

ANTI-LOCK BRAKE SYSTEM

Article Text

1993 Mazda 929

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ARTICLE BEGINNING

1993 BRAKES

Mazda Anti-Lock

929

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 this 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 in this article.

ANTI-LOCK BRAKE SAFETY PRECAUTIONS

- * 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

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- * 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).

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.

COMPONENT LOCATIONS TABLE

[illegible]

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Application

Location

929

ABS Control Unit

RX7 Behind Side Trim In Luggage Compartment

929 Behind Rear Seat Back

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

AA

ADJUSTMENTS

BRAKE PEDAL FREE PLAY

Depress pedal a few times to eliminate vacuum. Depress brake pedal by hand and check pedal free play. On 929, pedal free play should be .20-.31" (5-8 mm). On all models, adjust free play by loosening push rod lock nut. Turn push rod until correct free play is obtained. Tighten push rod lock nut to 17-25 ft. lbs. (23-34 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 17-25 ft. lbs. (23-34 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, rear brake adjustment or worn shoes or pads.

BRAKE PEDAL HEIGHT SPECIFICATIONS TABLE

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Application In. (mm)

Pedal Released

929 7.6-7.8 (193-198)

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Pedal Applied (1)

929 1.6 (40)

(1) - Minimum height.

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PARKING/EMERGENCY BRAKE

929

1) Depress brake pedal several times. Depress parking brake pedal several times with a force of 44 lbs. (20 kg). If stroke is 5-7 notches, parking brake is properly adjusted. If stroke is not 5-7 notches, rotate adjusting nut, located under parking brake pedal, until stroke is within specification.

2) Ensure rear brakes do not drag. Ensure parking brake warning light illuminates when brake pedal is depressed one notch.

DIAGNOSIS

ABS can only be diagnosed using ABS Tester (0000-42-0010) and Adapter Harness (49-H066-003 for 929). 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. 6. 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.

929

Turn ignition off. Connect Adapter Harness (49-H066-003) between hydraulic unit harness connector and battery positive terminal. See Fig. 1. Remove rear seat cushion and rear seat back, and remove ABS control unit protector panel. Connect ABS Tester (0000-42-

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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.

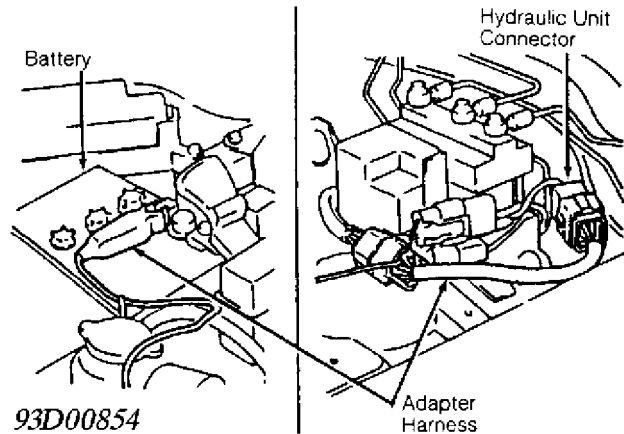


Fig. 1: Connecting ABS Tester & Adapter Harness (929)
Courtesy of Mazda Motors Corp.

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.

2) On 929, connect positive lead of DVOM to terminal "G" (Gray wire) and negative lead to Yellow/Red wire terminal of hydraulic unit connector. See Fig. 2.

3) On all models, 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.

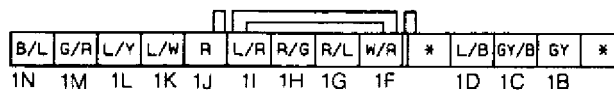
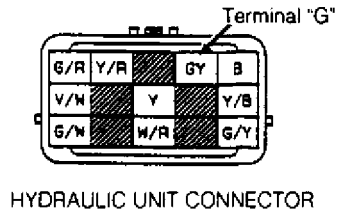
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WIRE COLOR IDENTIFICATION

Color	Abbreviation
Blue	L
Black	B
Green	G
Gray	GY
Red	R
White	W
Violet	V
Yellow	Y

93F00856

Fig. 2: Hydraulic Unit Harness Conn & Inst Cluster Conn Term ID (929)
Courtesy of Mazda Motors Corp.

WIRE COLOR IDENTIFICATION TABLE FOR Fig. 2

Color	Abbreviation
Blue	L
Black	B
Green	G
Gray	GY
Red	R
White	W
Violet	V
Yellow	Y

ABS GROUND

Continuity Test

Using a DVOM, check for continuity between ground and following ABS control unit connector terminals: 1D, 1S and AF. See Fig. 3. If continuity is not present, repair wiring harness.

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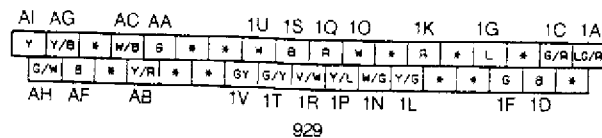
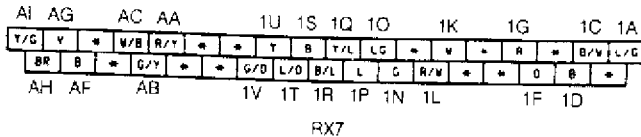
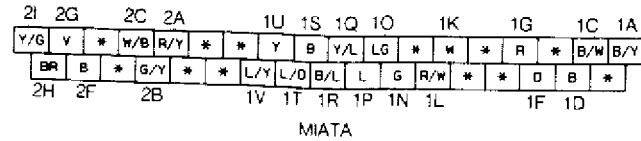
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WIRE COLOR IDENTIFICATION

Color	Abbreviation
Blue	L
Black	B
Brown	BR
Green	G
Gray	GY
Light Green	LG
Orange	O
Red	R
White	W
Violet	V
Yellow	Y

93F82417

Fig. 3: Identifying Control Unit Harness Connector Terminals
Courtesy of Mazda Motors Corp.

WIRE COLOR IDENTIFICATION TABLE FOR Fig. 3

Color	Abbreviation
Blue	L
Black	B
Brown	BR
Green	G
Gray	GY
Light Green	LG
Orange	O
Red	R
White	W
Violet	V
Yellow	Y

ABS WARNING LIGHT

Operational Test

- 1) Start engine and observe ABS warning light. Light should

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illuminate for a few seconds. If light does not illuminate as described, disconnect hydraulic unit connector, and turn ignition on. Using a jumper wire, connect terminal "G" (Gray wire) of hydraulic unit connector to ground. See Fig. 2.

2) If ABS warning light illuminates, inspect ABS control unit or hydraulic unit. If light does not illuminate, turn ignition to LOCK position, and reconnect hydraulic unit connector. Remove instrument cluster. Remove and check ABS warning light bulb. Replace bulb if necessary. If bulb is okay, go to next step.

3) Disconnect instrument cluster connector No. 1 (White). Turn ignition on. Using a jumper wire, connect terminal 1B (Gray wire) of instrument cluster connector No. 1 (White) to ground. See Fig. 2. If continuity is present, replace instrument cluster. If continuity is not present, repair wiring harness between instrument cluster and ABS control unit, or between instrument cluster and hydraulic unit.

STOPLIGHT SWITCH

Continuity Test

1) Disconnect stoplight switch connector. On 929, using a DVOM, check continuity between Green/Yellow wire and White/Green wire with brake pedal depressed.

2) On all models, ensure continuity exists. Release pedal, and note reading on DVOM. Continuity should not be present. 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

Continuity Test

1) Disconnect hydraulic unit connector. Using a DVOM, measure continuity between following wires: Yellow wire and Yellow/Red wire; Green/White wire and Yellow/Red wire; Green/Red wire and Yellow/Red wire. See Fig. 2. Continuity should be present in each measurement.

2) If continuity is not present, replace hydraulic unit. If continuity is present, 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. 4. Connect 12 volts to terminal "C", and

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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). Repair or replace if necessary.

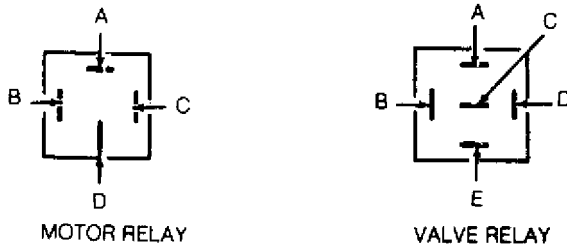


Fig. 4: Identifying Motor & Valve Relay Terminals
Courtesy of Mazda Motors Corp.

PUMP MOTOR

Voltage Test

1) Disconnect 2-pin connector at hydraulic unit. Using a DVOM, measure voltage between Black/Blue wire terminal of hydraulic unit connector and ground. Voltage should be 12 volts. If voltage is not as specified, check MAIN fuse and ABS fuse (60 amps). Also check wiring harness between battery and hydraulic unit. Repair or replace if necessary.

2) If voltage is 12 volts, on 929, check continuity between Green wire terminal of 2-pin hydraulic unit connector and ground. On 929, if continuity is not present, replace hydraulic unit.

VALVE RELAY

Continuity & Voltage Tests

1) Disconnect negative battery cable. Remove valve relay from hydraulic unit. Using a DVOM, check continuity between valve relay terminals "C" and "E", and between terminals "B" and "D". See Fig. 4.

2) Ensure continuity exists. 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.

3) On 929, if continuity is as specified, reconnect negative battery cable. Disconnect hydraulic unit connector. Measure voltage between White/Red wire terminal of hydraulic unit connector and ground. See Fig. 2. Voltage should be 12 volts. If voltage is not as specified, check MAIN fuse and ABS fuse (15 amps). Also check wiring harness between battery and hydraulic unit. Repair or replace if necessary.

WHEEL SPEED SENSORS

Sensor Resistance Test

Disconnect speed sensor connector. Using a DVOM, measure resistance between speed sensor connector terminals. On 929,

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resistance should be 800-1200 ohms. On all models, 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 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 TABLE

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(1) Test Between ABS Control

Application Unit Connector Terminals

Left Front	1K & 1G
Left Rear	1O & 1Q
Right Front	1U & 1F
Right Rear	1L & 1P

(1) - See Fig. 3 to identify ABS control unit terminals.

AA

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. On 929, remove rear seat cushion and rear seat back. On all models, 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.

HYDRAULIC UNIT

Removal & Installation

Disconnect negative battery cable. Disconnect hydraulic unit electrical connector. Using Flare Nut Wrench (49-0259-770B),

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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 table at the end of this article. 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 grease cap. Remove rotor. Remove ABS wheel speed sensor. Remove wheel bearing lock nut. Remove wheel hub. Using chisel and hammer, remove sensor rotor from hub.

Installation

To install, reverse removal procedure. On 929, install NEW sensor rotor on hub using Installer (49-H033-102). On all models, tighten bolts and nuts to specification. See TORQUE SPECIFICATIONS table at the end of this article.

REAR WHEEL SPEED SENSOR ROTOR

Removal

1) Raise and support vehicle. Remove rear wheel assemblies. Remove exhaust pipe. Separate rear lower lateral link from steering knuckle using Ball Joint Puller (49-0118-850C). Remove drive shaft from differential. Remove upper and lower lateral links from subframe. Remove stabilizer bar from stabilizer link.

2) Mark drive axle-to-flange position for reassembly reference. Support differential and subframe using jack. Remove drive axle-to-flange nuts. Remove wheel bearing lock nut and washer. Remove subframe mounting nuts and washers. Lower subframe and differential approximately 4" (102 mm). 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 table at the end of this article.

WHEEL SPEED SENSOR

Removal & Installation

Raise and support vehicle. Remove wheel assemblies. Disconnect wheel speed sensor electrical connectors. On Miata, remove filler pipe protector from left side and spare tire from right side. Remove mud guard. On all models, remove speed sensor mounting bolt. Remove wheel speed sensor from vehicle. To install, reverse removal procedure. Tighten mounting bolts to specification. See TORQUE SPECIFICATIONS table at the end of this article.

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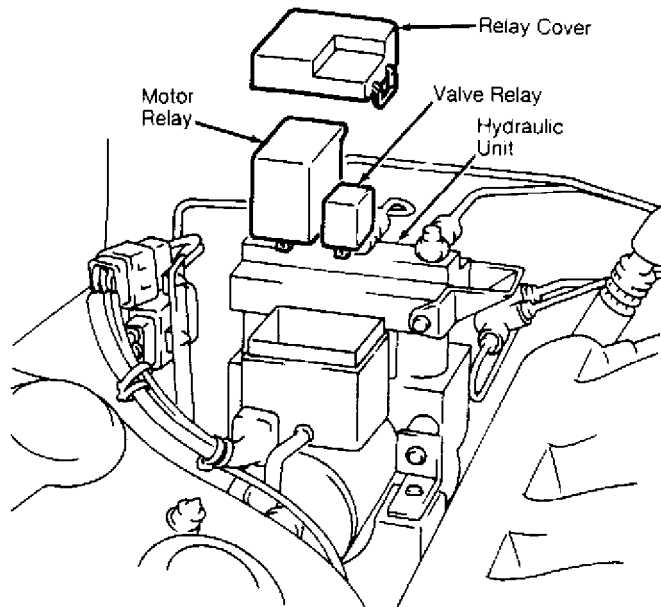
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VALVE & MOTOR RELAYS

Removal & Installation

Disconnect negative battery cable. Remove relay cover from hydraulic unit. Remove valve and motor relays. See Fig. 5. To install, reverse removal procedure.



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Fig. 5: Locating Valve Relay & Motor Relay
Courtesy of Mazda Motors Corp.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE

AA

Application	Ft. Lbs. (N.m)
Brake Caliper Mounting Bolts	
929	
Front	75-87 (102-118)
Rear	34-49 (46-66)
Brakeline Nuts	10-16 (14-22)
Drive Shaft-To-Flange Nuts	40-47 (54-64)
Hydraulic Unit Brakeline Union Bolts	
929	15-21 (20-29)
Hydraulic Unit Mounting Nuts	14-19 (19-26)
Speed Sensor Mounting Bolt	12-16 (16-22)
Wheel Bearing Lock Nut	

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Front 131-173 (177-235)

Rear 174-231 (236-314)

Wheel Lug Nuts 65-87 (88-118)

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DIAGNOSING ABS

ABS TESTER OPERATION

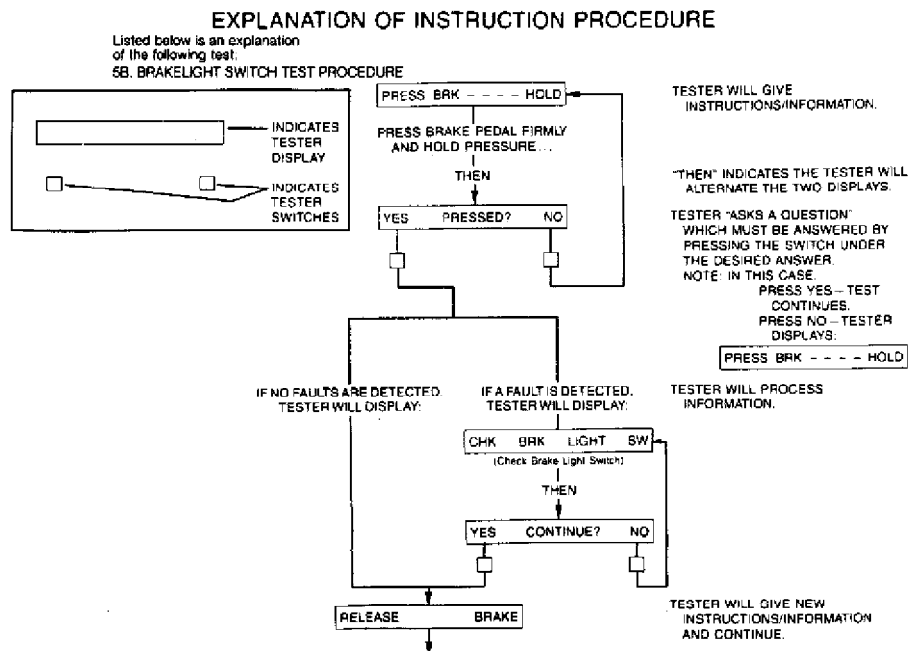


Fig. 6: Operating ABS Tester
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TESTING SEQUENCE

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TESTER WILL RAPIDLY DISPLAY SEVERAL MESSAGES DURING AN INITIAL
SEGMENT CHECK

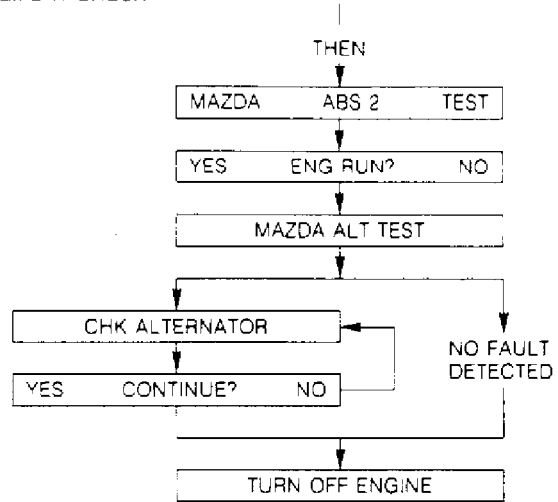


Fig. 7: ABS Testing Sequence: Chart 1 of 9
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4. SYSTEM VOLTAGE CHECKS

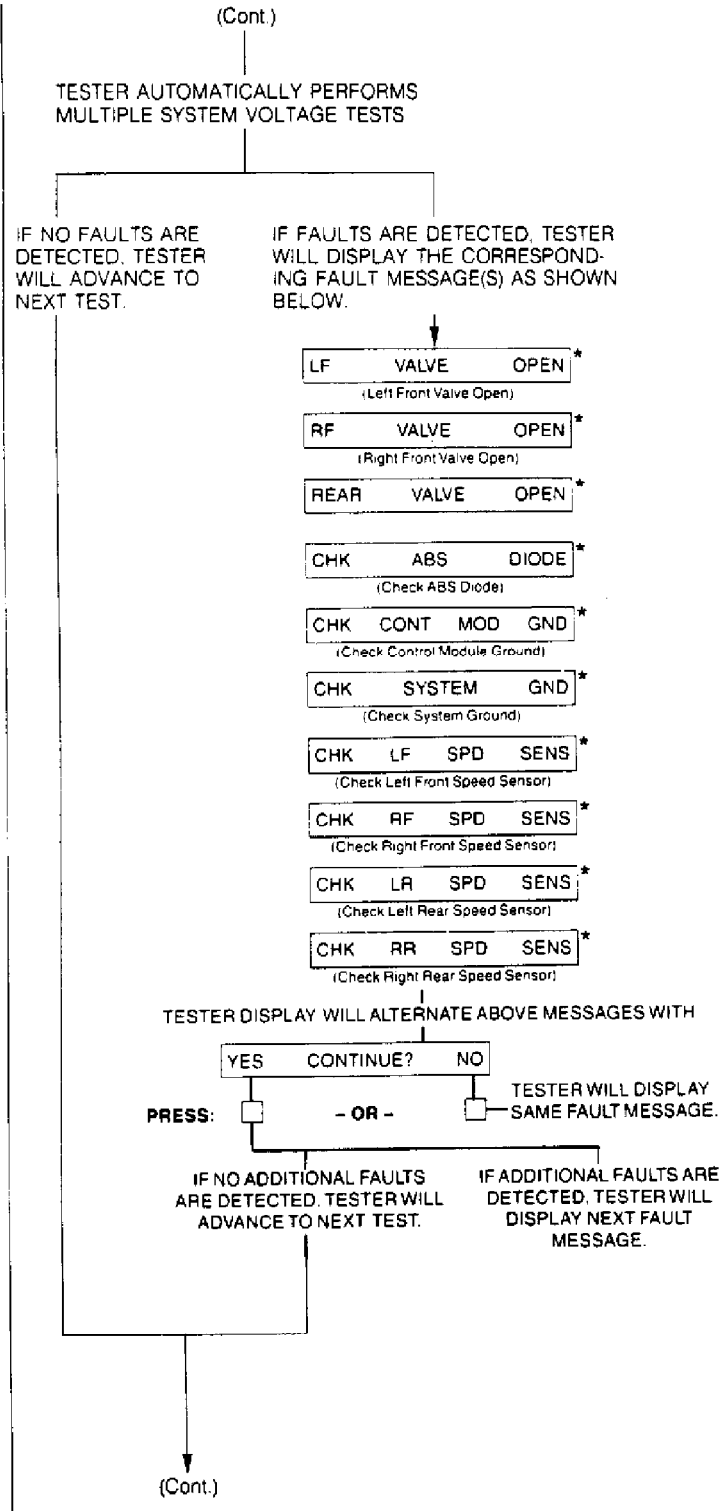


Fig. 8: ABS Testing Sequence: Chart 2 of 9
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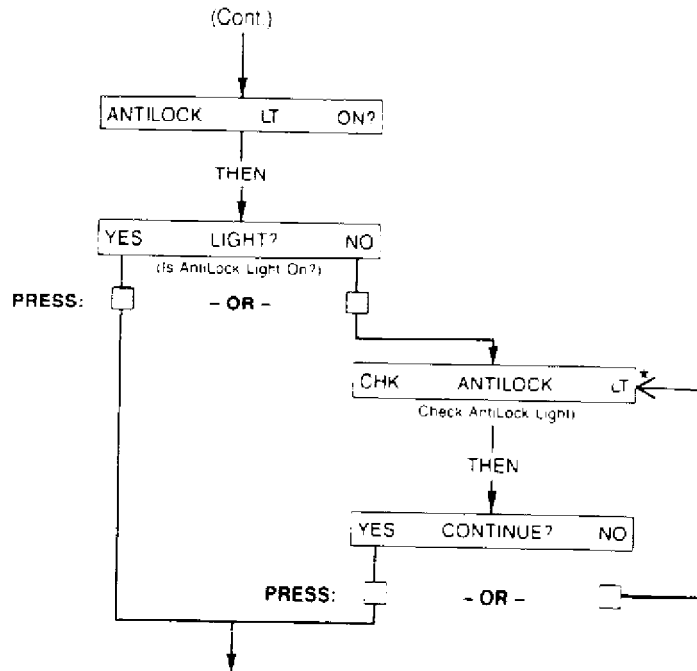


Fig. 9: ABS Testing Sequence: Chart 3 of 9
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5C. PUMP TEST

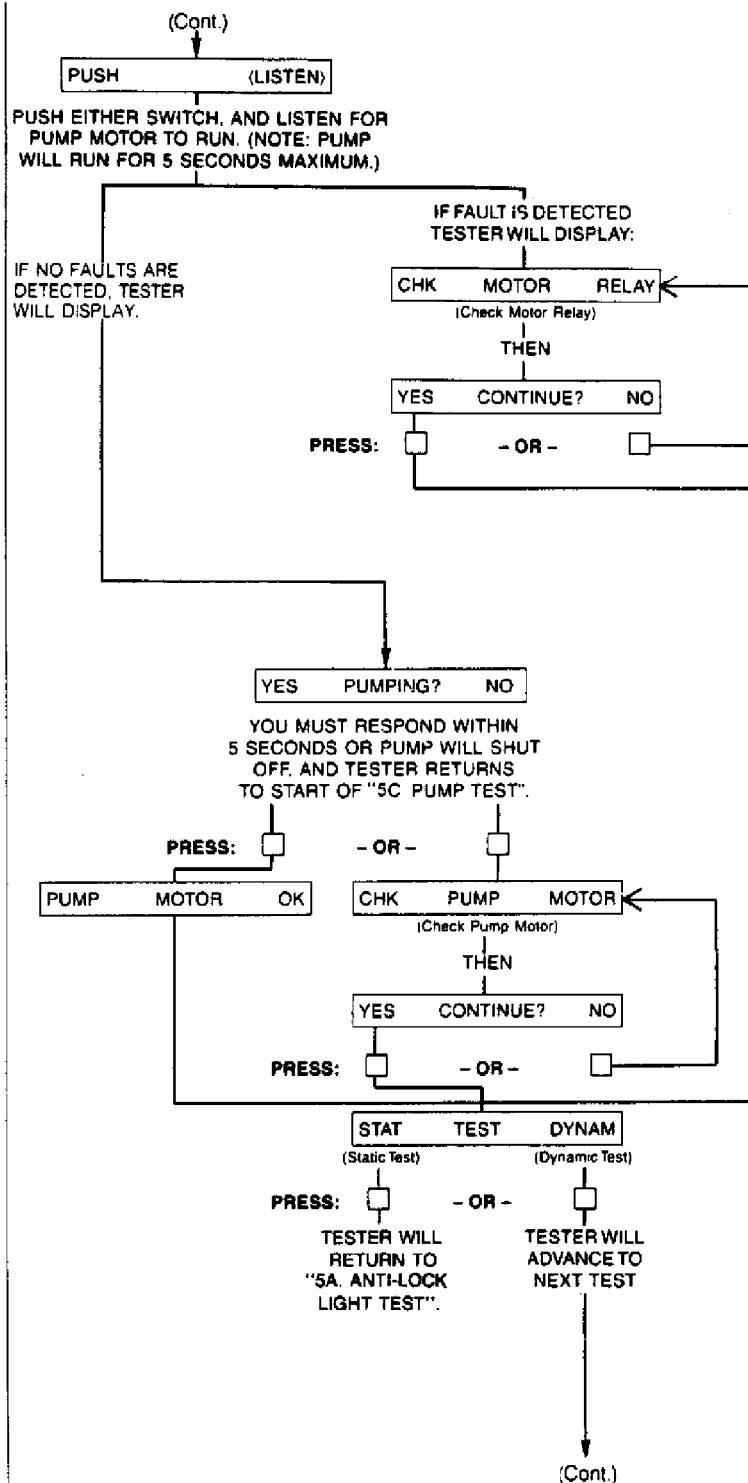


Fig. 10: ABS Testing Sequence: Chart 4 of 9
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6. DYNAMIC TESTS

6A. WHEEL SELECTION OR EXIT

THESE THREE MESSAGES
WILL ALTERNATE ON THE
DISPLAY SCREEN AT 3 1/2 SE-
COND INTERVALS. NOW,
SELECT ONE OF THE FOUR
WHEELS TO BEGIN THE DY-
NAMIC TEST SEQUENCE.

OR

PRESS EITHER SWITCH UN-
DER "PUSH TO EXIT" DIS-
PLAY TO RETURN TO "STAT
TEST DYNAM" SELECTION.

IMPORTANT:

WHEN ENTERING THE DY-
NAMIC 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.

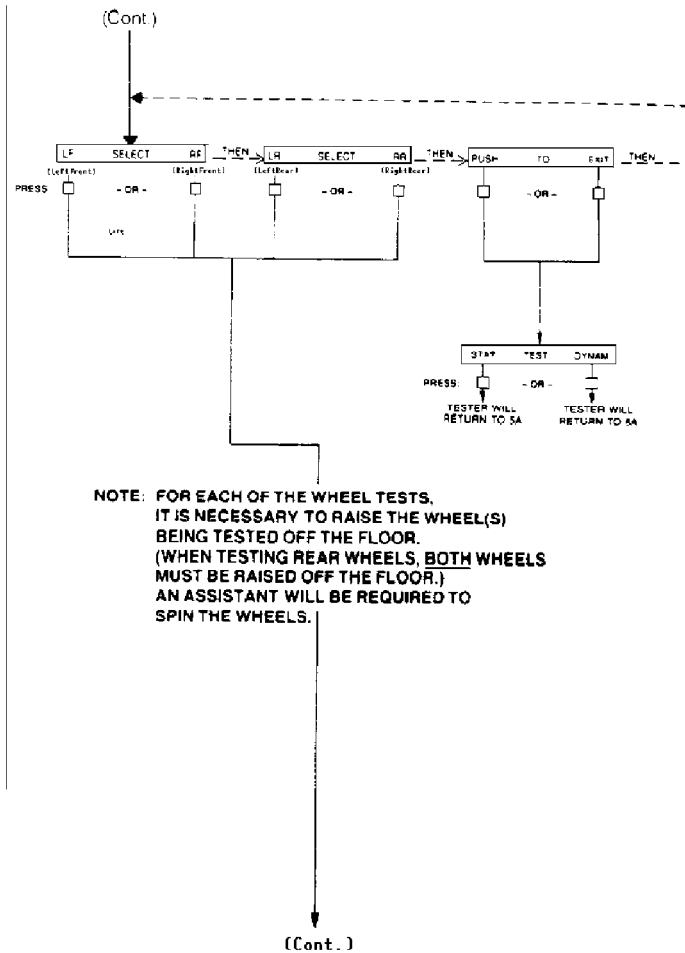


Fig. 11: ABS Testing Sequence: Chart 5 of 9
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6B. WHEEL SENSOR TEST

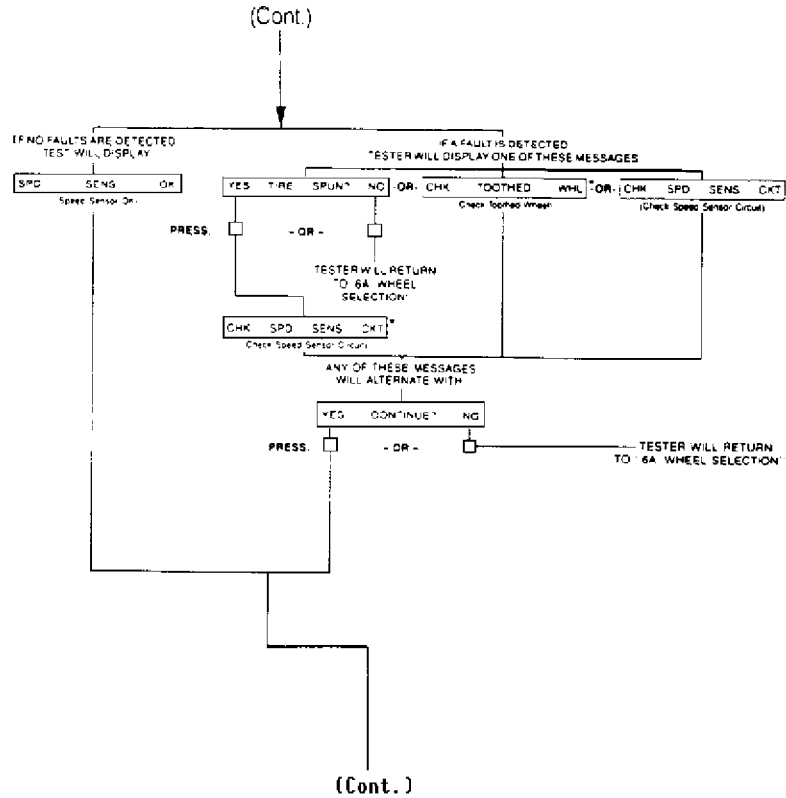


Fig. 12: ABS Testing Sequence: Chart 6 of 9
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6C. SOLENOID TEST

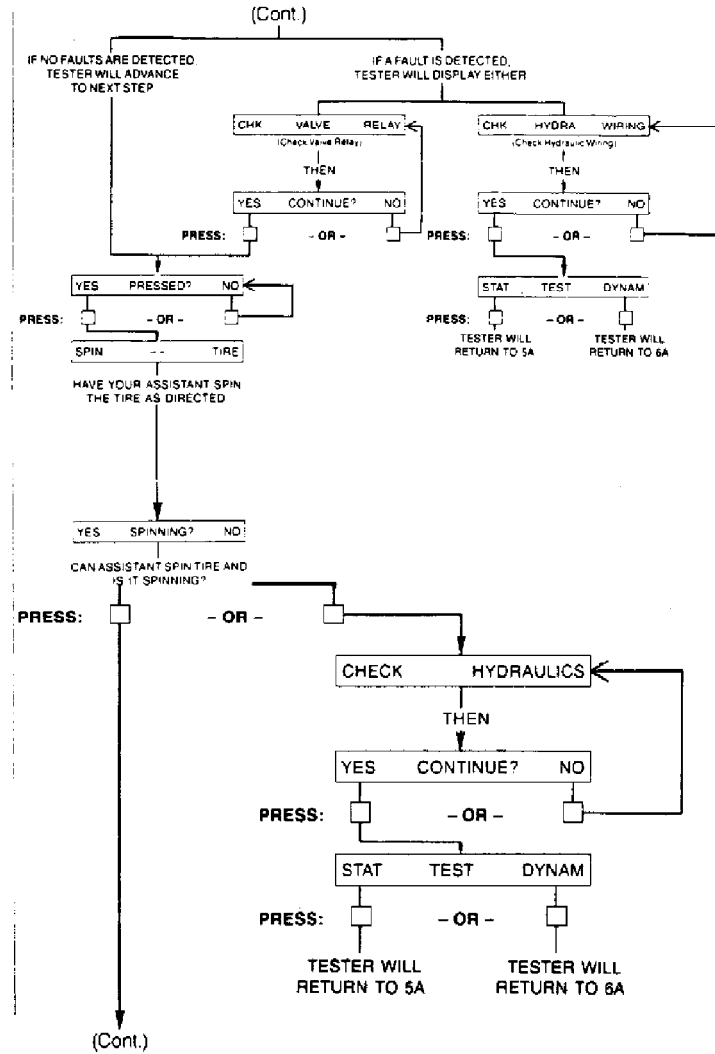


Fig. 13: ABS Testing Sequence: Chart 7 of 9
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6C. SOLENOID TEST

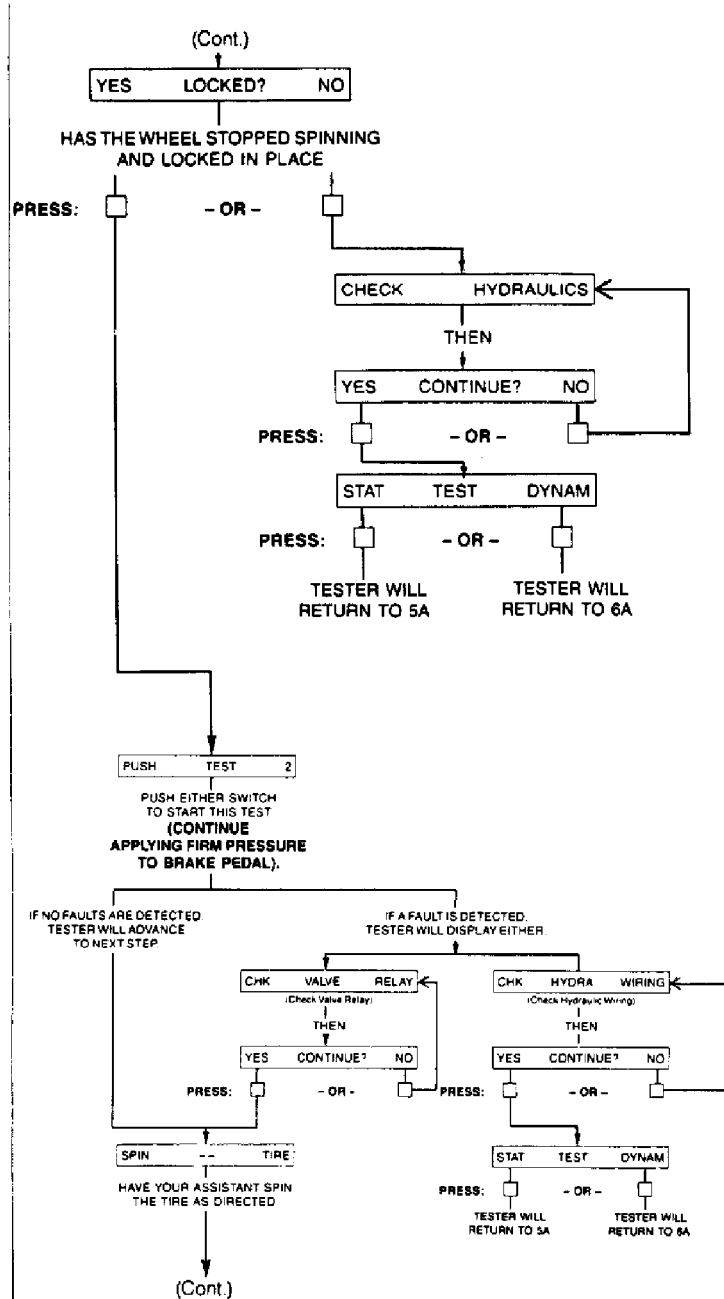


Fig. 14: ABS Testing Sequence: Chart 8 of 9
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6C. SOLENOID TEST

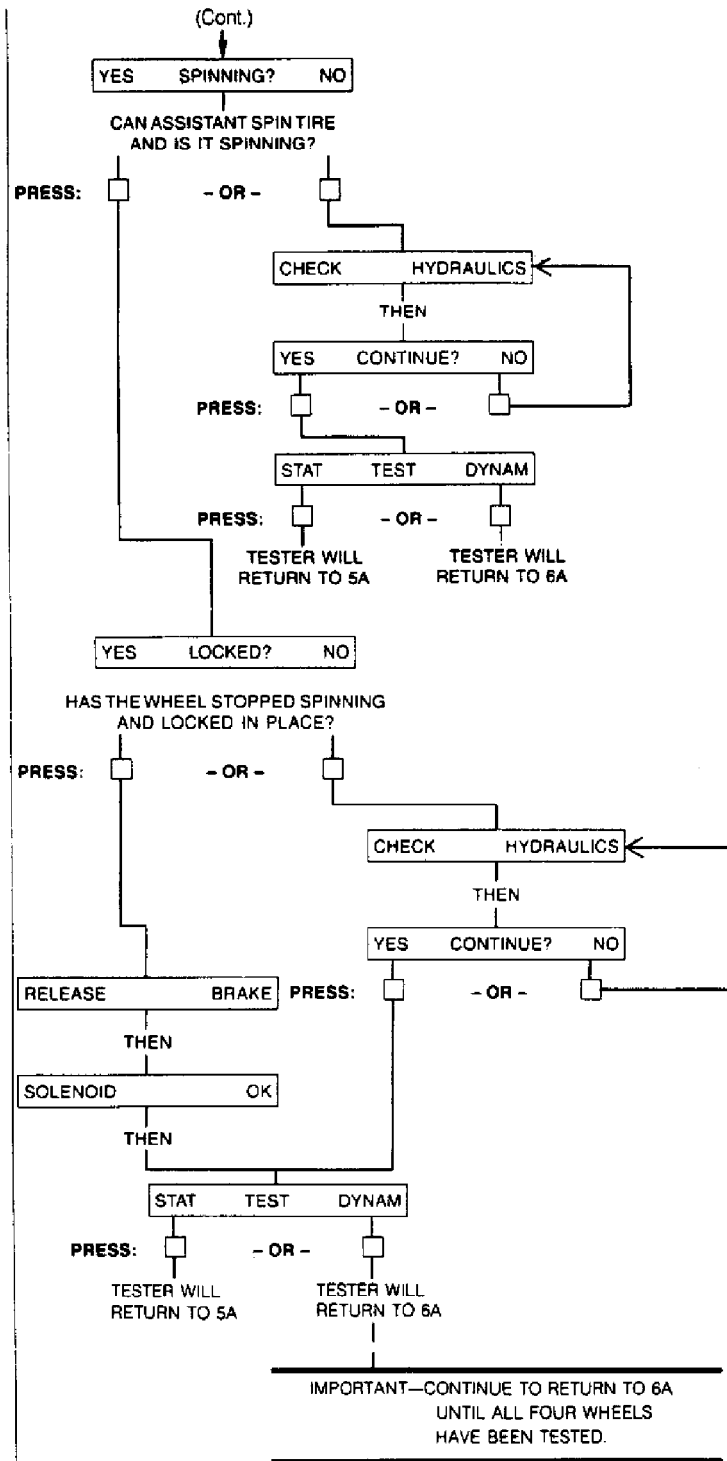


Fig. 15: ABS Testing Sequence: Chart 9 of 9
Courtesy of Mazda Motors Corp.

ANTI-LOCK BRAKE SYSTEM

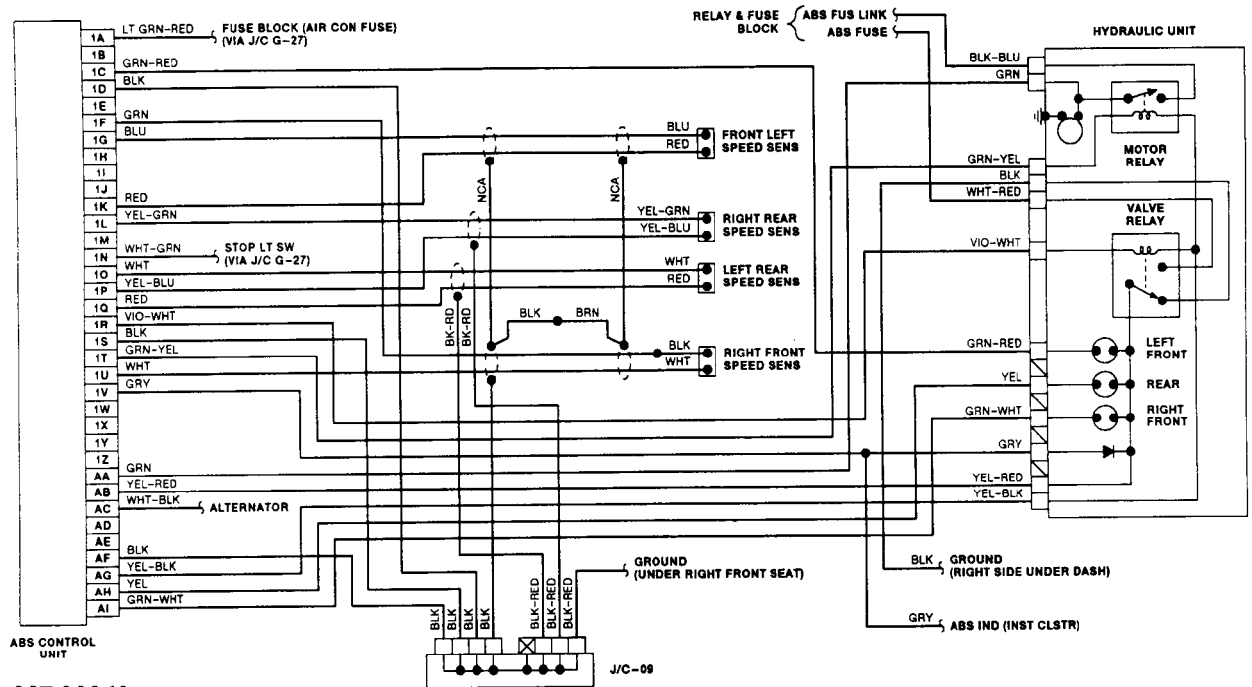
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Fig. 16: Anti-Lock Brake System (ABS) Wiring Diagram

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