A. Test the left front sensor between terminals 4 and 6. Test the right front sensor between terminals 11 and 21.
    B. Resistance for the front sensors must be 900–2200 ohms (0.9–2.2 kilohms). If the resistance is not within specifications, unfasten the harness connectors in the engine compartment and measure resistance directly at the sensor. If the readings still differ, inspect the wiring and/or replace the sensor. Also, check the pulse wheels for defects or damage; maximum radial run-out is 0.006 inch (0.15mm).
    C. Measure resistance of the rear speed sensor by testing at terminals 7 and 9. Resistance should be 600–1600 ohms (0.6–1.6 kilohms).
    D. If resistance is not correct, detach the sensor connector on the fuel filler pipe in the trunk. It will be necessary to break the connector seal; do so without damaging the wiring. If readings are still not within specification, inspect wiring and/or replace the sensor.
13. Check the wiring to each sensor.
    A. Raise and safely support the vehicle.
    B. Connect an ohmmeter to the pairs of terminals use in Step 11.
    C. As each pair is tested, have an assistant turn the correct wheel on the vehicle including the rear. Rotate the wheel(s) about one revolution per second; the resistance should vary as the wheel spins.
14. Test the hydraulic modulator solenoid valves: Connect one ohmmeter lead to terminal 32 on the control unit connector. Connect the other test lead to terminal 2 (LF solenoid), then 35 (RF) and then 18 (rear); Resistance should be 0.7–1.7 ohms.
15. Test the pump relay in the hydraulic modulator:
    A. Turn the ignition **ON**.
    B. Connect a jumper between terminal 28 on the control unit connector and ground. The pump should run.

    NOTE: Do not maintain the connection longer than 2 seconds; damage can occur.

    C. Repeat the test. Simultaneously, measure the voltage between terminal 14 and ground. With the jumper grounding terminal 28, 12 volts should be present.
    D. If the modulator does not start, inspect the wiring and connectors. If no fault is found, replace the pump relay and retest.
16. Test the valve relay in the hydraulic modulator:

A. Connect the voltmeter between terminal 32 on the control unit connector and ground. Use a jumper wire to connect terminal 27 to ground. The valve relay on the hydraulic modulator should activate (listen for distinct click) and the voltmeter should show 12 volts.

B. If the relay does not energize, or the correct voltage is not present, inspect the wiring and connectors carefully.

C. If no wiring fault is found, replace the valve relay.

17. Turn the ignition switch **OFF**. Disconnect all test equipment.
18. If no faults were found during testing, replace the ABS control unit and retest.
19. Reinstall the hydraulic modulator cover and the soundproofing at the left side of the dashboard.
20. Road test the vehicle and confirm proper system operation.

1992 Volvo 940

Submodel: | **Engine Type:** L4 | **Liters:** 2.3
Fuel Delivery: FI | **Fuel:** GAS

1993–95 900 Series Diagnostic Trouble Code Chart

DTC	Fault detected	ABS light	ABS system
(1-1-1)	No fault detected	-	-
1-2-5	Faulty signal from at least one wheel sensor	on	off
1-3-5	Fault in control module	on	off
1-4-2	Brake light switch, open circuit	off	on
1-5-1	L/H front wheel sensor, open or short-circ. to supply	on	off
1-5-2	R/H front wheel sensor, open or short-circ. to supply	on	off
1-5-5	Rear axle sensor, open or short-circ. to supply	on	off
2-1-5	Valve relay, open-circuit or short-circuit	on	off
2-3-1	L/H front wheel sensor, signal absent	on	off
2-3-2	R/H front wheel sensor, signal absent	on	off
2-3-5	Rear axle sensor, signal absent	on	off
4-1-1	L/H front wheel valve, open or short-circ.	on	off
4-1-3	R/H front wheel valve, open or short-circ.	on	off
4-1-5	Rear valve open or short-circ.	on	off
4-4-3	Pump motor/relay electrical or mechanical fault	on	off

1993–95 850 Series ABS Diagnostic Trouble Code Chart

DTC	Fault text	Notes
1-1-1	No faults detected by diagnostic system	
1-2-1	LH front wheel sensor, faulty signal at speed less than 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
1-2-2	RH front wheel sensor, faulty signal at speed less than 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
1-2-3	LH rear wheel sensor, faulty signal at speed less than 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
1-2-4	RH rear wheel sensor, faulty signal at speed less than 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
1-4-1	Faulty pedal sensor, shorted to ground or supply	Switches ABS warning indicator on Switches TRACS warning indicator on
1-4-2	Faulty brake light switch, open circuit or short circuit	
1-4-3	Fault in control module	
1-4-4	Brake discs overheated	Cars with TRACS only Switches TRACS warning indicator on
2-1-1	LH front wheel sensor, no signal on moving off	Switches ABS warning indicator on Switches TRACS warning indicator on
2-1-2	RH front wheel sensor, no signal on moving off	Switches ABS warning indicator on Switches TRACS warning indicator on
2-1-3	LH rear wheel sensor, no signal on moving off	Switches ABS warning indicator on Switches TRACS warning indicator on
2-1-4	RH rear wheel sensor, no signal on moving off	Switches ABS warning indicator on Switches TRACS warning indicator on
2-2-1	LH front wheel sensor, no signal from ABS system	Switches ABS warning indicator on Switches TRACS warning indicator on
2-2-2	RH front wheel sensor, no signal from ABS system	Switches ABS warning indicator on Switches TRACS warning indicator on
2-2-3	LH rear wheel sensor, no signal from ABS system	Switches ABS warning indicator on Switches TRACS warning indicator on
2-2-4	RH rear wheel sensor, no signal from ABS system	Switches ABS warning indicator on Switches TRACS warning indicator on
3-1-1	LH front wheel sensor, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
3-1-2	RH front wheel sensor, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
3-1-3	LH rear wheel sensor, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
3-1-4	RH rear wheel sensor, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on

1993–95 850 Series ABS Diagnostic Trouble Code Chart

DTC	Fault text	Notes
3-2-1	LH front wheel sensor, intermittent signal problems at speeds over 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
3-2-2	RH front wheel sensor, intermittent signal problems at speeds over 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
3-2-3	LH rear wheel sensor, intermittent signal problems at speeds over 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
3-2-4	RH rear wheel sensor, intermittent signal problems at speeds over 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
4-1-1	Inlet valve for LH front wheel, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
4-1-2	Return valve, LH front wheel, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
4-1-3	Inlet valve, RH front wheel, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
4-1-4	Return valve, RH front wheel, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
4-2-1	Inlet valve, rear wheel circuit, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
4-2-2	Return valve, rear wheel circuit, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
4-2-3	TRACS valve, open circuit or short circuit	Cars with TRACS only Switches ABS warning indicator on Switches TRACS warning indicator on
4-2-4	TRACS pressure sensor, faulty or short-circuit	Cars with TRACS only Switches TRACS warning indicator on
4-4-1	Faulty control module	Switches ABS warning indicator on Switches TRACS warning indicator on
4-4-2	Pump pressure low	Switches ABS warning indicator on Switches TRACS warning indicator on
4-4-3	Pump motor, electrical or mechanical fault	Switches ABS warning indicator on Switches TRACS warning indicator on
4-4-4	No power supply to valves in hydraulic unit	Switches ABS warning indicator on Switches TRACS warning indicator on

1996 and Later ABS Diagnostic Trouble Code Chart

DTC	Fault text	Note
ABS-141	EBD-pressure sensor signal, circuit fault	Switches on warning light ABS Switches on warning light TRACS
ABS-142	Brake light switch signal	
ABS-143	Road speed signal, circuit fault	
ABS-144	Brake discs on front wheels overheating	Cars with TRACS only Switches on TRACS warning light Only while temperature is still high
ABS-211	Wheel sensor signal LH front wheel wheel speed incorrect	Switches on ABS warning light Switches on TRACS warning light
ABS-212	Wheel sensor signal RH front wheel wheel speed incorrect	Switches on ABS warning light Switches on TRACS warning light
ABS-213	Wheel sensor signal LH rear wheel wheel speed incorrect	Switches on ABS warning light Switches on TRACS warning light
ABS-214	Wheel sensor signal RH rear wheel wheel speed incorrect	Switches on ABS warning light Switches on TRACS warning light
ABS-221	Wheel sensor signal LH front wheel ABS control phase too long	Switches on ABS warning light Switches on TRACS warning light
ABS-222	Wheel sensor signal RH front wheel ABS control phase too long	Switches on ABS warning light Switches on TRACS warning light
ABS-223	Wheel sensor signal LH rear wheel ABS control phase too long	Switches on ABS warning light Switches on TRACS warning light
ABS-224	Wheel sensor signal RH rear wheel ABS control phase too long	Switches on ABS warning light Switches on TRACS warning light
ABS-311	Wheel sensor signal LH front wheel circuit fault	Switches on ABS warning light Switches on TRACS warning light
ABS-312	Wheel sensor signal RH front wheel circuit fault	Switches on ABS warning light Switches on TRACS warning light
ABS-313	Wheel sensor signal LH rear wheel circuit fault	Switches on ABS warning light Switches on TRACS warning light
ABS-314	Wheel sensor signal RH rear wheel circuit fault	Switches on ABS warning light Switches on TRACS warning light
ABS-321	Wheel sensor signal LH front wheel extrapolation counter	Switches on ABS warning light Switches on TRACS warning light
ABS-322	Wheel sensor signal RH front wheel extrapolation counter	Switches on ABS warning light Switches on TRACS warning light
ABS-323	Wheel sensor signal LH rear wheel extrapolation counter	Switches on ABS warning light Switches on TRACS warning light
ABS-324	Wheel sensor signal RH rear wheel extrapolation counter	Switches on ABS warning light Switches on TRACS warning light

1996 and Later ABS Diagnostic Trouble Code Chart

DTC	Fault text	Note
ABS–411	Inlet valve LH front wheel, fault in valve terminal circuit	Switches on ABS warning light Switches on TRACS warning light
ABS–412	Outlet valve LH front wheel, fault in valve terminal circuit	Switches on ABS warning light Switches on TRACS warning light
ABS–413	Inlet valve RH front wheel, fault in valve terminal circuit	Switches on ABS warning light Switches on TRACS warning light
ABS–414	Outlet valve HR front wheel, fault in valve terminal circuit	Switches on ABS warning light Switches on TRACS warning light
ABS–421	Inlet valve rear wheel,fault in valve terminal circuit	Switches on ABS warning light Switches on TRACS warning light
ABS–422	Outlet valve rear wheel, fault in valve terminal circuit	Switches on ABS warning light Switches on TRACS warning light
ABS–423	Inlet valve TRACS, fault in valve terminal circuit	Cars with TRACS only
ABS–431	Control module - general hardware fault	Switches on ABS warning light Switches on TRACS warning light
ABS–432	Control module - general interference fault	Switches on ABS warning light Switches on TRACS warning light
ABS–433	Battery voltage too high	Switches on ABS warning light Switches on TRACS warning light
ABS–441	Main control module relay	Switches on ABS warning light Switches on TRACS warning light
ABS–442	Control module - creeping powers	Switches on ABS warning light Switches on TRACS warning light
ABS–443	Pump motor electrical or mechanical fault	Switches on ABS warning light Switches on TRACS warning light
ABS–444	Control module - valve reference power	Switches on ABS warning light Switches on TRACS warning light
ABS–445	Control module - general valve fault	Switches on ABS warning light Switches on TRACS warning light

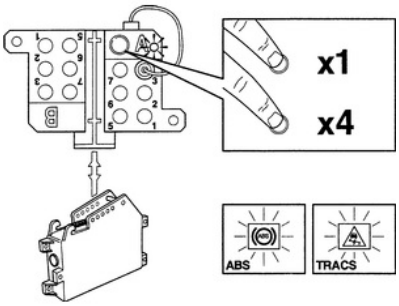
1990–92 Vehicles

On pre-1993 vehicles, the control unit does not store diagnostic codes; therefore diagnosis must be made in a progressive and logical order. The control unit contains a monitoring circuit to detect any internal faults within the control unit as well as electrical faults in the sensors, solenoids, modulator unit, etc. Refer to the fault tracing procedure, later in this section.

1993–95 Vehicles

The CU stores trouble codes when a fault is detected. These DTCs can be retrieved using the Data Link Connector (DLC) located on the driver's side of the engine compartment. Connect the selector cable to the DLC terminal 3. Turn the ignition to the **ON** position with the engine off. Press the button on the DLC and hold it down for about one second. Then press the button once, pausing then four times, the Light Emitting Diode (LED) on the DLC will then flash the code. The LED will pause after each number. The codes are three-digit numbers; for example, flash, pause, flash, flash, pause, flash, pause, would indicate code 121.

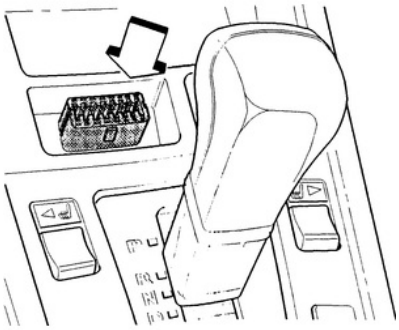
Fig. 1: Use the DLC to retrieve the ABS trouble codes



1996–98 Vehicles

1996 and later Volvos are equipped with OBD-II diagnostic capability. Codes are retrieved via the Data Link Connector (DLC), located in the console. The codes can be read after hooking up the Volvo Scan tool or equivalent Diagnostic tool. Follow the menu on the scan tool to retrieve the DTCs.

Fig. 2: The DLC is located on the center console, in front of the shifter handle



1992 Volvo 940

Submodel: | **Engine Type:** L4 | **Liters:** 2.3
Fuel Delivery: FI | **Fuel:** GAS

Before diagnosing an apparent ABS problem, make absolutely certain that the regular service braking system is in correct working order. Many common brake problems (dragging parking brake, seepage, etc.) will affect the ABS system. A visual check of specific system components may reveal problems creating an apparent ABS malfunction.

Performing this inspection may reveal a simple failure, thus eliminating extended diagnostic time.

- Inspect the tire pressures; they must be approximately equal for the system to operate correctly.
- Inspect the brake fluid level in the reservoir.
- Inspect brake lines, hoses, master cylinder assembly and brake calipers for leakage.
- Visually check brake lines and hoses for excessive wear, heat damage, punctures, contact with other parts, missing clips or holders, blockage or crimping.
- Check the calipers for rust or corrosion. Check for proper sliding action if applicable.
- Check the calipers for freedom of motion during application and release.
- Inspect the wheel speed sensors for proper mounting and connections.
- Inspect the sensor wheels for broken teeth or poor mounting.
- Inspect the wheels and tires on the vehicle. They must be of the same size and type to generate accurate speed signals.
- Confirm the fault occurrence with the operator. Certain driver induced faults, such as not releasing the parking brake fully, spinning the wheels under acceleration, sliding due to excessive cornering speed or driving on extremely rough surfaces may fool the system and trigger the dash warning light. These induced faults are not system failures but examples of vehicle performance outside the parameters of the control unit.
- Many system shut-downs are due to loss of sensor signals to or from the controller. The most common cause is not a failed sensor but a loose, corroded or dirty connector. Check harness and component connectors carefully.

If the ANTI-LOCK warning lamp is on during vehicle operation, the control unit has detected a fault and disabled the system.

If the monitoring circuit detects a fault, the control unit will disable the ABS system and light the warning lamp on the dashboard. If the light comes on during vehicle operation, perform diagnostics.

1992 Volvo 940

Submodel: | **Engine Type:** L4 | **Liters:** 2.3
Fuel Delivery: FI | **Fuel:** GAS

The Anti-lock Braking System, designated ABS, prevents wheel lock-up. The ABS provides the shortest possible braking distance while maintaining full directional stability. The ABS controls the front wheels individually and the rear wheels together. The rear piston in the master cylinder operates the front brakes and the front piston operates the rear axle brakes.

Under normal conditions, the ABS system functions in the same manner as a standard brake system and is transparent to the operator. The system is a combination of electrical and hydraulic components, working together to control the flow of brake fluid to the wheels when necessary.

The Control Unit (CU) is the electronic brain of the system, receiving and interpreting signals from the wheel speed sensors. The unit will enter anti-lock mode when it senses impending wheel lock at any wheel and immediately control the brake line pressures to the affected wheel(s) by issuing output signals to the hydraulic modulator.

The hydraulic modulator contains solenoids which react to the signals from the CU. When not activated, the solenoids allow brake line pressure to be modulated by the brake pedal in the normal fashion. At the direction of the (CU), the solenoids move to positions either isolating the brake line from pedal pressure (pressure hold) or isolating the line and opening a passage to relieve line pressure (pressure release). In this manner, brake application is controlled or actually lessened, dependent on the locking tendency of each wheel.

The decisions regarding these functions are made very rapidly and each solenoid can be cycled several times per second. Volvo employs a 3-channel control system. The front wheels are controlled separately; the rears are watched by a single sensor on all models except the 850/C70/S70/V70 which have two, and the common feed line to the rear brakes is controlled by one output on the hydraulic modulator.

The operator may feel a slight pulsing in the brake pedal and/or hear popping or clicking noises when the system engages. These sensations are due to the valves cycling and the pressures being changed rapidly within the brake system. While completely normal and not a sign of system failure, these sensations can be disconcerting to an operator unfamiliar with the system.

Although the ABS system prevents wheel lock-up under hard braking, as brake pressure increases, wheel slip is allowed to increase as well. This slip will result in some tire chirp during ABS operation. The sound should not be interpreted as lock-up but rather as an indication of the system holding the wheel(s) just outside the locking point. Additionally, the final few feet of an ABS-engaged stop may be completed with the wheels locked; the system is inoperative below 3 mph.

When the ignition is ON and vehicle speed is over 3 mph (5 kph), the CU monitors the function of the system. Should a fault be noted, such a loss of signal from a sensor, the ABS system is immediately disabled by the CU. The ANTI-LOCK dashboard warning lamp is illuminated to inform the operator. When the ABS system is disabled, the vehicle retains normal braking capacity without the benefits of anti-lock.

Some vehicles have a Traction Control System (TRACS) incorporated into the ABS system. The CU monitors the speed sensors just as it does for the ABS, and if one of the drive wheels is detected moving faster than the other, it engages that wheel's brakes to reduce the power to the wheel. This is accomplished by closing and opening the solenoids in the hydraulic modulator, causing the brake fluid to be "pumped" to that wheel, slowing the wheel rotation down and applying power equally.

Fig. 1: ABS braking circuit for 1990–91 models

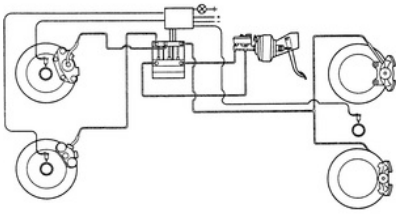
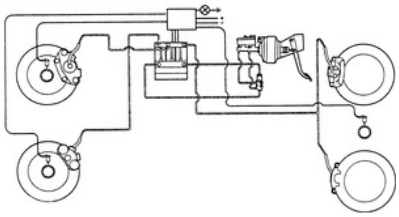


Fig. 2: ABS braking circuit for 1992–98 models



1992 Volvo 940

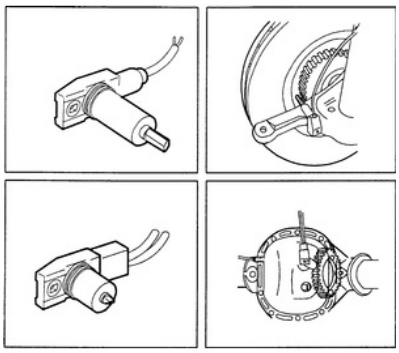
Submodel: | **Engine Type:** L4 | **Liters:** 2.3
Fuel Delivery: FI | **Fuel:** GAS

Wheel Speed Sensors

The speed signal is sent to the control unit via a sensor and pulse wheel assembly. Each front wheel has its own assembly. Rear wheel speed is measured by one sensor and pulse wheel assembly on all vehicles except for the 850/C70/S70/V70 models which have one on each wheel.

As the teeth of the pulse generator pass the tip of the sensor, the changes from peak to valley to peak generate a small AC voltage in the sensor. The frequency of the voltage — which increases with wheel speed — is used by the CU to determine wheel speed. By comparing wheel speed during braking, the control unit determines impending wheel lock.

Fig. 1: Various wheel speed sensors



Electronic Control Unit (CU)

The CU is located below the left dashboard, above the left kick panel on the 240 and most of the 700 series. It is located on the right front wheel housing on 760 models with a B280 engine. On most other models, it is attached to the hydraulic modulator and is alongside the brake master cylinder. The unit is a microprocessor that receives and processes signals according to predetermined logic, and supplies a control signal to the solenoid valves located on the hydraulic modulator.

The control unit contains the safety or monitor circuitry which will disable the ABS system if any electrical fault is detected. The safety circuit also monitors battery voltage and will disable the system if voltage becomes too high or too low.

The electronic control unit cannot be repaired or serviced; if an internal fault is detected, the unit must be replaced.

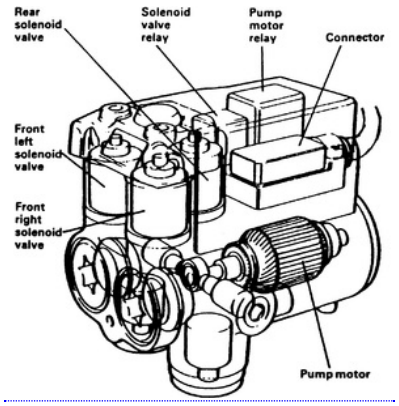
Hydraulic Modulator

Usually located under or near the brake master cylinder in the engine compartment, the hydraulic modulator contains the solenoid valves, the system recirculation pump, the solenoid control relay and the pump control relay. Certain engine and body combinations will locate the hydraulic modulator on the left wheel arch.

The 3 internal solenoids are electrically operated valves. When no current is applied, the valves are in the normal or open position, allowing brake fluid pressure to be controlled by the brake pedal. Engagement of ABS causes the solenoid to move through part of its travel, blocking the brake fluid passage. This puts the valve in the hold position, maintaining existing brake line pressure. If the CU still senses a wheel locking or about to lock, the solenoid is moved to the full extent of its travel, opening the pressure relief passage. Brake fluid in the circuit is allowed to escape, reducing line pressure and releasing the brake. The released fluid is momentarily held in a pressure accumulator which serves to reduce the pedal pounding sensation to the operator. Once released from the accumulator, the fluid is pumped back into the system for reuse.

With the exception of the two relays mounted on the unit, the hydraulic unit has no serviceable parts and cannot be repaired. If an internal fault is found, the unit must be replaced.

Fig. 2: Cutaway view of the hydraulic modulator assembly



Brake Lamp

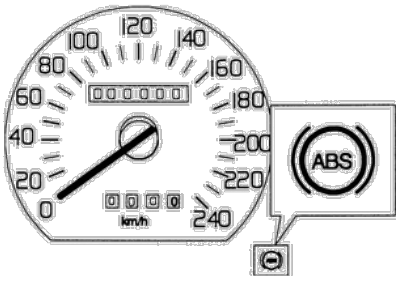
The red dashboard BRAKE warning lamp functions in a manner identical to non-ABS vehicles. If the fluid level should drop below an acceptable level, the lamp will light as a warning to the operator. If the BRAKE lamp is lit, braking function on the vehicle may be impaired; do not operate the vehicle until the status and reliability of the braking system is determined.

Anti-lock Lamp

The Anti-lock Braking System (ABS) warning lamp is coupled to the ABS CU. The lamp will light briefly during engine start-up as the CU performs an initial check of the system. If no faults are found, the CU will extinguish the lamp within a few seconds. After this initial test, the lamp should not come on during vehicle operation.

If the ABS lamp does come on during operation, the CU has detected a fault and disabled the system. If only the ABS warning lamp is lit, the vehicle retains normal braking characteristics and may be safely driven. If both warning lamps are lit, the braking capacity of the vehicle may be impaired.

Fig. 3: Location of the ABS light on the instrument cluster



1992 Volvo 940

Submodel: | **Engine Type:** L4 | **Liters:** 2.3
Fuel Delivery: FI | **Fuel:** GAS

Hydraulic Modulator

1. Disconnect the negative battery cable.
2. Remove the cover (if equipped) from the hydraulic modulator.
3. Remove both relays (if equipped) from the top of the unit; disconnect the wiring connector at the unit.
4. Remove the air inlet hose.
5. Unplug any connectors from the unit.
6. Place rags or towels around the unit to absorb brake fluid which will be spilled.
7. Clean the line connections thoroughly.
8. Label each line for installation.
9. Remove the brake lines from the modulator.
10. Remove the bolts from the modulator support and push the support to the right.
11. Remove the hydraulic modulator.

To install:

12. If a new modulator is being installed, remove the hexagonal plugs from the old unit and install on the new unit. Check that the rubber pads are not damaged; install the rubber pads onto the hexagonal plugs.
13. Install the modulator and tighten the support. If installing a new unit, remove the plugs from the brake line ports.
14. Reconnect the brake lines according to the labels made at removal. The lines must be in their exact original positions.
15. Remove the rags from the work area and dispose of them properly.
16. Plug in any removed connectors.
17. Install the air inlet hose.
18. Install the relays (if equipped) on the hydraulic modulator.
19. Install the cover on the unit.
20. Bleed the brake system. Vehicles with hydraulic clutches may require bleeding of the clutch system as well.
21. When bleeding is complete, test the brake system by having an assistant press hard on the brake pedal; keep it depressed for 30 seconds. During the 30 second period, check that no leakage occurs at the brake line connections on the hydraulic modulator.
22. Connect the negative battery cable.
23. Test drive the vehicle, confirming system function.

Control Unit

1990–93 MODELS

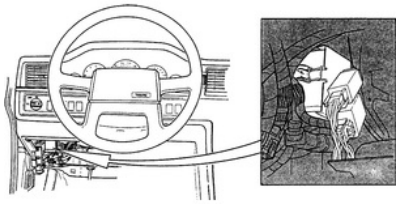
The control unit is located under the steering wheel, behind the knee bolster panel.

1. Disconnect the negative battery cable.
2. Remove the knee bolster panel under the steering wheel..
3. Loosen or remove the clips and retainers holding the control unit.
4. Lift out the unit.
5. Remove the electrical harness from the unit.

To install:

6. Attach the harness to the control module.
7. Place the control module into place and install the clips and retainers.
8. Install the knee bolster panel.
9. Connect the negative battery cable.

Fig. 1: Control unit location on 1990–93 vehicles



1994–98 MODELS

The control unit is located in the engine compartment, near the master cylinder/brake booster.

1. Disconnect the negative battery cable.
2. Clean the connector of any dirt, grime and/or oil.
3. Remove the connector from the control unit.
4. Remove the control unit retaining bolts.
5. Lift the control unit out of the engine compartment.

To install:

6. Lower the control unit into place aligning the bolts holes.
7. Tighten the retaining bolts.
8. Install the connector on the control unit.
9. Connect the negative battery cable.

Fig. 2: The control unit and hydraulic modulator assembly — 850 series model shown

Wheel Speed Sensors

FRONT

1. Raise and safely support the front of the vehicle.
2. Remove the tire and wheel.
3. With the ignition switch **OFF**, disconnect the wheel speed sensor lead from the ABS harness. Remove any retaining bolts or clips holding the harness in place.

NOTE: Clips and retainers must be reinstalled in their exact original location. Take careful note of the position of each retainer and of the correct harness routing during removal.

4. Remove the single bolt holding the speed sensor.
5. Carefully remove the sensor straight out of its mount. Do not subject the sensor to shock or vibration; protect the tip of the sensor at all times.

To install:

6. Fit the sensor into position. Make certain the sensor sits flush against the mounting surface; it must not be crooked.
7. Install the retaining bolt.
8. Route the sensor cable correctly and install the harness clips and retainers. The cable must be in its original position and completely clear of moving components.
9. Connect the sensor cable to the ABS harness.
10. Install the wheel.
11. Lower the vehicle to the ground.

Fig. 3: Unplug the sensor connector

Fig. 4: Remove the sensor retaining bolt

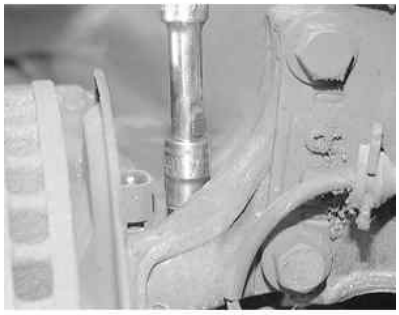


Fig. 5: Carefully lift the sensor straight up and remove it

Fig. 6: If the sensor is going to be reused, clean the tip off before installing

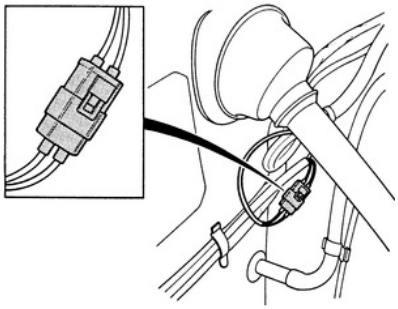
REAR WITHOUT MULTI-LINK SUSPENSION — EXCEPT 850

1. Raise and safely support the vehicle.
2. Disconnect the sensor connector from the harness.
3. Remove the clips and retainers holding the sensor wire to the axle. Take note of the routing of the sensor wire; exact reinstallation is required.
4. Remove the retaining bolt holding the sensor to the differential housing.
5. Remove the sensor straight from its housing; protect the tip from impact.

To install:

6. Install the sensor into the housing.
7. Tighten the retaining bolt.
8. Route the wire harness and attach the connectors.
9. Install the clips and retainers to the harness.
10. Lower the vehicle.

Fig. 7: Sensor connector location



REAR WITH MULTI-LINK SUSPENSION — EXCEPT 850

1. Remove the spare tire and fold back the trunk carpet to expose the fuel filler pipe.
2. Remove the cover(s) from the filler pipe.
3. Break the seal on the speed sensor harness connector and disconnect the sensor from the ABS harness.
4. Press the rubber grommet free of the bodywork and feed the sensor harness to the outside of the vehicle.
5. Raise and safely support the vehicle.
6. Install a jack with support fixture 5972 or its equivalent under the rear axle.
7. Remove the 2 bolts on each side of the rear axle assembly which hold the member to the body.
8. Lower the rear axle slightly, but do not allow the drive shaft to press against the fuel tank.
9. Disconnect the right brake wire from its attachment.
10. Remove the sensor cable from the retaining clips and clamps. Take note of the routing of the cable; it must be reinstalled in its exact original position.
11. Clean the sensor area; remove the retaining bolts and remove the sensor. Protect the tip from damage or impact.

To install:

12. Apply a light coat of oil to the O-ring on the new sensor.
13. Fit the sensor into place without damaging the tip.
14. Tighten the retaining bolts to 90 inch lbs. (10 Nm).
15. Install the sensor harness into the cable retainers, making certain it is routed correctly and out of the way of all moving parts.
16. Feed the cable through the body and secure the grommet.
17. Connect the right brake wire.
18. Raise the rear axle assembly and install the 4 bolts. Tighten each bolt to 52 ft. lbs. (70 Nm), then angle tighten each an additional 60 degrees.
19. Lower the vehicle.
20. Connect the sensor wiring harness to the ABS harness in the trunk and reseal the connector.
21. Clamp the cable to the filler pipe.
22. Install the filler covers, reposition the carpet and install the spare tire.
23. Test drive the vehicle, confirming correct function of the ABS system and the dashboard warning lamp.

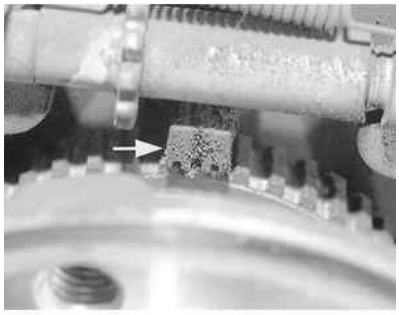
850/C70/S70/V70 REAR SENSORS

1. Disconnect the negative battery cable.
2. On sedans and the C70:
    A. Fold the passenger side rear seat forward.
    B. Remove the luggage compartment mat.
    C. Remove the fuel pump and level sensor covers.
3. On wagons:
    A. Fold up the floor panel, and bend mat back to access the fuel pump and level sensor covers.
4. Remove the wheel sensor connector.
5. Raise and safely support the vehicle.
6. Note the direction and installation of the sensor harness for reinstallation. Pull the wheel sensor harness through from underneath the vehicle.
7. Remove the wheel(s).
8. Remove the sensor attaching bolt, and remove the sensor.

To install:

9. Install the new sensor into place, and tighten the retaining bolt.
10. Route the harness through the suspension and place into opening in floor.
11. Install the wheel(s).
12. Lower the vehicle.
13. Attach the sensor connector.
14. Install the removed covers and trim.
15. Connect the negative battery cable.

Fig. 8: The rear wheel speed sensor as viewed with the brake disc removed



Pulse Wheel

INTEGRAL WITH THE ROTOR

1. Raise and safely support the vehicle.
2. Remove the wheel(s) of the pulse wheel being replaced.
3. Remove the brake rotor.
4. Remove the grease seal and the wheel bearings from the rotor.
5. Place the rotor in a shop vise or other suitable holding fixture.
6. Using a suitable puller, remove the pulse wheel from the rotor.

To install:

7. Install the new pulse wheel onto the rotor, and using handle 1801 and driver 5276 or equivalent bearing/race/seal driver, press the pulse wheel onto the rotor.
8. Repack wheel bearings and install them into the rotor, and install a new grease seal.
9. Install the brake rotor onto the vehicle.
10. Install the wheel(s).
11. Lower the vehicle.

INTEGRAL WITH THE HUB

1. Raise and safely support the vehicle.
2. Remove the wheel(s) of the pulse wheel being replaced.
3. Remove the brake rotor.
4. Remove the hub from the vehicle.
5. Place the hub in a vise or other suitable holding fixture.
6. Using a suitable puller, remove the pulse wheel from the hub.

To install:

7. Place the hub into a shop press, and using the suitable adapter press the new wheel onto the hub.
8. Install the hub onto the vehicle.
9. Install the brake rotor.
10. Install the wheel(s).
11. Lower the vehicle.

INTEGRAL WITH THE AXLE SHAFT

1. Raise and safely support the vehicle.
2. Remove the wheel(s) of the pulse wheel being replaced.
3. Remove the brake rotor.
4. Remove the axle shaft from the vehicle.
5. Install the axle shaft in a vise or suitable fixture, ensuring not to damage the axle, or rip the CV-joint boot.
6. Using a suitable puller, remove the pulse wheel from the outer CV-joint.

To install:

7. Place the axle shaft into a shop press and, using the suitable adapter, press the new wheel onto the outer joint.
8. Install the axle shaft into the vehicle.
9. Install the brake rotor.
10. Install the wheel(s).
11. Lower the vehicle.

ON THE DIFFERENTIAL

The pulse wheel is located on the ring gear inside the differential. Teardown of the differential is necessary to replace the pulse wheel. This job requires many special tools and is not recommended for the do-it-yourselfer.

- If the vehicle is equipped with an air bag system, always properly disable the system before commencing work on the ABS system. Refer to Section 6 for the correct disabling procedure.
- Certain components within the ABS system are not intended to be serviced or repaired individually. Only those components with removal and installation procedures should be serviced.
- Do not use rubber hoses or other parts not specifically specified for the ABS system. When using repair kits, replace all parts included in the kit. Partial or incorrect repair may lead to functional problems and require the replacement of other components.
- Lubricate rubber parts with clean, fresh brake fluid to ease assembly. Do not use lubricated shop air to clean parts; damage to rubber components may result.
- Use only brake fluid from an unopened container. Use of suspect or contaminated brake fluid can reduce system performance and/or durability.
- A clean repair area is essential. Perform repairs after components have been thoroughly cleaned. Do not allow ABS components to come into contact with any substance containing mineral oil; this includes used shop rags.
- The control unit is a microprocessor similar to other computer units in the vehicle. Insure that the ignition switch is **OFF** before removing or installing controller harnesses. Avoid static electricity discharge at or near the controller.
- Never disconnect any electrical connection with the ignition switch **ON** unless instructed to do so in a test.
- Avoid touching connector pins with fingers.
- Leave new components and modules in the shipping package until ready to install them.
- To avoid static discharge, always touch a vehicle ground after sliding across a vehicle seat or walking across carpeted or vinyl floors.
- If any arc welding is to be done on the vehicle, the ABS control unit should be disconnected before welding operations begin.
- Never allow welding cables to lie on, near or across any vehicle electrical wiring.
- If the vehicle is to be baked after paint repairs, disconnect and remove the control unit from the vehicle.