

ANTI-LOCK BRAKE SYSTEM**1994 BRAKES Mazda - Anti-Lock****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 ABS warning light is located on the instrument panel.

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

OPERATION

Under normal driving conditions, Anti-Lock Brake System (ABS) functions like a standard brake system. When vehicle speed reaches 3.8 MPH, ABS will diagnose pump motor by briefly operating motor. Pump motor operation may be heard inside vehicle.

ABS control unit 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 is detected in ABS, ABS will function like a conventional brake system. ABS 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** article in the **GENERAL INFORMATION** section.

COMPONENT LOCATIONS**COMPONENT LOCATIONS**

Application	Location
ABS Control Unit	Passenger-Side Footwell
Diagnosis Connector	Left Side Of Engine Compartment
Front Sensor Rotor	On Front Wheel Hub
Hydraulic Unit	Right Rear Of Engine Compartment
Motor & Valve Relays	On Hydraulic Unit
Pump Motor	On Hydraulic Unit
Rear Sensor Rotor	On Rear Drive Shaft
Wheel Speed Sensor	On Wheel Hub

BLEEDING BRAKE SYSTEM

CAUTION: DO NOT allow reservoir to run dry during brake bleeding procedure. If brake fluid is spilled, clean surface immediately, as brake fluid will damage painted surfaces. Use only DOT 3 brake fluid and DO NOT mix with any other types.

1. Raise and support vehicle. Ensure brake fluid reservoir is at least half full during bleeding procedure. When bleeding brake system, start with longest brakeline first. Remove bleeder cap. Connect one end of transparent vinyl tube to bleeder screw. Submerge other end of tube in a container half filled with clean brake fluid.
2. Have an assistant depress brake pedal several times and hold in depressed position. Loosen bleeder screw, and drain fluid into container. Tighten bleeder screw.

NOTE: Ensure brake pedal remains depressed until bleeder screw is tightened.

3. Refill brake fluid reservoir if necessary. Repeat step 2) until air is no longer discharged. Tighten bleeder screw to 52-78 INCH lbs. (6-9 N.m). Ensure fluid leakage is not present. Add fluid to reservoir. Repeat procedure for remaining wheels.

DIAGNOSIS

ABS can only be diagnosed using ABS Tester (0000-42-0010) and Adapter Harness (49-H066-003). 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 ABS control unit with a known good unit and retest system.

PRE-DIAGNOSIS INSPECTION

Visually inspect ABS components for possible cause of anti-lock problem. Visual inspection may help identify cause of simple malfunction.

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. 2** . To diagnose ABS system, proceed to CONNECTING ABS TESTER under DIAGNOSIS. If ABS tester does not operate, check fuses, ignition switch and ignition circuit.

CONNECTING ABS TESTER

CAUTION: DO NOT drive vehicle with ABS Tester (0000-42-0010) connected.

Turn ignition off. Connect Adapter Harness (49-H066-003) between hydraulic unit harness connector and battery positive terminal. See **Fig. 1** . Roll back carpet from passenger-side footwell, and remove ABS control unit protector panel. Connect ABS Tester (0000-42-0010) harness to harness side of ABS control unit connector. Proceed to TESTING SEQUENCE charts under DIAGNOSING ABS. When diagnosing ABS, complete tests in the order given under TESTING SEQUENCE.

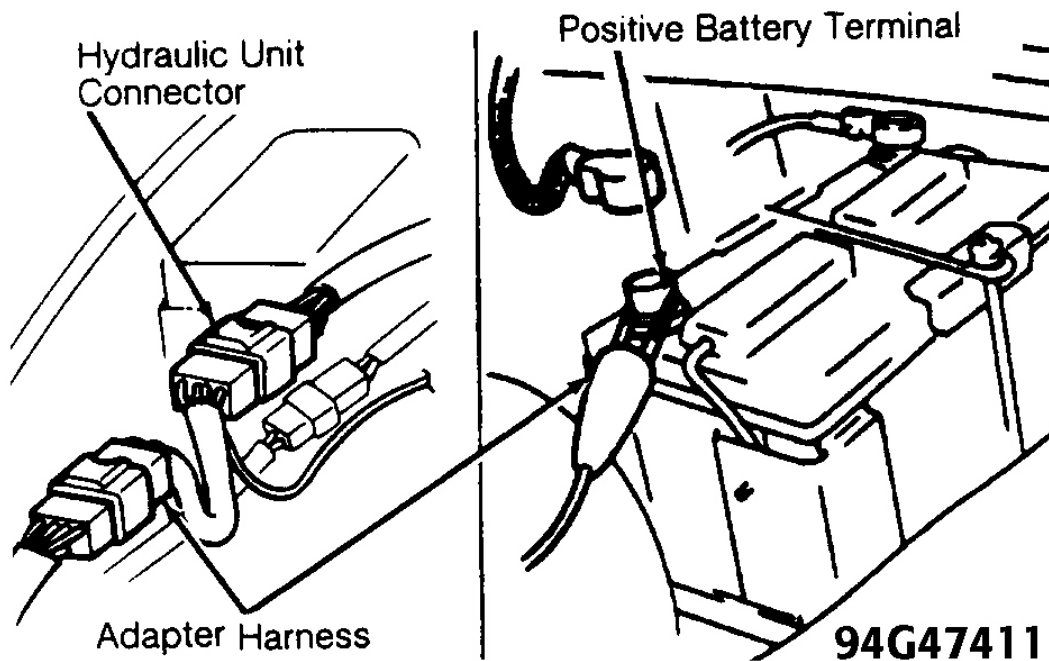


Fig. 1: Connecting ABS Tester & Adapter Harness
Courtesy of MAZDA MOTORS CORP.

DIAGNOSING ABS

ABS TESTER OPERATION

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EXPLANATION OF INSTRUCTION PROCEDURE

Listed below is an explanation of the following test:

5B. BRAKELIGHT SWITCH TEST PROCEDURE

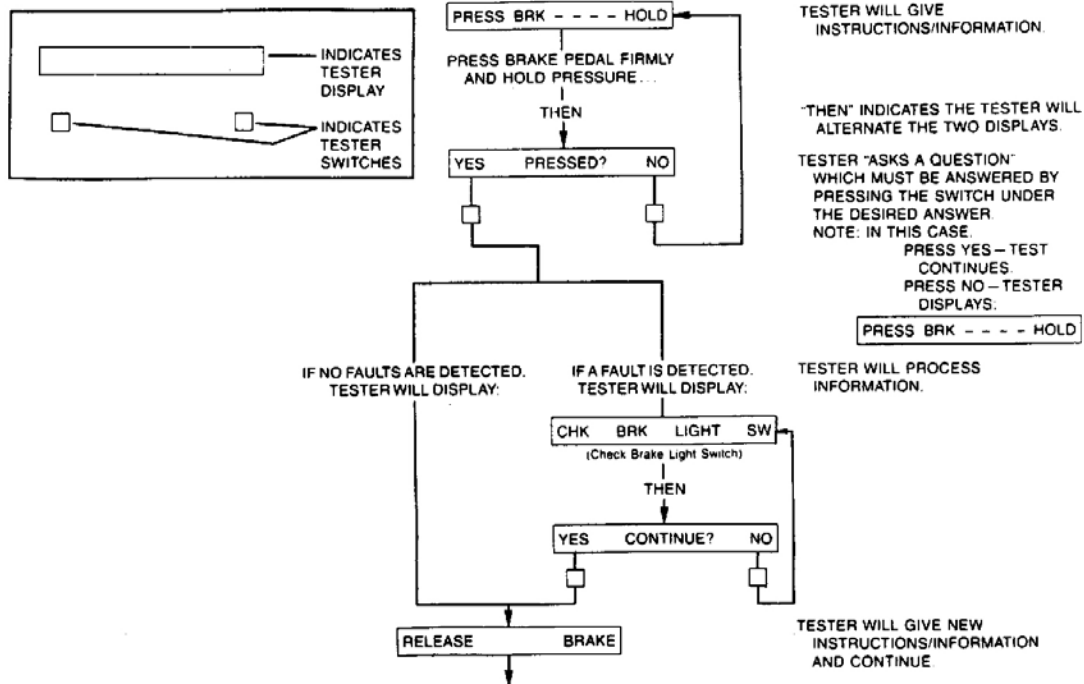


Fig. 2: Operating ABS Tester
Courtesy of MAZDA MOTORS CORP.

TESTING SEQUENCE

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TESTER WILL RAPIDLY DISPLAY SEVERAL MESSAGES DURING AN INITIAL SEGMENT CHECK

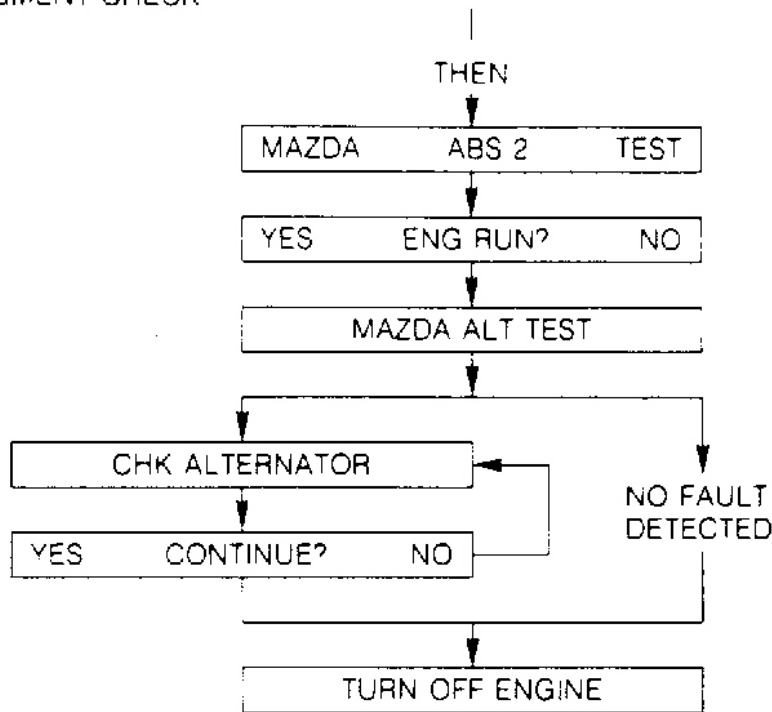


Fig. 3: Power Up/Alternator Test/ABS System Test (1 of 9)
Courtesy of MAZDA MOTORS CORP.

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4. SYSTEM VOLTAGE CHECKS

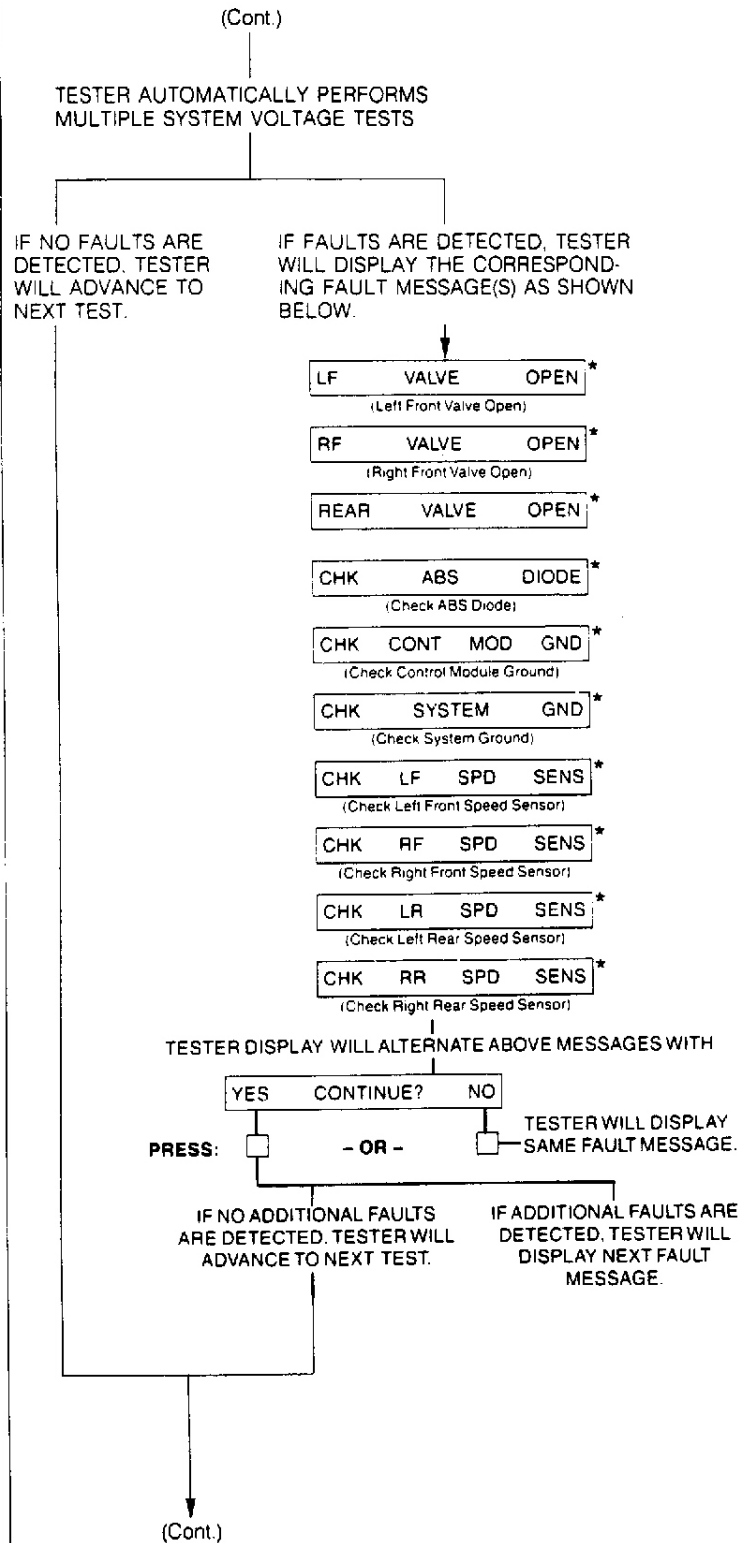


Fig. 4: System Voltage Checks (2 of 9)
 Courtesy of MAZDA MOTORS CORP.

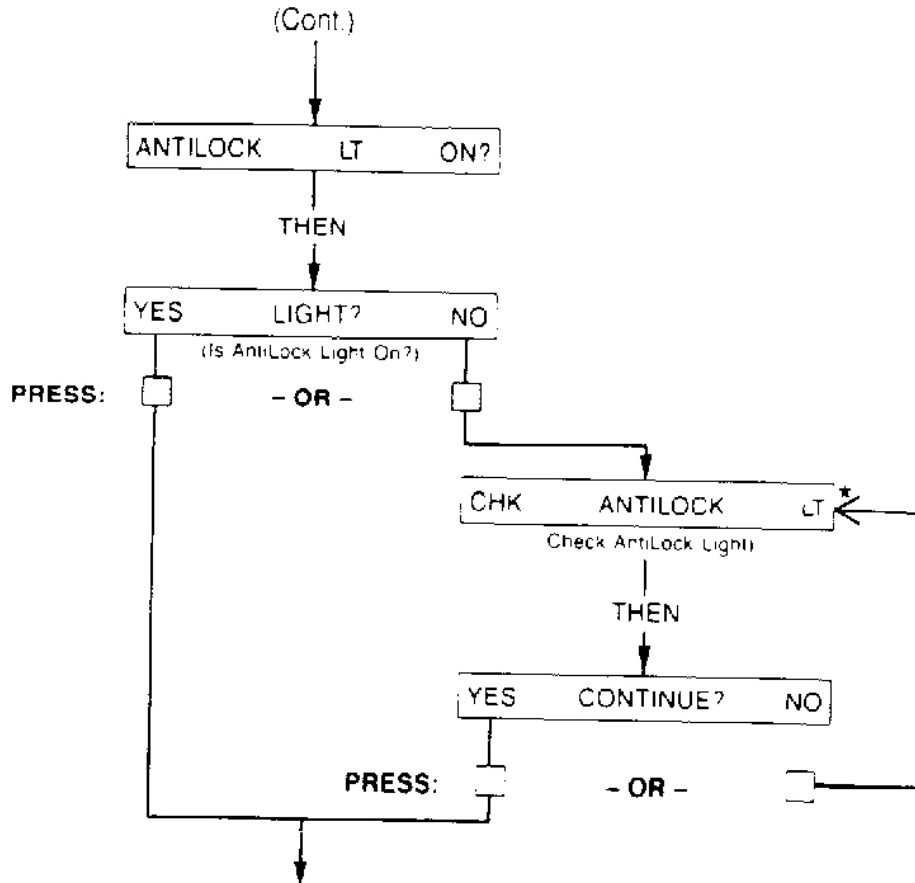


Fig. 5: Static Tests/Brake Light Switch Test (3 of 9)
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5C. PUMP TEST

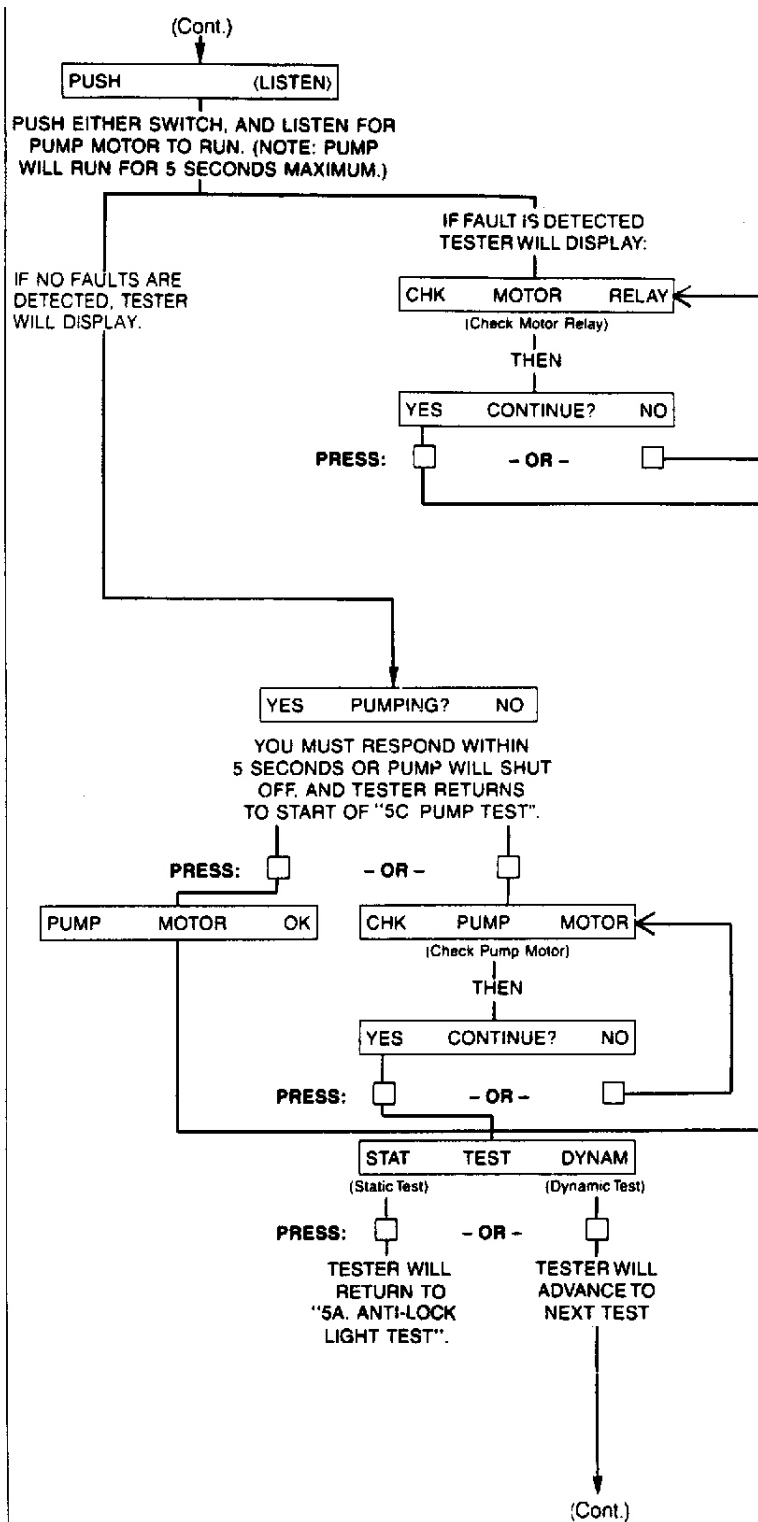


Fig. 6: Pump Test (4 of 9)

Courtesy of MAZDA MOTORS CORP.

6. DYNAMIC TESTS
6A. WHEEL SELECTION
OR EXIT

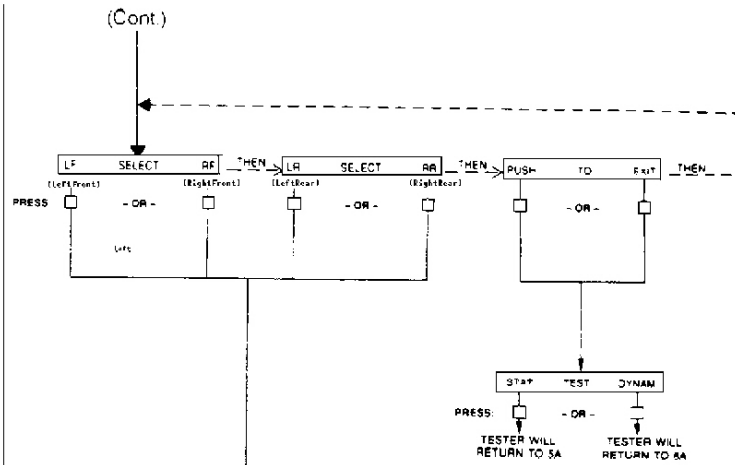
THESE THREE MESSAGES WILL ALTERNATE ON THE DISPLAY SCREEN AT 3 1/2 SECOND INTERVALS. NOW, SELECT ONE OF THE FOUR WHEELS TO BEGIN THE DYNAMIC TEST SEQUENCE.

OR

PRESS EITHER SWITCH UNDER "PUSH TO EXIT" DISPLAY TO RETURN TO "START 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". TO SELECT ANOTHER WHEEL, AND REPEAT THESE TEST PROCEDURES FOR ALL FOUR WHEELS.



NOTE: FOR EACH OF THE WHEEL TESTS, IT IS NECESSARY TO RAISE THE WHEEL(S) BEING TESTED OFF THE FLOOR. (WHEN TESTING REAR WHEELS, BOTH WHEELS MUST BE RAISED OFF THE FLOOR.) AN ASSISTANT WILL BE REQUIRED TO SPIN THE WHEELS.

(Cont.)

Fig. 7: Dynamic Tests/Wheel Sensor Test (5 of 9)

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6B. WHEEL SENSOR TEST

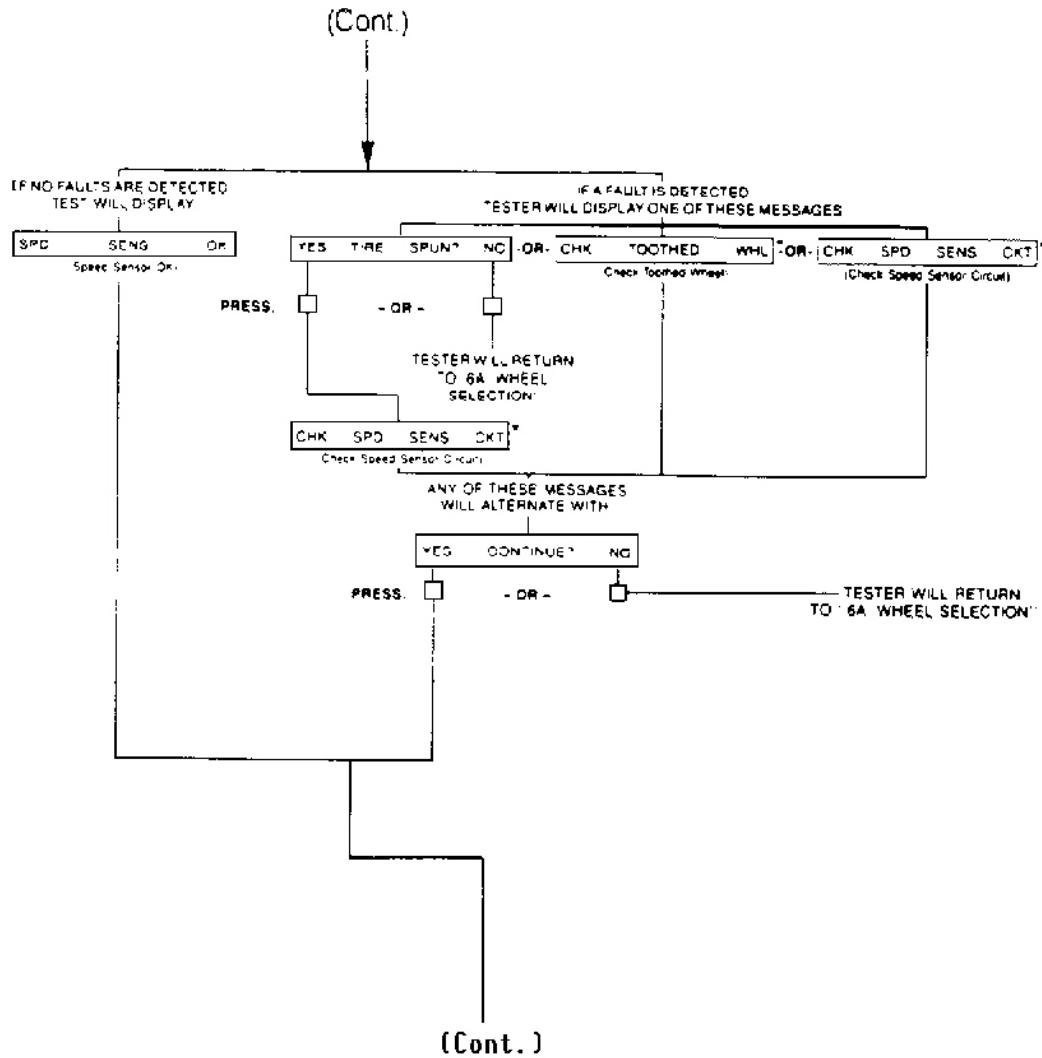


Fig. 8: Wheel Sensor Test (Cont.)/Solenoid Test (6 of 9)
Courtesy of MAZDA MOTORS CORP.

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6C. SOLENOID TEST

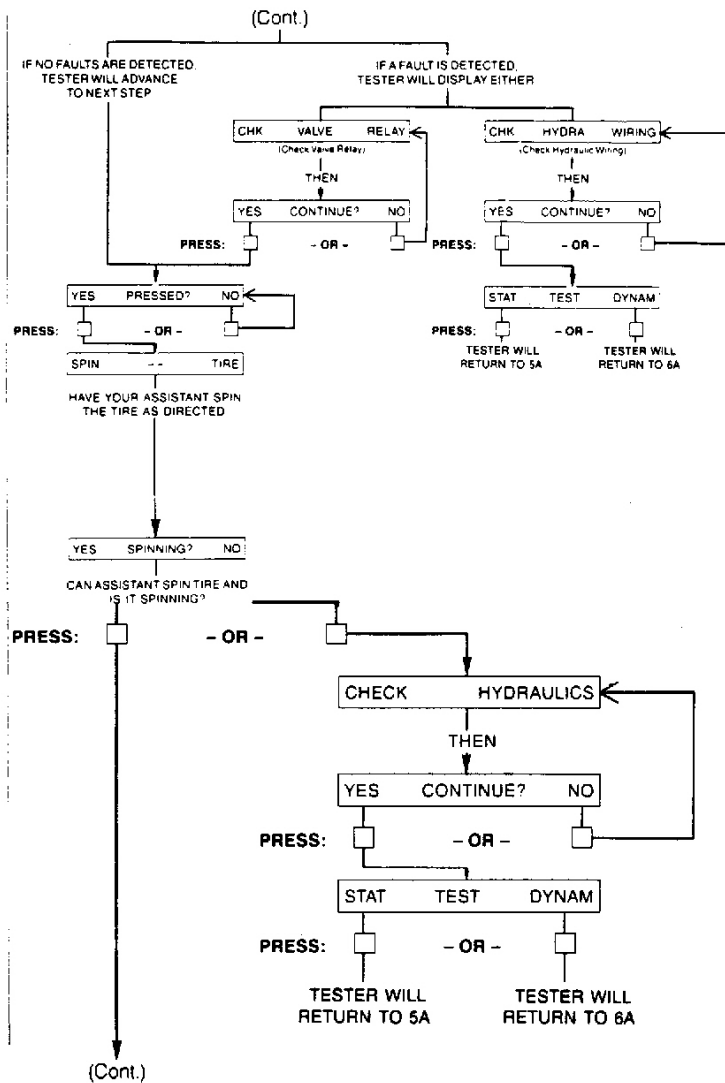


Fig. 9: Solenoid Test (Cont.) (7 of 9)
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6C. SOLENOID TEST

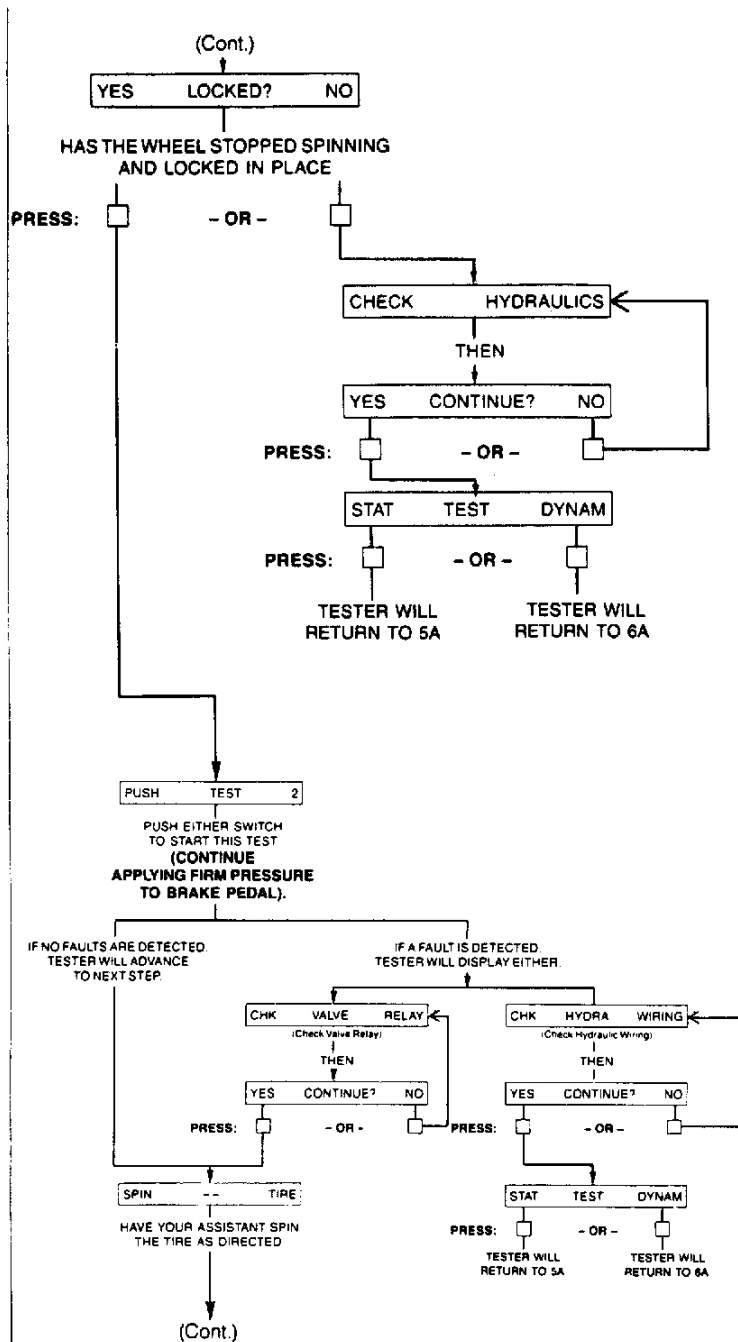


Fig. 10: Solenoid Test (Cont.) (8 of 9)
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6C. SOLENOID TEST

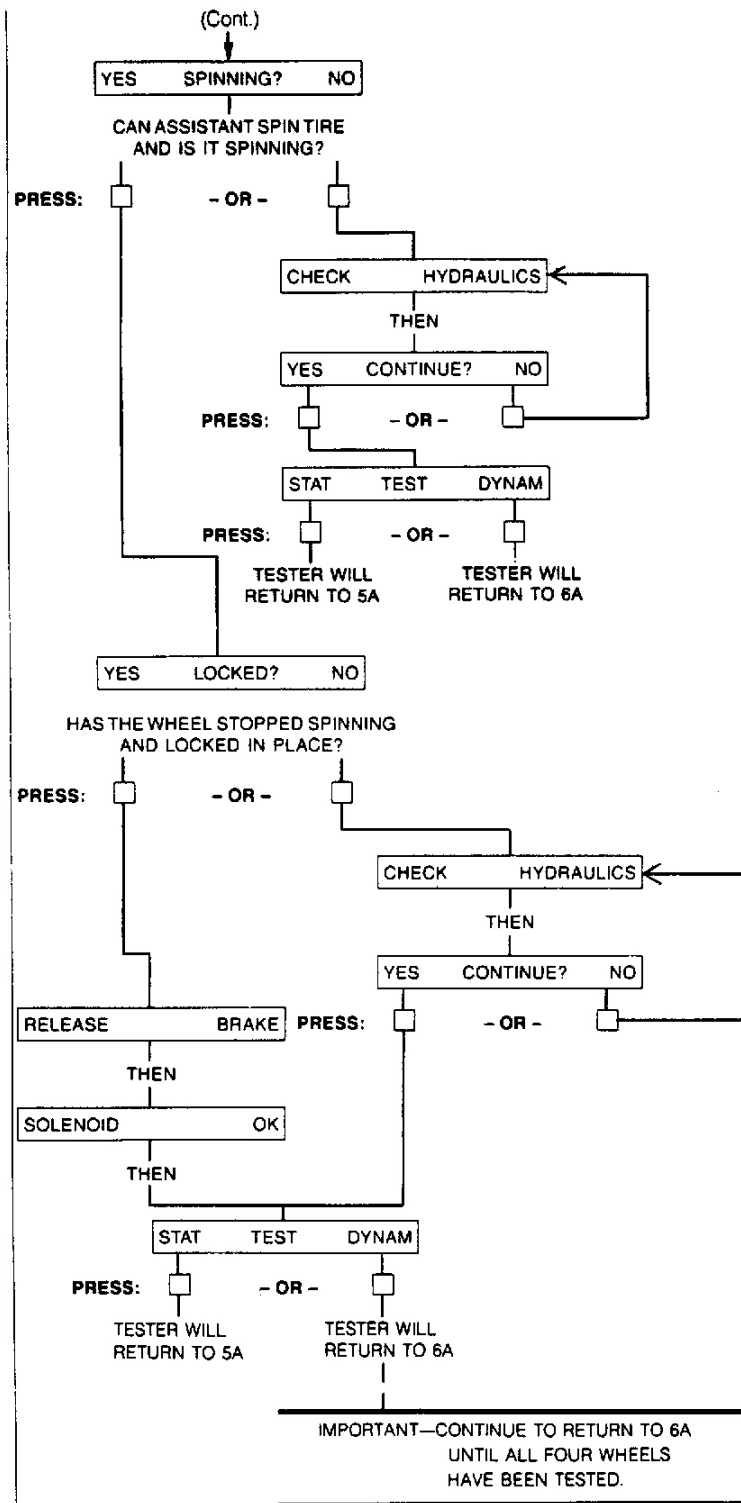


Fig. 11: Solenoid Test (Cont.) (9 of 9)

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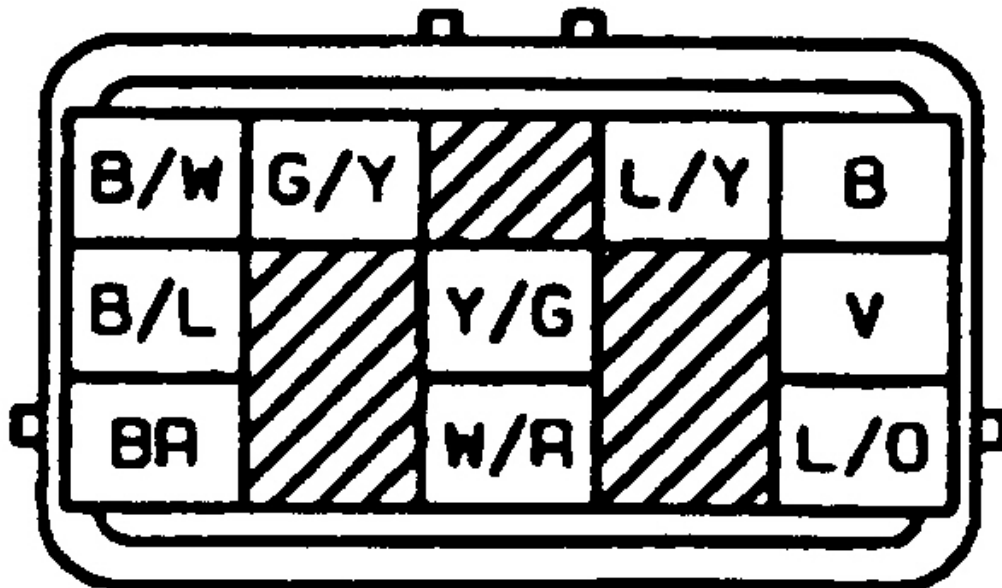
TESTING

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. Check METER fuse and ABS warning light bulb. Check wiring harness between ABS warning light and ABS control unit, and between ABS warning light and hydraulic unit. Repair or replace as necessary. Disconnect hydraulic unit connector. Connect positive lead of DVOM to Blue/Yellow wire terminal and negative lead to Gray wire terminal of hydraulic unit connector. See **Fig. 12** .
2. 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 hydraulic unit.



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Fig. 12: Hydraulic Unit Harness Connector Terminals ID

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ABS GROUND

NOTE: To prevent damage to ABS control unit connector, use very thin pins when probing connector.

Continuity Test

Using a DVOM, check for continuity between ground and following ABS control unit connector terminals: 1D, 1S and AF. See **Fig. 13** . If continuity is not present, repair wiring harness.

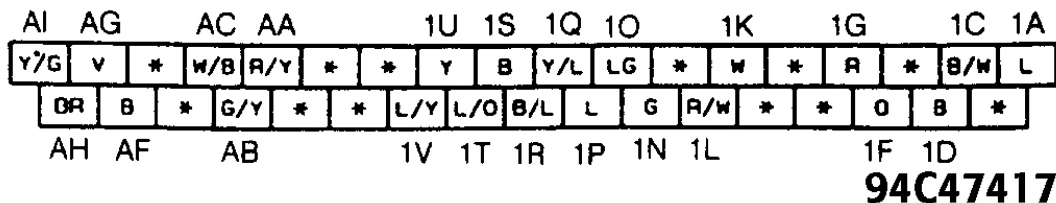


Fig. 13: Control Unit Harness Connector Terminals ID

Courtesy of MAZDA MOTORS CORP.

ABS WARNING LIGHT

Operational Test

1. Start engine, and observe ABS warning light. Light should illuminate for a few seconds. If light does not illuminate as described, remove instrument cluster. Connect 12 volts to terminal 2K (Black/Yellow wire) of instrument cluster. See **Fig. 14** . Using a jumper wire, connect terminal 1K (Blue/Yellow wire) of instrument cluster to ground. ABS warning light should illuminate. If light does not illuminate, check bulb. If bulb is okay, check METER fuse and wiring harness. Repair or replace if necessary.
2. Install instrument cluster, and recheck warning light operation. If light still does not illuminate for a few seconds, check wiring harness between ABS warning light and ABS control unit, and between ABS warning light and hydraulic unit. Repair or replace if necessary.

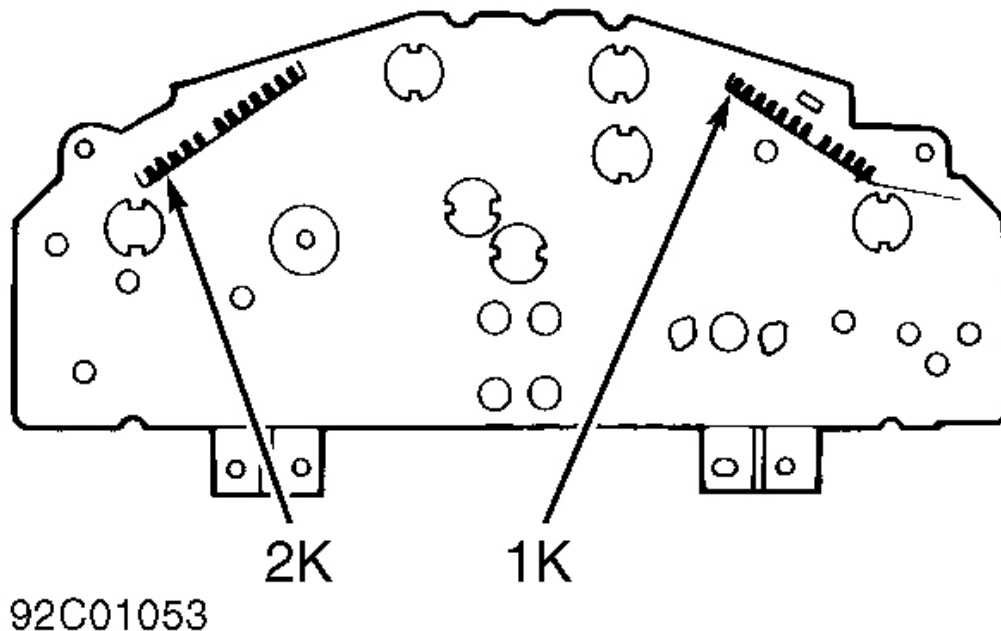


Fig. 14: Instrument Cluster Connector Terminals
 Courtesy of MAZDA MOTORS CORP.

STOPLIGHT SWITCH

Continuity Test

Disconnect stoplight switch harness connector. Using a DVOM, check continuity between stoplight switch connector terminals. Continuity should exist with pedal depressed. Continuity should not exist with pedal released. If continuity is not as specified, check STOP fuse and wiring harness. Check wiring harness between stoplight switch and ABS control unit. Repair or replace if necessary. If fuse and wiring harness are okay, replace switch.

FRONT & REAR VALVES

Resistance Test

1. Disconnect hydraulic unit 12-pin connector. Using a DVOM, measure resistance between following wires: Yellow/Green wire and Black wire; Brown wire and Black wire; Black/White wire and Black wire. See **Fig. 12**. 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. Repair or replace if necessary.

HYDRAULIC UNIT

The only serviceable parts of hydraulic unit are the motor relay and valve relay. If other parts of unit malfunction, replace hydraulic unit.

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. 15** . 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-amp). Repair or replace if necessary.

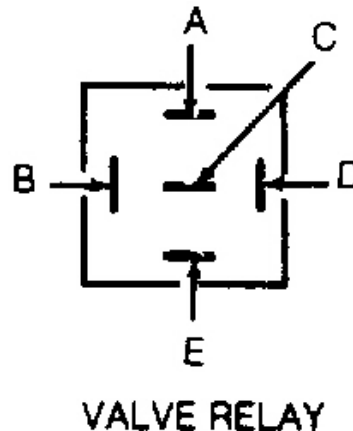
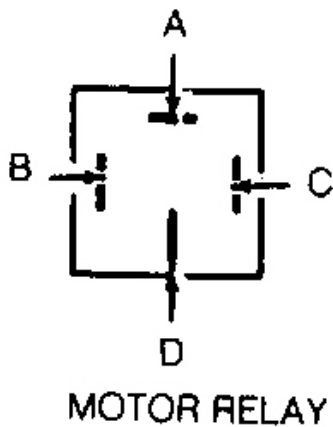


Fig. 15: Motor & Valve Relay Terminals
Courtesy of MAZDA MOTORS CORP.

PUMP MOTOR

Continuity Test

Disconnect 2-pin connector at hydraulic unit. Using a DVOM, check continuity between Red/Yellow wire terminal of 2-pin hydraulic unit connector and ground. If continuity is not present, replace hydraulic unit. If continuity is present, pump is okay. Check wiring between hydraulic unit and ABS control unit. Repair or replace if necessary.

VALVE RELAY

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Continuity & Voltage Tests

1. Disconnect negative battery cable. Remove valve relay from hydraulic unit. Using a DVOM, ensure continuity exists between valve relay terminals "C" and "E", and between terminals "B" and "D". See **Fig. 15**.
2. Connect 12 volts to terminal "B", and ground terminal "D". Ensure continuity exists between terminals "A" and "E". Replace relay if continuity is not as specified.

WHEEL SPEED SENSORS

Sensor Resistance Test

Disconnect speed sensor connector. Using a DVOM, measure resistance between speed sensor connector terminals. Resistance should be 1000-1200 ohms. If resistance is not as specified, replace speed sensor.

NOTE: To prevent damage to ABS control unit connector, use very thin pins when probing connector.

Harness Continuity & Voltage Tests

1. With ignition off and speed sensors connected, disconnect ABS control unit connector. Using a DVOM, check continuity between indicated ABS control unit terminals. See WHEEL SPEED SENSOR TESTS table. If continuity is not present, check wiring harness between wheel speed sensor and ABS control unit. Repair or replace if necessary.
2. If continuity exists, measure voltage between indicated ABS control unit terminals while rotating corresponding wheel one rotation per second by hand. See WHEEL SPEED SENSOR TESTS table. If voltage is not 50-60 millivolts, replace wheel speed sensor. If voltage is 50-60 millivolts, replace ABS control unit.

WHEEL SPEED SENSOR TESTS

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

(1) See **Fig. 13** to identify ABS control unit terminals.

WHEEL SPEED SENSOR ROTORS

Inspection

Perform a comprehensive visual inspection of sensor rotor. If any teeth are damaged or missing, or any other damage is noted, replace sensor rotor.

REMOVAL & INSTALLATION

ABS CONTROL UNIT

Removal & Installation

Disconnect negative battery cable. Roll back carpet from passenger-side footwell. Remove ABS control unit protector panel (if equipped). Disconnect ABS control unit electrical connector. Remove ABS control unit mounting nuts. Remove ABS control unit. To install, reverse removal procedure. Tighten ABS control unit mounting bolts/nuts to 61-87 INCH lbs. (6.9-9.8 N.m).

HYDRAULIC UNIT

Removal & Installation

Disconnect negative battery cable. Disconnect hydraulic unit electrical connector. Using Flare Nut Wrench (49-0259-770B), disconnect brakelines from hydraulic unit. Remove hydraulic unit mounting bolts and nuts. Remove hydraulic unit. To install, reverse removal procedure. Tighten mounting bolts and nuts to specification. See TORQUE SPECIFICATIONS. Bleed air from system. See BLEEDING BRAKE SYSTEM.

FRONT WHEEL SPEED SENSOR ROTOR

Removal

Raise and support vehicle. Remove front wheel assemblies. Remove brake caliper, and wire aside. Remove rotor. Remove grease cap and wheel bearing lock nut. Remove wheel hub. Using Puller (49-0839-425C) and Attachment (49-F027-007), remove sensor rotor from hub.

Installation

To install, reverse removal procedure. Install NEW sensor rotor on hub using Installer (49-V001-795). Tighten bolts and nuts to specification. See TORQUE SPECIFICATIONS.

REAR WHEEL SPEED SENSOR ROTOR

Removal

Raise and support vehicle. Remove rear wheel assemblies. Remove wheel bearing lock nut. Mark drive axle-to-flange position for reassembly reference. Remove drive axle. Using chisel and hammer, remove sensor rotor from drive axle.

Installation

To install, reverse removal procedure. Install NEW sensor rotor on drive axle using Installer (49-H026-101A). Align drive axle-to-flange marks. Tighten bolts and nuts to specification. See TORQUE SPECIFICATIONS.

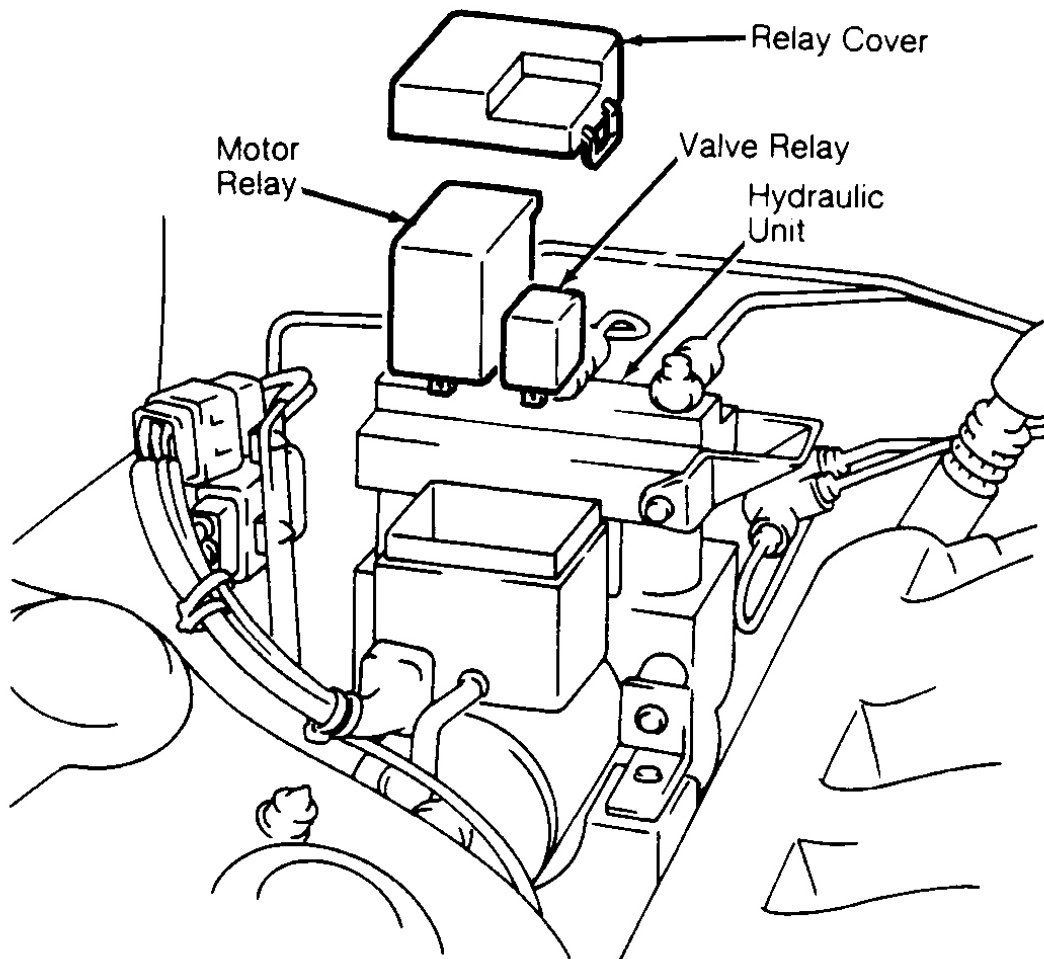
WHEEL SPEED SENSOR

Removal & Installation

Raise and support vehicle. Remove wheel assemblies. Disconnect wheel speed sensor electrical connectors. Remove filler pipe protector from left side and spare tire from right side. Remove mud guard. Remove speed sensor mounting bolt. Remove wheel speed sensor from vehicle. To install, reverse removal procedure. Tighten mounting bolts to specification. See **TORQUE SPECIFICATIONS**.

VALVE & MOTOR RELAYS**Removal & Installation**

Disconnect negative battery cable. Remove relay cover from hydraulic unit. Remove valve and motor relays. See **Fig. 16** . To install, reverse removal procedure.

**93H00858****Fig. 16: Locating Valve Relay & Motor Relay**

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Courtesy of MAZDA MOTORS CORP.

ADJUSTMENTS

BRAKE PEDAL FREE PLAY

Depress pedal a few times to eliminate vacuum. Depress brake pedal by hand and check pedal free play. Pedal free play should be .16-.28" (4-7 mm). Adjust free play by loosening push rod lock nut. Turn push rod until correct free play is obtained. Tighten push rod lock nut to 18-25 ft. lbs. (24-34 N.m).

BRAKE 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 electrical connector. Loosen lock nut on stoplight switch. Rotate switch away from pedal. Loosen push rod lock nut. Rotate push rod until correct pedal height is obtained. See BRAKE PEDAL HEIGHT SPECIFICATIONS table.
2. Adjust pedal free play. See BRAKE PEDAL FREE PLAY under ADJUSTMENTS. Tighten push rod lock nut. Tighten push rod lock nut to 18-25 ft. lbs. (24-34 N.m).
3. Rotate stoplight switch until it contacts pedal, and then rotate an additional 1/2 turn. Tighten stoplight switch lock nut to 10-13 ft. lbs. (14-18 N.m). Reconnect stoplight switch electrical connector.
4. Applied pedal height is measured from angled portion of firewall (without carpet) to pedal pad center. Start engine. Depress brake pedal with a pressure of 132 lbs. (60 kg).
5. Measure applied pedal height. See BRAKE PEDAL HEIGHT SPECIFICATIONS table. If distance is not as specified, check for air in system, faulty rear brake adjustment, or worn shoes or pads.

BRAKE PEDAL HEIGHT SPECIFICATIONS

Application	In. (mm)
Pedal Released	6.8-7.1 (171-181)
Pedal Applied ⁽¹⁾	3.7 (95)
(1) Minimum height.	

PARKING/EMERGENCY BRAKE

1. Depress brake pedal several times. Pull parking brake lever with a force of 44 lbs. (20 kg). If stroke is 5-9 notches, parking brake is properly adjusted. If stroke is not 5-9 notches, raise and support rear of vehicle. Release parking brake lever.
2. Rotate cable adjusting nut at lever end of cable, located under console cover, until stroke is within specification. Ensure rear brakes do not drag. Ensure parking brake warning light illuminates when brake lever is pulled one notch.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

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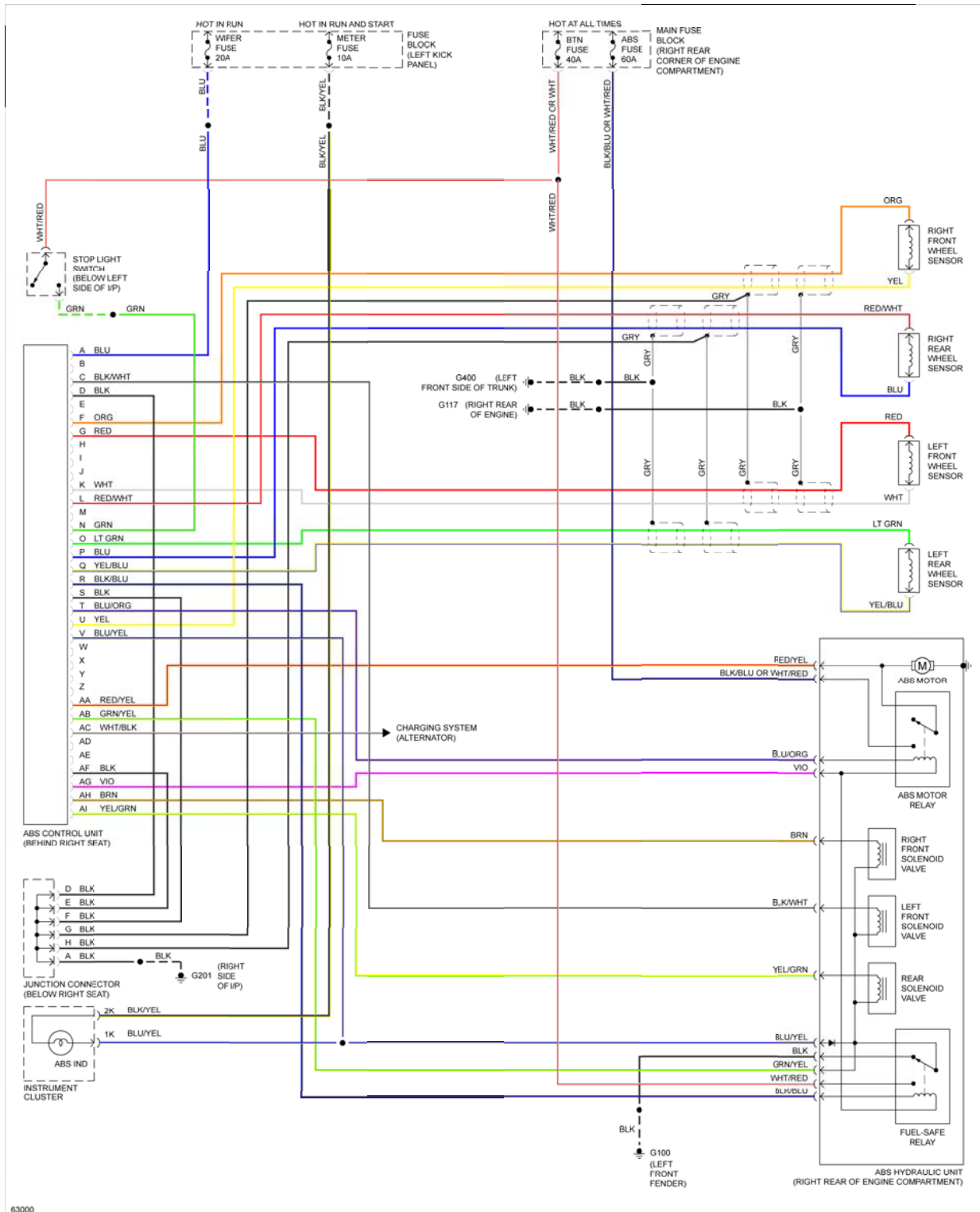
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Application	Ft. Lbs. (N.m)
Brake Caliper Mounting Bolts	36-51 (49-69)
Brakeline Nuts	10-16 (14-22)
Drive Shaft-To-Flange Nuts	40-47 (54-64)
Hydraulic Unit Brakeline Union Bolts	15-21 (20-29)
Hydraulic Unit Mounting Nuts	14-19 (19-26)
Push Rod Lock Nut	18-25 (24-34)
Speed Sensor Mounting Bolt	12-16 (16-22)
Stoplight Switch Lock Nut	10-13 (14-18)
Wheel Bearing Lock Nut	
Front	123-159 (167-216)
Rear	159-217 (216-294)
Wheel Lug Nuts	65-87 (88-118)
	INCH Lbs. (N.m)
ABS Control Unit Mounting Bolts/Nuts	61-87 (6.9-9.8).

WIRING DIAGRAM

1994 Mazda MX-5 Miata

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ANTI-LOCK BRAKE SYSTEM 1994 BRAKES Mazda - Anti-Lock

Fig. 17: Anti-Lock Brake System (ABS) Wiring Diagram