ANTI-LOCK BRAKE SYSTEM

1992 Subaru SVX

1992 BRAKES
Subaru Anti-Lock

Legacy, SVX

DESCRIPTION

Anti-Lock Brake System (ABS) is designed to prevent wheel lock-up during heavy braking. ABS electronically controls brake fluid pressure, reducing chance of wheel lock-up. This allows driver to maintain better steering control of the vehicle. ABS system consists of 4 wheel speed sensors, 4 tone rings, ABS Electronic Control Unit (ECU), hydraulic control unit, "G" sensor (Legacy 4WD M/T) and ABS warning light. See Figs. 1 and 2.

Two types of hydraulic control units are used. One is manufactured by Bosch; the other is manufactured by Nippon under license from Bosch. The Nippon unit has "F" Valve to prevent brake pedal pulsation when brake fluid pressure decreases.

CAUTION: See ANTI-LOCK BRAKE SAFETY PRECAUTIONS below.

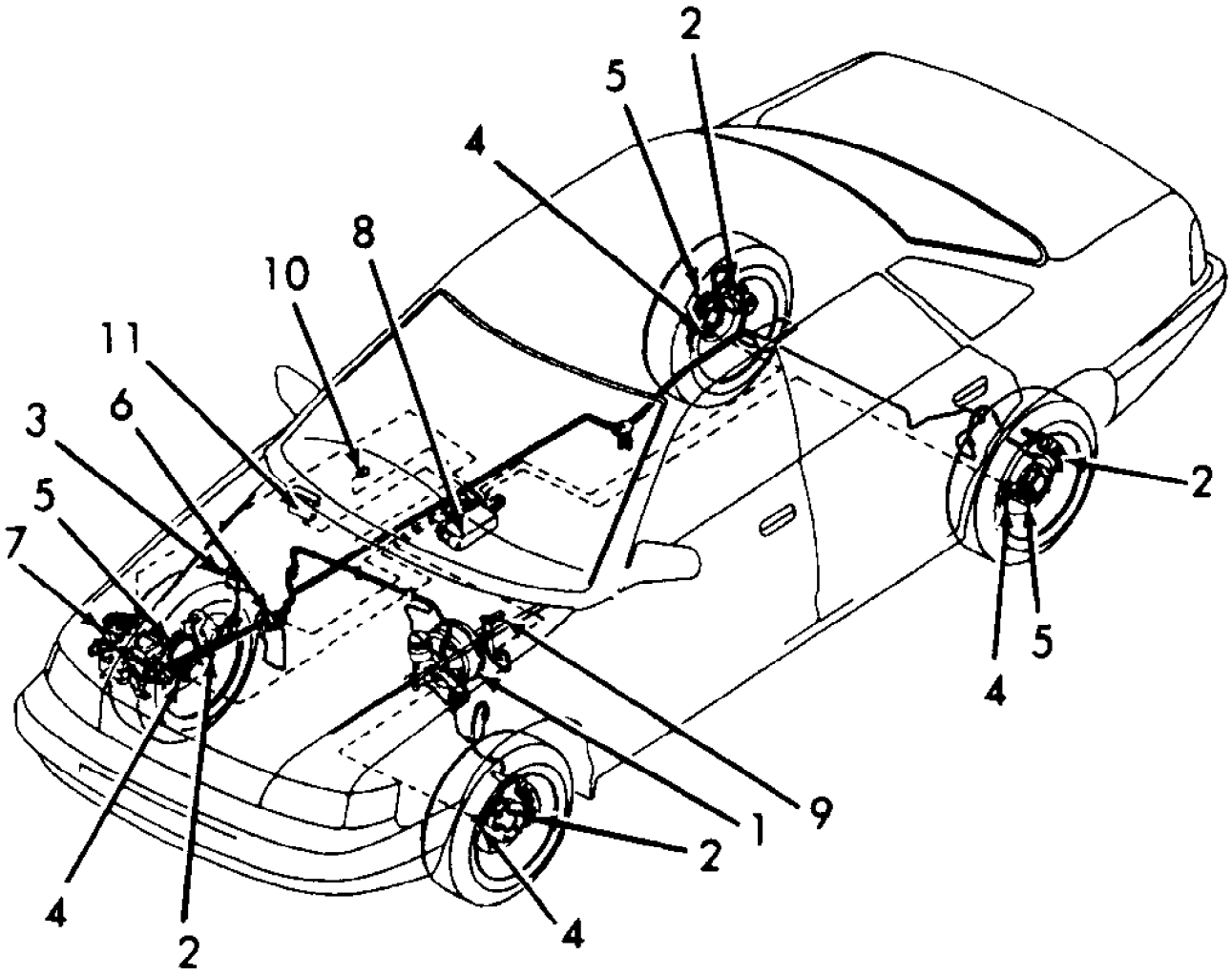
ANTI-LOCK BRAKE SAFETY PRECAUTIONS

NOTE: Information below is for General Information ONLY, may not apply to all models.

* NEVER open a bleeder valve or loosen a hydraulic line while ABS is pressurized.
* NEVER disconnect or reconnect any electrical connectors while ignition is on. Damage to ABS control unit may result.
* DO NOT attempt to bleed hydraulic system without first referring to the appropriate article.
* Only use specially designed brake hoses/lines on ABS-equipped vehicles.
* DO NOT tap on speed sensor components (sensor, sensor rings). Speed rings must be pressed, NOT hammered into hubs. Striking these components can cause demagnetization or a loss of polarization, affecting the accuracy of the speed signal returning to the ABS control unit.
* DO NOT mix tire sizes. Increasing the width, as long as tires remain close to the original diameter, is acceptable. Rolling diameter must be identical for all 4 tires. Some manufacturers recommend tires of the same brand, style and type. Failure to follow this precaution may cause inaccurate wheel speed readings.
* DO NOT contaminate speed sensor components with grease. Only use recommended anti-corrosion coating.
* When speed sensor components have been removed, ALWAYS check sensor-to-ring air gaps when applicable. These specifications can be found in each appropriate article.
* ONLY use recommended brake fluids. DO NOT use silicone brake fluids in an ABS-equipped vehicle.
* When installing transmitting devices (CB's, telephones, etc.) on ABS-equipped vehicles, DO NOT locate the antenna near the ABS control unit (or any control unit).
* Disconnect all on-board computers, when using electric welding equipment.
* DO NOT expose the ABS control unit to prolonged periods of high heat (185°F/85°C for 2 hours is generally considered a

maximum limit).

NOTE: For more information on brake system, See DISC & DRUM article in the BRAKES Section



1. Master Cylinder
2. Brake Caliper
3. Proportioning Valve
4. Wheel Speed Sensor
5. Tone Wheel
6. "G" Sensor (M/T 4WD Only)
7. Hydraulic Control Unit
8. Electronic Control Unit
9. Brake Switch
10. ABS Warning Light
11. Transmission Control Unit (A/T Only)

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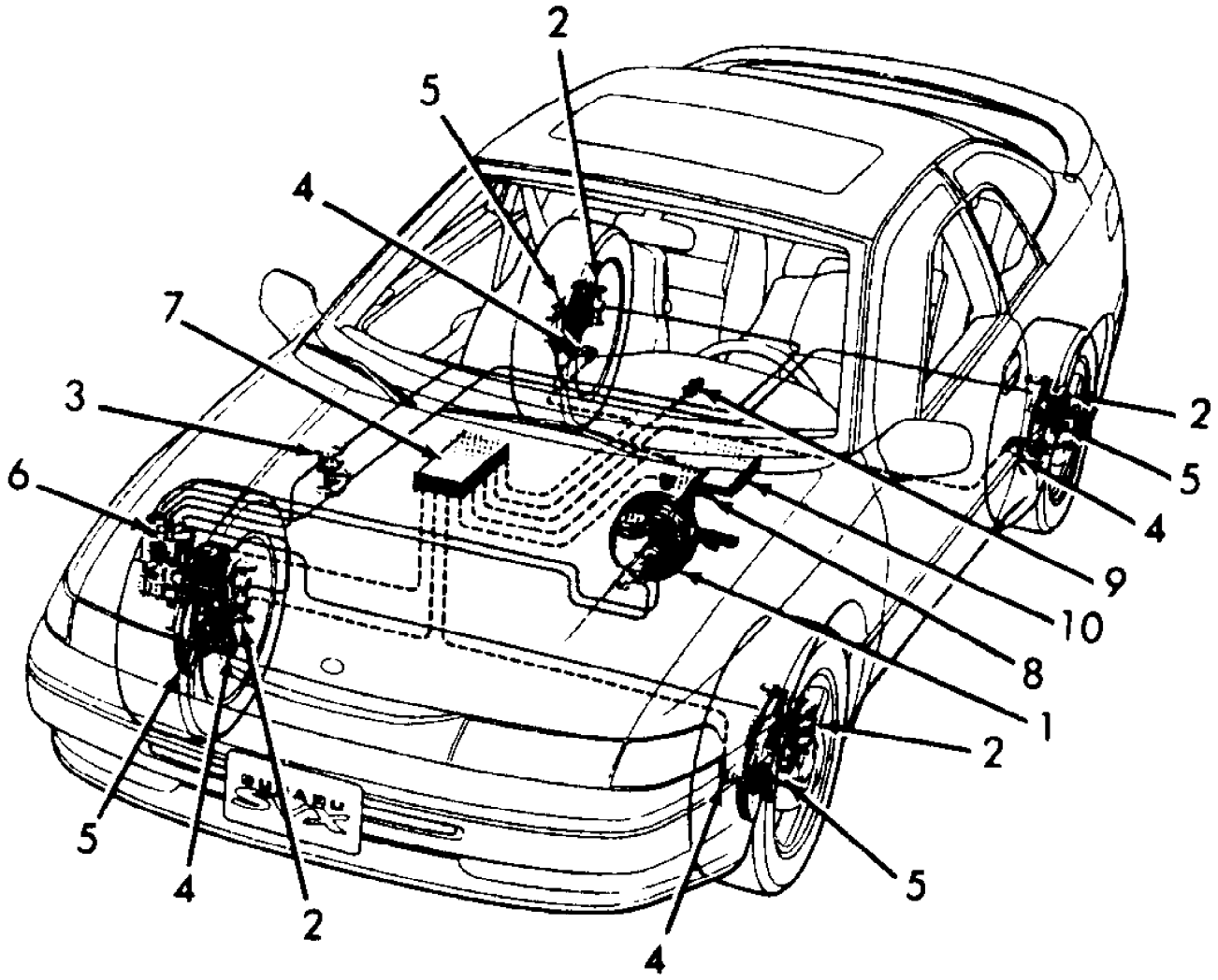
Fig. 1: Locating ABS Components (Legacy)
Courtesy of Subaru of America, Inc.



1. Master Cylinder
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6. Hydraulic Control Unit
7. Electronic Control Unit
8. Brake Switch
9. ABS Warning Light
10. A/T Transmission Control Unit

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Fig. 2: Locating ABS Components (SVX)
Courtesy of Subaru of America, Inc.

OPERATION

As vehicle is driven, each wheel speed sensor sends an AC signal to ABS ECU. As brake pedal is depressed, ABS ECU starts to monitor vehicle rate of deceleration. If rate of deceleration is greater than preprogrammed amount, ABS ECU signals hydraulic control unit solenoid valves to regulate brake hydraulic pressure. Solenoid

valves increase or decrease hydraulic pressure to each front wheel and/or to both rear wheels. This action will slow each wheel at a preprogrammed rate to prevent wheel lock-up, allowing driver to maintain steering control.

If ABS malfunction occurs, ABS warning light will come on in instrument cluster panel. ABS ECU will then deactivate ABS system, leaving conventional braking system intact. ABS ECU can also self-diagnose ABS during each ignition cycle (OFF-ON-OFF). If an ABS fault is detected, ABS ECU will store a trouble code to assist technician in diagnosing ABS.

BLEEDING BRAKE SYSTEM

NOTE: Use FMVSS No. 116, fresh DOT 3 or 4, brake fluid only. Ensure brake fluid reserve tank never becomes empty. Check all brake system lines and connections for leaks.

ABS BLEEDING PROCEDURES

1) Using conventional manual brake bleeding method (using vinyl tubing and container, with foot pressure on brake pedal), follow sequence in BRAKELINE BLEEDING SEQUENCE table. See Fig. 3 or 4.

2) Attach one end of tubing to bleeder screw and place other end into container. Have assistant depress and hold pressure on brake pedal. Open bleeder screw 1-2 seconds and then close it. Release pressure on brake pedal. Repeat procedure until air has been discharged from system. See BRAKELINE BLEEDING SEQUENCE table. Bleed each caliper until air bubbles stop appearing from bleeder tubing in fluid bottle. Close bleeder screw. ABS system bleeding is completed.

3) When air has been removed from all six connections, depress brake pedal using about 66 lbs. (30 kg) force and hold it for about 20 seconds. Check pedal for any unusual movement. Install wheels. Test drive car for 1-2 miles, ensuring proper operation of brakes and ABS system.

BRAKELINE BLEEDING SEQUENCE TABLE

Application	Sequence
Legacy	(1) HS, RF, LR, (1) HP, LF, RR
SVX	(1) HP, (1) HS, RF, LR, LF, RR

(1) - HP (hydraulic unit primary bleeder between LF and RR); HS (hydraulic unit secondary bleeder between RF and LR).

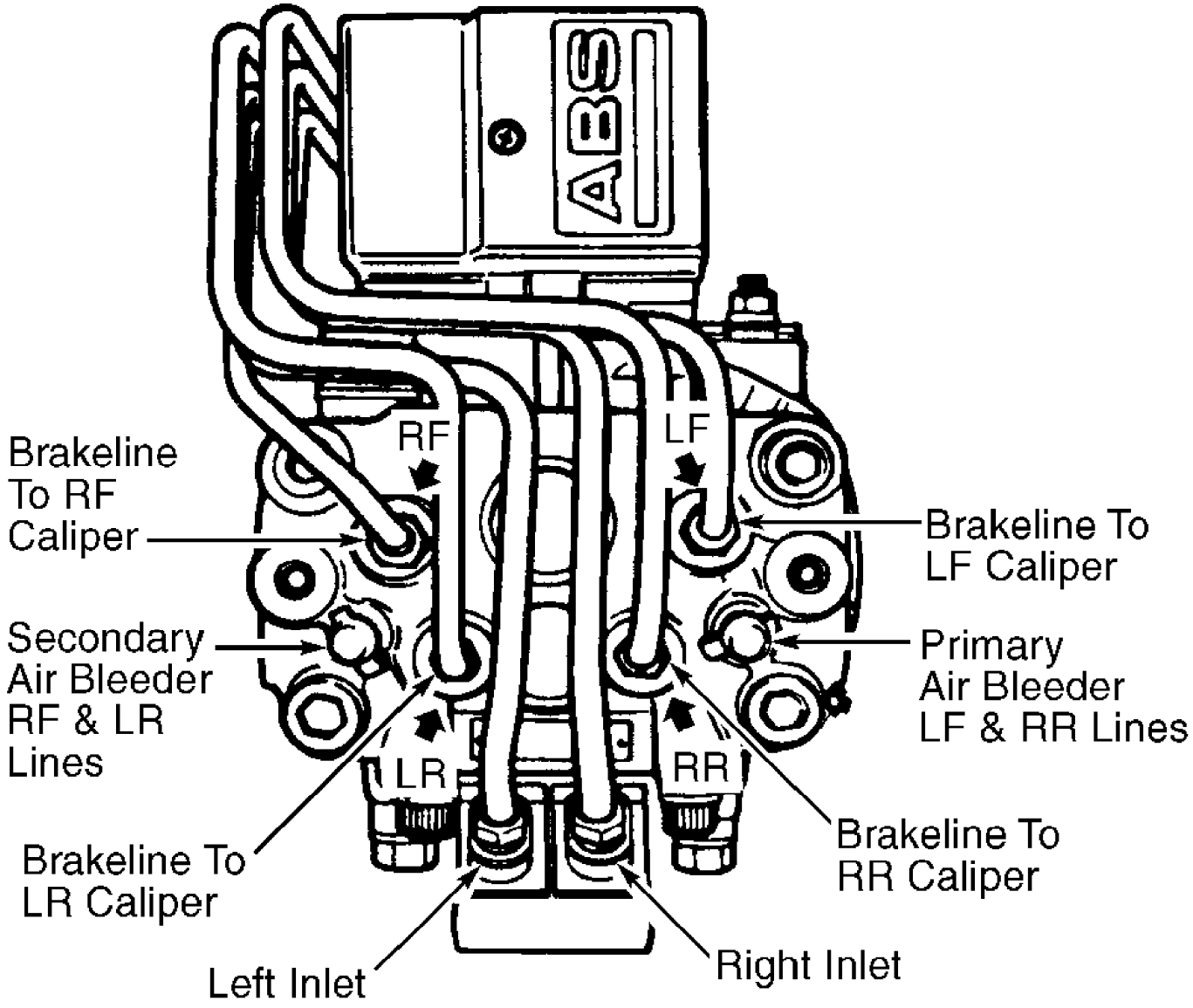

Fig. 3: ABS Hydraulic Control Unit Line Routing & Bleeding Ports ID (Nippon)
Courtesy of Subaru of America, Inc.

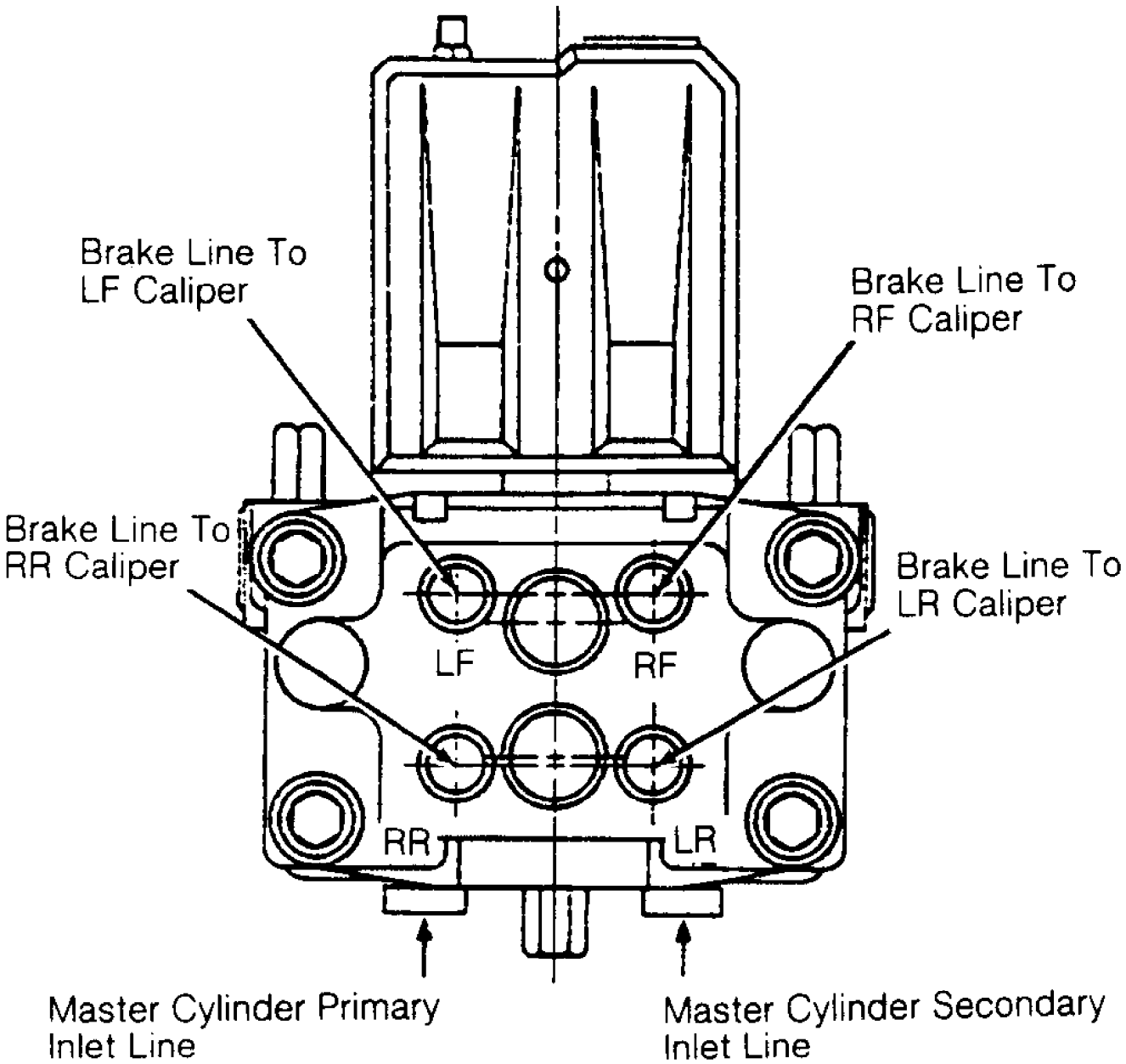

Fig. 4: ABS Hydraulic Control Line Routing & Bleeding Ports ID (Bosch)
Courtesy of Subaru of America, Inc.

ADJUSTMENTS

NOTE: For parking brake, brake pedal height and free play, and hill-holder brake (Legacy only) adjustment information, See DISC & DRUM article in BRAKES Section.

WHEEL SPEED SENSOR AIR GAP

1) Raise vehicle, and remove wheel. Measure air gap between wheel speed sensor, rear of disc rotor, and each tooth of tone ring. Legacy tone rings have 44 teeth; SVX tone rings have 45 teeth. Front wheel air gap should be .039-.059" (1.00-1.50 mm) on Legacy and .028-.039" (.70-1.00 mm) on SVX. Rear wheel air gap should be .031-.051"(.78-1.30 mm) on Legacy and .020-.028" (.50-.70 mm) on SVX. Maximum hub/tone wheel runout is .002" (.05 mm).

2) If gap is too small, use Spacer (26755AA000) to increase gap to specification. If gap exceeds specification, remove spacer(s) or replace tone ring or faulty wheel speed sensor.

TROUBLE SHOOTING

Before fault testing ABS, ensure battery voltage, brake fluid level, tire specification, tire wear and tire air pressure are okay. Check for brake fluid leakage. Ensure brake drag is minimal and brake pads and rotors are okay. For additional trouble shooting information, see TROUBLE SHOOTING CHARTS at end of article.

DIAGNOSIS & TESTING

NOTE: Resistance readings of one megohm are same as readings of infinity.

RETRIEVING CODES

1) ABS can store trouble codes when system fault is detected. To retrieve trouble codes, locate ABS Electronic Control Unit (ECU) under right side of front passenger seat. Fold back carpet between door sill and seat to expose ABS ECU. See Fig. 5.

2) Drive vehicle at 19 MPH (30 km/h) for at least one minute. When system fault is detected, dash board warning light will come on. About 5-12 seconds later, an ABS ECU LED light will start to flash if a trouble code is stored. With vehicle stopped and engine running, count LED flashes. See Fig. 6.

NOTE: ABS ECU trouble code memory will reset when ignition is turned off.

3) ABS ECU can display one code at a time. If more than one code is stored, lowest number code will be displayed first. If necessary, drive vehicle after repairing first code to store and read any additional codes.

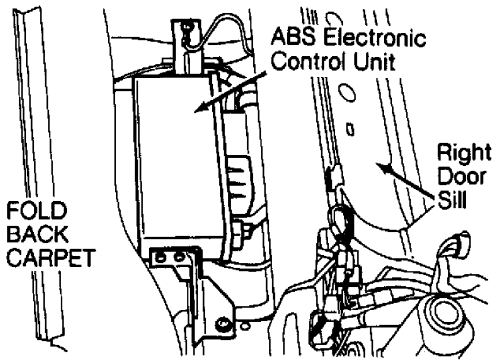

Fig. 5: Locating ABS Electronic Control Unit (ECU) (Typical)
Courtesy of Subaru of America, Inc.

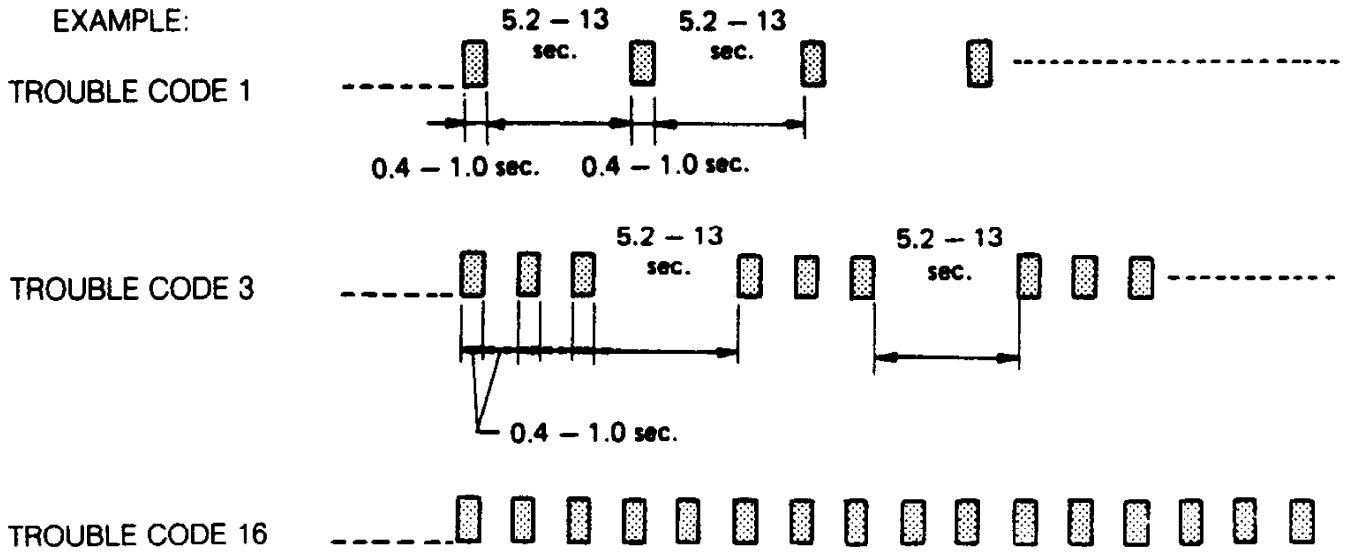

Fig. 6: Reading ABS Trouble Codes
Courtesy of Subaru of America, Inc.

TROUBLE CODES

NOTE: For additional voltage specifications, see ABS ECU pin voltage chart. See Fig. 7. To identify ABS ECU terminals, see Fig. 8. To identify check connector terminals, see Figs. 9 or 10. For additional information, see WIRING DIAGRAMS. See Figs. 21 and 22.

Contents			Terminal No.	With engine idling	Input/output signals	
					Measured value	Measuring conditions
ABS sensor	Left front wheel		22, 5*	0V	200 — 300 mV (AC range)	• No. 22 or No. 5* — No. 4 • Vehicle speed 2.75 km/h (1.7 MPH)
	GND		4			
	Right front wheel		11	0V	200 — 300 mV (AC range)	• No. 11 — No. 21 • Vehicle speed 2.75 km/h (1.7 MPH)
	GND		21			
	Left rear wheel		7	0V	200 — 300 mV (AC range)	• No. 7 — No. 9 • Vehicle speed 2.75 km/h (1.7 MPH)
	GND		9			
	Right rear wheel		24	0V	200 — 300 mV (AC range)	• No. 24 — No. 26 • Vehicle speed 2.75 km/h (1.7 MPH)
	GND		26			
G sensor (See NOTE)			16	13 — 14V	0V	
Stop light switch			25	0V	13 — 14V	When brake pedal is depressed.
Motor monitoring			14	0V	13 — 14V	When motor operates.
Valve power-supply monitoring			32	13 — 14V	13 — 14V	—
Hydraulic unit	Solenoid	Left front wheel	2	13 — 14V	0V	When solenoid is energized to produce output.
		Right front wheel	35	13 — 14V	0V	
		Left rear wheel	18	13 — 14V	0V	
		Right rear wheel	19	13 — 14V	0V	
	Valve relay coil		27	0V	0V	—
	Motor relay coil		28	13 — 14V	0V	When motor operates to produce output
Warning light			29	13 — 14V	0V	Ignition switch ON (Engine OFF)
Power supply	Alternator		15	13 — 14V	1.7V	Ignition switch ON (Engine OFF)
	Battery		1	13 — 14V	13 — 14V	—
	Relay coil (valve, motor, etc.)		17	13 — 14V	13 — 14V	—
Grounding line			10	0V	0V	—
			20	0V	0V	—
			34	0V	0V	—

NOTE: "G" sensor only used on Legacy
* - FWD Model Only

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Fig. 7: ABS ECU Pin Voltage Chart
Courtesy of Subaru of America, Inc.

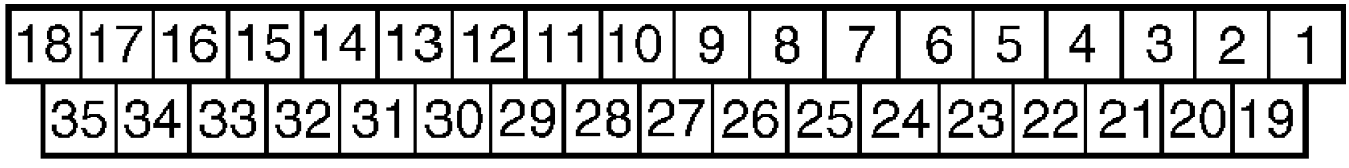

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Fig. 8: Identifying ABS ECU Terminals
Courtesy of Subaru of America, Inc.

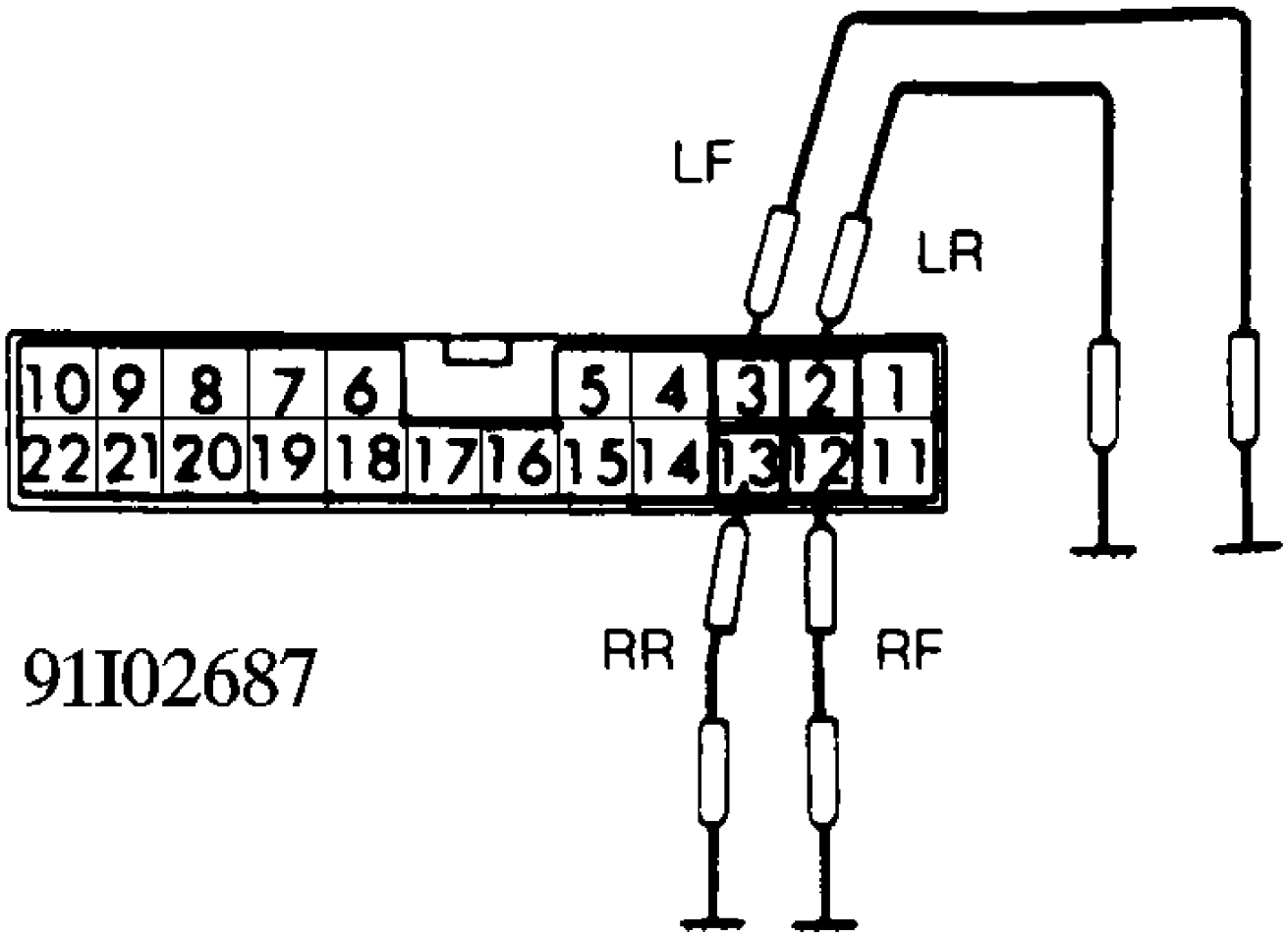


Fig. 9: Identifying Check Connector Terminals (Legacy)
Courtesy of Subaru of America, Inc.

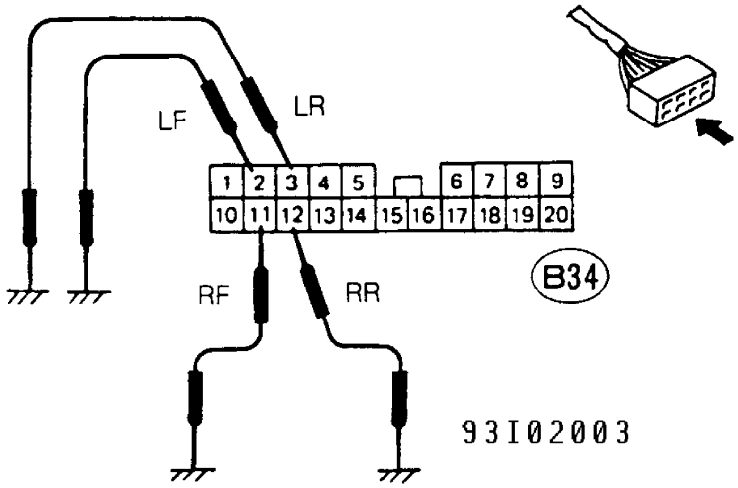


Fig. 10: Identifying Check Connector Terminals (SVX)
Courtesy of Subaru of America, Inc.

Accessing ABS ECU Connector
1) Ensure ignition is off. Locate ABS Electronic Control Unit

(ECU) under right side of front passenger seat. Fold back carpet between door sill and seat to expose ABS ECU. Remove screws retaining ABS ECU bracket to floor.

2) To unplug ABS ECU connector, remove screw from end of connector opposite of harness end. Slide harness rubber boot backward over harness. Slide plastic connector cover away from harness end of connector, and remove cover from unit.

Trouble Code No. 0: Improper Input Voltage Or Faulty ABS ECU Connector

1) Unplug ABS ECU connector. See ACCESSING ABS ECU CONNECTOR. Turn ignition on. Using a voltmeter, measure voltage between ABS ECU connector terminal No. 1 (Blue wire on Legacy; Brown/Red wire on SVX) and ground. See Fig. 8. Reading should be battery voltage (10-13 volts).

2) If reading is less than 10 volts, repair wiring and retest. If voltage is within specification, start engine. Measure voltage between ABS ECU terminal No. 15 (Black/White wire on Legacy; Brown wire on SVX) and ground. See Fig. 8. If reading is not 13.5 volts or more, check wiring between ABS ECU connector and alternator. If wiring is okay, check alternator output and repair as required.

3) If voltage between ABS ECU terminal No. 15 (Black/White wire on Legacy; Brown wire on SVX) and ground is 13.5 volts or more, turn ignition off. Reconnect ABS ECU connector. Using an ohmmeter, check for continuity between ABS ECU terminal No. 20 (Black wire) and ground. If continuity does not exist, repair wiring to ground. If continuity exists, turn ignition on. Using a voltmeter, check voltage at terminal No. 20 (Black wire). Reading should be zero volts.

4) If reading is more than zero volts, turn ignition off. Unplug ABS ECU connector. Turn ignition on, and recheck voltage at terminal No. 20 (Black wire). If reading is now zero volts, replace ABS ECU. If reading is more than zero volts, wiring is shorted to voltage.

5) Repair wiring, and retest. If system checks okay but trouble code No. 0 is still present after road-testing vehicle, replace ABS ECU with known good unit and retest.

Trouble Codes No. 1-4: Faulty Solenoid Valve Circuit(s) In Hydraulic Unit

1) Locate check connector (Black wire) under instrument panel, right of steering column. Legacy has 22-pin connector; SVX has 20-pin connector. Turn ignition on. Ground check connector terminal using a jumper wire to check solenoid valve operation. See TROUBLE CODES NO. 1-4 (SOLENOID ACTIVATION) table. See Fig. 9 or 10.

WARNING: Hydraulic unit cannot be serviced or disassembled. DO NOT loosen bolts or nuts on unit.

2) Solenoid valve should be heard activating when terminal is grounded. Each time solenoid activates, system circuit is interrupted. To test circuit, ignition must be turned off and back on. If solenoid valve(s) does not activate, replace hydraulic unit.

3) If all solenoid valves are okay, turn ignition on. Verify voltage between specified terminals and ground is zero volts as solenoid activates. Each time solenoid activates, system circuit is interrupted. To test circuit, ignition must be turned off and then on. See TROUBLE CODES NO. 1-4 (CONTROL UNIT SIDE) table. See Fig. 9 or 10.

TROUBLE CODES NO. 1-4 TABLE (SOLENOID ACTIVATION)

Trouble Code	Connector & Terminal To Ground

Legacy	
1	(B47) No. 3 (GRN/RED Wire)
2	(B47) No. 12 (BLU/BLK Wire)
3	(B47) No. 13 (YEL/GRN Wire)
4	(B47) No. 2 (WHT/BLU Wire)
SVX	
1	(B34) No. 2 (GRN/RED Wire)
2	(B34) No. 11 (BLU/BLK Wire)
3	(B34) No. 12 (YEL/GRN Wire)
4	(B34) No. 3 (WHT/BLU Wire)

TROUBLE CODES NO. 1-4 TABLE (CONTROL UNIT SIDE)

Trouble Code	Connector & Terminal To Ground
Legacy	
1	(P12) No. 2 (GRN/RED Wire)
2	(P12) No. 35 (BLU/BLK Wire)
3	(P12) No. 19 (YEL/GRN Wire)
4	(P12) No. 18 (WHT/BLU Wire)
SVX	
1	(R7) No. 2 (GRN/RED Wire)
2	(R7) No. 35 (BLU/BLK Wire)
3	(R7) No. 19 (YEL/GRN Wire)
4	(R7) No. 18 (WHT/BLU Wire)

Trouble Codes No. 5 & 6: Faulty Front Wheel Speed Sensors

1) Unplug ABS ECU connector. See ACCESSING ABS ECU CONNECTOR. Connect a digital voltmeter (AC range) between ABS ECU connector terminals. See TROUBLE CODES NO. 5 & 6 (VOLTAGE) table. See Fig. 8.

2) Raise and support vehicle. Rotate each wheel, individually and faster than 2 MPH, and measure voltage. See TROUBLE CODES NO. 5 & 6 (VOLTAGE) table. If reading is 200-300 millivolts, measure sensor and wiring resistance by connecting ohmmeter between ABS ECU connector terminal and ground. See TROUBLE CODES NO. 5 & 6 (CONNECTOR RESISTANCE) table. If resistance is infinity, speed sensor and wiring are good. Replace ABS ECU.

3) If reading is not 200-300 millivolts, measure speed sensor wiring resistance by connecting ohmmeter between ABS ECU connector terminal and ground. See TROUBLE CODES NO. 5 & 6 (CONNECTOR RESISTANCE) table. If resistance is infinity, speed sensor wiring is good. Check speed sensor in step 4). If resistance is less than infinity, repair wiring between speed sensor and ABS ECU connector or replace speed sensor.

4) Unplug wheel speed sensor connector (in engine compartment). Measure resistance across speed sensor connector terminals. See TROUBLE CODES NO. 5 & 6 (SENSOR RESISTANCE) table. If resistance is less than 800-1300 ohms, replace speed sensor. If resistance is 800-1300 ohms, measure resistance between speed sensor connector terminal and ground. See TROUBLE CODES NO. 5 & 6 (CONNECTOR RESISTANCE) table.

5) If resistance is infinity, speed sensor is good. Repair wiring, and retest system. If resistance is less than infinity, check tone wheel(s). Replace speed sensor or repair wiring as necessary. Retest system.

TROUBLE CODES NO. 5 & 6 TABLE (VOLTAGE)

Trouble Code	Connector & Terminal (Wire Color) To Terminal (Wire Color)

Legacy	
5 (FWD)	(P12) No. 4 (RED/WHT) To No. 5 (YEL/WHT)
5 (4WD)	(P12) No. 4 (RED/WHT Wire) To No. 22 (YEL/WHT)
6	(P12) No. 11 (BLU/WHT) To No. 21 (GRN/WHT)
SVX	
5	(R7) No. 4 (RED/WHT) To No. 22 (YEL/WHT)
6	(R7) No. 11 (BLU/WHT) To No. 21 (GRN/BLU)

TROUBLE CODES NO. 5 & 6 TABLE (CONNECTOR RESISTANCE)

Trouble Code	Connector & Terminal To Ground
ABS Control Unit Connector	
Legacy	
5 (FWD)	(P12) No. 5 (YEL/WHT Wire)
5 (4WD)	(P12) No. 22 (YEL/WHT Wire)
6	(P12) No. 21 (GRN/WHT Wire)
SVX	
5	(R7) No. 22 (YEL/WHT Wire)
6	(R7) No. 21 (GRN/BLU Wire)
Speed Sensor Connector	
Legacy	
5 (LF)	(B13) No. 1 (YEL Wire)
6 (RF)	(B22) No. 1 (BLU Wire)
SVX	
5 (LF)	(B18) No. 1 (WHT Wire)
6 (RF)	(B3) No. 1 (WHT Wire)

TROUBLE CODES NO. 5 & 6 TABLE (SENSOR RESISTANCE)

Trouble Code	Terminal To Terminal
Legacy	
5 (LF Sensor)	No. 1 To No. 2
6 (RF Sensor)	No. 1 To No. 2
SVX	
5 (LF Sensor)	No. 1 To No. 2
6 (RF Sensor)	No. 1 To No. 2

Trouble Codes No. 7 & 8: Faulty Rear Wheel Speed Sensors

1) Unplug ABS ECU connector. See ACCESSING ABS ECU CONNECTOR. Connect a digital voltmeter (AC range) between ABS ECU connector terminals. See TROUBLE CODES NO. 7 & 8 (VOLTAGE) table. See Fig. 8.

2) Raise and support vehicle. Rotate each wheel, individually and faster than 2 MPH, and measure voltage. See TROUBLE CODES NO. 7 & 8 (VOLTAGE) table. If reading is 200-300 millivolts, measure sensor and wiring resistance by connecting ohmmeter between ABS ECU connector terminal and ground. See TROUBLE CODES NO. 7 & 8 (CONNECTOR RESISTANCE) table. If resistance is infinity, speed sensor and wiring are good. Replace ABS ECU.

3) If reading is not 200-300 millivolts, measure speed sensor wiring resistance by connecting ohmmeter between ABS ECU connector terminal and ground. See TROUBLE CODES NO. 7 & 8 (CONNECTOR RESISTANCE) table. If resistance is infinity, speed sensor wiring is good. Check speed sensor in step 4). If resistance is less than infinity, repair wiring between speed sensor and ABS ECU connector or replace speed sensor.

4) Unplug wheel speed sensor connector (in engine

compartment). Measure resistance across speed sensor connector terminals. See TROUBLE CODES NO. 7 & 8 (SENSOR RESISTANCE) table. If resistance is less than 800-1300 ohms, replace speed sensor. If resistance is 800-1300 ohms, measure resistance between speed sensor connector terminal and ground. See TROUBLE CODES NO. 7 & 8 (CONNECTOR RESISTANCE) table.

5) If resistance is infinity, speed sensor is good. Repair wiring, and retest system. If resistance is less than infinity, check tone wheel(s). Replace speed sensor or repair wiring as necessary. Retest system.

TROUBLE CODES NO. 7 & 8 TABLE (VOLTAGE)

Trouble Code	Connector & Terminal (Wire Color) To Terminal (Wire Color)
Legacy	
7	(P12) No. 24 (BLU/RED) To No. 26 (GRN/YEL)
8	(P12) No. 7 (YEL/RED) To No. 9 (GRN/RED)
SVX	
7	(R7) No. 24 (BLU/RED) To No. 26 (GRN/YEL)
8	(R7) No. 7 (YEL/WHT) To No. 9 (GRN)

TROUBLE CODES NO. 7 & 8 TABLE (CONNECTOR RESISTANCE)

Trouble Code	Connector & Terminal To Ground
ABS Control Unit Connector	
Legacy	
7	(P12) No. 26 (GRN/YEL Wire)
8	(P12) No. 9 (GRN/RED Wire)
SVX	
7	(R7) No. 26 (GRN/YEL Wire)
8	(R7) No. 9 (GRN Wire)
Speed Sensor Connector	
Legacy	
7 (RR)	(P20) No. 1 (BLU/RED Wire)
8 (LR)	(P26) No. 1 (YEL/RED Wire)
SVX	
7 (RR)	(R18) No. 1 (BLU/RED Wire)
8 (LR)	(R36) No. 1 (YEL/WHT Wire)

TROUBLE CODES NO. 7 & 8 TABLE (SENSOR RESISTANCE)

Trouble Code	Terminal To Terminal
Legacy	
7 (RR Sensor)	No. 1 (BLU/RED Wire) & No. 2 (GRN/YEL Wire)
8 (LR Sensor)	No. 1 (YEL/RED Wire) & No. 2 (GRN/RED Wire)
SVX	
7 (RR Sensor)	No. 1 (BLU/RED Wire) & No. 2 (GRN/YEL Wire)
8 (LR Sensor)	No. 1 (YEL/WHT Wire) & No. 2 (GRN Wire)

Trouble Code No. 9: Faulty Hydraulic Motor Or Motor Relay

1) Turn ignition off. Unplug ABS ECU connector. See ACCESSING

ABS ECU CONNECTOR. Measure resistance between ABS ECU connector terminals No. 17 (Green/White wire) and No. 28 (Blue/White wire on Legacy; Blue/Yellow wire on SVX). If reading is 72-88 ohms for Legacy and 45-55 ohms for SVX, go to step 6).

2) If resistance is not as specified, unplug hydraulic control unit connectors. Measure resistance between hydraulic control unit terminals No. 5 (Green/White wire on Legacy; Blue/Yellow wire on SVX) and No. 6 (Blue/White wire on Legacy; Green/White wire on SVX). If reading is 45-55 ohms, go to step 4). If reading is not 45-55 ohms, remove ABS cover on hydraulic control unit and remove motor relay (4-terminal relay).

3) Connect ohmmeter to relay terminals No. 87 and 30. See Fig. 11. Apply 12 volts to relay terminals No. 85 and 86 (ground). Ohmmeter should indicate zero ohms. Remove 12 volts from relay; ohmmeter reading should be infinity. If either reading is not as specified, replace relay or repair connectors and wiring between ABS ECU and hydraulic control unit. If relay readings are as specified, replace hydraulic control unit.

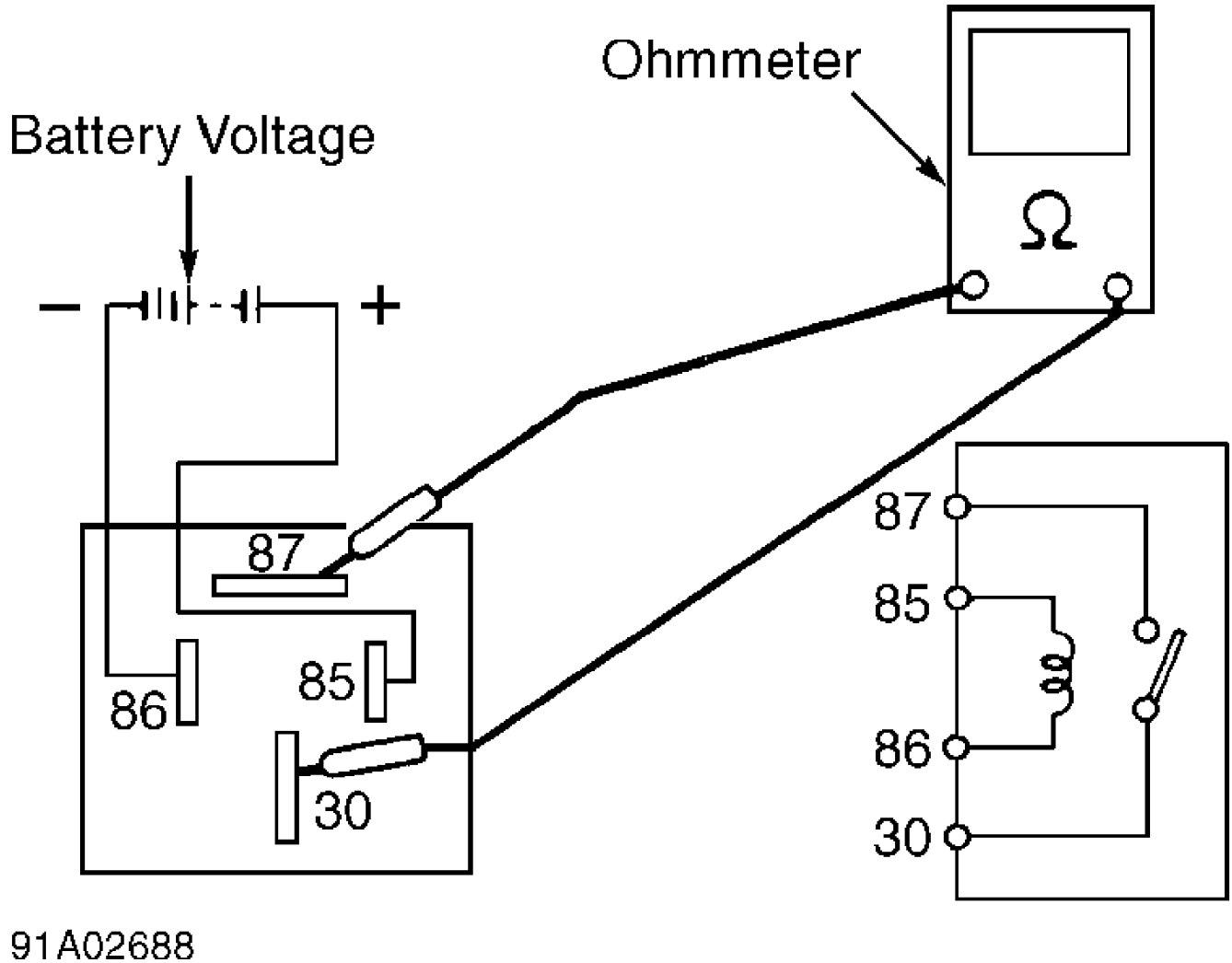


Fig. 11: Checking Hydraulic Motor Relay
Courtesy of Subaru of America, Inc.

4) If reading between hydraulic control unit terminals No. 5 (Green/White wire on Legacy; Blue/Yellow wire on SVX) and No. 6

(Blue/White wire on Legacy; Green/White wire on SVX) is 45-55 ohms, ensure ABS ECU connector and hydraulic control unit connectors are unplugged. Use ohmmeter to measure resistance between each unit's connector terminals and from unit connector terminal to ground. See HYDRAULIC CONTROL UNIT HARNESS RESISTANCE I table.

HYDRAULIC CONTROL UNIT HARNESS RESISTANCE I TABLE

Connector (1) Terminal No.	Connector (2) Terminal No.	Resistance (Ohms)
Legacy		
HCU/(F9) 6	ECU/(P12) 28	0
HCU/(F9) 5	ECU/(P12) 17	0
HCU/(F9) 6	Ground	Infinity
HCU/(F9) 4	Ground	Infinity
SVX		
HCU/(R1) 5	ECU/(R7) 28	0
HCU/(R1) 6	ECU/(R7) 17	0
HCU/(R1) 5	Ground	Infinity
HCU/(R1) 6	Ground	Infinity

(1) - Hydraulic Control Unit (HCU) connector.
(2) - ABS Electronic Control Unit (ECU) connector.

5) If any resistance is not as specified, repair appropriate wiring as required and retest system. If all resistances are as specified, replace hydraulic control unit and retest system.

6) If reading was 45-55 ohms in step 1), unplug both connectors from hydraulic control unit. Using an ohmmeter, measure resistance between hydraulic control unit 2-pin (control unit side - F8 on Legacy; F43 on SVX) connector terminal No. 2 (White/Red wire) and hydraulic control unit 12-pin (control unit side - F9 on Legacy; R1 on SVX) connector terminal No. 4 (Blue/White wire on Legacy; Blue/Black wire on SVX).

7) If reading is less than infinity, remove motor relay. Go to step 9). If reading is infinity, motor relay is good. Check and repair voltage input wiring to hydraulic control unit. To check voltage input wiring to hydraulic control unit, turn ignition on.

8) Measure voltage between hydraulic control unit 2-pin (F8 on Legacy; F43 on SVX) connector terminal No. 2 (White/Red wire) and ground. Reading should be 10-12 volts. Repair wiring as required. See Fig. 21 or 22.

9) Remove ABS cover on hydraulic control unit, and remove motor relay (4-terminal relay). Connect ohmmeter to relay terminals No. 87 and 30. See Fig. 11. Apply 12 volts to relay terminals No. 85 and 86 (ground). Ohmmeter should indicate zero ohms.

10) Remove 12 volts from relay. Ohmmeter reading should be infinity. If either reading is not as specified, replace relay. If relay readings are as specified, replace hydraulic control unit.

Trouble Code No. 10: Faulty Solenoid Valve Relay Or System Interruption

1) Turn ignition off. Unplug ABS ECU connector. See ACCESSING ABS ECU CONNECTOR. Using an ohmmeter, measure resistance between ABS ECU connector terminals No. 17 (Green/White wire) and No. 27 (Blue/Orange wire). If reading is 93-113 ohms for Legacy and 80-90 ohms for SVX, go to step 6).

2) If resistance is not as specified, unplug hydraulic control unit connectors. Measure resistance between hydraulic control unit terminals No. 5 (Green/White wire) and No. 7 (Blue/Orange wire) for Legacy and No. 6 (Green/White wire) and No. 12 (Blue/Orange wire)

for SVX. If reading is not 72-88 ohms for Legacy and 80-90 ohms for SVX, go to step 4). If reading is as specified, ensure ABS ECU connector and hydraulic control unit connectors are unplugged.

3) Use ohmmeter to measure wiring resistances between units' connector terminals and from unit connector terminal to ground. See HYDRAULIC CONTROL UNIT HARNESS RESISTANCE II table. If any resistance is not as specified, repair appropriate wiring as required and retest system. If all resistances are as specified, replace hydraulic control unit. Retest system.

HYDRAULIC CONTROL UNIT HARNESS RESISTANCE II TABLE

Connector (1) Terminal No.	Connector (2) Terminal No.	Resistance (Ohms)
Legacy		
HCU/(F9) 5	ECU/(P12) 17	0
HCU/(F9) 7	ECU/(P12) 27	0
HCU/(F9) 5	Ground	Infinity
HCU/(F9) 7	Ground	Infinity
SVX		
HCU/(R1) 6	ECU/(R7) 17	0
HCU/(R1) 12	ECU/(R7) 27	0
HCU/(R1) 6	Ground	Infinity
HCU/(R1) 12	Ground	Infinity

(1) - Hydraulic Control Unit (HCU) connector.
(2) - ABS Electronic Control Unit (ECU) connector.

4) If reading between hydraulic control unit terminals No. 5 (Green/White wire) and No. 7 (Blue/Orange wire) is not 72-88 ohms for Legacy or reading between terminals No. 6 (Green/White wire) and No. 12 (Blue/Orange wire) is not 80-90 ohms for SVX, remove ABS cover on hydraulic control unit. Remove solenoid valve relay (5-terminal relay). Connect ohmmeter to relay terminals No. 87 and 30. See Fig. 12. Apply 12 volts to relay terminals No. 85 and 86 (ground). Ohmmeter should indicate zero ohms. Remove 12 volts from relay; ohmmeter reading should be infinity.

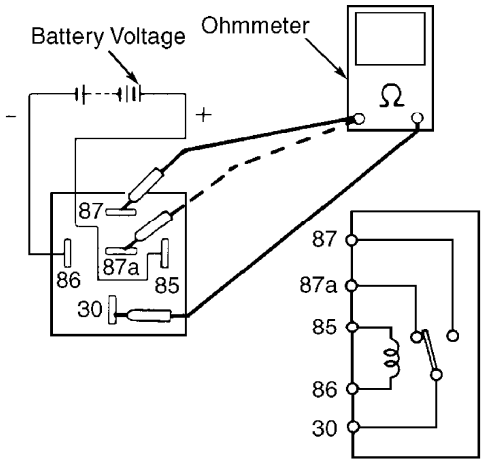


Fig. 12: Checking Solenoid Valve Relay
Courtesy of Subaru of America, Inc.

5) Connect ohmmeter to relay terminals No. 87a and 30. See Fig. 12. Apply 12 volts to relay terminals No. 85 and 86 (ground).

Ohmmeter reading should be infinity. Remove 12 volts from relay; ohmmeter should indicate zero ohms. If any readings are not as specified, replace relay or repair connectors and wiring between ABS ECU and hydraulic control unit. If all relay readings are as specified, replace hydraulic control unit.

6) Unplug both hydraulic control unit connectors. Using an ohmmeter, measure resistance between hydraulic control unit 2-pin connector terminal No. 1 (White/Green wire on Legacy; White/Black wire on SVX) and hydraulic control unit 12-pin connector terminal No. 8 (Green/Black wire) for Legacy or terminal No. 11 (Green/Black wire) for SVX. If reading is less than infinity, go to step 8). If reading is infinity, solenoid valve relay is good. Check voltage input wiring to hydraulic control unit, and repair wiring as necessary. See Fig. 21 or 22.

7) To check voltage input wiring to hydraulic control unit, turn ignition on. Measure voltage between hydraulic control unit 2-pin connector terminal No. 1 (White/Green wire on Legacy; White/Black wire on SVX) and ground. Reading should be 10-12 volts. If reading is less than 10 volts, check fuse No. 19 and/or wiring between connector and fuse block. Repair wiring as required.See Fig. 21 or 22.

8) Remove ABS cover on hydraulic control unit. Remove solenoid valve relay (5-terminal relay). Connect ohmmeter to relay terminals No. 87 and 30. See Fig. 12. Apply 12 volts to relay terminals No. 85 and 86 (ground). Ohmmeter should indicate zero ohms. Remove 12 volts from relay; ohmmeter reading should be infinity.

9) Connect ohmmeter to relay terminals No. 87a and 30. See Fig. 12. Apply 12 volts to relay terminals No. 85 and 86 (ground). Ohmmeter reading should be infinity. Remove 12 volts from relay; ohmmeter should indicate zero ohms. If any readings are not as specified, replace relay and repair connectors and wiring between ABS ECU and hydraulic control unit. If all ohmmeter readings are as specified, replace hydraulic control unit.

Trouble Code No. 16: Faulty ABS ECU Or "G" Sensor (Legacy 4WD M/T)

1) Position vehicle on a flat surface. Unplug ABS ECU connector. See ACCESSING ABS ECU CONNECTOR. Using an ohmmeter, measure resistance between ABS ECU connector terminals No. 1 (Blue wire) and No. 16 (Yellow/Black wire). If resistance is 550-670 ohms, check ABS ECU input power supply at connector terminal No. 1 (Blue) for battery voltage. If power supply is okay, replace ABS ECU and retest.

2) If reading is not 550-670 ohms between ABS ECU connector terminals No. 1 (Blue wire) and No. 16 (Yellow/Black wire), unplug "G" sensor connector. "G" sensor is located in engine compartment, below right shock tower, on frame rail. See Fig. 13. Measure resistance between "G" sensor terminals. Ensure "G" sensor is mounted horizontally and vehicle is horizontal. If reading is not 550-670 ohms, replace "G" sensor.

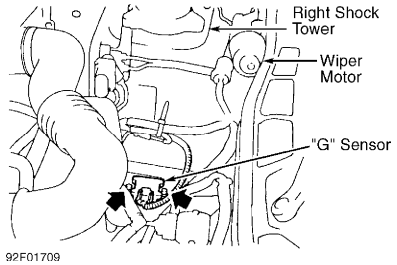


Fig. 13: Locating "G" Sensor (Legacy 4WD M/T)
Courtesy of Subaru of America, Inc.

3) If reading is 550-670 ohms between "G" sensor terminals,

check wiring between "G" sensor and ABS ECU by plugging in "G" sensor connector and turning ignition on. Using voltmeter, backprobe "G" sensor connector terminal No. 2 (Blue) and ground. Note reading. Using voltmeter, backprobe ABS ECU connector terminal No. 16 (Yellow/Black) to ground. Note reading.

4) Both readings should be 10-12 volts. If readings are not as specified, repair wiring as required. If both readings are 10-12 volts, replace ABS ECU. Drive vehicle and retest system for any other trouble codes.

5) Check all wheel sensors for physical damage, corrosion, opens and shorts. See TROUBLES CODES NO. 1-4.

Trouble Code 16: Faulty ABS ECU (SVX)

1) Check power supply to ABS control unit. See TROUBLE CODE NO. 0.

2) Check ABS sensors. See TROUBLE CODES NO. 5 & 6 and TROUBLE CODES NO. 7 & 8.

"G" SENSOR (LEGACY 4WD M/T)

1) "G" sensor is located in engine compartment, below right shock tower, on frame rail. See Fig. 13. With "G" sensor removed from vehicle and horizontal, measure resistance between "G" sensor terminals. See Fig. 14. If reading is not 550-670 ohms, replace "G" sensor.

2) If reading is 550-670 ohms, tilt sensor forward 14-21 degrees. See Fig. 14. Using an ohmmeter, check for continuity between "G" sensor connector terminals. Continuity should be greater than 100, 000 ohms. Replace "G" sensor if continuity is not as specified.

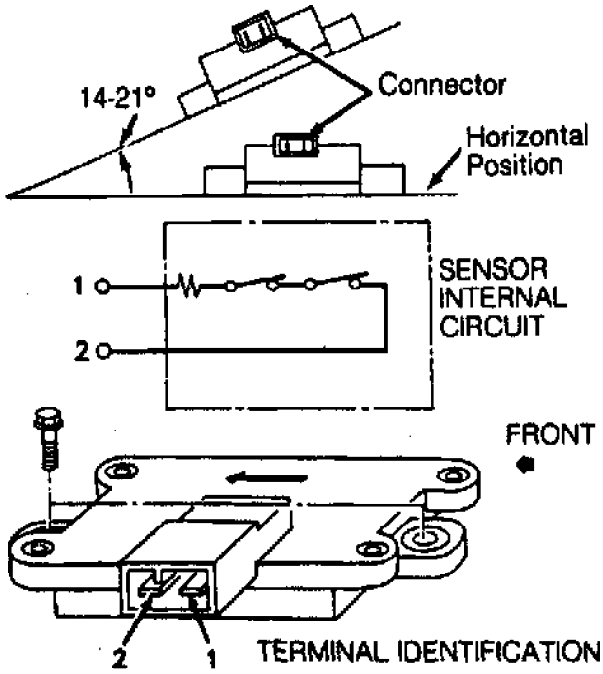


Fig. 14: Testing "G" Sensor (Legacy 4WD M/T)
Courtesy of Subaru of America, Inc.

REMOVAL & INSTALLATION

ELECTRONIC CONTROL MODULE

Removal & Installation

1) Ensure ignition is off. Locate ABS electronic control unit (ECU) under right side of front passenger seat. Fold back carpet between door sill and seat to expose ABS ECU. See Fig. 5. Remove screws retaining ABS ECU bracket to floor.

2) To unplug ABS ECU connector, remove screw from end of connector opposite of harness end. Slide harness rubber boot backward over harness. Slide plastic connector cover away from harness end of connector, and remove cover. To install, reverse removal procedure.

"G" SENSOR (LEGACY)

NOTE: If "G" sensor is tilted backwards or is not mounted horizontally, sensor will not function properly.

Removal & Installation

"G" sensor is located in engine compartment, below right shock tower, on frame rail. See Fig. 13. Unplug harness connector. Remove bolts retaining "G" sensor. To install, reverse removal procedure. Ensure "G" sensor is mounted horizontally and top arrow points forward. See Fig. 14.

HYDRAULIC CONTROL UNIT

NOTE: DO NOT place hydraulic control unit upside-down or on its side during removal or installation procedure.

Removal & Installation (Legacy)

Remove carbon canister from engine compartment. Disconnect hydraulic lines from hydraulic control unit. See Fig. 15 or 16. Plug all line openings. Remove ABS cover from hydraulic control unit. Remove bolts retaining hydraulic control unit. To install, reverse removal procedure. When installing a new control unit, apply Rust Preventive Wax (Nippeco LT or GB) to retaining bolts after tightening them.

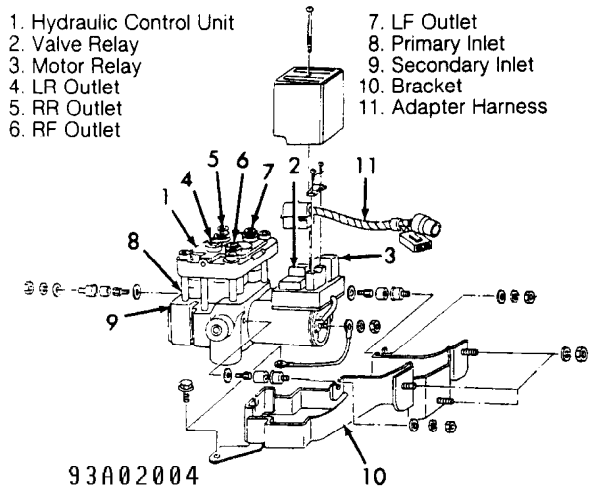
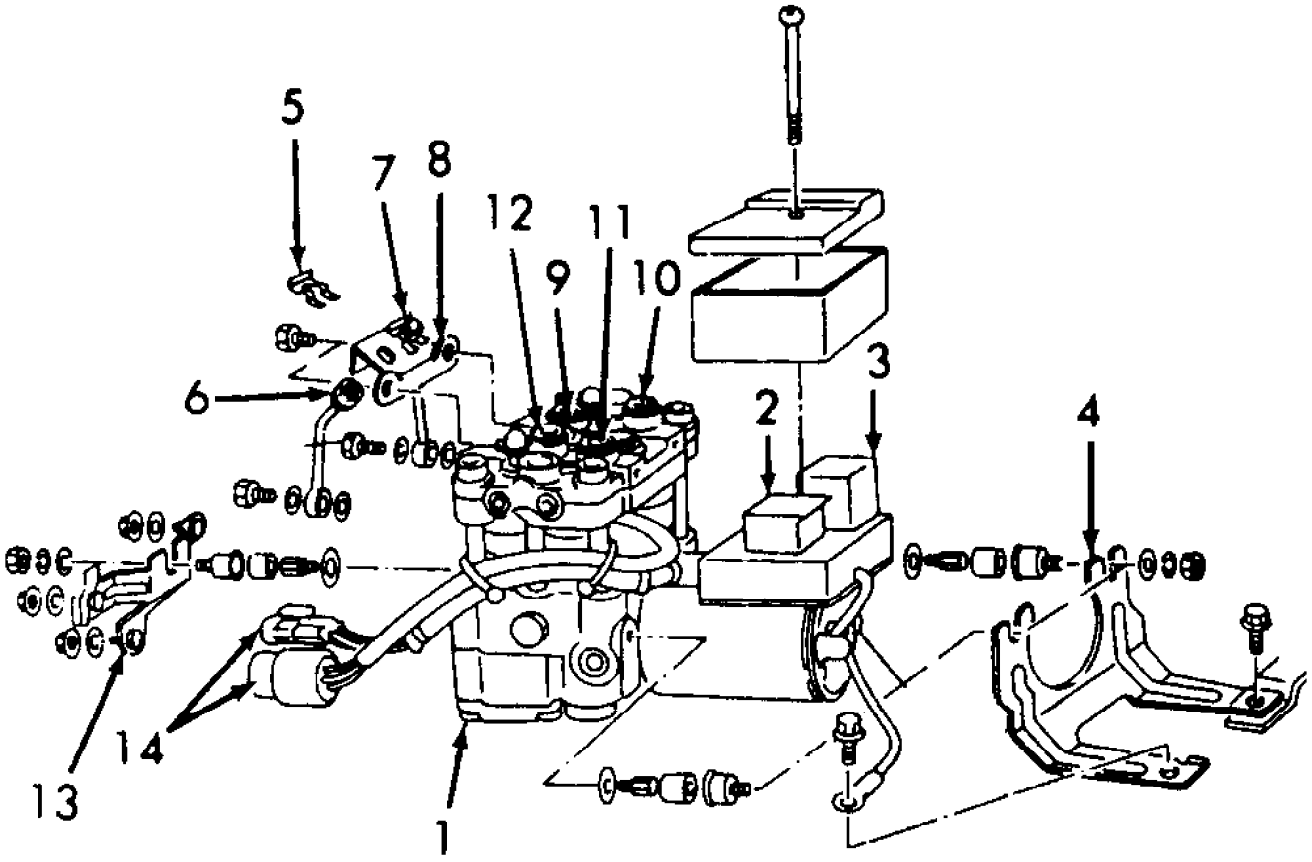


Fig. 15: Identifying ABS Hydraulic Unit (Bosch - Legacy & SVX)
Courtesy of Subaru of America, Inc.



1. Hydraulic Control Unit
2. Motor Relay
3. Valve Relay
4. Control Unit Bracket
5. Clamp
6. Right Side Inlet Joint
7. Left Side Inlet Joint
8. Joint Bracket
9. LR Outlet
10. RF Outlet
11. LF Outlet
12. RR Outlet
13. Control Unit Bracket
14. Connector

93D02005

Fig. 16: Identifying ABS Hydraulic Unit (Nippon - Legacy)
Courtesy of Subaru of America, Inc.

Removal & Installation (SVX)

Disconnect battery ground cable and airflow meter and hydraulic unit connectors. Remove air cleaner covers. Disconnect hydraulic lines from hydraulic control unit. See Fig. 15. Remove bolts retaining hydraulic control unit. To install, reverse removal procedure. When installing a new control unit, apply Rust Preventive Wax (Nippeco LT or GB) to retaining bolts after tightening them.

PROPORTIONING VALVE

NOTE: DO NOT disassemble or adjust proportioning valve. Valve must be replaced as an assembly.

Removal & Installation (Legacy)

Valve is located on passenger side of engine compartment, mounted to shock tower. See Figs. 1 and 17. Remove all brakelines, and plug all openings. Remove valve from bracket. To install, reverse removal procedure. Tighten valve-to-bracket bolts to 10-17 ft. lbs. (13-23 N.m). Bleed system. See BLEEDING BRAKE SYSTEM.

Removal & Installation (SVX)

Valve is located on passenger side of engine compartment, behind windshield washer assembly, mounted to shock tower. See Figs. 2 and 18. Remove windshield washer assembly, disconnecting motor connection and hose. Remove all brakelines, and plug all openings. Remove valve from bracket. To install, reverse removal procedure. Tighten valve-to-bracket bolts to 10-17 ft. lbs. (13-23 N.m). Bleed system. See BLEEDING BRAKE SYSTEM.

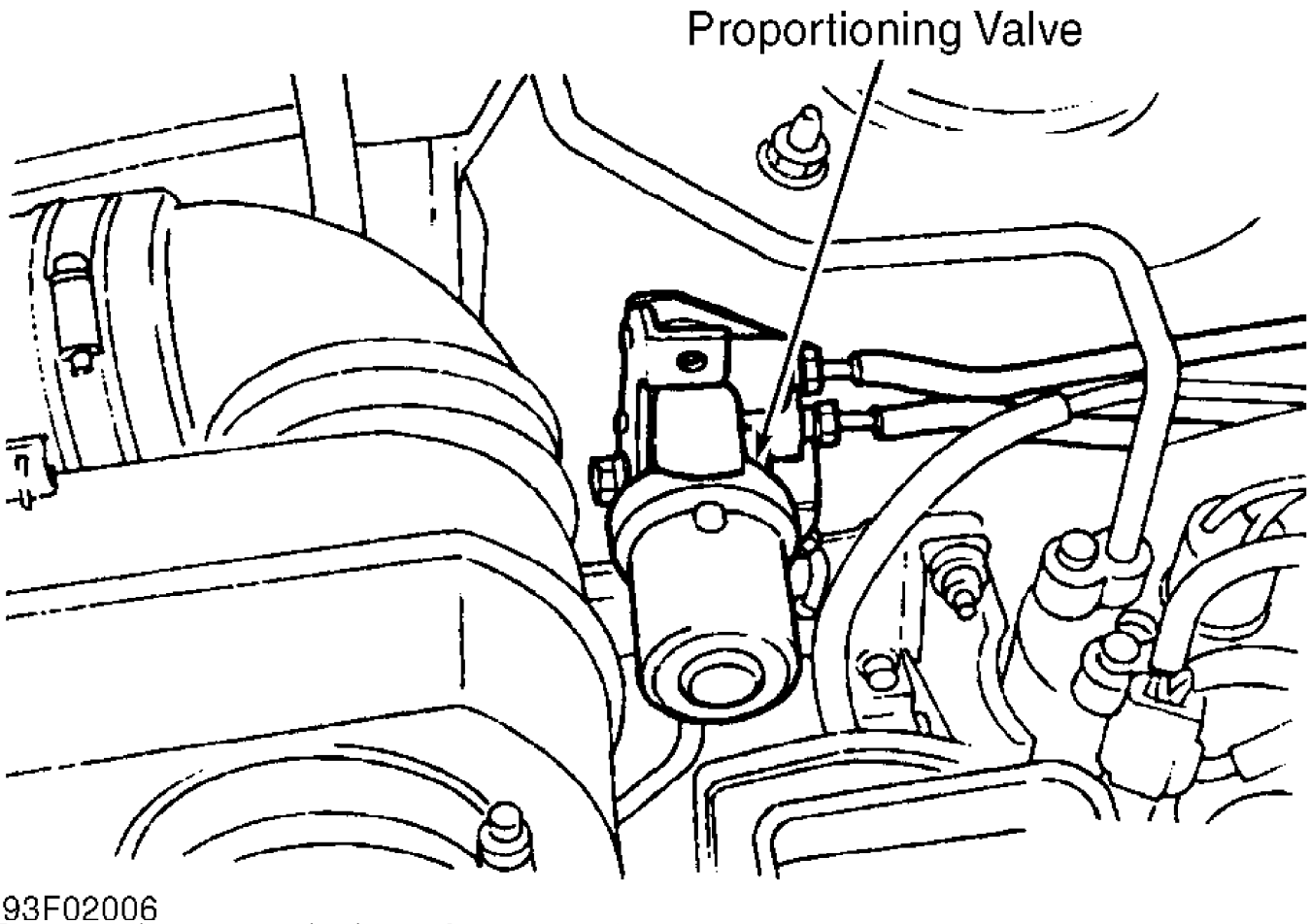


Fig. 17: Locating Proportioning Valve (Legacy)
Courtesy of Subaru of America, Inc.

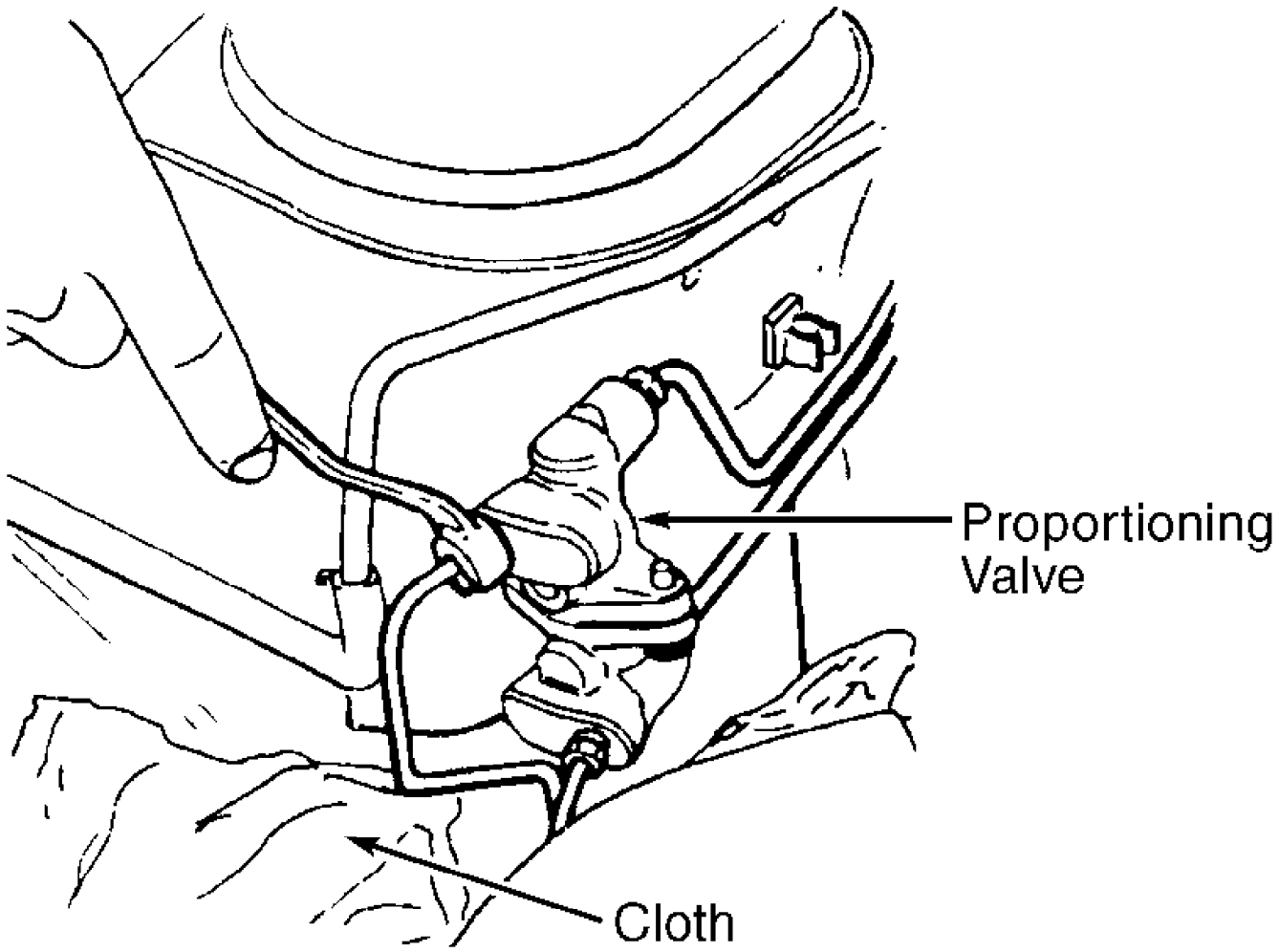


Fig. 18: Locating Proportioning Valve (SVX)
Courtesy of Subaru of America, Inc.

TONE RING

Removal & Installation (Front)

1) Raise and support vehicle. Remove front wheel. Remove disc brake caliper, and wire it aside. Unplug wheel speed sensor connector and remove speed sensor from hub assembly. See Fig. 20. Mark rotor-to-hub location, and remove brake rotor. Remove axle shaft nut. Remove stabilizer.

2) Loosen transverse link ball joint nut and separate ball joint from wheel hub assembly. Drive out spring pin retaining inner CV joint to transaxle spline. Remove drive shaft from vehicle. Disconnect tie rod and ball joints from wheel hub assembly. Remove bolts retaining strut assembly to wheel hub assembly.

3) Remove wheel hub assembly from vehicle. Remove hub from wheel hub assembly using press. Remove bolts retaining tone ring to hub flange. See Fig. 19. Remove tone ring. To install, reverse removal procedure. Use new inner axle joint spring pin and new outer axle shaft nut.

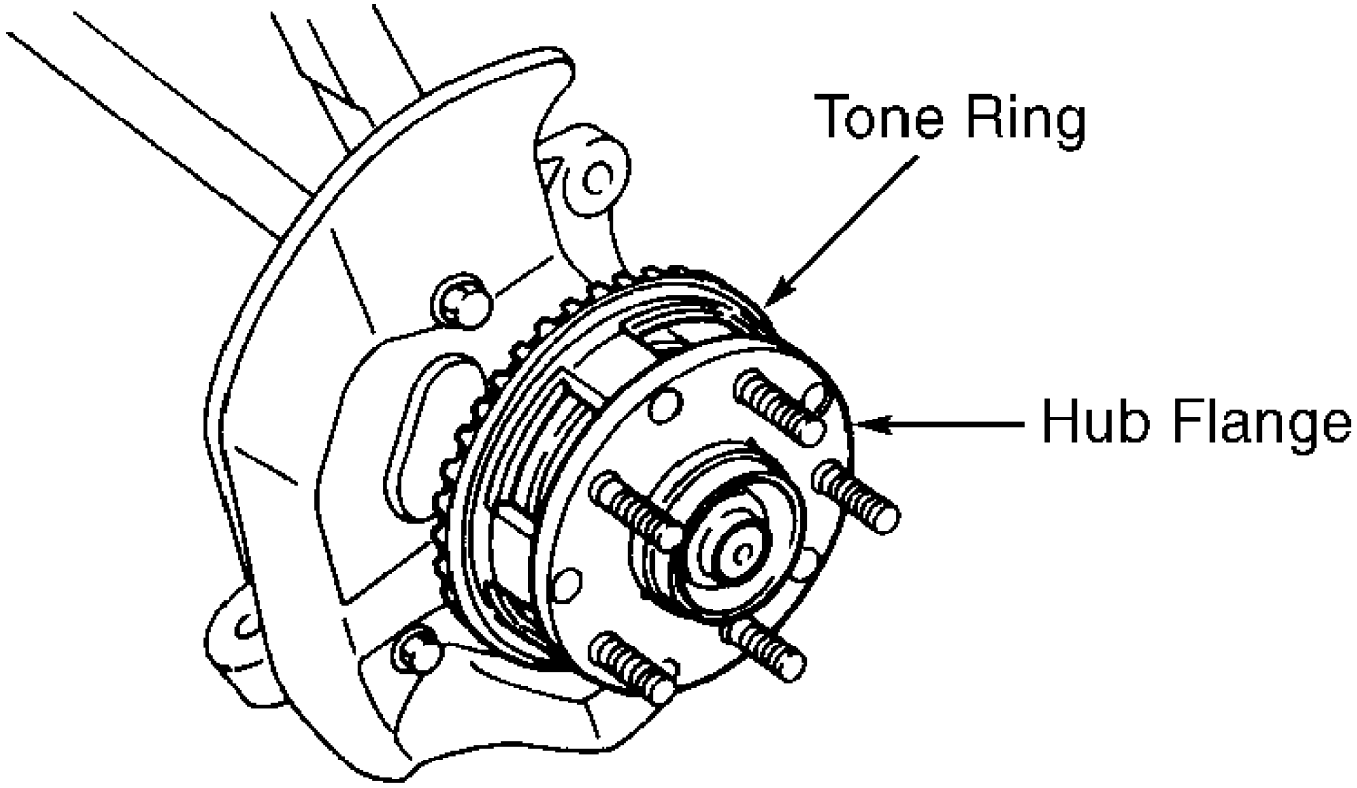


Fig. 19: Locating Tone Ring & Hub Assembly (Similar)
Courtesy of Subaru of America, Inc.

Removal & Installation (Rear)

1) Raise and support vehicle. Remove rear wheel. Remove disc brake caliper, and wire it aside. Unplug wheel speed sensor connector and remove speed sensor from hub assembly. See Fig. 20. Mark rotor-to-hub location, and remove brake rotor. Disconnect parking brake adjuster cable.

2) Remove axle shaft nut. Remove lateral link and trailing link retaining bolts. Drive out spring pin retaining inner CV joint to drive axle case. Remove drive shaft from vehicle. Remove bolts retaining strut assembly to wheel hub assembly.

3) Remove wheel hub assembly. Remove hub from wheel hub assembly using press. Remove bolts retaining tone ring to hub flange. See Fig. 19. Remove tone ring. To install, reverse removal procedure. Use new spring pin, axle shaft nut, and training link and lateral link self-locking nuts.

WHEEL SPEED SENSOR

NOTE: To prevent damage to sensor tip, use care when removing and installing wheel speed sensor.

Removal & Installation (Front)

Unplug front wheel speed sensor connector. Remove bolt retaining wheel speed sensor and wiring harness. Remove wheel speed sensor. See Fig. 20. To install, reverse removal procedure. See TORQUE SPECIFICATIONS table. See WHEEL SPEED SENSOR AIR GAP under ADJUSTMENTS.

Removal & Installation (Rear)

Remove rear seat. Unplug rear wheel speed sensor connector. From underneath vehicle, remove wheel speed sensor retaining bolt. Remove wheel speed sensor. See Fig. 20. To install, reverse removal procedure. See TORQUE SPECIFICATIONS table. See WHEEL SPEED SENSOR AIR GAP under ADJUSTMENTS.

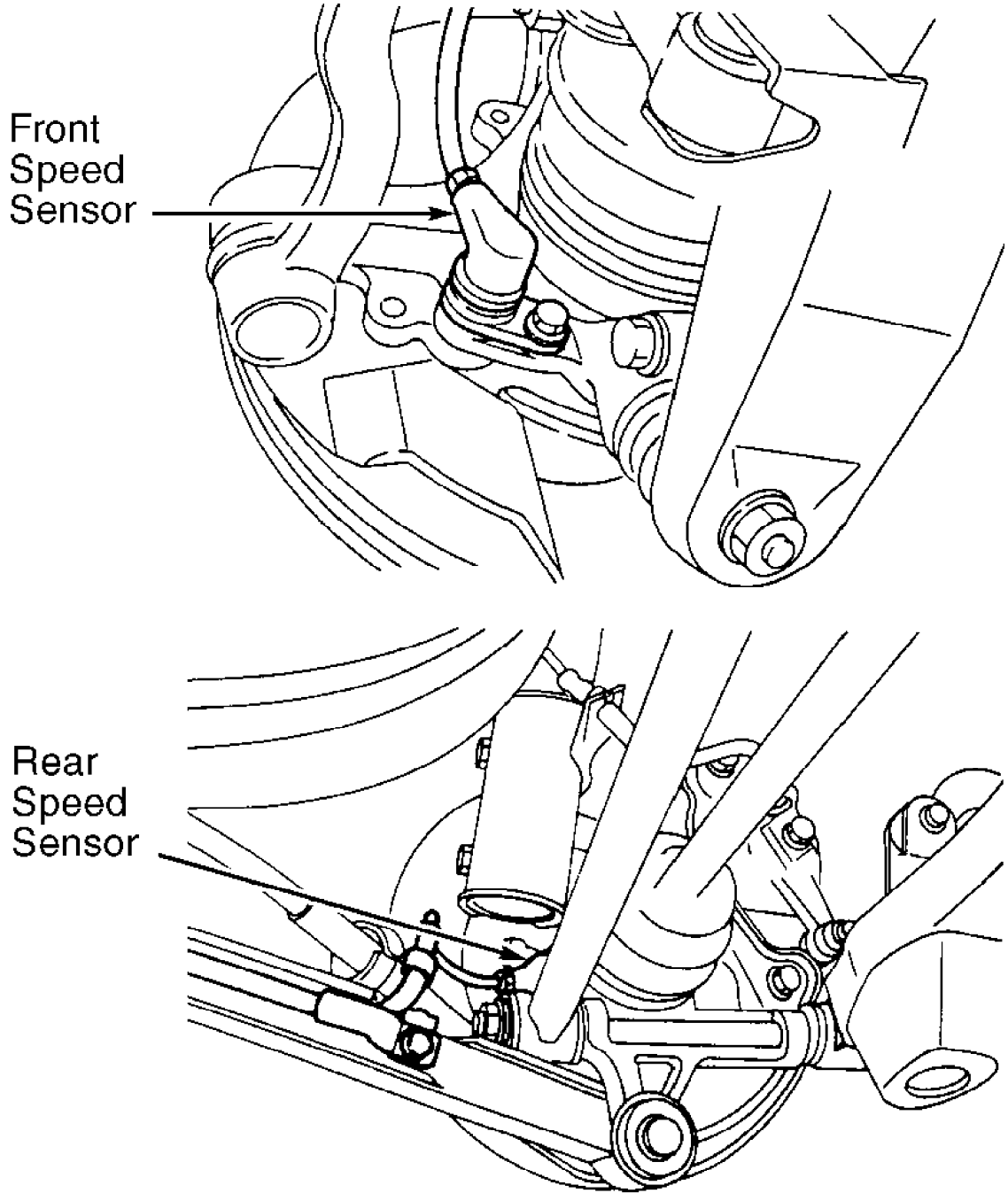


Fig. 20: Locating Wheel Speed Sensors
Courtesy of Subaru of America, Inc.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE

Application	Ft. Lbs. (N.m)
Axle Shaft Nut	123-152 (167-206)
Backing Plate Mounting Bolts	34-43 (46-58)
Booster Mounting Nuts	9-17 (12-23)
Brakeline-To-Caliper	
Front	12-14 (16-19)
Rear	10-13 (14-18)
Brakeline-To-Master Cylinder	10-13 (14-18)
Caliper Guide Pin	
Front	
Dual Piston Caliper	25-32 (34-44)
Single Piston Caliper	33-40 (45-54)
Rear	16-23 (22-31)
Caliper Pin Bolt	23-30 (31-41)
Caliper Support Bracket Mounting Bolts	
Front	
Dual Piston Caliper	50-65 (68-88)
Single Piston Caliper	36-51 (49-69)
Rear	34-43 (46-58)
Hydraulic Control Unit Retaining Bolt	17-31 (23-42)
Hydraulic Lines-To-Control Unit	10-13 (14-18)
Lateral Link Self-Locking Nut (Rear)	
Legacy	87-116 (118-157)
SVX	
Inside	61-83 (83-113)
Outside	72-101 (98-137)
Master Cylinder Mounting Nut	7-13 (10-18)
Proportioning Valve Bracket Bolts	10-17 (13-23)
Stabilizer Link-To-Front Transverse Link	14-22 (19-30)
Stabilizer-To-Crossmember	15-21 (21-28)
Strut Lower Retaining Bolts	
Electronic Air Suspension (Legacy)	137-173 (186-235)
Standard Suspension	98-119 (133-162)
Tie Rod Ball Joint Nut	18-22 (24-30)
Tone Wheel	7-12 (10-16)
Trailing Link Self-Locking Nut	72-94 (98-128)
Transverse Link Ball Joint Nut	28-37 (38-50)
Wheel Lug Nut	
Legacy	58-72 (79-98)
SVX	72-87 (98-118)
Wheel Speed Sensor Harness Bracket Bolt	
Front	7-12 (10-16)
Rear	17-31 (23-42)
Wheel Speed Sensor Retaining Bolt	17-31 (23-42)
	INCH Lbs. (N.m)
Bleeder Screw	62-80 (7.0-9.0)
Hydraulic Control Unit ABS Cover	11-13 (1.2-1.5)

WIRING DIAGRAMS

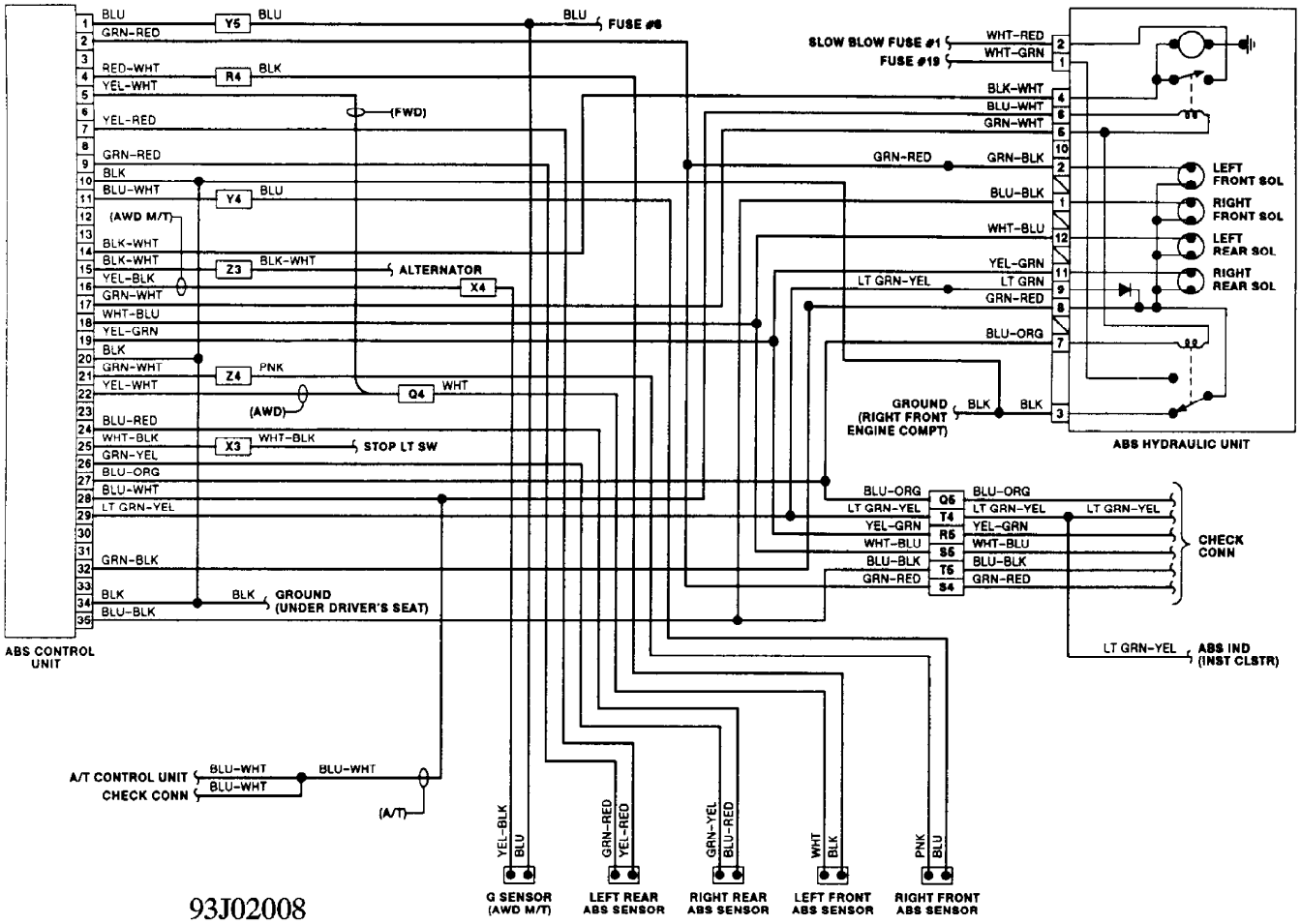


Fig. 21: ABS Wiring Diagram (Legacy)
Courtesy of Subaru of America, Inc.

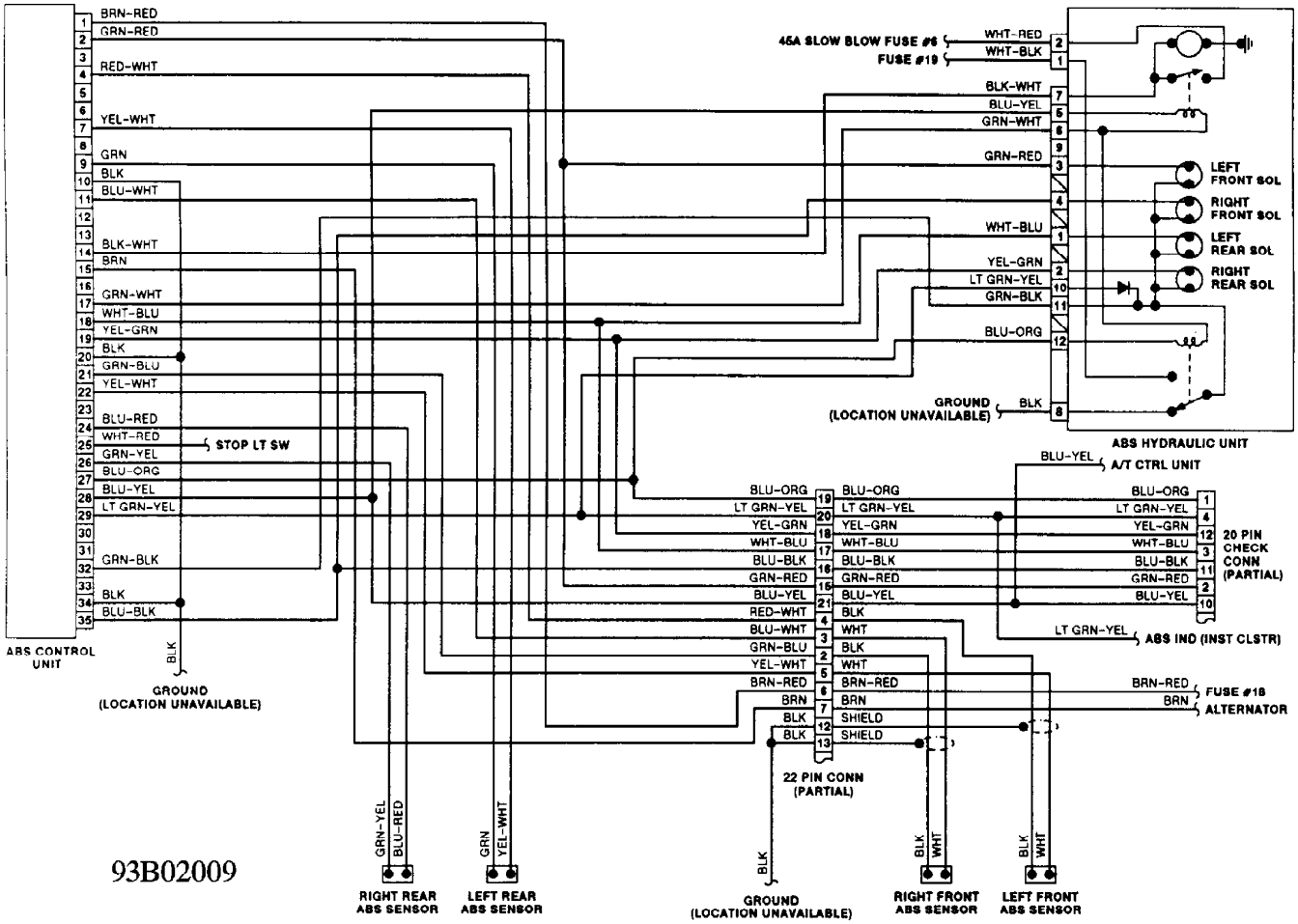


Fig. 22: ABS Wiring Diagram (SVX)
Courtesy of Subaru of America, Inc.

TROUBLE SHOOTING CHARTS

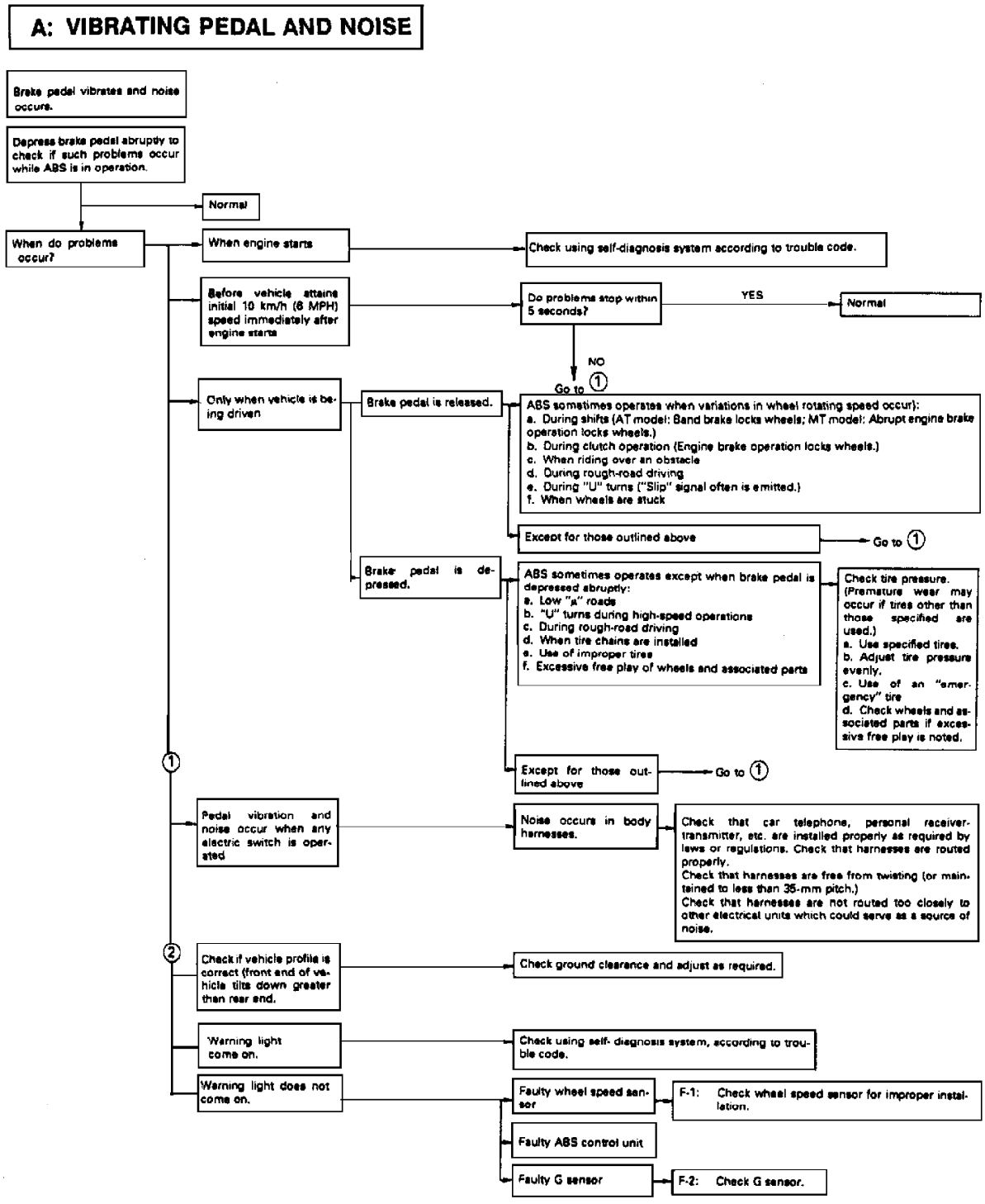


Fig. 23: A - Vibrating Pedal and Noise
Courtesy of Subaru of America, Inc.

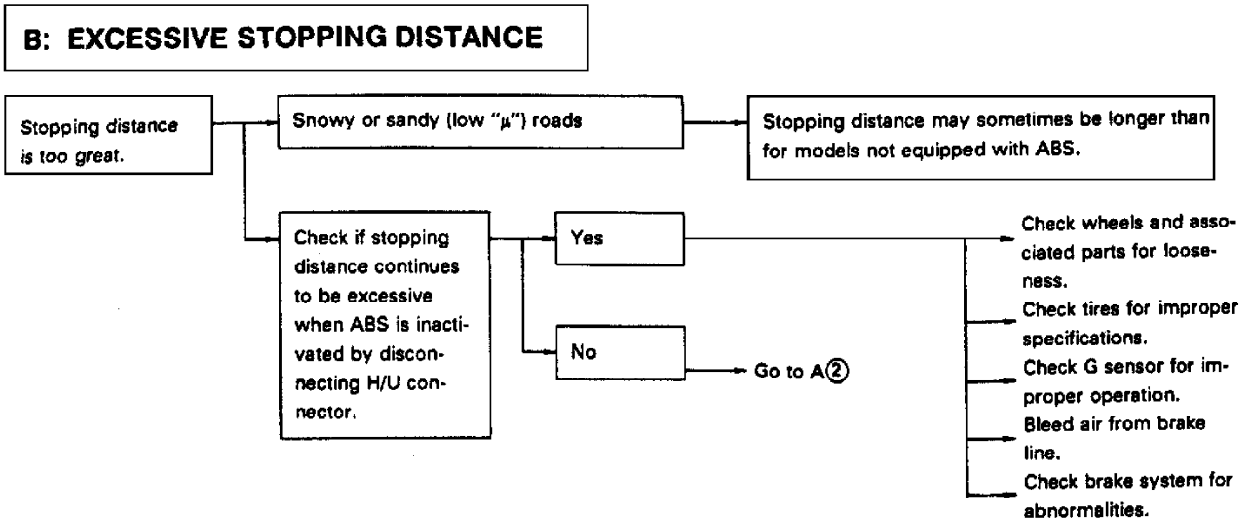


Fig. 24: B - Excessive Stopping Distance
Courtesy of Subaru of America, Inc.

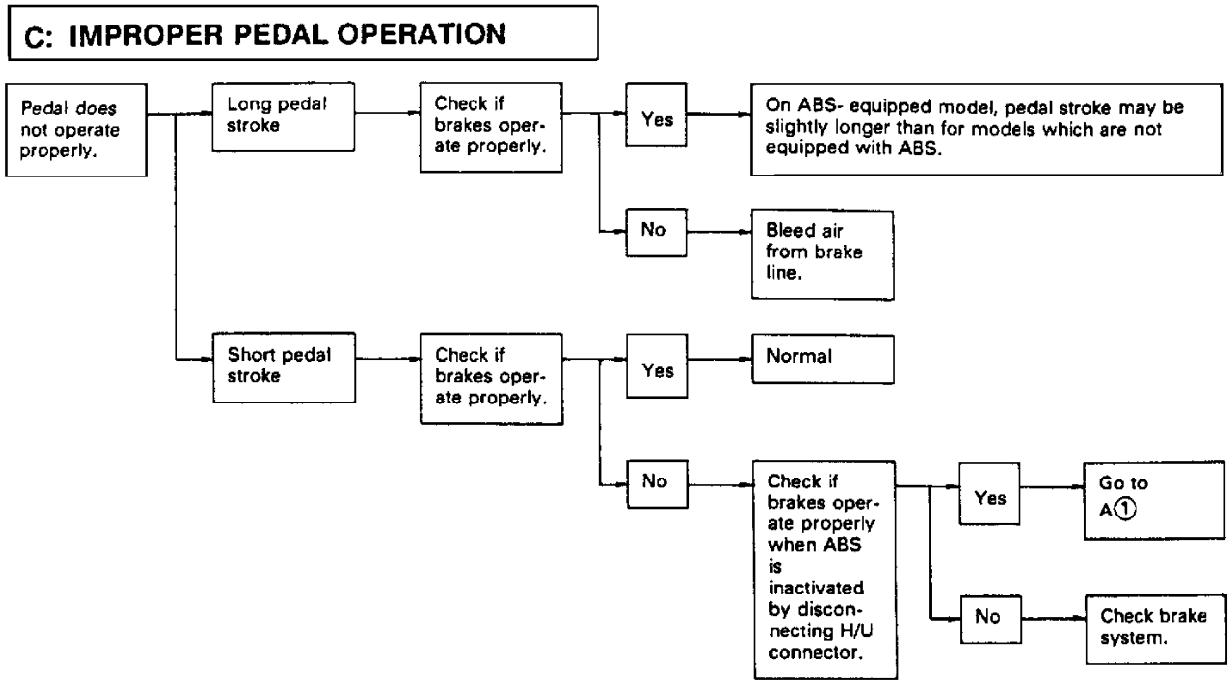


Fig. 25: C - Improper Pedal Operation
Courtesy of Subaru of America, Inc.