ANTI-LOCK BRAKE SYSTEM

1997 BRAKES Mazda - Anti-Lock

DESCRIPTION

CAUTION: See ANTI-LOCK BRAKE SAFETY PRECAUTIONS article in GENERAL INFORMATION.

The Anti-Lock Brake System (ABS) control module 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 module. An ABS warning light is located on the instrument cluster.

NOTE: For more information on brake system, see BRAKE SYSTEM article.

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 module controls ABS by detecting speed sensor signals and activating solenoid valve in hydraulic unit. Control module 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.

COMPONENT LOCATIONS

COMPONENT LOCATIONS

Application	Location
ABS Control Module	Under Carpet, Behind Passenger Seat
Data Link 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 Axle
Wheel Speed Sensor	On Knuckle

BLEEDING BRAKE SYSTEM

CAUTION: DO NOT allow reservoir to run dry during brake bleeding procedure. If brake fluid is spilled, clean surface immediately with alcohol, 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 remains at least half full during bleeding procedure. When bleeding brake system, start with longest brakeline first. Remove bleed screw cap. Connect one end of transparent vinyl tube to bleed 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 bleed screw and drain fluid into container. Tighten bleed screw.

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

3. Refill brake fluid reservoir if necessary. Repeat step 2) until air is no longer discharged. Tighten bleed screw to 52-78 INCH lbs. (5.9-8.8 N.m). Ensure fluid leakage is not present. Add fluid to reservoir. Repeat procedure for remaining wheels.

TROUBLE SHOOTING

Before attempting to diagnose vehicle, ensure ABS warning light is functioning properly. ABS warning light will not illuminate and ABS will not operate if battery voltage is insufficient. Perform trouble shooting procedures on ABS warning light to eliminate unnecessary repairs and/or component replacement.

ABS WARNING LIGHT DOES NOT ILLUMINATE WHEN IGNITION IS TURNED ON

1. Turn ignition on. Check if other warning lights illuminate. If other warning lights do not illuminate, check METER fuse. Replace as necessary. If other warning lights illuminate, check for possible malfunction and repair as necessary. Go to next step.
2. Turn ignition off. Disconnect ABS Control Module (ABS CM) connector. See **COMPONENT LOCATIONS** . Turn ignition on. Check if ABS warning light illuminates. If ABS warning light illuminates, go to next step. If ABS warning light does not illuminate, go to step 5).
3. Reconnect ABS CM connector. Turn ignition on. Check if ABS warning light illuminates. If ABS warning light does not illuminate, go to next step. If ABS warning light illuminates, a temporary poor contact in wiring may have occurred and ABS is now functioning properly.
4. Check if terminal AD of ABS CM harness connector is damaged or deformed. See **Fig. 3** . If terminal AD is damaged or deformed, replace wiring harness connector. If terminal AD is okay, replace ABS CM.
5. With ABS CM connector disconnected, use a jumper wire and ground terminal AD of ABS CM harness connector. Check if ABS warning light illuminates. If ABS warning light illuminates, go to next step. If ABS warning light does not illuminate, go to step 7).
6. With ABS CM disconnected, check continuity between terminal AB of ABS CM harness connector and ground. Also, check continuity between terminal AC of ABS CM harness connector and ground, and

between terminal AM of ABS CM harness connector and ground. If continuity exists, replace wiring harness connector. If continuity does not exist, repair wiring harness.

7. Check ABS warning light bulb. Replace bulb as necessary. If bulb is okay, go to next step.
8. Check continuity between terminal AD of ABS CM harness connector and terminal 1K of instrument cluster connector. See **WIRING DIAGRAMS** . If continuity exists, check ABS warning light. See ABS WARNING LIGHT under **COMPONENT TESTING** . If continuity does not exist, repair wiring harness.

ABS WARNING LIGHT REMAINS ILLUMINATED

1. Ensure battery is fully charged. Charge or replace as necessary. If battery is fully charged, go to next step.
2. Check ABS Control Module (ABS CM) connector for poor connection. Turn ignition on. Check if ABS warning light goes out. If ABS warning light does not go out, go to next step. If ABS warning light goes out, a temporary poor contact in wiring may have occurred and ABS is now functioning properly.

NOTE: ABS warning light will illuminate if voltage between terminal "A" (voltage supply) of ABS CM harness connector and ground is less than about 10 volts.

3. Turn ignition off. Disconnect ABS CM connector. See **COMPONENT LOCATIONS** . Measure voltage between terminals "A" and AB of ABS CM harness connector. See **Fig. 3** . Also, measure voltage between terminals "A" and AC of ABS CM harness connector, and between terminals "A" and AM of ABS CM harness connector. If battery voltage is present, go to next step. If battery voltage is not present, repair wiring harness.
4. Connect ABS CM connector. Check for ABS DTCs. See **RETRIEVING DIAGNOSTIC TROUBLE CODES** under DIAGNOSIS & TESTING. If no DTCs are present, go to next step.
5. Turn ignition off. Disconnect ABS CM connector. Connect Harness Adapter (49-F066-022). Turn ignition on. Check if ABS warning light goes out. If ABS warning light does not go out, repair short in ABS warning light drive harness or instrument cluster. If ABS warning light goes out, replace ABS CM.

ABS WARNING LIGHT FLASHES WITH VEHICLE STOPPED

1. Ensure battery is fully charged. Charge or replace as necessary. If battery is fully charged, go to next step.
2. Check if a jumper wire is installed between terminals TBS and GND of Data Link Connector (DLC). See **Fig. 1** . If jumper wire is installed, remove jumper wire from DLC. If jumper wire is not installed, go to next step.
3. Turn ignition off. Disconnect ABS Control Module (ABS CM) connector. See **COMPONENT LOCATIONS** . Check continuity between terminal "P" of ABS CM harness connector and ground. See **Fig. 3** . If continuity exists, repair short to ground in DLC wiring harness. If continuity does not exist, replace ABS CM.

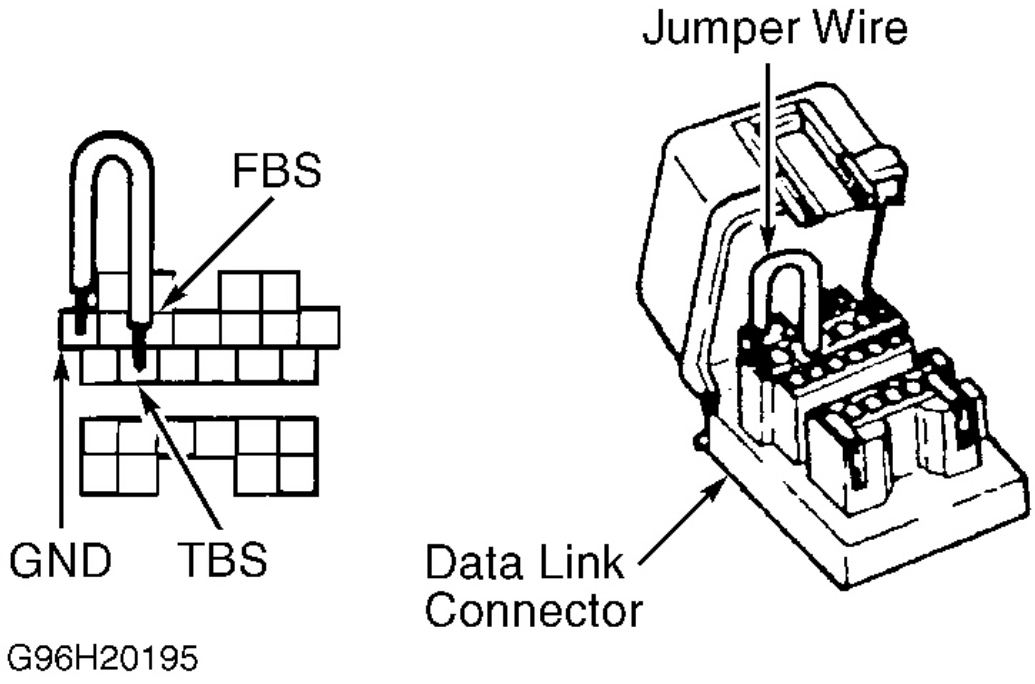

Fig. 1: Identifying Data Link Connector (DLC) Terminals
Courtesy of MAZDA MOTORS CORP.

ABS WARNING LIGHT REMAINS ILLUMINATED DURING DRIVING UNTIL IGNITION IS TURNED OFF

1. Check for ABS DTCs. See **RETRIEVING DIAGNOSTIC TROUBLE CODES** under DIAGNOSIS & TESTING. If no DTCs are present, go to next step.
2. Check ABS Control Module (ABS CM) connector for poor connection. Drive vehicle and recheck ABS warning light. If ABS warning light remains illuminated during driving and goes out when ignition is turned off, replace ABS CM. If ABS warning light does not remain illuminated during driving, a temporary poor contact in wiring may have occurred and ABS is now functioning properly.

ABS WARNING LIGHT ILLUMINATES/GOES OUT WITH VEHICLE STOPPED AND DURING DRIVING

1. Check for ABS DTCs. See **RETRIEVING DIAGNOSTIC TROUBLE CODES** under DIAGNOSIS & TESTING. If no DTCs are present, go to next step.
2. Turn ignition off. Disconnect ABC Control Module (ABS CM) connector. See **COMPONENT LOCATIONS** . Turn ignition on. Check if ABS warning light illuminates. If ABS warning light illuminates, go to next step. If ABS warning light does not illuminate, repair ABS warning light wiring harness or instrument cluster.

3. Turn ignition off. Disconnect ABS CM connector. Measure voltage between terminals "A" and AB of ABS CM harness connector. See **Fig. 3** . Also, measure voltage between terminals "A" and AC of ABS CM ha rness connector, and between terminals "A" and AM of ABS CM harness connector. If battery voltage is present, go to next step. If battery voltage is not present, repair wiring harness.
4. Turn ignition off. Reconnect ABS CM connector. Drive vehicle and recheck ABS warning light. If ABS warning light illuminates/goes out with vehicle stopped and during driving, replace ABS CM. If ABS warning light does not illuminate/go out with vehicle stopped and during driving, a temporary poor contact in wiring may have occurred and ABS is now functioning properly.

ABS WARNING LIGHT INDICATES NORMAL, BUT ABS DOES NOT OPERATE PROPERLY

Check for ABS DTCs. See **RETRIEVING DIAGNOSTIC TROUBLE CODES** under DIAGNOSIS & TESTING. If no DTCs are present, inspect mechanical system.

PRE-DIAGNOSIS INSPECTION

Visually inspect ABS components for possible cause of anti-lock problem. Visual inspection may help identify cause of a simple malfunction. Ensure ABS warning light is functioning properly. See **TROUBLE SHOOTING** .

ABS warning light illuminates under the following conditions:

- Vehicle operated on snow or ice with parking brake activated, or a dragging brake at one wheel.
- Different size tires being used.
- Tires with different traction characteristics are used on same axle.
- Vehicle is jacked up and drive wheels spin for 20 seconds or more with ignition on.
- Low battery voltage.

If ABS warning light illuminates because of these conditions, turn ignition off, then back on. ABS warning light will go out and no DTCs for described conditions will be stored in ABS control module memory.

DIAGNOSIS & TESTING

Diagnose ABS using New Generation Star (NGS) Tool (49-T088-0A0) and Adapter Harness (49-F066-002). See **RETRIEVING DIAGNOSTIC TROUBLE CODES** . On all models, test ABS control module using DVOM and adapter harness. See ABS CONTROL MODULE under **COMPONENT TESTING** .

If ABS test equipment is unavailable, test each component of ABS. See **COMPONENT TESTING** . If all ABS components test okay, replace ABS control module with a known-good module and retest system.

RETRIEVING DIAGNOSTIC TROUBLE CODES

Using New Generation Star (NGS) Tool

1. Turn ignition off. Connect New Generation Star (NGS) Tool (49-T088-0A0) to Data Link Connector

(DLC). Set NGS Adapter (49-T088-003) to ABS. Select VEHICLE & ENGINE SELECTION, then select vehicle model, engine type and model year. Select DIAGNOSTIC DATA LINK. Select ABS-ANTI LOCK BRAKE MODULE.

2. Select DIAGNOSTIC TEST MODE and note any codes displayed. See **DIAGNOSTIC TROUBLE CODE DESCRIPTION** table. Perform appropriate test. See **DIAGNOSTIC TROUBLE CODE (DTC) TESTING** . Clear codes after servicing. See **CLEARING CODES** .

DIAGNOSTIC TROUBLE CODE DESCRIPTION

DTC	Probable Cause
05	Stoplight Switch Wiring Harness
11	Right Front Wheel Speed Sensor/Sensor Rotor
12	Left Front Wheel Speed Sensor/Sensor Rotor
13	Right Rear Wheel Speed Sensor/Sensor Rotor
14	Left Rear Wheel Speed Sensor/Sensor Rotor
15	Wheel Speed Sensor/Sensor Rotor
22	(1) Right Front Solenoid Valve (AV)
23	(2) Right Front Solenoid Valve (EV)
24	(1) Left Front Solenoid Valve (AV)
25	(2) Left Front Solenoid Valve (EV)
26	(1) Rear Solenoid Valve (AV)
27	(2) Rear Solenoid Valve (EV)
51	Valve Relay
53	Motor Relay/Pump Motor
61	ABS Control Module

(1) Pressure retention valve.

(2) Pressure reduction valve.

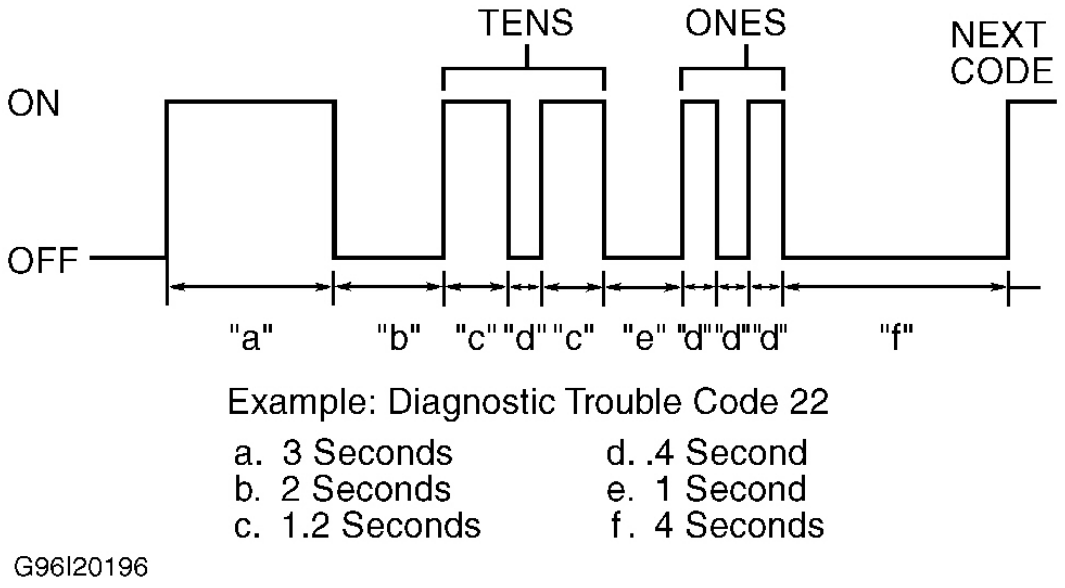

Fig. 2: Reading Diagnostic Trouble Code Output
Courtesy of MAZDA MOTORS CORP.

CLEARING CODES

NOTE: Disconnecting battery does not clear Diagnostic Trouble Codes (DTCs). If DTCs will not clear, ensure stoplight switch is functioning properly.

1. Turn ignition off. Connect a jumper wire between TBS terminal and GND terminal of Data Link Connector (DLC). See **Fig. 1** . Turn ignition on. Output all diagnostic trouble codes stored in ABS control module memory. When first code is repeated, depress brake pedal 10 times at intervals of less than one second.
2. When codes are cleared, ABS warning light will illuminate for 3 seconds, then go out. ABS operation should return to normal control. If ABS warning light does not operate as described and ABS does not return to normal operation, repeat procedure ensuring brake pedal interval does not exceed one second.

DIAGNOSTIC TROUBLE CODE (DTC) TESTING

*** PLEASE READ FIRST ***

NOTE: See PRE-DIAGNOSIS INSPECTION and DIAGNOSIS & TESTING before proceeding with DIAGNOSTIC TROUBLE CODE (DTC) TESTING. After repairs are complete, clear DTCs from ABS control module memory. See CLEARING CODES under DIAGNOSIS & TESTING.

DTC 05: STOPLIGHT SWITCH WIRING HARNESS

1. Check stoplight switch wiring harness for open or short to ground between stoplight switch and ABS control module. See **WIRING DIAGRAMS** . Repair as necessary. If wiring harness is okay, go to next step.
2. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Recheck for DTCs. If DTC 05 is displayed, replace ABS control module. If DTC 05 is not displayed, a temporary poor contact in wiring may have occurred and ABS is now functioning properly.

DTCS 11, 12, 13 & 14: WHEEL SPEED SENSOR, SENSOR ROTOR, HYDRAULIC UNIT OR WIRING HARNESS

1. Check ABS control module connector for poor connection. See **COMPONENT LOCATIONS** . Repair as necessary. If connector is okay, go to next step.
2. Check wiring harness for open or short to ground between suspect wheel speed sensor and ABS control module. See **WIRING DIAGRAMS** . Repair as necessary. If wiring harness is okay, go to next step.
3. Check suspect wheel speed sensor. See WHEEL SPEED SENSORS under **COMPONENT TESTING** . Replace as necessary. If wheel speed sensor is okay, go to next step.
4. Inspect wheel speed sensor rotor for damage or missing teeth. If sensor rotor is damaged or has missing teeth, replace sensor rotor. If sensor rotor is okay, go to next step.
5. Inspect brakeline for damage. If brakeline is damaged, replace brakeline. If brakeline is okay, go to next step.
6. Check hydraulic unit. See HYDRAULIC UNIT under **COMPONENT TESTING** . Replace as necessary. If hydraulic unit is okay, go to next step.
7. Clear DTCs. See **CLEARING CODES** under DIAGNOSIS & TESTING. Recheck for DTCs after driving vehicle from a stop to faster than 6.2 MPH. If DTC 11, 12, 13 or 14 is displayed, replace ABS control module. If DTC 11, 12, 13 or 14 is not displayed, a temporary poor contact in wiring may have occurred and ABS is now functioning properly.

DTC 15: WHEEL SPEED SENSOR, SENSOR ROTOR, HYDRAULIC UNIT OR WIRING HARNESS

If DTC 15 is displayed, perform **DTCS 11** , 12, 13 & 14: WHEEL SPEED SENSOR, SENSOR ROTOR, HYDRAULIC UNIT OR WIRING HARNESS test.

DTCS 22, 23, 24, 25, 26 & 27: SOLENOID VALVE OR WIRING HARNESS

1. Check ABS control module connector for poor connection. See **COMPONENT LOCATIONS** . Repair as necessary. If connection is okay, go to next step.
2. Check suspect solenoid valve with valve relay installed. See **SOLENOID VALVES** under COMPONENT TESTING. Replace as necessary. If solenoid valve with valve relay installed is okay, go to next step.
3. Check suspect solenoid valve with valve relay removed. See **SOLENOID VALVES** under COMPONENT TESTING. Replace solenoid valve as necessary. If solenoid valve with valve relay removed is okay, go to next step.

4. Check wiring harness for open or short to ground between hydraulic unit and ABS control module. See **WIRING DIAGRAMS** . Repair as necessary. If wiring harness is okay, go to next step.
5. Clear DTCs. See **CLEARING CODES** under DIAGNOSIS & TESTING. Recheck for DTCs. If DTC 22, 23, 24, 25, 26 or 27 is displayed, replace ABS control module. If DTC 22, 23, 24, 25, 26 or 27 is not displayed, a temporary poor contact in wiring may have occurred and ABS is now functioning properly.

DTC 51: VALVE RELAY OR WIRING HARNESS

1. Check BTN fuse. Replace as necessary. If BTN or ABS fuse is okay, go to next step.
2. Check valve relay. See **VALVE RELAY** under COMPONENT TESTING. Replace as necessary. If valve relay is okay, check wiring harness for open or short to ground between valve relay and ABS control module. See **WIRING DIAGRAMS** . Repair as necessary. If wiring harness is okay, go to next step.
3. Clear DTCs. See **CLEARING CODES** under DIAGNOSIS & TESTING. Recheck for DTCs. If DTC 51 is displayed, replace ABS control module. If DTC 51 is not displayed, a temporary poor contact in wiring may have occurred and ABS is now functioning properly.

DTC 53: PUMP MOTOR, MOTOR RELAY OR WIRING HARNESS

1. Turn ignition off and check if pump motor continues to operate. If pump motor continues operating after ignition is off, replace motor relay. If pump motor does not continue to operate after ignition is off, go to next step.
2. Check ABS fuse. Replace as necessary. If ABS fuse is okay, go to next step.
3. Check motor relay. See **MOTOR RELAY** under COMPONENT TESTING. Replace as necessary. If motor relay is okay, check wiring harness for open or short to ground between motor relay and ABS control module. See **WIRING DIAGRAMS** . Repair as necessary. If wiring harness is okay, go to next step.
4. Check pump motor. See **PUMP MOTOR** under COMPONENT TESTING. Replace as necessary. If pump motor is okay, check wiring harness for open or short to ground between hydraulic unit and ABS control module. Repair as necessary. If wiring harness is okay, go to next step.
5. Clear DTCs. See **CLEARING CODES** under DIAGNOSIS & TESTING. Recheck for DTCs. If DTC 53 is displayed, replace ABS control module. If DTC 53 is not displayed, a temporary poor contact in wiring may have occurred and ABS is now functioning properly.

DTC 61: ABS CONTROL MODULE

1. Check ABS control module connector for poor connection. See **COMPONENT LOCATIONS** . Repair as necessary. If connector is okay, go to next step.
2. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Recheck for DTCs. If DTC 61 is displayed, replace ABS control module. If DTC 61 is not displayed, a temporary poor contact in wiring may have occurred and ABS is now functioning properly.

COMPONENT TESTING

GENERAL NOTE

NOTE: Before testing ABS components, ensure battery and charging system are functioning properly.

ABS CONTROL MODULE

Turn ignition off. Test ABS Control Module (ABS CM) using DVOM and Adapter Harness (49-F066-002) connected to ABS CM connector. See **Fig. 3** . Measure resistance, continuity or voltage as specified. See **Fig. 3** -7. If checking voltage, measure between applicable terminal and GND terminal (AB, AC or AM) of ABS CM connector. If voltage, continuity or resistance is not as specified, replace ABS CM.

Fig. 3: Identifying ABS Control Module Connector Terminals
Courtesy of MAZDA MOTORS CORP.

Terminal	Signal name	Connected to	Item	Condition	Specification	Possible cause
A	Voltage supply (System)	IG SW	Voltage	IG SW ON	B+	Harness (IG SW-ABS CM connector)
				IG SW OFF	0 V	
B	Voltage supply (Relay drive)	HU (motor relay, valve relay coil)	Continuity	B—GND	No	Harness (B-motor relay-valve relay, G-motor relay, B-valve relay) Motor relay Valve relay
				B—A (IG SW ON)	No	
			Resistance	B—G	72—88 Ω	
				B—AK	93—113 Ω	
G	Motor relay drive	HU (motor relay coil)	Continuity	G—GND	No	Harness (B-motor relay-valve relay, G-motor relay, B-valve relay) Motor relay Valve relay
				G—A (IG SW ON)	No	
			Resistance	B—G	72—88 Ω	
AK	Valve relay drive	HU (valve relay coil)	Continuity	AK—GND	No	Harness (B-motor relay-valve relay, G-motor relay, B-valve relay) Motor relay Valve relay
				AK—A (IG SW ON)	No	
			Resistance	B—AK	93—113 Ω	
P	On-board diagnosis TBS	Data link connector TBS	Continuity	P—GND	No	Harness (P-TBS at DLC)
				P—A (IG SW ON)	No	
				P—TBS at DLC	Yes	
AT	On-board diagnosis FBS	Data link connector FBS	Continuity	AT—GND	No	Harness (AT-FBS at DLC)
				AT—A (IG SW ON)	No	
				AT—FBS at DLC	Yes	

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Fig. 4: Testing ABS Control Module (1 Of 3)
Courtesy of MAZDA MOTORS CORP.

Terminal	Signal name	Connected to	Item	Condition	Specification	Possible cause
X	Motor monitor	HU (ABS motor)	Voltage	When B+ applied between B and G	B+	Harness (B-motor relay-G, motor relay-battery, X-motor relay-motor, motor-motor GND) Motor Motor relay
				When open between B and G	0 V	
			Continuity	X—GND	Yes	
AB	System GND (power)	Ground point	Continuity	AB—ground point	Yes	Harness (Each terminal-ground point)
AC	System GND (power)			AC—ground point	Yes	
AM	System GND (signal)			AM—ground point	Yes	
				AB—AD, AC—AD	Yes	Short plate of harness connector
				AM—AD	Yes	
AD	Warning light	ABS warning light	Continuity	AD—GND (IG OFF)	Yes	Harness (AD-meter, meter-IG SW) Meter
				AD—A (IG OFF)	No	
			Voltage	When IG SW ON	B+	
AV	Brake switch	Brake switch	Voltage	When brake pedal depressed	B+	Harness (AV-brake SW) (When brake light normal)
				When brake pedal released	0 V	
AJ	LF wheel-speed	LF wheel-speed sensor	Voltage	Vehicle stopped	0 V (AC)	Harness (sensor-ABS CM harness connector)
J				When turned 1 revolution per second	0.25—1.2 V (AC)	
			Resistance	AJ—J	0.8—1.2 kΩ	Sensor, Installation condition
O	RF wheel-speed	RF wheel-speed sensor	Voltage	Vehicle stopped	0 V (AC)	Harness (sensor-ABS CM harness connector)
N				When turned 1 revolution per second	0.25—1.2 V (AC)	
			Resistance	O—N	0.8—1.2 kΩ	Sensor, Installation condition
K	RR wheel-speed	RR wheel-speed sensor	Voltage	Vehicle stopped	0 V (AC)	Harness (sensor-ABS CM harness connector)
AL				When turned 1 revolution per second	0.25—1.2 V (AC)	
			Resistance	K—AL	0.8—1.2 kΩ	Sensor, Installation condition
AN	LR wheel-speed	LR wheel-speed sensor	Voltage	Vehicle stopped	0 V (AC)	Harness (sensor-ABS CM harness connector)
L				When turned 1 revolution per second	0.25—1.2 V (AC)	
			Resistance	AN—L	0.8—1.2 kΩ	Sensor, Installation condition

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Fig. 5: Testing ABS Control Module (2 Of 3)
Courtesy of MAZDA MOTORS CORP.

Terminal	Signal name	Connected to	Item	Condition	Specification	Possible cause
E	Left front solenoid valve (EV) drive	HU (LF solenoid valve)	Voltage	When B+ applied between B and AK	B+	Harness (B-motor relay-AK, valve relay-battery, valve relay-solenoid Each terminal-solenoid valve) Valve relay Solenoid valve
			Continuity	E—GND	No	
				E—A	No	
AG	Left front solenoid valve (AV) drive	HU (LF solenoid valve)	Voltage	When B+ applied between B and AK	B+	
			Continuity	AG—GND	No	
				AG—A	No	
BB	Right front solenoid valve (EV) drive	HU (RF solenoid valve)	Voltage	When B+ applied between B and AK	B+	
			Continuity	BB—GND	No	
				BB—A	No	
Z	Right front solenoid valve (AV) drive	HU (RF solenoid valve)	Voltage	When B+ applied between B and AK	B+	
			Continuity	Z—GND	No	
				Z—A	No	
BA	Rear solenoid valve (EV) drive	HU (Rear solenoid valve)	Voltage	When B+ applied between B and AK	B+	
			Continuity	BA—GND	No	
				BA—A	No	
Y	Rear solenoid valve (AV) drive	HU (Rear solenoid valve)	Voltage	When B+ applied between B and AK	B+	
			Continuity	Y—GND	No	
				Y—A	No	

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Fig. 6: Testing ABS Control Module (3 Of 3)
Courtesy of MAZDA MOTORS CORP.

HYDRAULIC UNIT

On-Vehicle Inspection

1. Ensure all diagnostic trouble codes have been cleared and battery is fully charged. See **CLEARING CODES** under DIAGNOSIS & TESTING. Turn ignition on and check if ABS warning light goes out after 2-4 seconds. If ABS warning light remains illuminated, ABS control module has detected a failure and will not activate hydraulic unit. See **DIAGNOSIS & TESTING** .
2. Turn ignition off. Ensure vehicle is on level surface. Raise and support vehicle. Place transmission in Neutral. Release parking brake. Rotate wheels by hand and check for brake drag. Connect a jumper wire between TBS terminal and GND terminal of data link connector. See **Fig. 1** . Depress brake pedal and have an assistant attempt to rotate right front wheel. Wheel should not rotate.
3. With brake pedal still depressed, turn ignition on. Brake should be momentarily released (about .5 second) and wheel should turn when pressure reduction operates. Check operation of remaining wheels using same procedure beginning with left front, right rear, then left rear wheels.
4. If all wheels operate as specified, the following systems are operating properly.
    - Brake piping to hydraulic unit.
    - Braking system, including hydraulic unit.
    - Hydraulic unit electrical system (solenoid, pump motor, etc.)

- ABS control module output system (solenoid, relay, etc.) and harness.

5. If all wheels do not operate as specified, check ABS control module input system and wiring harness for intermittent failure. Check for fluid leakage. Repair as necessary. If input system, wiring harness, intermittent failure or fluid leakage are not present, replace hydraulic unit.

PUMP MOTOR

1. Turn ignition off. Disconnect ABS Control Module (ABS CM) connector. See **COMPONENT LOCATIONS** . Connect Adapter Harness (49-F066-002) to ABS CM connector. Using ohmmeter, measure resistance between terminal "X" of ABS CM connector and ground. See **Fig. 3** . Resistance should not be more than one ohm. If the resistance is not as specified, check wiring harness between ABS CM and pump motor. Refer to **WIRING DIAGRAMS** . If wiring harness is okay, go to next step.
2. Turn ignition off. Disconnect pump motor/hydraulic unit 2-pin connector. Using ohmmeter, measure resistance between terminal "B" of pump motor/hydraulic unit connector and ground. See **Fig. 7** . Resistance should not be more than one ohm. Apply 12 volts across pump motor/hydraulic unit 2-pin connector terminals. Pump motor should operate. If resistance is not as specified or pump motor does not operate, check wiring harness. If wiring harness is okay, replace hydraulic unit.

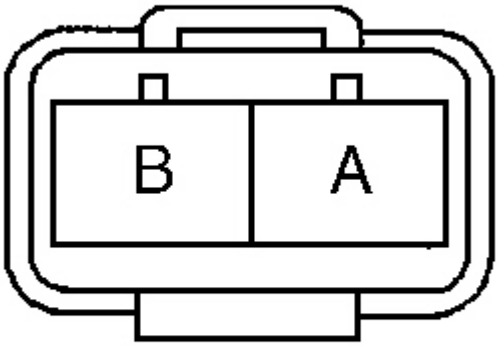

Fig. 7: Identifying Pump Motor/Hydraulic Unit Connector Terminals
Courtesy of MAZDA MOTORS CORP.

SOLENOID VALVES

With Valve Relay Installed

Turn ignition off. Disconnect hydraulic unit 12-pin connector. See **COMPONENT LOCATIONS** . Apply 12

volts to terminal "A" and ground terminal "D" of hydraulic unit 12-pin connector. See **Fig. 8** . Using ohmmeter, measure resistance between terminal "B" and specified terminals of hydraulic unit connector. See **HYDRAULIC UNIT CONNECTOR TERMINAL RESISTANCE** table. If resistance is not as specified, check solenoid valves with vale relay removed. See WITH VALVE RELAY REMOVED. Also check valve relay. See VALVE RELAY.

HYDRAULIC UNIT CONNECTOR TERMINAL RESISTANCE

Terminal	Ohms
"H"	4.7
"I"	4.7
"J"	4.7
"M"	9
"N"	9
"O"	9

With Valve Relay Removed

Turn ignition off. Remove hydraulic unit. See HYDRAULIC UNIT under **REMOVAL & INSTALLATION** . Remove valve relay from hydraulic unit. Using ohmmeter, measure resistance between terminal "X" of hydraulic unit valve relay connector and specified terminals of hydraulic unit connector. See **Fig. 8** and **Fig. 9** . See **HYDRAULIC UNIT CONNECTOR TERMINAL RESISTANCE** table. If resistance is not as specified, check wiring harness. If wiring harness is okay, replace hydraulic unit.

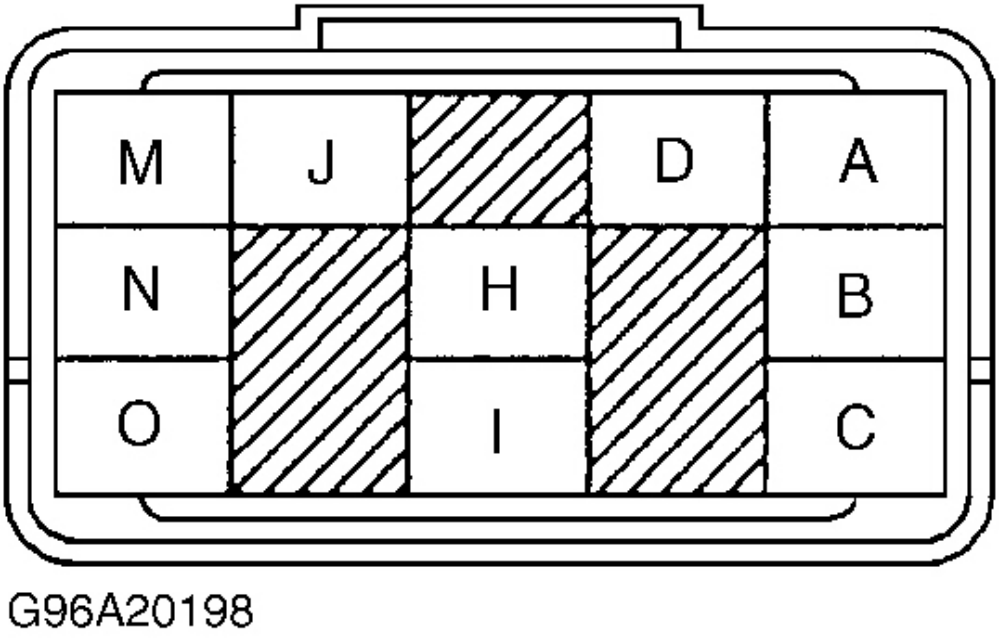

Fig. 8: Identifying Hydraulic Unit Connector Terminals
Courtesy of MAZDA MOTORS CORP.

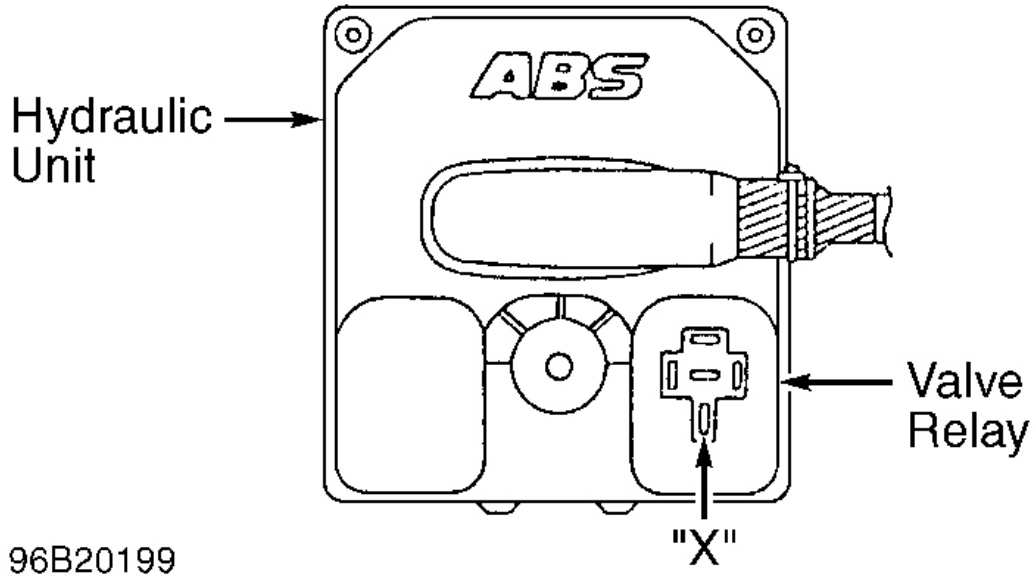

Fig. 9: Locating Hydraulic Unit Valve Relay Connector Terminals
Courtesy of MAZDA MOTORS CORP.

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, turn ignition off. Disconnect ABS control module connector. Using a jumper wire, connect terminal AD of ABS control module connector to ground. See **Fig. 3** . Turn ignition on.
2. If ABS warning light illuminates, check ABS control module. See ABS CONTROL MODULE. If light does not illuminate, remove instrument cluster. Remove and check ABS warning light bulb. Replace bulb as necessary. If bulb is okay, check METER fuse and wiring harness. Repair or replace as necessary. If METER fuse and wiring harness are okay, go to next step.
3. Using ohmmeter, connect positive lead to terminal 2K (Black/Yellow wire) of instrument cluster and negative lead to terminal 1K (Blue/Yellow wire) of instrument cluster. See **Fig. 10** . If continuity is not present, replace instrument cluster. If continuity is present, repair wiring harness between instrument cluster and ABS control module.

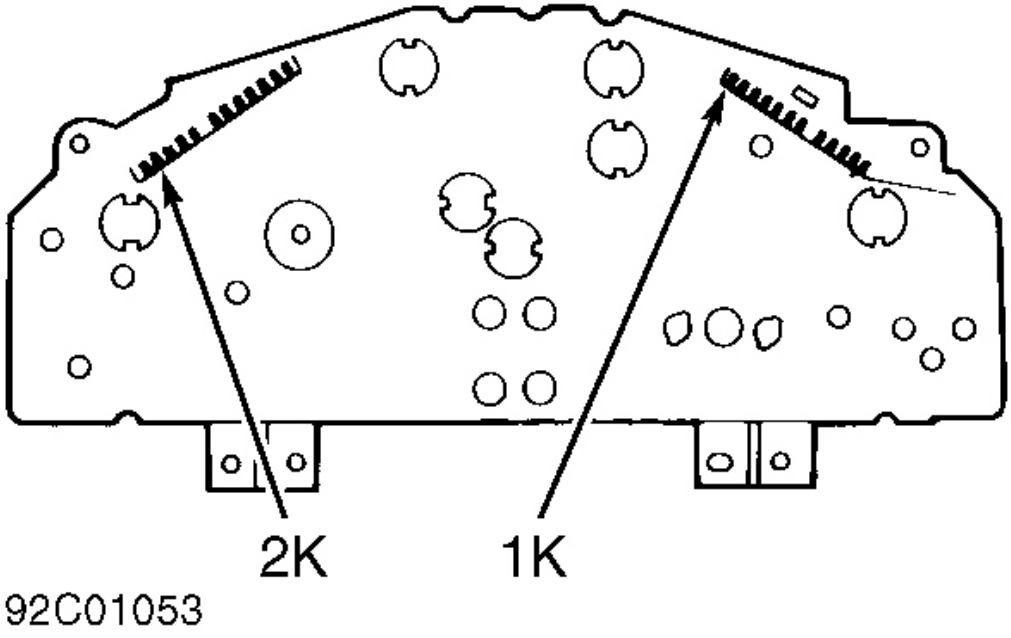

Fig. 10: Identifying Instrument Cluster Connector Terminals
Courtesy of MAZDA MOTORS CORP.

STOPLIGHT SWITCH

Disconnect stoplight switch connector. Using ohmmeter, check continuity between stoplight switch terminals. With brake pedal depressed, continuity should exist. With brake pedal released, continuity should not exist. If continuity is not as specified, replace stoplight switch.

MOTOR RELAY

1. Turn ignition off. Disconnect ABS Control Module (ABS CM) connector. See **COMPONENT LOCATIONS** . Connect Adapter Harness (49-F066-002) to ABS CM connector. Turn ignition on. Using voltmeter, measure voltage between terminals "X" and AB of ABS CM connector. See **Fig. 3** . Voltage should be zero volts. Apply 12 volts to terminal "B" an d ground terminal "G" of ABS CM connector. Using voltmeter, measure voltage between terminals "X" and AB of ABS CM connector. Voltage should be 12 volts. If voltage is not as specified, check wiring harness. If wiring harness is okay, go to next step.
2. Remove motor relay from hydraulic unit. See **Fig. 14** . Using ohmmeter, check continuity between terminals "B" and "C" of motor relay. See **Fig. 11** . Continuity should exist. Apply 12 volts to terminal "C" and ground terminal "B". Using ohmmeter, check continuity between terminals "A" and "D" of motor relay. Continuity should exist. If continuity is not as specified, replace motor relay.

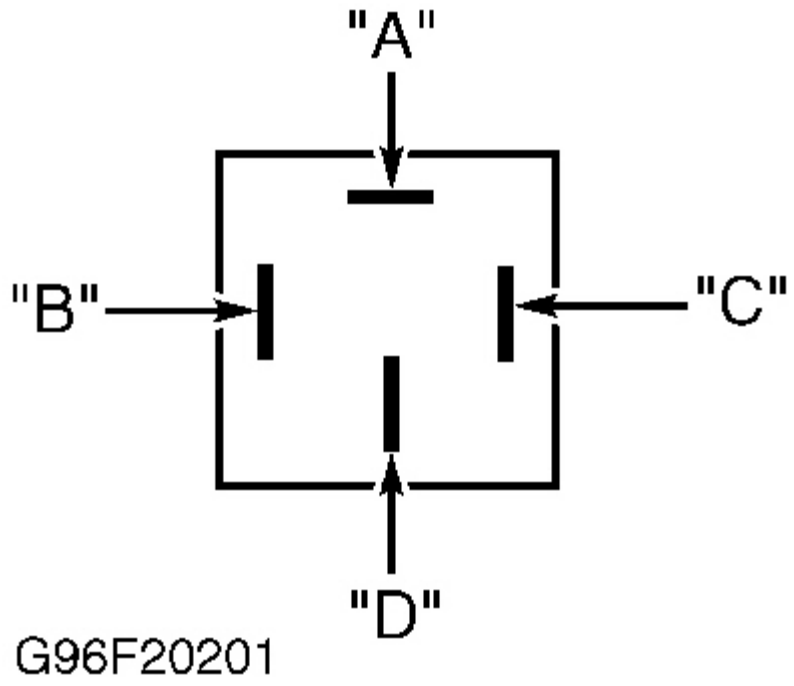

Fig. 11: Identifying Motor Relay Terminals
Courtesy of MAZDA MOTORS CORP.

VALVE RELAY

1. Turn ignition off. Disconnect ABS Control Module (ABS CM) connector. See **COMPONENT LOCATIONS** . Connect Adapter Harness (49-F066-002) to ABS CM connector. Turn ignition on. Using voltmeter, measure voltage between terminal AB and terminals "E", "Z", "Y", AG, BA and BB of ABS CM connector. See **Fig. 3** . Voltage on all terminals should be zero volts. If voltage is as specified, go to next step. If voltage is not as specified, check wiring harness and repair as necessary. If wiring harness is okay, go to step 3).
2. Apply 12 volts to terminal "B" and ground terminal AK of ABS CM connector. Using voltmeter, measure voltage between terminal AB and terminals "E", "Z", "Y", AG, BA and BB of ABS CM connector. See **Fig. 3** . Voltage on all terminals should be 12 volts. If voltage is not as specified, check wiring harness. If wiring harness is okay, go to next step.
3. Remove valve relay from hydraulic unit. See **Fig. 14** . Using ohmmeter, check continuity between terminals "B" and "C" of valve relay. See **Fig. 12** . Continuity should exist. Apply 12 volts to terminal "B" and ground terminal "C". Using ohmmeter, check continuity between terminals "A" and "D" of valve relay. Continuity should exist. If continuity is not as specified, replace valve relay.

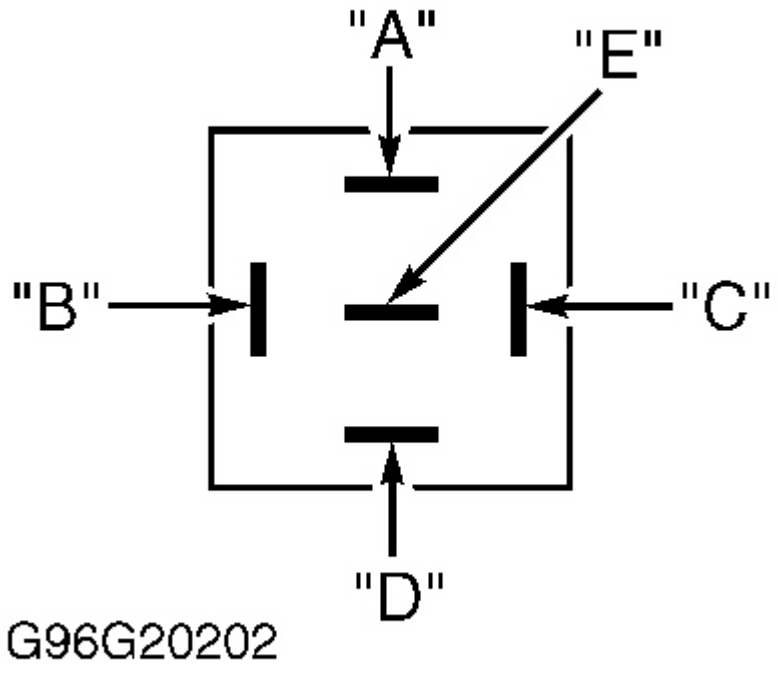

Fig. 12: Identifying Valve Relay Terminals
Courtesy of MAZDA MOTORS CORP.

WHEEL SPEED SENSORS

On-Vehicle Inspection

Remove wheel. Inspect wheel speed sensor for looseness and damage. Replace as necessary. Measure clearance between wheel speed sensor and sensor rotor. See **Fig. 13** . Clearance should be .012-.043" (.3-1.1 mm). If clearance is not as specified, replace wheel speed sensor or sensor rotor.

Resistance Test

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

Voltage Test

Ensure vehicle is on level surface. Raise and support vehicle on safety stands. Disconnect wheel speed sensor connector. Using voltmeter, while rotating wheel one revolution per second, measure voltage between wheel speed sensor terminals. Voltage should be .25-1.2 volts (AC). If voltage is not as specified, replace wheel speed

sensor or sensor rotor.

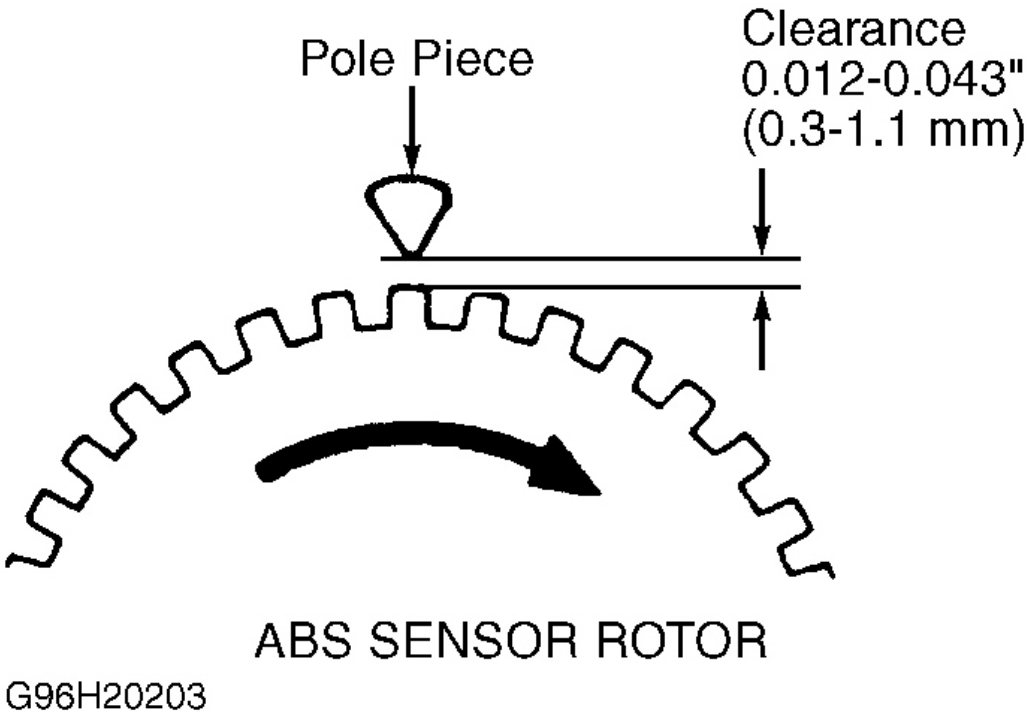

Fig. 13: Measuring Wheel Speed Sensor Clearance
Courtesy of MAZDA MOTORS CORP.

WHEEL SPEED SENSOR ROTORS

Inspection

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

REMOVAL & INSTALLATION

ABS CONTROL MODULE

Removal & Installation

1. Disconnect negative battery cable. Roll back carpet from passenger-side footwell. Remove ABS control module protector panel (if equipped).

2. Disconnect ABS control module electrical connector. Remove ABS control module mounting bolts/nuts. Remove ABS control module. To install, reverse removal procedure. Tighten ABS control module mounting bolts/nuts to 61-87 INCH lbs. (6.9-9.8 N.m).

HYDRAULIC UNIT

Removal & Installation

1. Disconnect negative battery cable. Disconnect hydraulic unit electrical connector. Using Flare Nut Wrench (49-0259-770B), disconnect brakelines from hydraulic unit. Note location of brakelines for installation reference. Disconnect electrical connectors. Remove hydraulic unit mounting bolts and nuts.
2. Remove hydraulic unit. To install, reverse removal procedure. Tighten mounting bolts and nuts to specification. See **TORQUE SPECIFICATIONS** . Add fluid and 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 wheel speed sensor rotor from hub.

Installation

To install, reverse removal procedure. Tighten bolts and nuts to specification. See **TORQUE SPECIFICATIONS** .

REAR WHEEL SPEED SENSOR ROTOR

Removal

Raise and support vehicle. Remove rear wheel assemblies. Remove brake caliper and wire aside. Remove wheel bearing lock nut. Remove lower control arm-to-rear steering knuckle bolt and nut. Remove drive axle. DO NOT disassemble drive axle assembly to remove sensor rotor. Replace drive axle assembly.

Installation

To install, reverse removal procedure. 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 connector. Remove wheel speed sensor mounting bolt. Remove wheel speed sensor from vehicle. To install, reverse

removal procedure. Tighten mounting bolt 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. 14** . To install, reverse removal procedure.

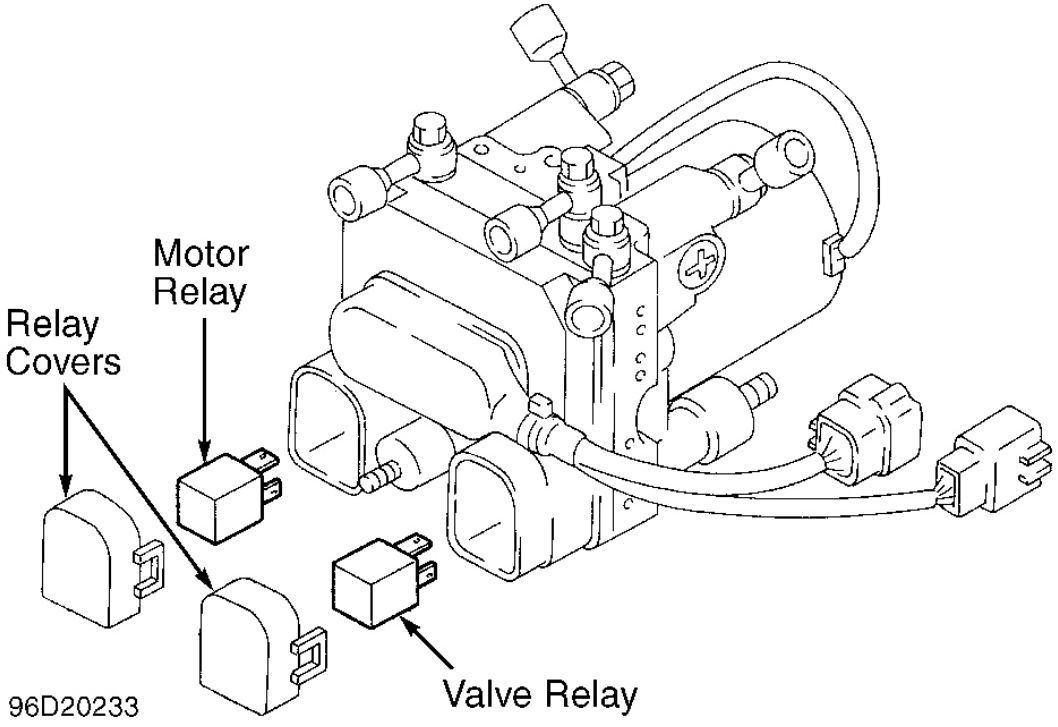

Fig. 14: Locating Valve Relay & Motor Relay
Courtesy of MAZDA MOTORS CORP.

ADJUSTMENTS

MASTER CYLINDER PUSH ROD

1. Before installing master cylinder, measure clearance between master cylinder piston and power brake unit push rod. Turn adjusting nut on Adjustment Gauge (49-B043-001) clockwise to fully retract gauge rod. Place adjustment gauge onto power brake unit and tighten mounting nuts to 88-138 INCH lbs. (9.9-15.6 N.m).
2. Using a hand-held vacuum pump, apply 19.7 in. Hg to power brake unit. Turn adjusting gauge nut counterclockwise until gauge rod just contacts push rod end of power brake unit. Perform STEP 1. See

Fig. 15 .

3. Lightly push on end of adjusting gauge rod to ensure it is properly seated. Verify no gap exists between adjusting nut and adjusting gauge body. Remove adjusting gauge from power brake unit without disturbing adjusting nut. Place adjusting gauge on master cylinder.

NOTE: When lightly pushing on end of adjusting gauge rod in step 4), only use enough pressure to bottom rod in piston. Too much pressure may cause a false reading.

4. Lightly push on end of adjusting gauge rod to ensure gauge rod is bottomed in master cylinder piston. Ensure no clearance exists between adjusting gauge body and adjusting nut (clearance "B") or between body and master cylinder (clearance "C"). Perform STEP 2. See **Fig. 15** .
5. If clearance "B" exists, push rod is too short. If clearance "C" exists, push rod is too long. To adjust clearance "B", go to next step. To adjust clearance "C", go to step 8).

NOTE: Push rod threads are specially designed so bolt becomes harder to turn past a certain point to prevent loosening of bolt. Turn bolt only within this range.

6. To adjust clearance "B", lightly push on end of adjusting gauge rod. Using a feeler gauge, measure clearance between adjusting nut and adjusting gauge. Perform STEP 3. See **Fig. 15** .
7. Using Push Rod Adjuster (49-B043-004) and Adapter (49-B043-003), turn push rod nut to lengthen power brake booster push rod an amount equal to amount measured at clearance "B" in step 6). Perform STEP 4. See **Fig. 15** .
8. To adjust clearance "C", measure and record adjusting gauge rod height D1. Perfrom STEP 5. See **Fig. 15** . Turn adjusting nut until adjusting gauge body sits squarely on master cylinder.
9. Turn adjusting nut only enough for body to touch adjusting gauge. Measure and record adjusting gauge height D2 of adjusting gauge rod. Perform STEP 6. See **Fig. 15** . Subtract D1 from D2 measurement.
10. Using push rod adjuster and adapter, turn push rod nut to shorten power brake booster push rod an amount equal to difference between height D1 and D2. Perform STEP 4. See **Fig. 15** .

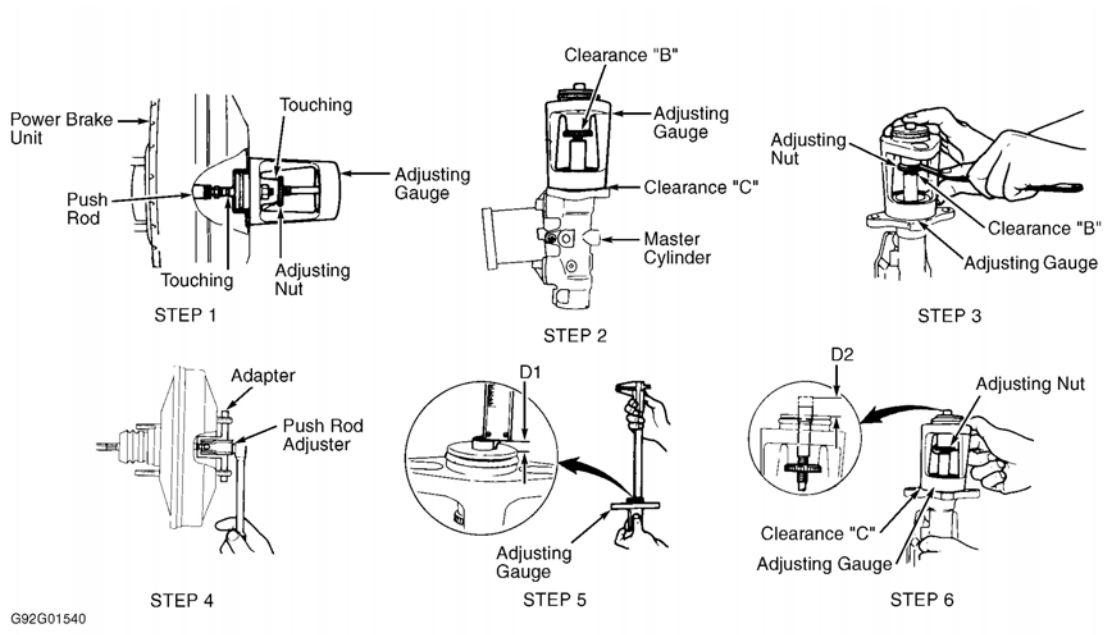

Fig. 15: Adjusting Master Cylinder Push Rod
Courtesy of MAZDA MOTORS CORP.

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 as specified. 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, 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 or worn pads. Repair as necessary.

BRAKE PEDAL HEIGHT SPECIFICATIONS

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

BRAKE PEDAL FREE PLAY

With engine off, depress pedal a few times to eliminate vacuum. Depress brake pedal by hand and check pedal free play. See **BRAKE PEDAL FREE PLAY SPECIFICATIONS** table. Adjust 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 FREE PLAY SPECIFICATIONS

Application	In. (mm)
Miata	.16-.28 (4-7)

PARKING/EMERGENCY BRAKE

1. Depress brake pedal several times. Pull parking brake lever with a force of 44 lbs. (20 kg). If stroke is 7-9 notches, parking brake is properly adjusted. If stroke is not 7-9 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

Application	Ft. Lbs. (N.m)
Brake Caliper Mounting Bolts	37-50 (50-68)
Brakeline Nuts	10-16 (14-22)
Hydraulic Unit Brakeline Union Bolts	18-26 (24-35)
Hydraulic Unit Mounting Bolts/Nuts	14-18 (19-24)
I-Arm-To-Rear Steering Knuckle Bolt (RX7)	44-54 (59-73)
Lower Control Arm-To-Rear Steering Knuckle Nut	47-54 (64-73)
Push Rod Lock Nut	18-25 (24-34)
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	66-86 (89-117)
Wheel Speed Sensor Mounting Bolt	12-16 (16-22)
	INCH Lbs. (N.m)
ABS Control Unit Mounting Bolts/Nuts	61-87 (6.9-9.8)

WIRING DIAGRAMS

1997 Mazda MX-5 Miata

ANTI-LOCK BRAKE SYSTEM 1997 BRAKES Mazda - Anti-Lock

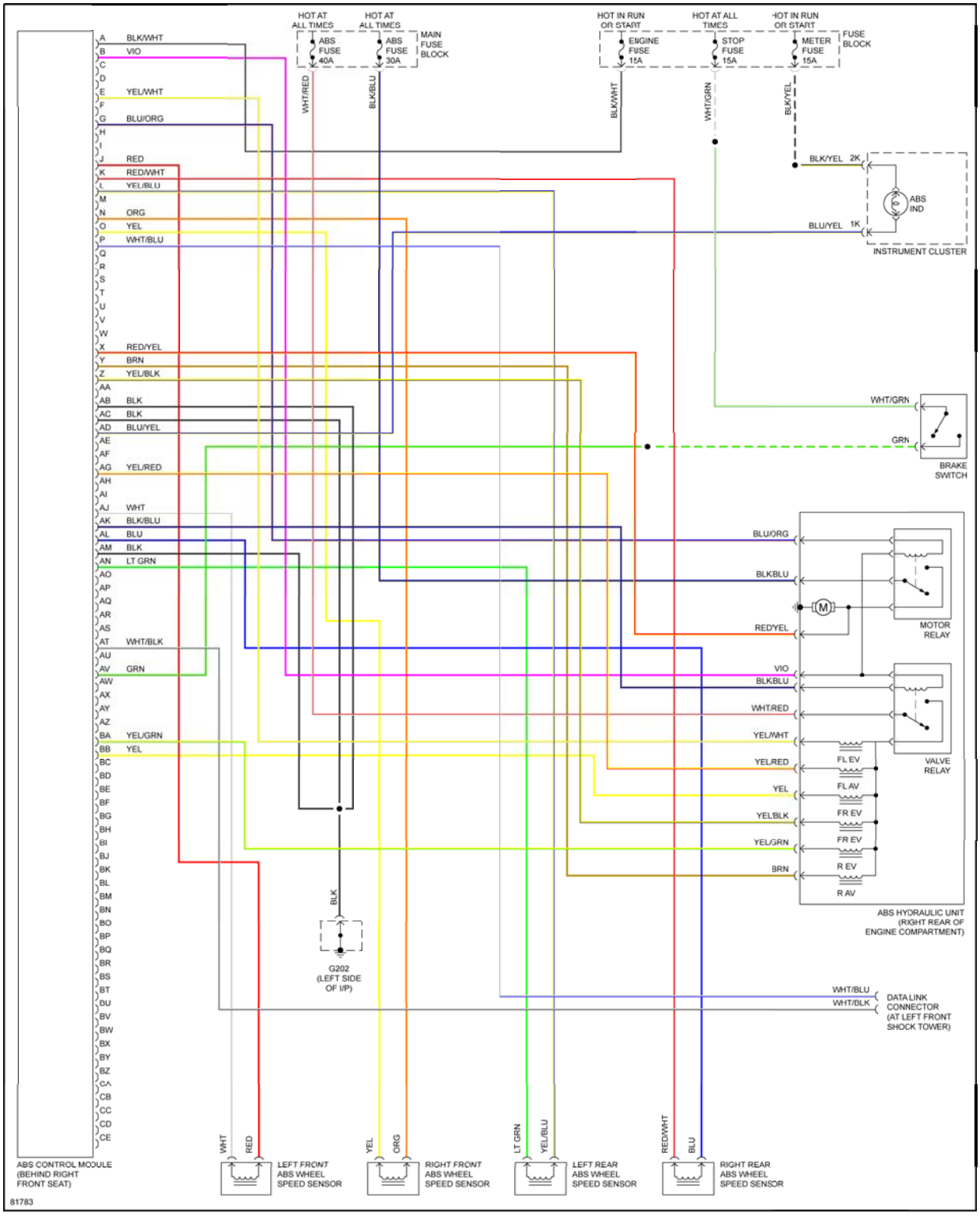

Fig. 16: Anti-Lock Brake System (ABS) Wiring Diagram (1997 Miata)