ANTI-LOCK BRAKE SYSTEM

1991 Mazda Miata

1988—91 BRAKES
Mazda Anti-Lock Brake System

Mazda; Miata (1991 Only)
RX7 & 929 (1988-91)

DESCRIPTION

The Anti-Lock Brake System (ABS) control unit senses reductions in front and rear wheel speed, and modulates hydraulic pressure to the brakes to prevent wheel lock-up. The ABS consists of a hydraulic unit, 4 wheel speed sensors and sensor rotors, valve relay, motor relay, pump motor, and ABS control unit. An ANTI-LOCK warning light is located on the instrument panel. See Figs. 1-3.

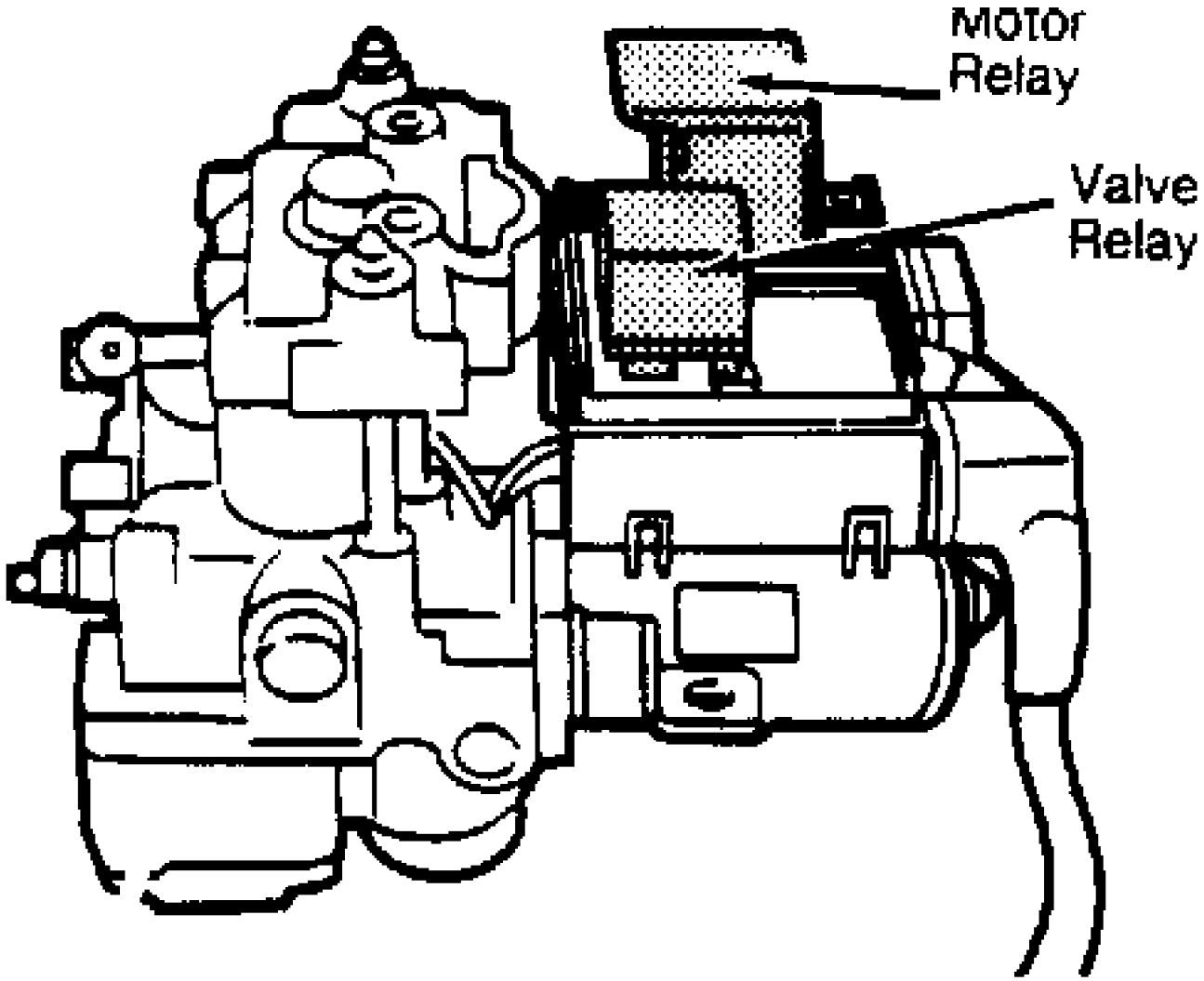

Fig. 1: Locating Motor Relay & Valve Relay
Courtesy of Mazda Motors Corp.

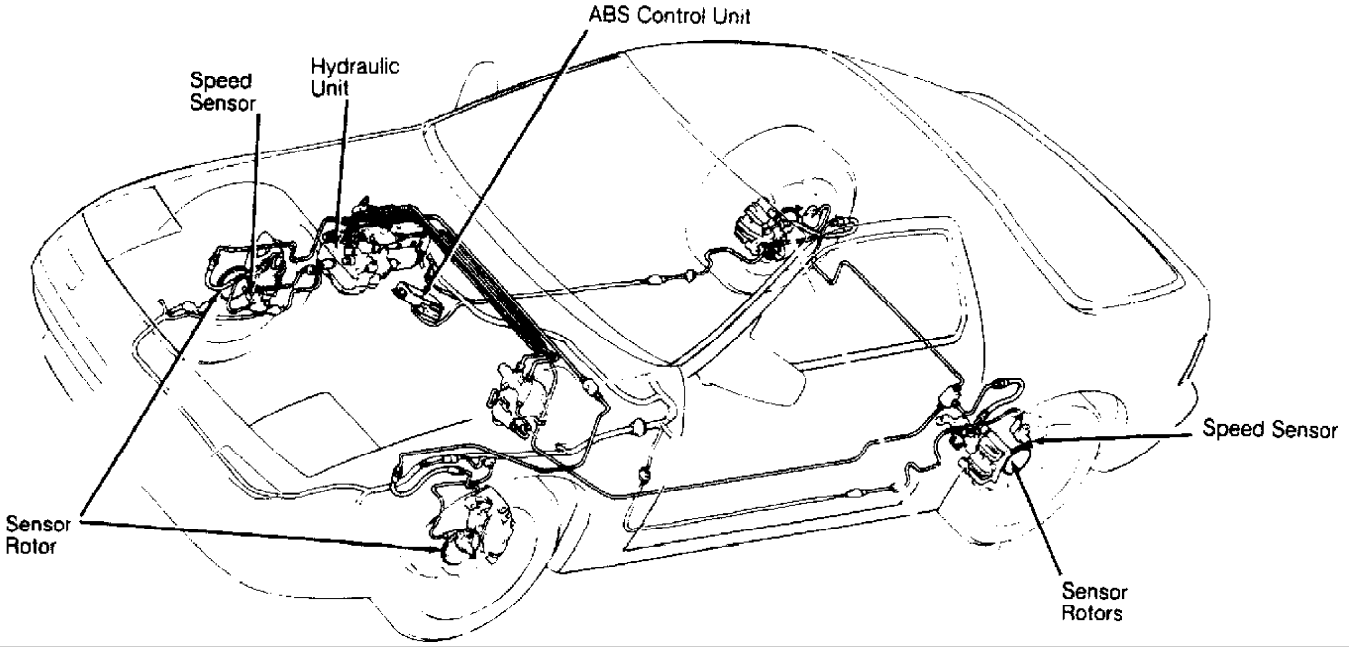

Fig. 2: Locating ABS Components (RX7 Shown; Miata Similar)
Courtesy of Mazda Motors Corp.

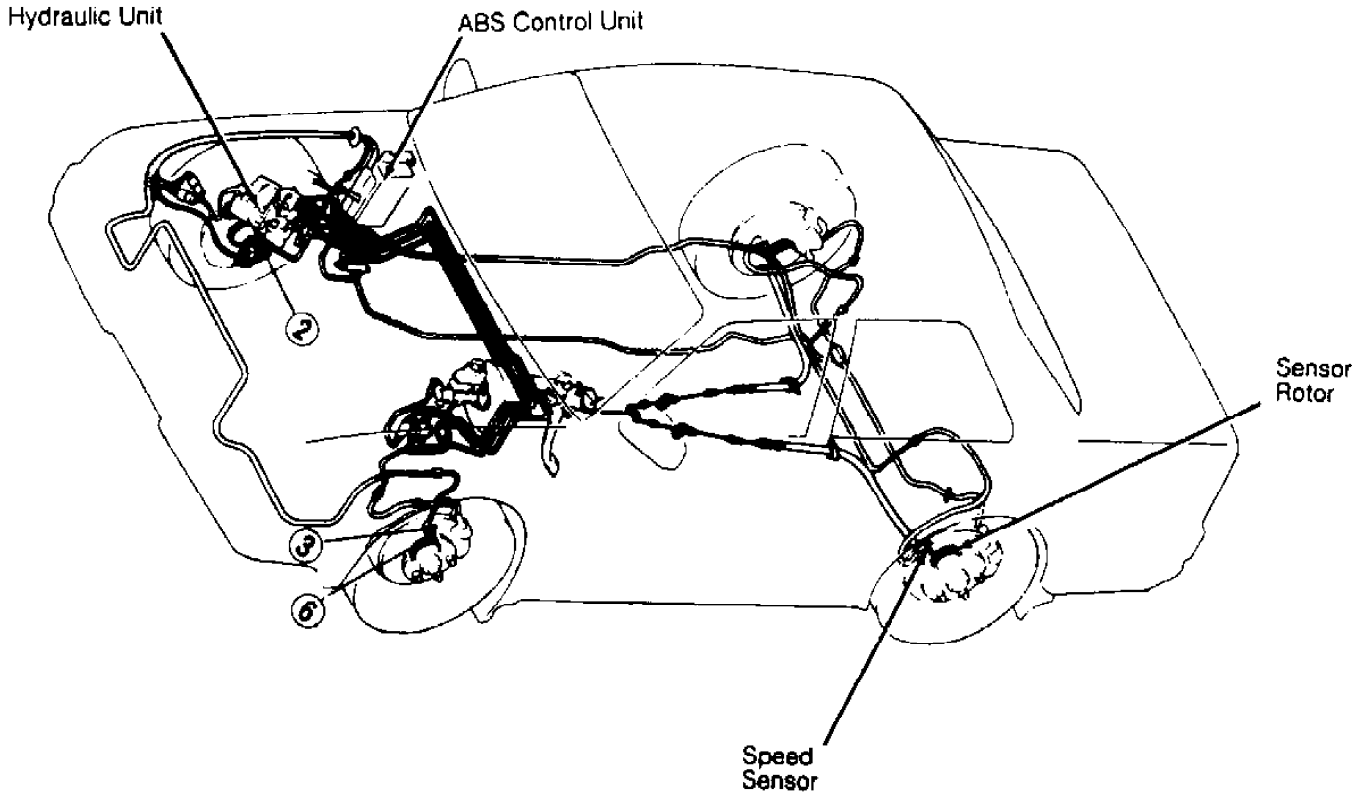

Fig. 3: Locating ABS Components (929)
Courtesy of Mazda Motors Corp.

NOTE: For more information on brake system, see BRAKE SYSTEM article in the BRAKES Section.

OPERATION

Under normal driving conditions, the anti-lock brake system functions as a standard brake system. When vehicle speed reaches 3.8 MPH, the ABS system will diagnose pump motor by briefly operating motor. Pump motor operation may be heard inside vehicle.

The Electronic Control Unit (ECU) controls ABS by detecting speed sensor signals and activating solenoid valve in hydraulic unit. Control unit also controls pump motor and self-diagnostic function. If a problem in the ABS system is detected, ABS system functions as a conventional brake system. The ANTI-LOCK brake warning light will also come on.

With detection of wheel lock-up, short pedal pulsations, occurring in rapid succession, will be felt in brake pedal and steering wheel. Vehicle body may also vibrate slightly. These conditions are normal. Pedal pulsation will continue until there is no longer a need for anti-lock function or until vehicle is stopped.

CAUTION: See ANTI-LOCK BRAKE SAFETY PRECAUTIONS below.

ANTI-LOCK BRAKE SAFETY PRECAUTIONS

WARNING: Refer to appropriate Anti-Lock Brakes (ABS) article for description, operation, depressurizing, testing, system bleeding, trouble shooting and system service. Failure to depressurize ABS could lead to physical injury.

* 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).

BLEEDING BRAKE SYSTEM

NOTE: See BRAKE BLEEDING article in the BRAKES Section.

For ABS hydraulic unit bleeding, see HYDRAULIC UNIT under REMOVAL & INSTALLATION.

BRAKE LINE BLEEDING SEQUENCE TABLE

Application	Sequence
Miata & 929	Longest Line First
RX7 (1)	RR, LR, RF, LF

(1) - If rear caliper has not been disassembled, open upper bleed valve only.

ADJUSTMENTS

PEDAL FREE PLAY

Depress pedal several times to release vacuum. Pedal free play should be .16-.28" (4-7 mm).

PEDAL HEIGHT & STOPLIGHT SWITCH

1) Released pedal height is measured from carpet surface on vertical portion of firewall to pedal pad center. Disconnect stoplight switch. Move switch away from pedal. Adjust brake pedal push rod until correct released pedal height is obtained. See BRAKE PEDAL HEIGHT SPECIFICATIONS TABLE.

2) Adjust pedal free play. See PEDAL FREE PLAY under ADJUSTMENTS. Tighten push rod lock nut. Rotate stoplight switch until it contacts pedal, then rotate an additional 1/2 turn. Tighten stoplight switch lock nut. Reconnect stoplight switch.

3) The applied pedal height is measured from angled portion of firewall (without carpet) to pedal pad center. Start engine. Depress brake pedal with 132-lb. (60 kg) pressure.

4) Measure the applied pedal height. If distance is not as specified, check brake adjustment, or check for air in system. See BRAKE PEDAL HEIGHT SPECIFICATIONS TABLE.

BRAKE PEDAL HEIGHT SPECIFICATIONS TABLE

Application	In. (mm)
Pedal Released	
Miata & 929	6.7-7.1 (171-181)
RX7	7.2-7.4 (184-189)
Pedal Applied (1)	
Miata & 929	3.7 (95)
RX7	3.9 (100)

(1) - Minimum height.

DIAGNOSIS

ABS system can only be diagnosed using ABS Tester (0000-42-

0010). See Fig. 13. An Adapter Harness (49N0-66-001) is also required to test Miata ABS system. ABS tester cannot diagnose ABS control unit. If a malfunction is detected in ABS and all other components in brake system are okay, replace ABS control unit.

If ABS tester is unavailable, test each component of ABS. See test procedures under TESTING. If all ABS components test okay, replace control unit with a known good unit, and retest system for correct operation.

PRE-DIAGNOSIS INSPECTION

Perform a visual inspection of ABS components that could cause anti-lock problem. Visual inspection may help identify cause of simple problem.

DIAGNOSTIC PROCEDURE WITH ABS TESTER

ABS tester uses one display window and 2 switches for reading information from unit. Become thoroughly familiar with ABS tester displays and operation before proceeding. See Fig. 13. To diagnose ABS system, go to TESTING SEQUENCE charts under DIAGNOSING ABS SYSTEM. When diagnosing ABS system, complete tests in order given under TESTING SEQUENCE. If ABS tester does not operate, check fuses, ignition switch and ignition circuit.

TESTING

NOTE: Before testing ABS components, ensure battery and charging system are functioning properly. To prevent damage to ABS control unit connector, use very thin pins when probing connector.

ABS DIODE

Continuity Test

1) Unplug hydraulic unit 12-pin connector. On Miata, connect positive lead of DVOM to Blue/Yellow wire terminal and negative lead to Gray wire terminal of hydraulic unit. On RX7, connect positive lead of DVOM to Red wire terminal and negative lead to Yellow/Red wire terminal of hydraulic unit.

2) On 929, connect positive lead of DVOM to Violet wire terminal and negative lead to Yellow/Red wire terminal of hydraulic unit. Ensure continuity is present between terminals. Reverse DVOM leads. Continuity should not be present with leads reversed. If ABS diode does not test as described, replace ABS diode.

ABS SYSTEM GROUND

Continuity Test (Miata)

Using a DVOM, check for continuity between terminals "D", "S", and "f" of control unit harness connector and ground. See Fig. 4 or 5. If continuity is not present, repair harness.

Continuity Test (RX7 & 929)

Use DVOM to check continuity. ON RX7, check between control unit harness connector terminal "D" and JC-02 connector. See Figs. 4 and 6 or 5 and 7. On 929, check between control unit harness connector terminal "T" and JC-02 connector. If continuity is not present, repair harness.

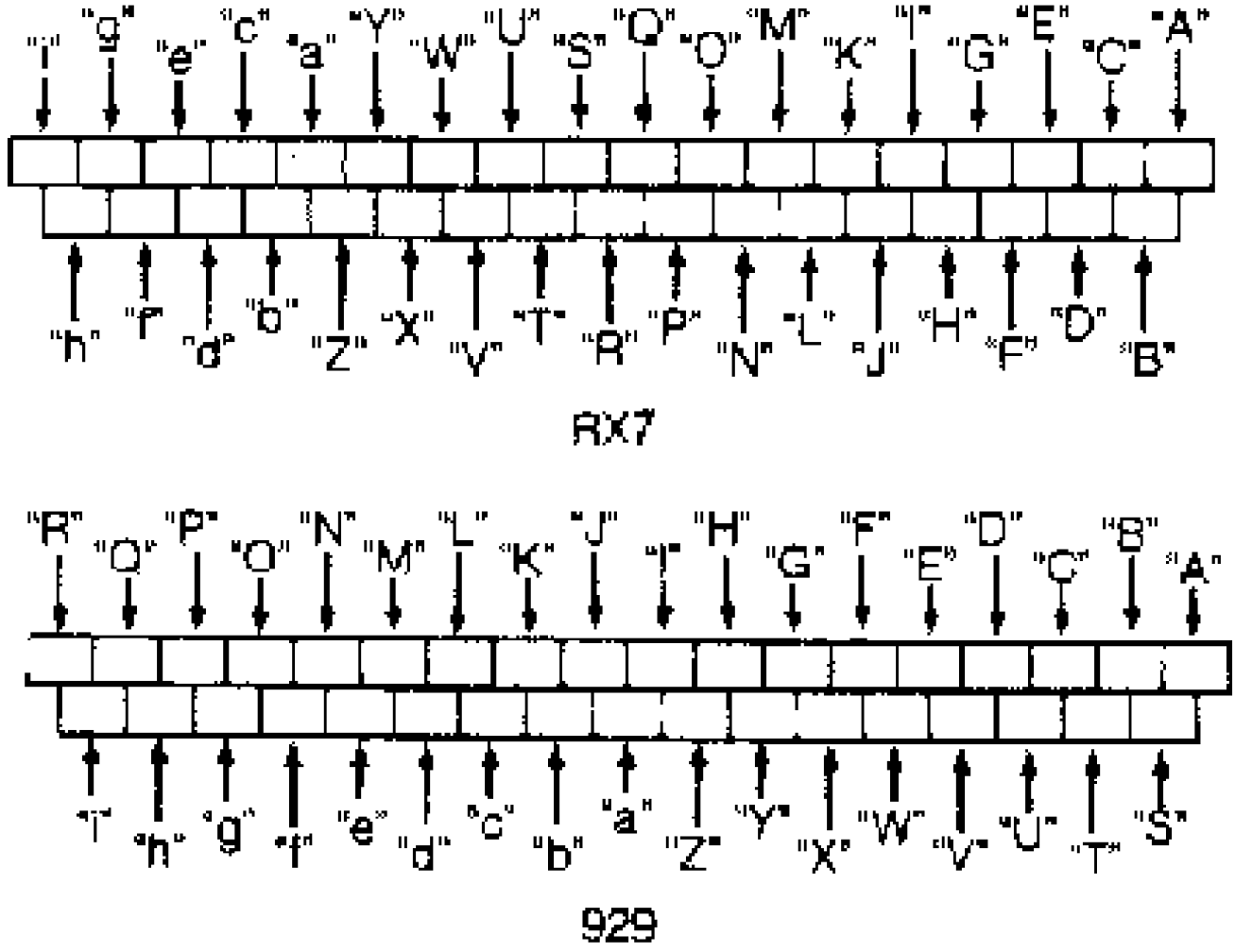

Fig. 4: Identifying Control Unit Harness Connector Terminals
Courtesy of Mazda Motors Corp.

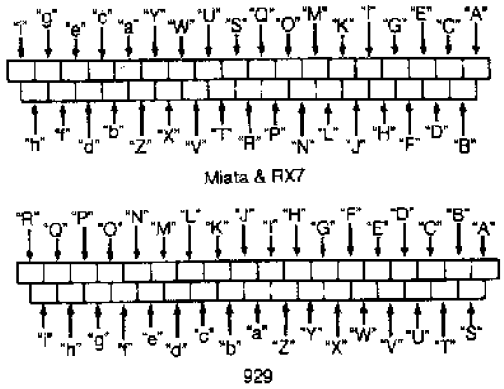

Fig. 5: Identifying Control Unit Harness Connector Terminals
Courtesy of Mazda Motors Corp.

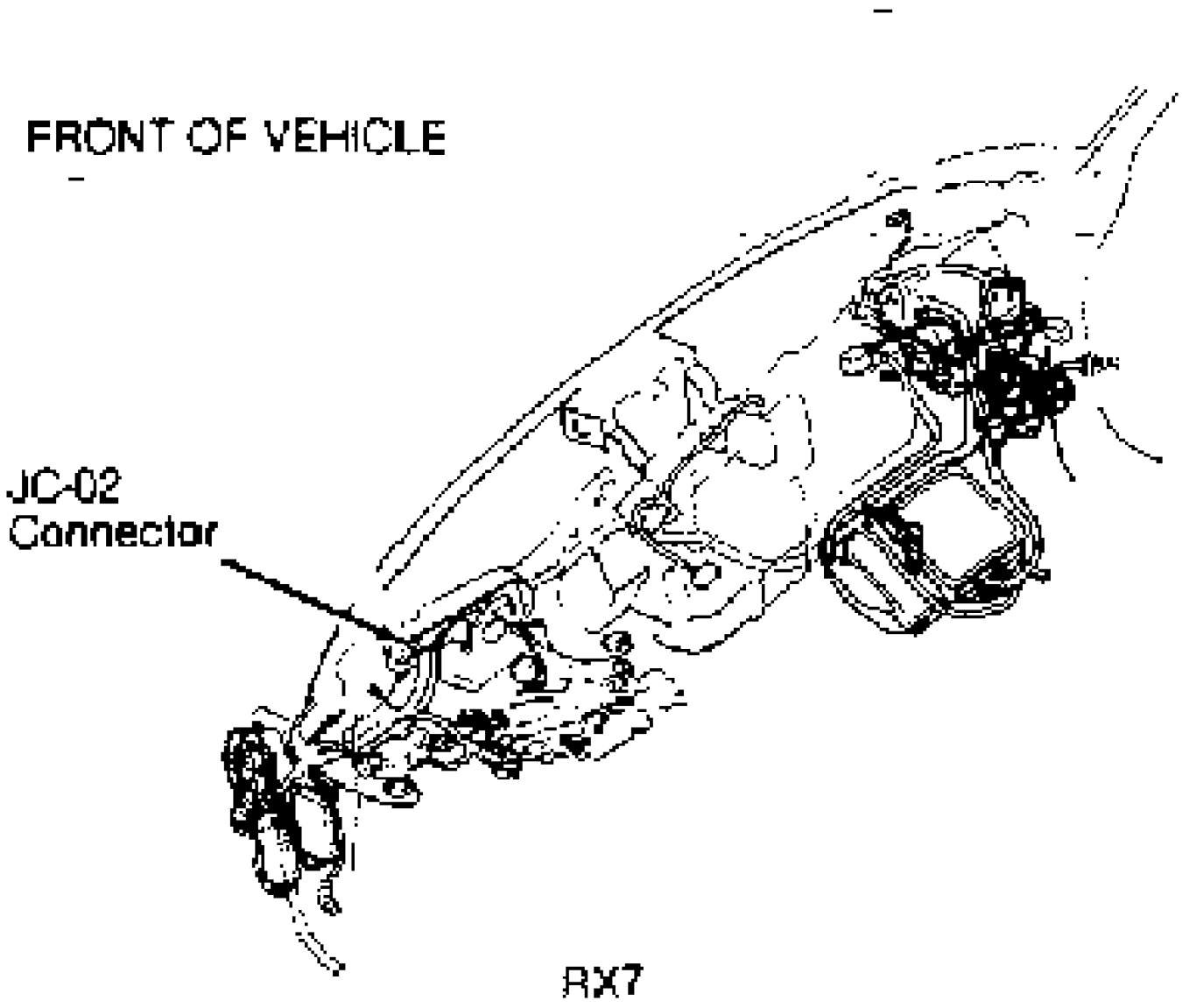

Fig. 6: Locating JC-02 Connector
Courtesy of Mazda Motors Corp.

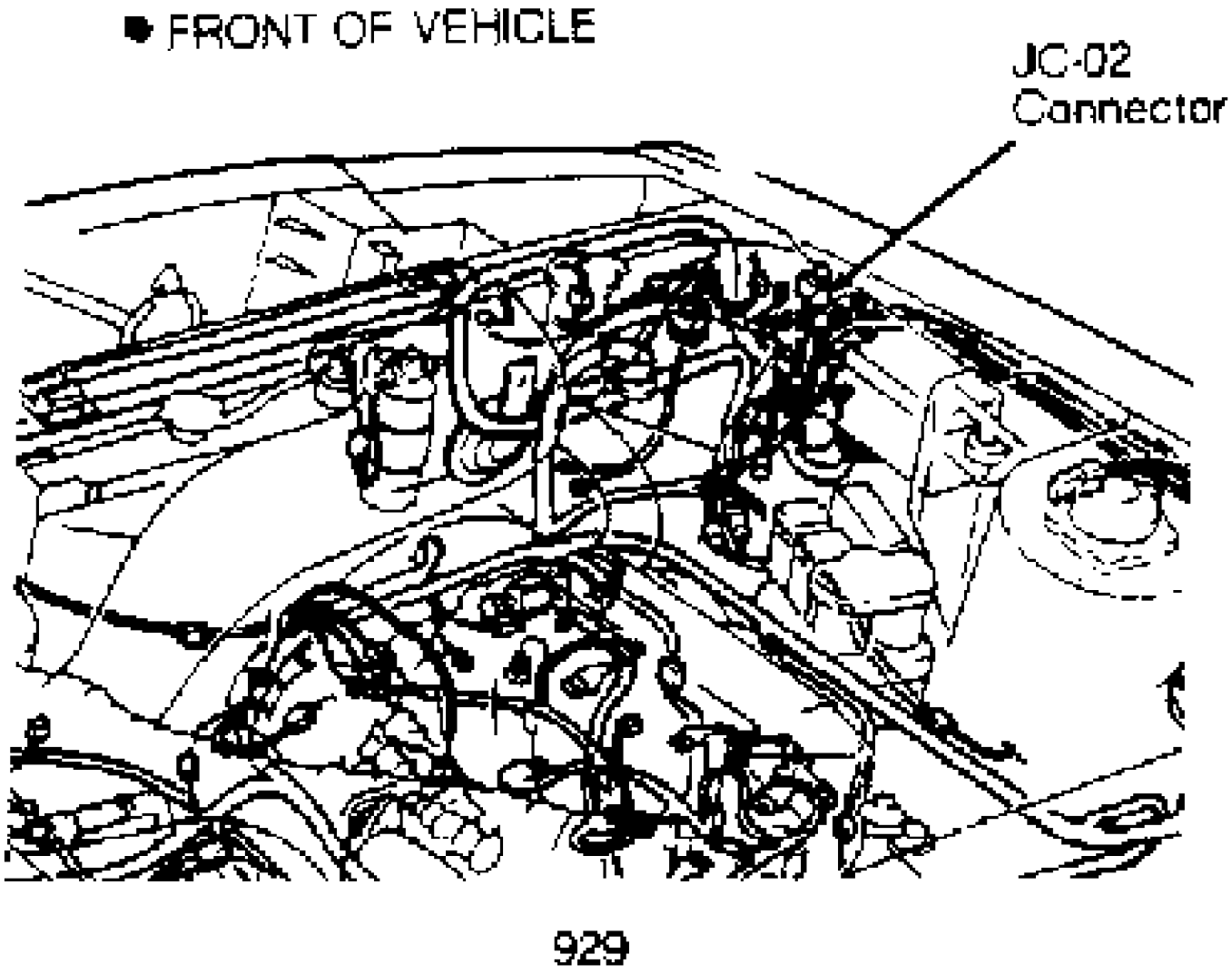

Fig. 7: Locating JC-02 Connector
Courtesy of Mazda Motors Corp.

ANTI-LOCK WARNING LIGHT

Operational Test (Miata)

1) Start engine, and observe ANTI-LOCK light. Light should illuminate for a few seconds. If light does not illuminate as described, remove instrument cluster. Connect 12 volts to terminal 2k

of instrument cluster. See Fig. 8. Using a jumper wire, connect terminal 1K of instrument cluster to ground. ANTI-LOCK light should illuminate. If light does not illuminate, check bulb. If bulb is okay, check meter fuse and wiring harness.

2) Install instrument cluster, and recheck warning light operation. If light still does not illuminate for a few seconds, check wiring harness between ANTI-LOCK light and control unit and between ANTI-LOCK light and hydraulic unit. Check operation of hydraulic unit valve relay.

Operational Test (RX7)

1) Start engine, and observe ANTI-LOCK light. Light should illuminate for a few seconds. If light does not illuminate as described, remove clock and bezel assembly from dashboard. Slide warning and clock unit from instrument panel. Connect terminal "E" to ground. See Fig. 9. ANTI-LOCK light should illuminate. If light does not illuminate, check bulb. If bulb is okay, check meter fuse and wiring harness.

2) Install instrument cluster, and recheck warning light operation. If light still does not illuminate for a few seconds, check wiring harness between ANTI-LOCK light and control unit, and ANTI-LOCK light and hydraulic unit. Check operation of hydraulic unit valve relay.

Operational Test (929)

1) Start engine, and observe ANTI-LOCK light. Light should illuminate for a few seconds. If light does not illuminate as described, remove instrument cluster. Connect 12 volts to terminal "J" of instrument cluster connector I-06. See Fig. 10. Using a jumper wire, connect terminal "E" of instrument cluster connector I-08 to negative ground. ANTI-LOCK light should illuminate. If light does not illuminate, check bulb. If bulb is okay, check meter fuse and wiring harness.

2) Install instrument cluster, and recheck warning light operation. If light still does not illuminate for a few seconds, check wiring harness between ANTI-LOCK light and control unit and between ANTI-LOCK light and hydraulic unit. Check operation of hydraulic unit valve relay.

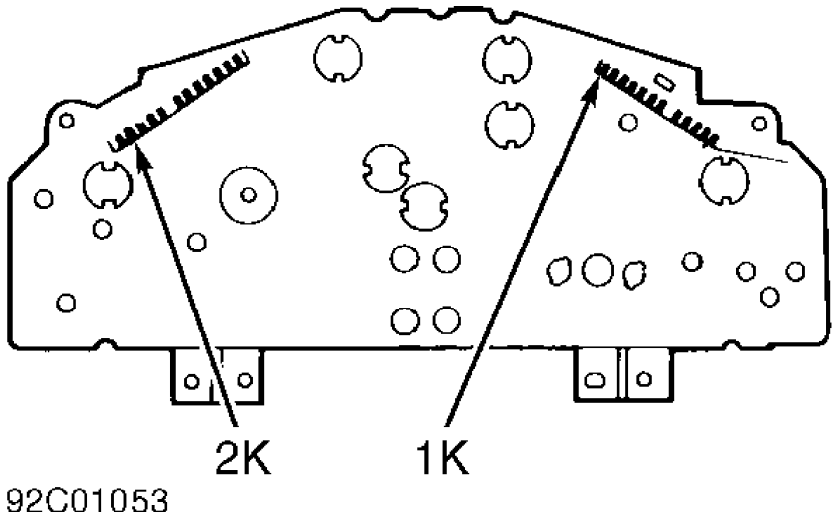

Fig. 8: Testing ANTI-LOCK Warning Light (Miata)
Courtesy of Mazda Motors Corp.

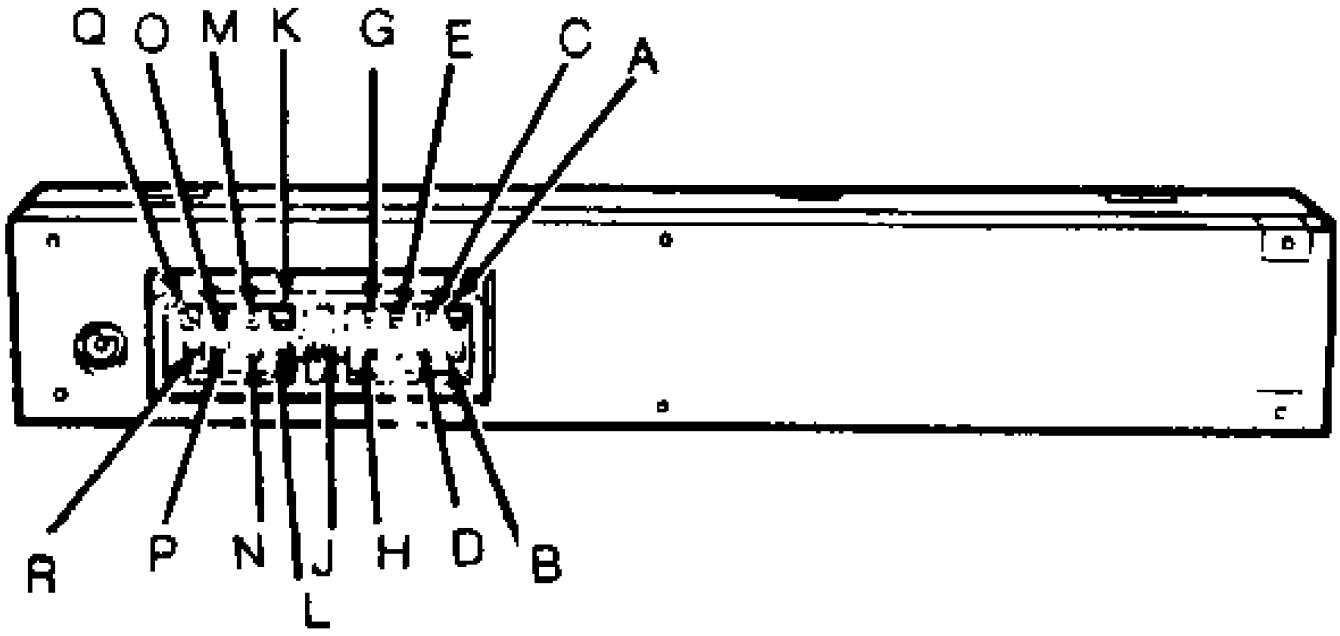

Fig. 9: Testing ANTI-LOCK Warning Light (RX7)
Courtesy of Mazda Motors Corp.

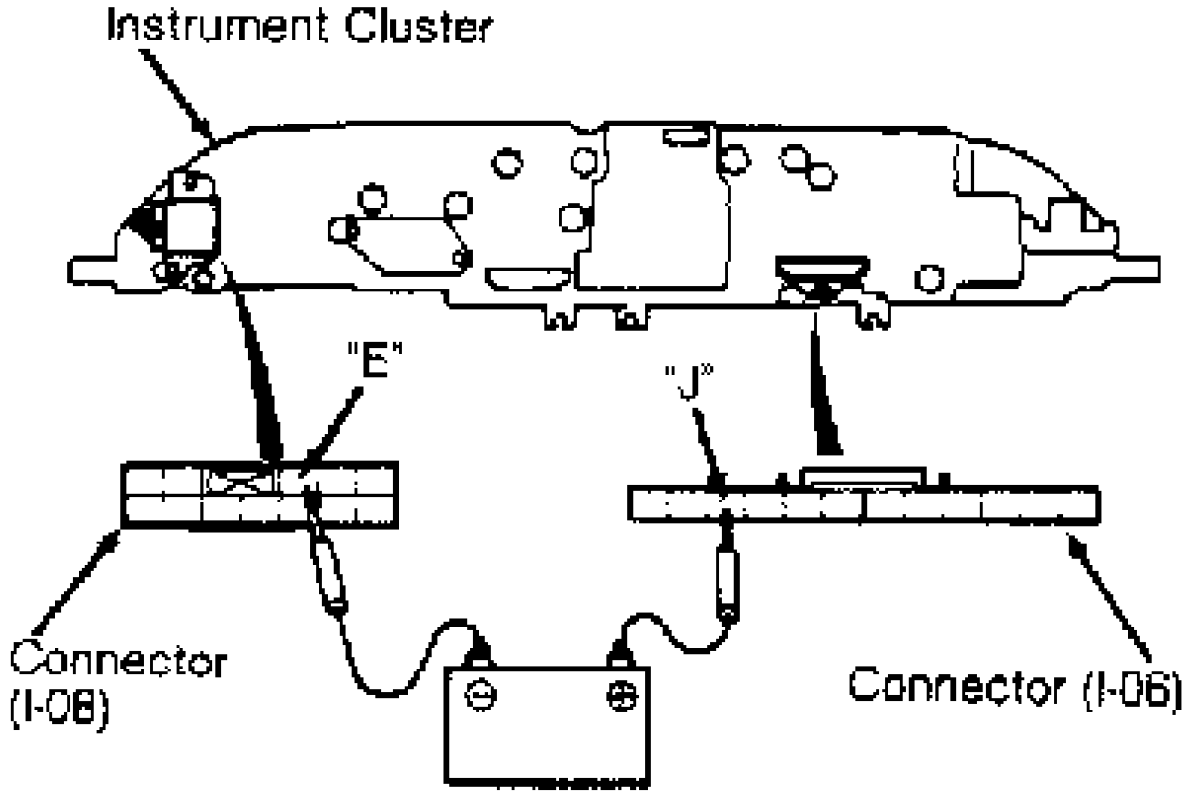

Fig. 10: Testing ANTI-LOCK Warning Light (929)
Courtesy of Mazda Motors Corp.

STOPLIGHT SWITCH

Continuity Test

Disconnect stoplight switch connector. Using a DVOM, check continuity between Green or Green/White wire and White/Green wire with brake pedal depressed. Ensure continuity exists. Release pedal, and note reading on DVOM. Continuity should not be present. If continuity is not as specified, replace switch.

FRONT & REAR VALVES

Resistance Test (Miata)

1) Disconnect hydraulic unit 12-pin connector. Using a DVOM, measure resistance between the following wires: Yellow/Green wire and Black wire; Brown wire and Black wire; Black/White wire and Black wire. Resistance should be 1-1.2 ohms in each measurement.

2) If resistance is not as specified, replace hydraulic unit. If resistance is as specified, check wiring harness between ABS control unit and hydraulic unit.

Resistance Test (RX7 & 929)

1) Disconnect hydraulic unit 12-pin connector. Using a DVOM, measure resistance between Green/Black and Yellow/Red wires, Green/White and Yellow/Red wires and Yellow and Yellow/Red wires. Resistance should be 1-1.2 ohms in each measurement.

2) If resistance if not as specified, replace hydraulic unit. If resistance is as specified, check wiring harness between ABS control unit and hydraulic unit.

HYDRAULIC UNIT

Only serviceable parts of hydraulic unit are motor relay and valve relay. If other parts of unit malfunction, replace hydraulic unit assembly.

MOTOR RELAY

Continuity Tests

1) Disconnect negative battery cable. Remove motor relay from hydraulic unit. Ensure continuity exists between terminals "B" and "C" of motor relay. See Fig. 11. Connect 12 volts to terminal "C", and ground terminal "B". Ensure continuity exists between terminals "A" and "D".

2) Replace relay if continuity is not as specified. If continuity is as specified, check wiring harness between motor relay and ABS control unit fuse (60 amps).

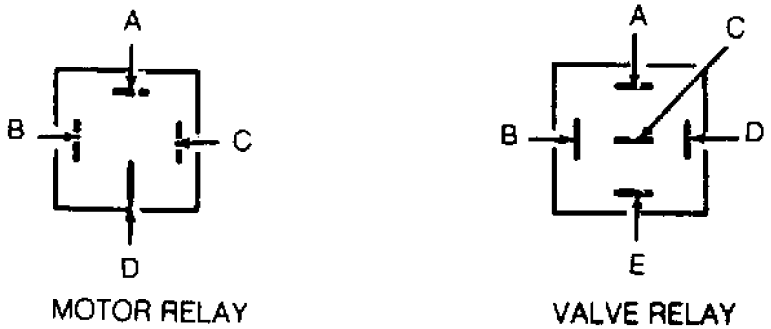

Fig. 11: Identifying Motor & Valve Relay Terminals
Courtesy of Mazda Motors Corp.

PUMP MOTOR

Continuity Test (Miata)

Disconnect 2-pin connector at hydraulic unit. Check continuity at hydraulic control between Red/Yellow wire terminal and ground. If continuity is not present, replace hydraulic control unit. If continuity is present, pump is okay. Check wiring between hydraulic control and ABS control unit.

Continuity Test (RX7 & 929)

1) Disconnect 12-pin hydraulic unit connector. Using a DVOM, check continuity between Black wire and ground. If there is continuity, check continuity between Black wire terminal at hydraulic unit connector and Green wire terminal at 2-pin hydraulic unit connector.

2) If continuity exists, connect hydraulic unit connectors. If continuity is not present, replace wiring harness between control unit and body ground.

3) Disconnect ABS control unit connector. Check continuity between Green wire of ABS control unit harness connector and ground. If continuity is present, check for poor connection of ABS control unit connector or faulty ABS control unit. If continuity is not present, repair open circuit.

VALVE RELAY

Continuity Tests

1) Disconnect negative battery cable. Remove valve relay from hydraulic unit. Using a DVOM, check continuity between relay terminals "C" and "E" and between terminals "B" and "D". See Fig. 11.

2) Ensure continuity exists. Connect 12 volts to terminal "B", and ground terminal "D". Check continuity between terminals "A" and "E". Ensure continuity exists. If continuity is not as specified, replace valve relay.

WHEEL SPEED SENSORS

Sensor Resistance Test

Disconnect speed sensor connector. Using a DVOM, measure resistance between sensor terminals. Resistance should be 800-1200 ohms. If resistance is not as specified, replace speed sensor.

Harness Continuity & Voltage Tests

1) With ignition off and speed sensors connected, disconnect ABS control unit connector. Using a DVOM, check continuity between indicated terminals of ABS control unit harness connector. See WHEEL SPEED SENSOR TESTS TABLE.

2) If reading on DVOM is not 800-1200 ohms, check wiring harness between wheel speed sensor and ABS control unit. If DVOM reading is 800-1200 ohms, check voltage between indicated terminals in WHEEL SPEED SENSOR TESTS TABLE.

3) Turn ignition on. Rotate appropriate wheel one revolution per second by hand to check voltage. If DVOM does not indicate 50-60 millivolts, replace wheel speed sensor.

WHEEL SPEED SENSOR TESTS TABLE

Application	(1) Test Between Control Unit Connector Terminals
Miata	
Left Front	"K" & "G"
Left Rear	"O" & "Q"
Right Front	"U" & "F"
Right Rear	"L" & "P"

RX7	
Left Front	"D" & "F"
Left Rear	"H" & "I"
Right Front	"U" & "W"
Right Rear	"X" & "Z"
929	
Left Front	"K" & "G"
Left Rear	"O" & "Q"
Right Front	"J" & "F"
Right Rear	"L" & "P"

(1) - See Fig. 4 or 5 to identify ABS control unit terminals.

WHEEL SPEED SENSOR ROTORS

Inspection

Perform a comprehensive visual inspection of sensor rotor. If any damage is noted, replace sensor rotor. Sensor rotors are attached to wheel hubs.

REMOVAL & INSTALLATION

HYDRAULIC UNIT

Removal

Remove hydraulic lines from unit. Disconnect hydraulic unit connectors. Remove nuts securing unit. Remove hydraulic unit.

Bleeding Hydraulic Unit

Before bleeding hydraulic unit, bleed brake system in appropriate sequence. See BRAKE LINE BLEEDING SEQUENCE TABLE under BLEEDING BRAKE SYSTEM. Bleed hydraulic unit by opening bleeder screw on unit. See Fig. 12.

Installation

To install, reverse removal procedure. Tighten mounting bolts to specification. See TORQUE SPECIFICATIONS TABLE at end of article.

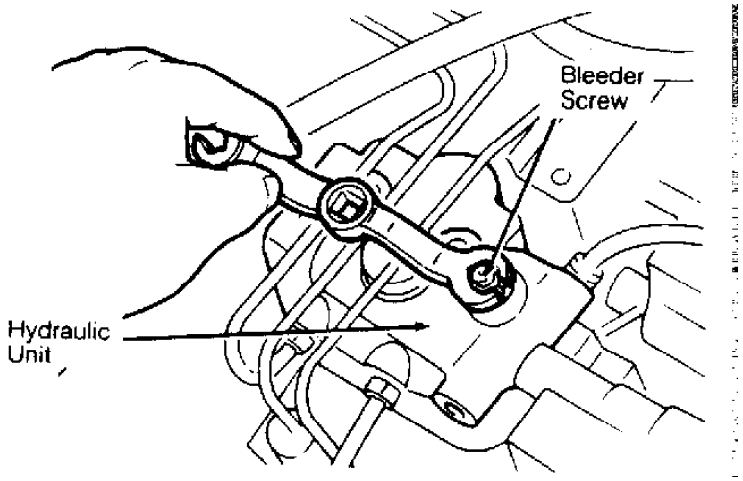

Fig. 12: Locating Hydraulic Unit Bleeder Screw
Courtesy of Mazda Motors Corp.

WHEEL SPEED SENSOR ROTOR

Removal (Miata)

Remove brake caliper. Remove wheel hub. On rear axle, carefully remove sensor rotor from axle using a chisel. On front rotor, remove sensor rotor using Puller (49- 0839-425C).

Installation

Press sensor rotor onto axle using Installer (49- H026-101A). Install sensor rotor on front rotor with chamfered edge toward hub using Press Adapter (49-F001-95). To complete installation, reverse removal procedure. Tighten mounting bolts to specification. See TORQUE SPECIFICATIONS TABLE at end of article.

Removal & Installation (RX7)

Remove brake caliper and wheel hub. On rear hub, remove wheel hub from outer toe control hub using Puller (49-F026-103) and Installer (49-F026-102). On front rotor, remove rotor-to-hub bolts using Allen wrench. On rear rotor, remove rotor-to-hub screws. To install, reverse removal procedure. Tighten mounting bolts to specification. See TORQUE SPECIFICATIONS TABLE at end of article.

Removal & Installation (929)

Remove brake caliper and wheel hub. On rear axle, carefully remove sensor rotor from axle using chisel. On front rotor, remove sensor rotor using Puller (49-0839-425C). To install, press sensor rotors onto axle and front rotor using Installer (49-H026-101A). On front rotor, install sensor rotor with chamfered edge toward hub. To complete installation, reverse removal procedure. Tighten mounting bolts to specification. See TORQUE SPECIFICATIONS TABLE at end of article.

WHEEL SPEED SENSOR

Removal & Installation

Unplug wheel sensor connector. Remove sensor bolt. Remove wheel sensor from vehicle. To install, reverse removal procedure. On RX7, adjust wheel sensor so clearance between sensor and rotor is .016-.039" (.40-1.0 mm). Tighten mounting bolts to specification. See TORQUE SPECIFICATIONS TABLE at end of article.

DIAGNOSING ABS SYSTEM

ABS TESTER OPERATION

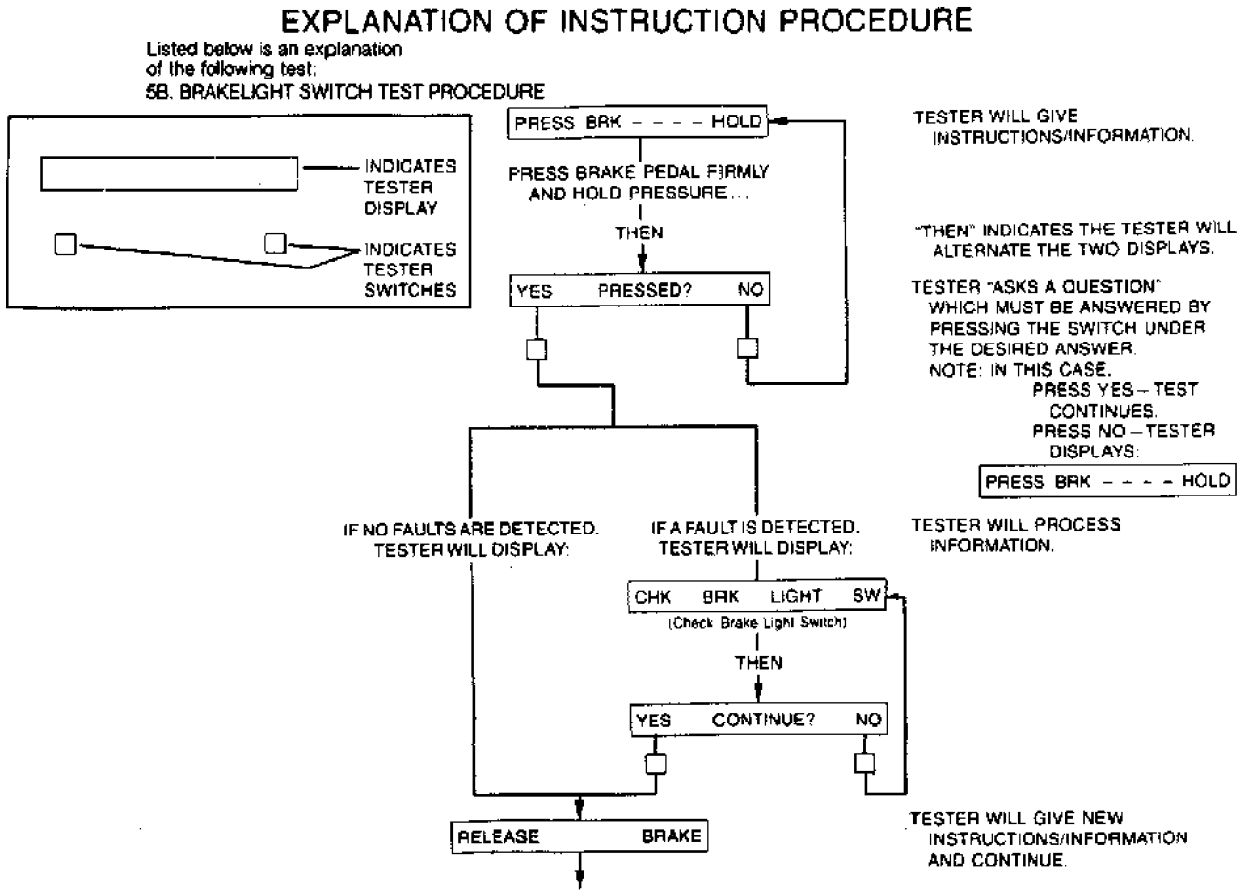

Fig. 13: Operating ABS Tester
Courtesy of Mazda Motors Corp.

TESTING SEQUENCE

TEST 1. CONNECTION POWER UP

CONNECTION/POWER-UP
1) Locate ABS Control Unit.
2) Disconnect Control Unit Harness from Control Unit.
3) Connect ABS Tester Harness to Control Unit Harness Connector.
4) Turn Ignition Key to "ON" position.

TEST 2 ALTERNATOR TEST

ALTERNATOR TEST START ENGINE (ALTERNATOR TESTED BY RUNNING ENGINE)
Tester will rapidly display several messages during an Initial Segment Check.

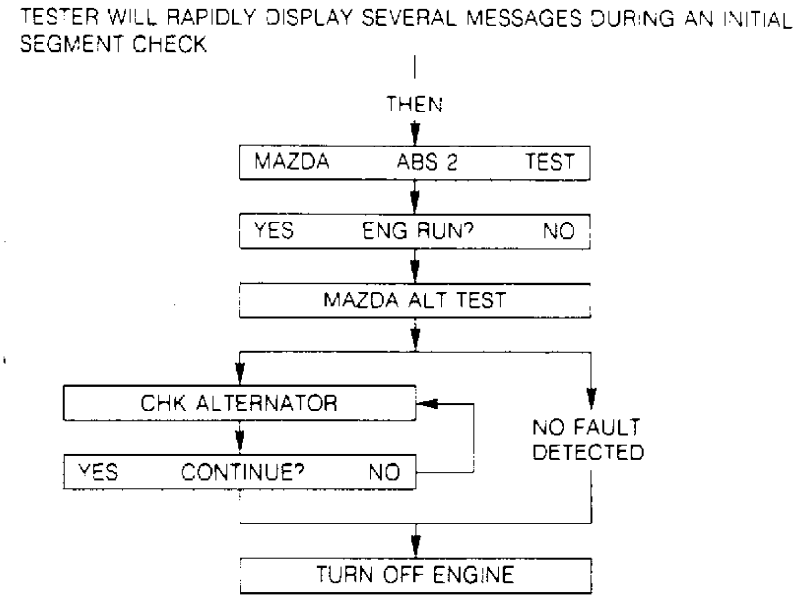

Fig. 14: Test 2 Alternator Test
Courtesy of Mazda Motors Corp.

TEST 3 ABS SYSTEM TEST

ABS SYSTEM TEST TURN IGNITION KEY ON (DO NOT RUN ENGINE
Tester will rapidly display several messages during an Initial Segment Check.

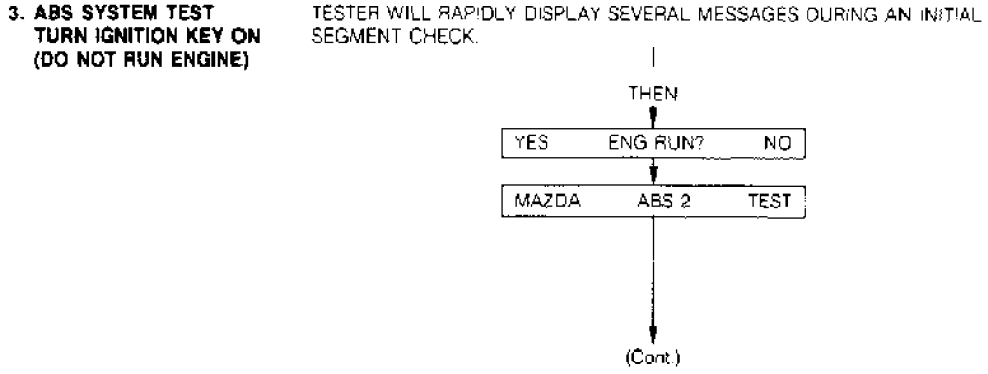

Fig. 15: Test 3 ABS System Test
Courtesy of Mazda Motors Corp.

TEST 4 SYSTEM VOLTAGE TEST

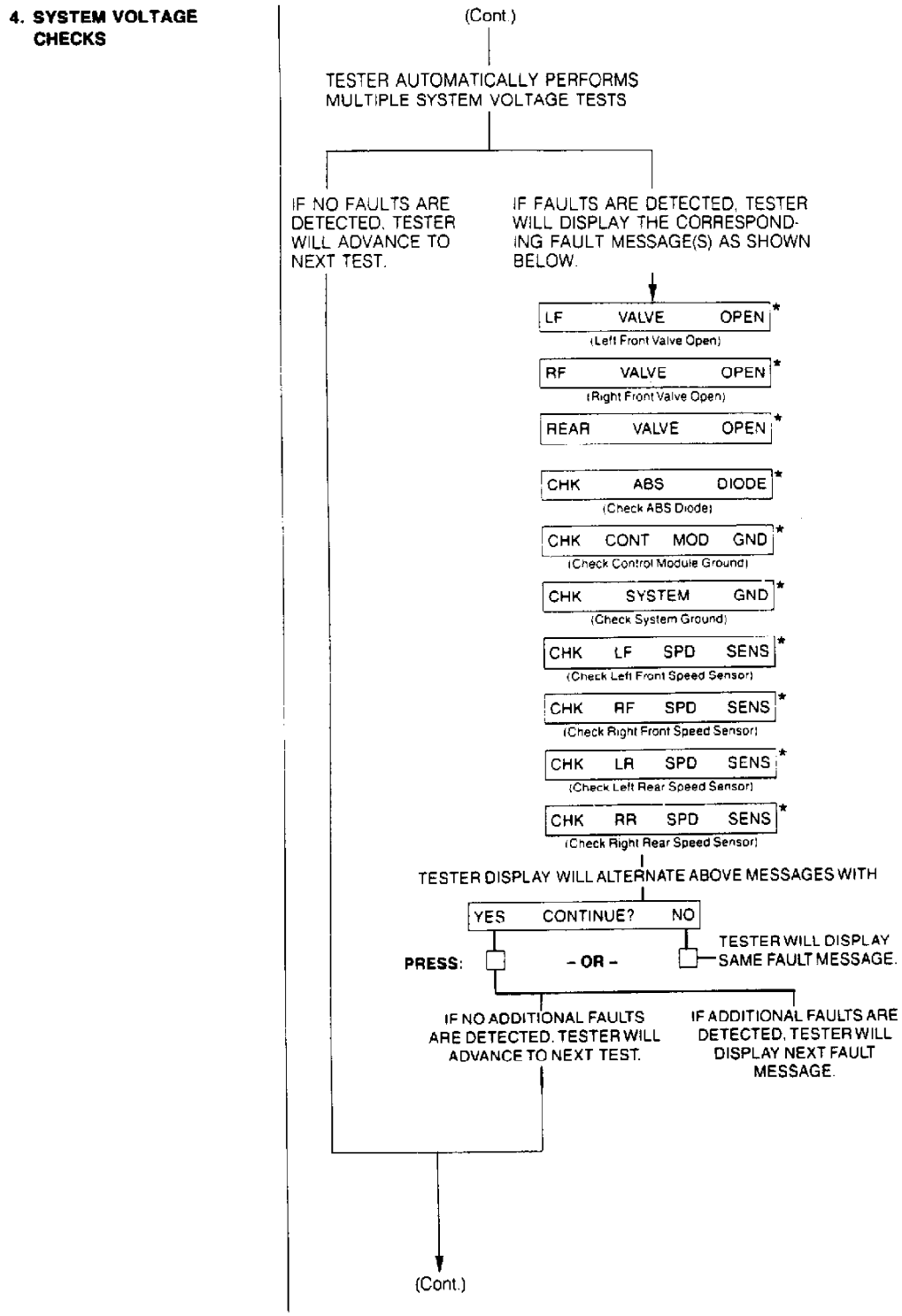

Fig. 16: Test 4 System Voltage Test
Courtesy of Mazda Motors Corp.

Test 5A. ANTI-LOCK LIGHT TEST

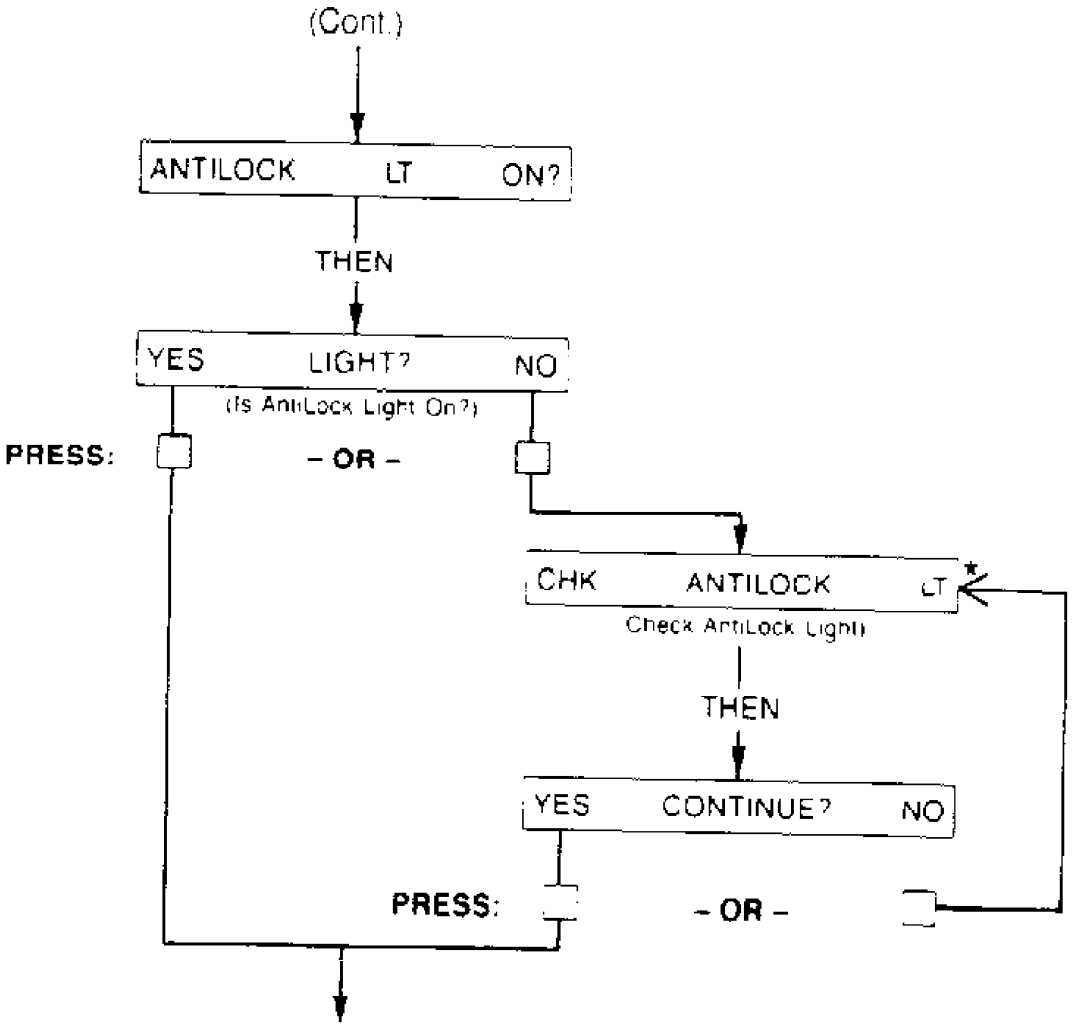

Fig. 17: Test 5A. Anti-Lock Light Test
Courtesy of Mazda Motors Corp.

Test 5B. BRAKE LIGHT SWITCH TEST

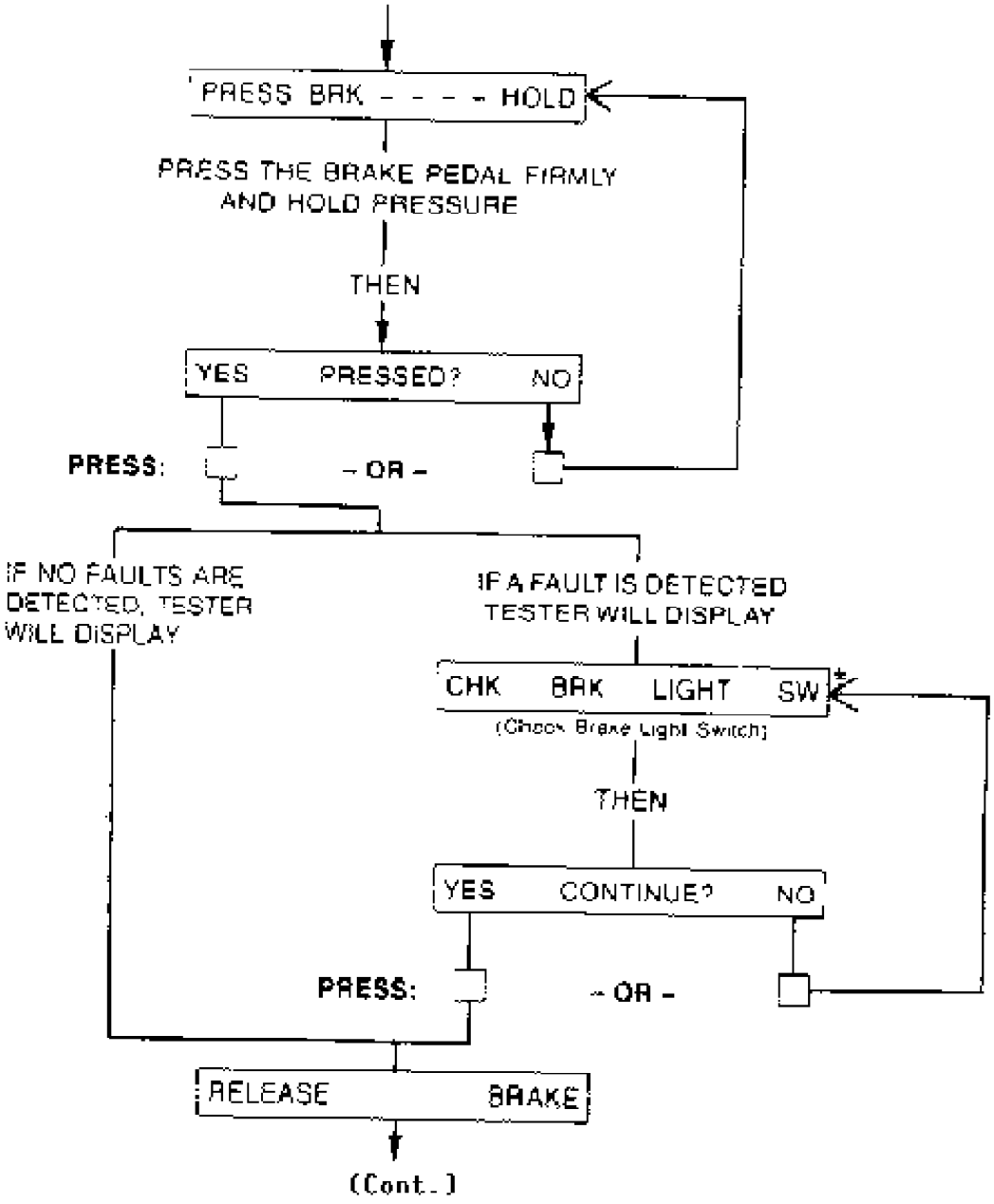

Fig. 18: Test 5B. Brake Light Switch Test
Courtesy of Mazda Motors Corp.

Test 5C. PUMP TEST

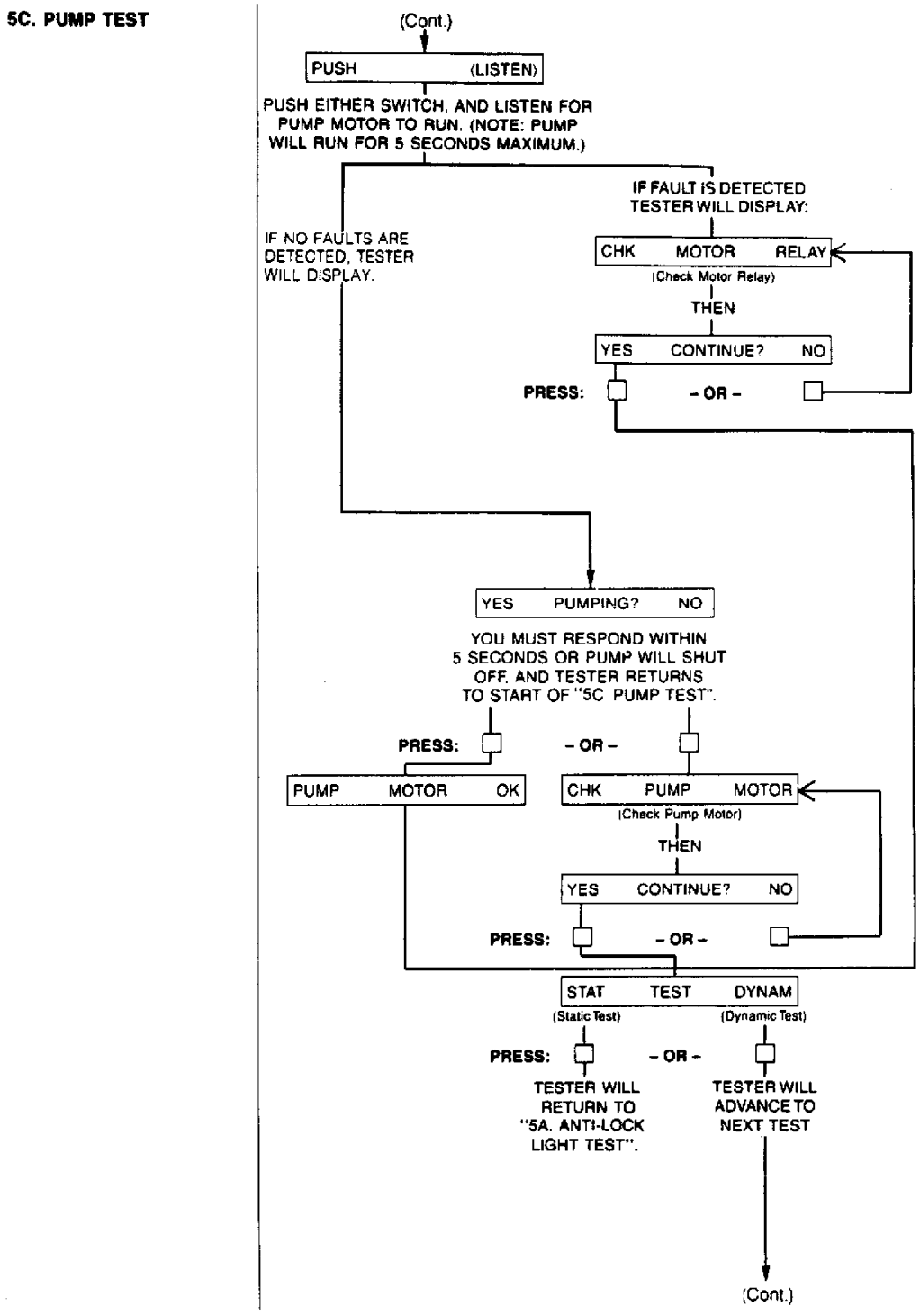

Fig. 19: Test 5C. Pump Test
Courtesy of Mazda Motors Corp.

6A. DYNAMIC WHEEL SELECTION TEST OR EXIT

WHEEL SELECTION TEST

These three messages will alternate on the dispaly screen at 3 1/2 second intervals. Now, select one of the four wheels to begin the dynamic test sequence.

EXIT

Press either switch under "PUSH TO EXIT" Display to return to "STAT TEST DYNAM" Selection.

IMPORTANT: When entering the dynamic test sequence, you will select one of four wheels to begin. When you have finished with that wheel test, you should return to 6A. WHEEL SELECTION TEST to select another wheel, and repeat these test procedures for all four wheels

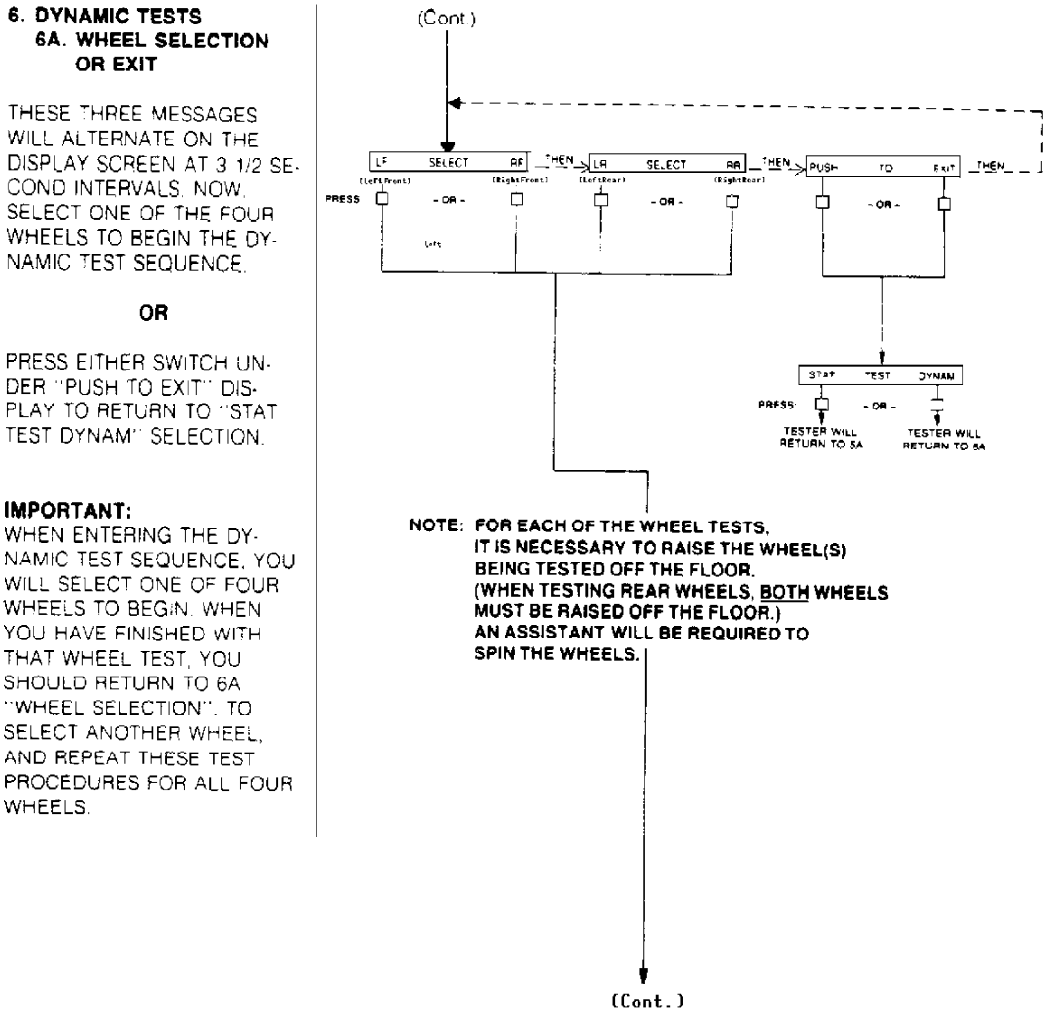

Fig. 20: 6A. Dynamic Wheel Selection Test
Courtesy of Mazda Motors Corp.

6B. DYNAMIC WHEEL SENSOR TEST

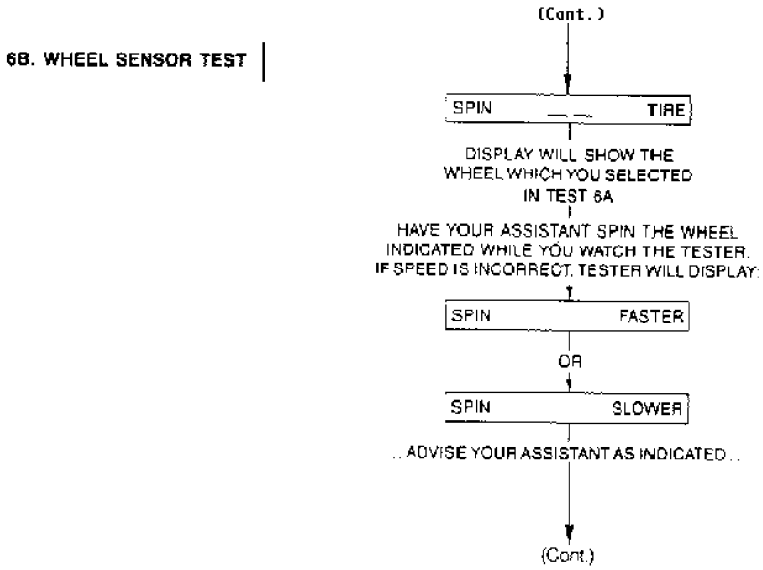

Fig. 21: 6B. Dynamic Wheel Sensor Test (1 of 2)
Courtesy of Mazda Motors Corp.

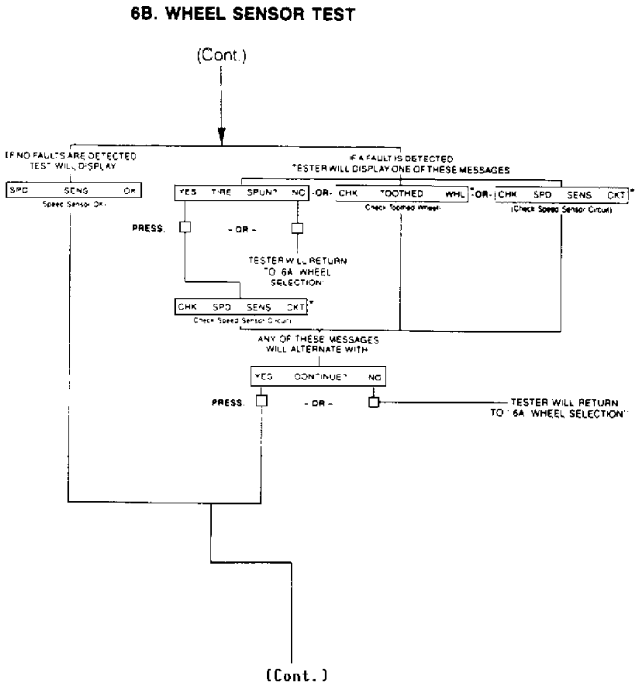

Fig. 22: 6B. Dynamic Wheel Sensor Test (2 of 2)
Courtesy of Mazda Motors Corp.

6C. SOLENOID TEST

6C. SOLENOID TEST

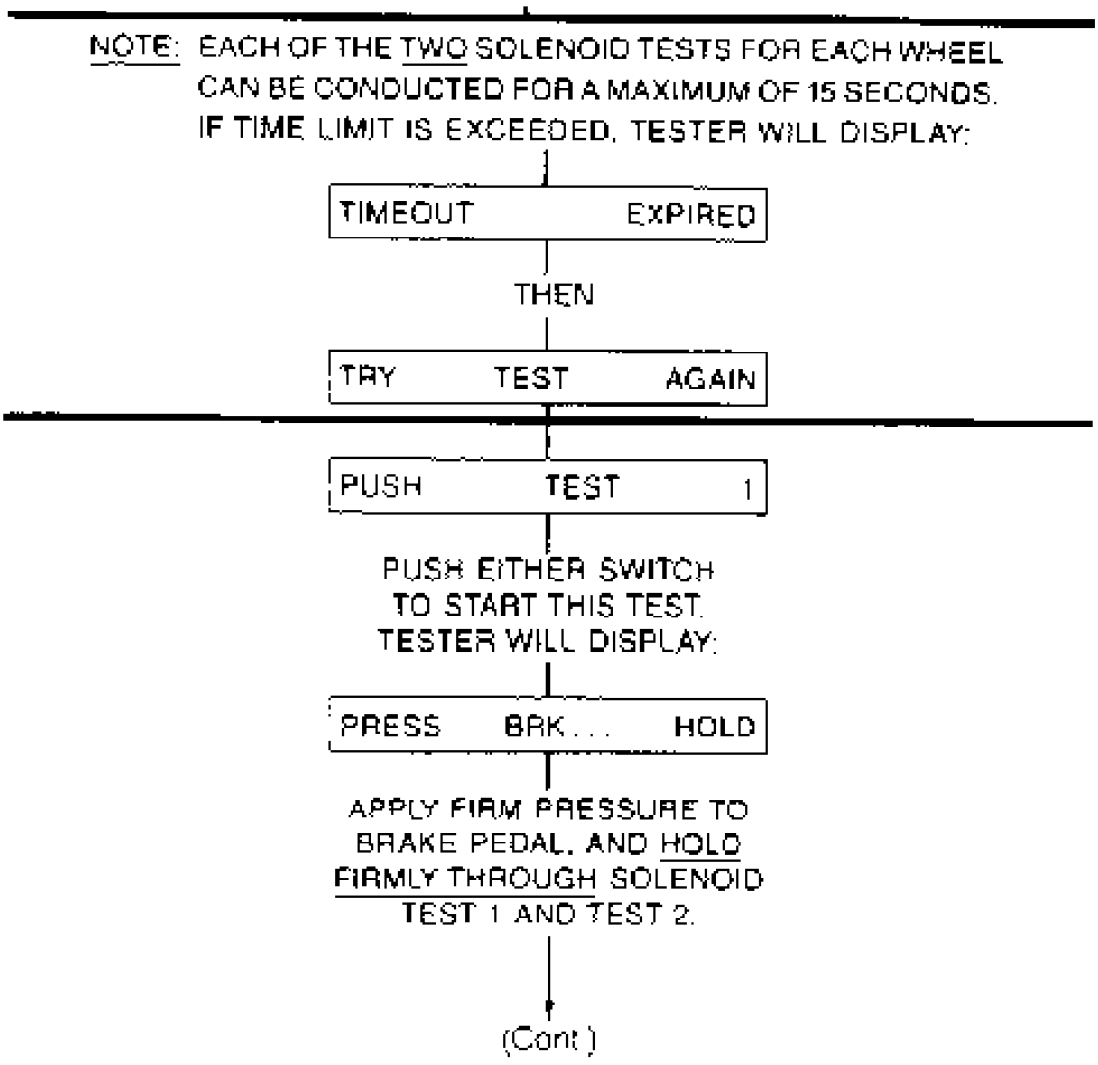

Fig. 23: 6C. Solenoid Test (1 of 4)
Courtesy of Mazda Motors Corp.

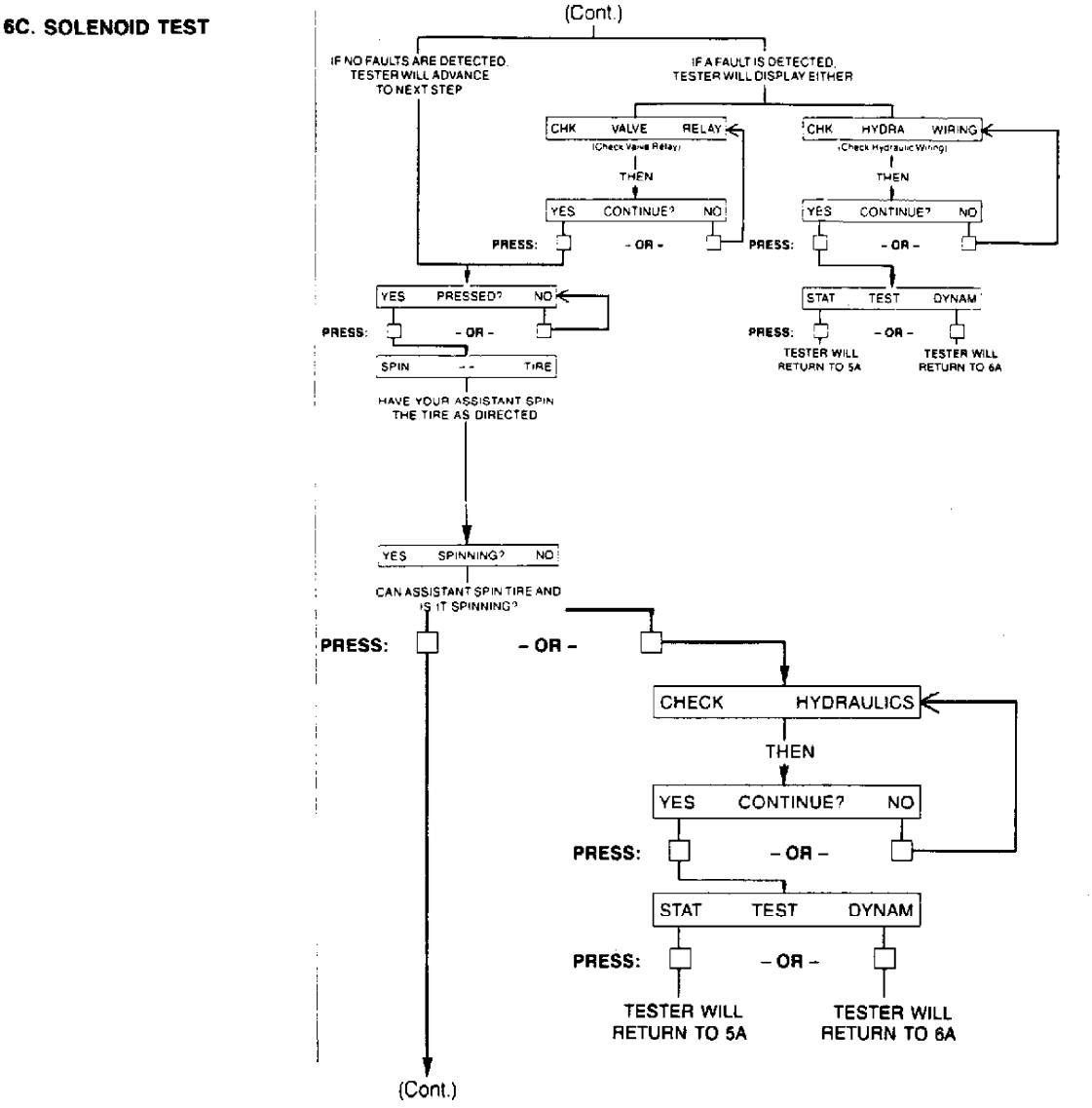

Fig. 24: 6C. Solenoid Test (2 of 4)
Courtesy of Mazda Motors Corp.

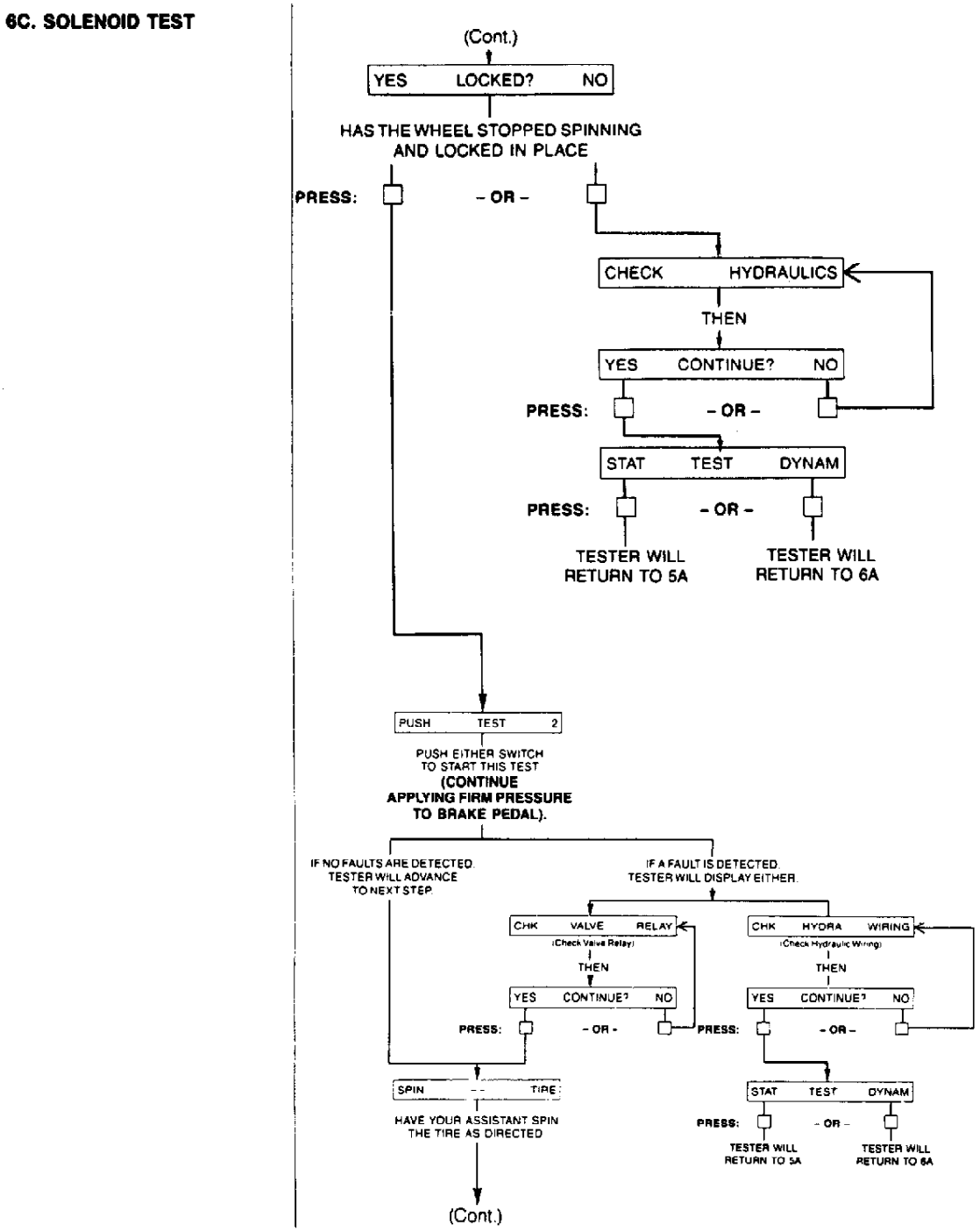

Fig. 25: 6C. Solenoid Test (3 of 4)
Courtesy of Mazda Motors Corp.

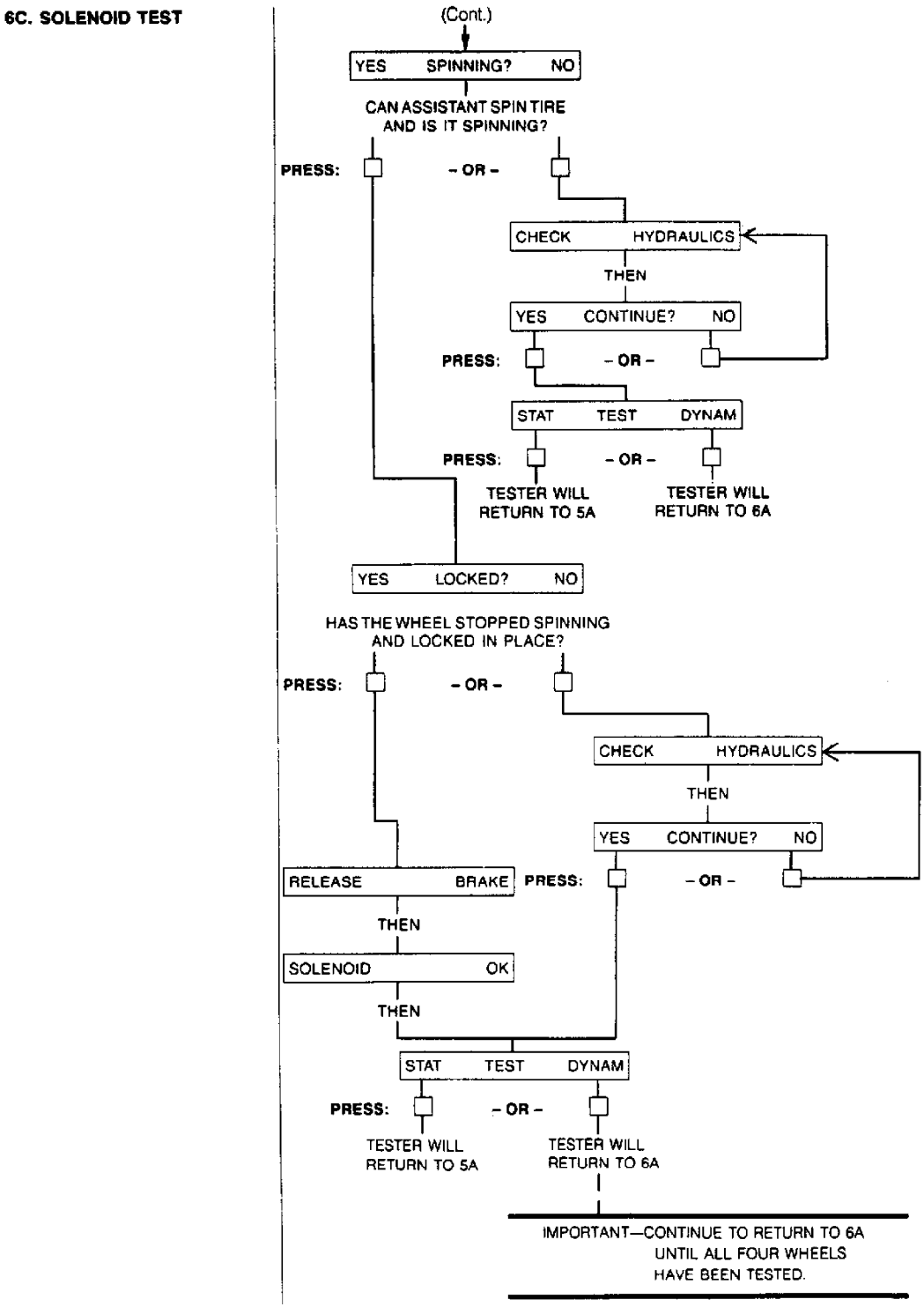

Fig. 26: 6C. Solenoid Test (4 of 4)
Courtesy of Mazda Motors Corp.

TORQUE SPECIFICATIONS TABLE

Application	Ft. Lbs. (N.m)
Brake Caliper Mounting Bolts	
Miata	36-51 (49-69)
RX7	
Front	58-72 (79-98)
Rear	33-40 (45-54)
929	
Front	61-69 (83-94)
Rear	12-17 (16-23)
Brake Line Nuts	10-16 (14-22)
Hydraulic Unit Mounting Nuts	
Miata & 929	14-19 (19-26)
RX7	12-21 (16-28)
Speed Sensor Bolt	12-17 (16-23)
Union Bolt	14-22 (19-30)
Wheel Bearing Nut	
Miata	
Front	123-159 (167-216)
Rear	159-217 (216-294)
RX7	
Front	(1) 14-22 (19-30)
Rear	174-231 (235-314)
929	
Front	72-130 (98-176)
Rear	174-231 (235-314)

(1) - Tighten and loosen 2 or 3 times to seat bearing.

WIRING DIAGRAMS

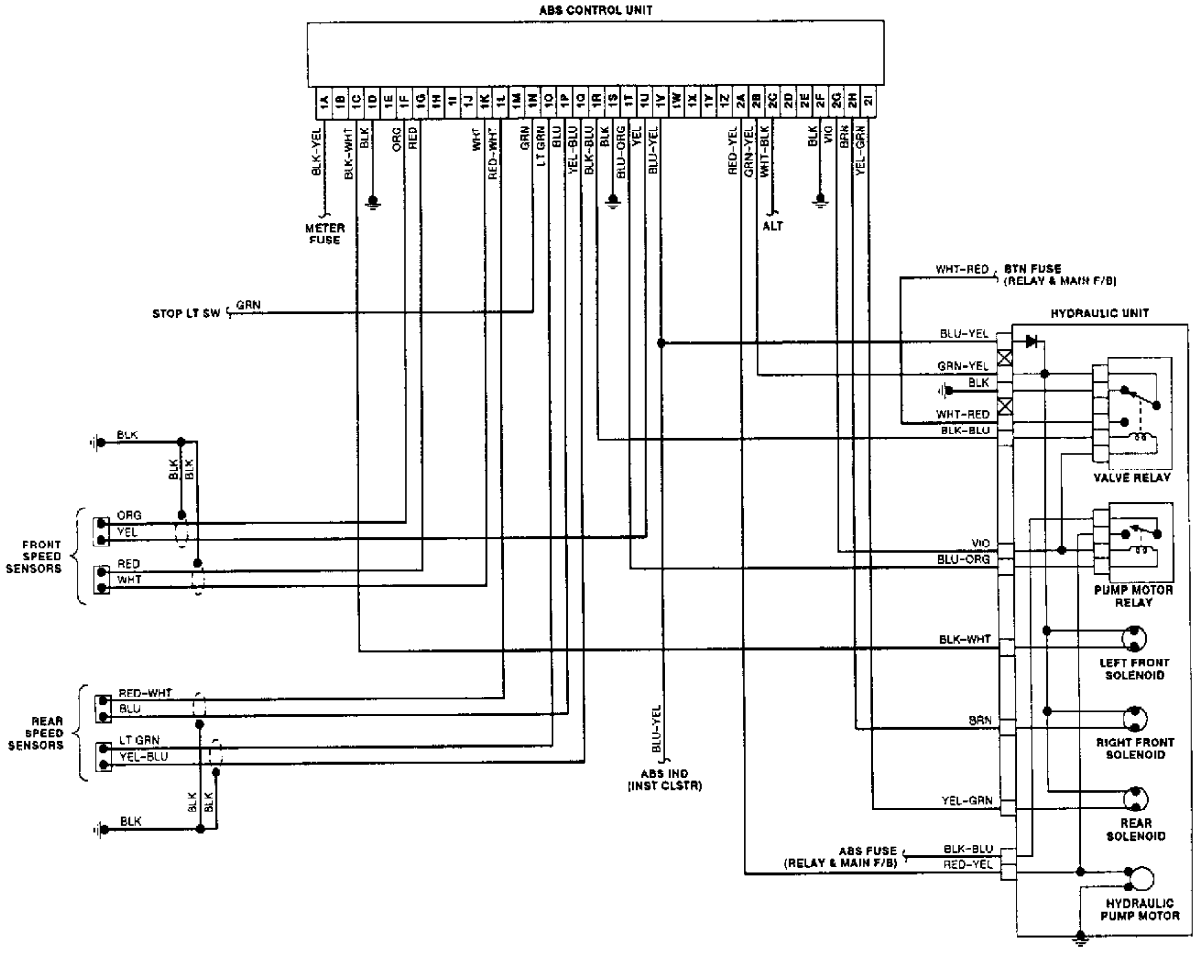

Fig. 27: Anti-Lock Brake System Wiring Diagram (Miata)

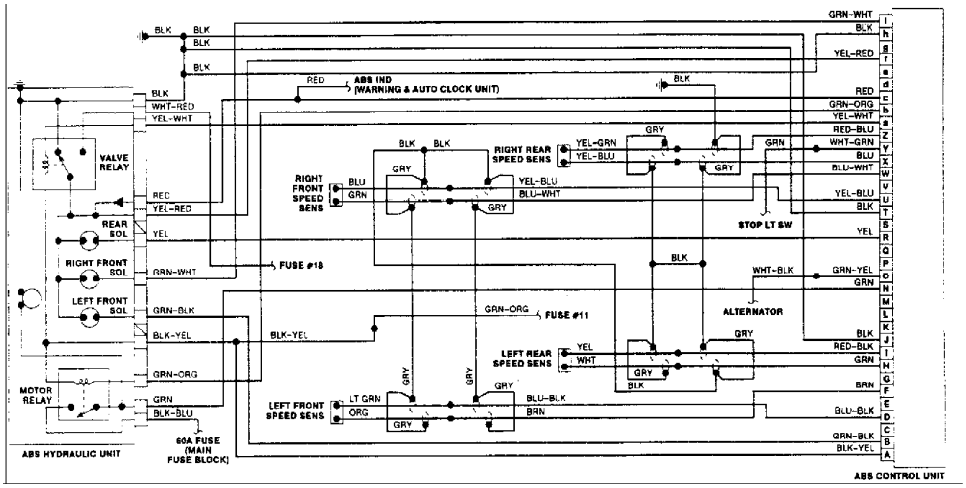

Fig. 28: Anti-Lock Brake System Wiring Diagram (RX7)

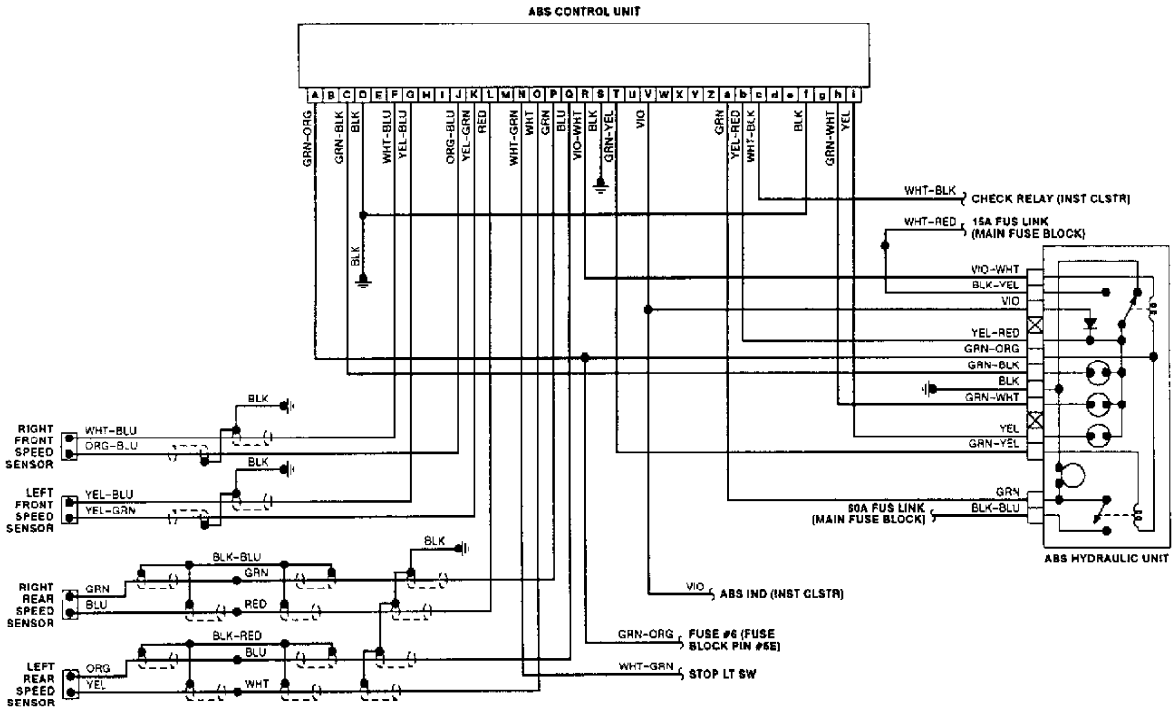

Fig. 29: Anti-Lock Brake System Wiring Diagram (929)