Section 5

Brakes

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Hydraulic Brakes

Specifications

Fastener Tightening Specifications

Application	Metric	English
Brake Pedal Bracket to Dash Fastener	29 N·m	21 lb ft
Brake Pedal Pivot Bolt Nut	10 N·m	89 lb in
Brake Pedal Pushrod to Pedal Fastener	34 N·m	25 lb ft
Brake Pipe Clip Bolts or Screws	12 N·m	106 lb in
Brake Pipe Fittings	14 N·m	124 lb in
Brake Pipe Fittings (at the Master Cylinder)	24 N·m	18 lb ft
Brake Pipe Fittings (at Rear Axle)	23.5 N·m	17 lb ft
Brake Rod Boot Screws	1.7 N·m	15 lb in
Commercial Brake Pedal Linkage Pivot Bolt	55 N·m	41 lb ft
Commercial Brake Pedal Linkage Retainer Nut	34 N·m	25 lb ft
Front Brake Hose Bracket Bolt	17 N·m	13 lb ft
Front Brake Hose Frame Nut	9.5 N·m	84 lb in
Front Brake Hose Frame Nut (FL7 with JF9)	9.0 N·m	80 lb in
Front and Rear Brake Hose to Caliper Fastener	44 N·m	32 lb ft
Hydraulic Brake Booster Cover Bolts	30 N·m	20 lb ft
Hydraulic Brake Booster to Cowl Nuts	36 N·m	27 lb ft
Hydraulic Brake Booster Hoses	27 N·m	20 lb ft
Master Cylinder to Hydraulic Brake Booster Nuts	36 N·m	27 lb ft
Master Cylinder Mounting Nuts	29 N·m	21 lb ft
Push Rod Adjusting Nut	30 N·m	22 lb ft
Rear Brake Hose Bracket Bolt	17 N·m	13 lb ft
Rear Brake Hose to Axle Bracket	17 N·m	13 lb ft

Brake System Specifications

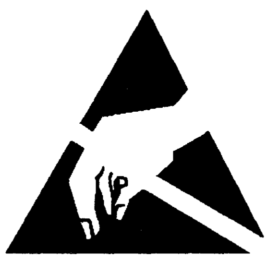
System	Master Cylinder Diameter	Front Disc Brakes	Rear Drum Brakes	Rear Disc Brakes	Brake Assist
JB7	31.8 mm	319 x 39.3 mm	331.5 x 63.8 mm	—	Hydraulic Hydro-Boost
	1.25 in	12.50 x 1.54 in	13.00 x 2.50 in	—	
JB8	31.8 mm	319 x 39.3 mm	331.5 x 63.8 mm	—	Hydraulic Hydro-Boost
	1.25 in	12.50 x 1.54 in	13.00 x 2.50 in	—	
JF9	40.0 mm	357 x 36.7 mm	—	346.8 x 36.7 mm	Hydraulic Hydro-Boost
	1.57 in	14.00 x 1.44 in	—	13.60 x 1.44 in	

Schematic and Routing Diagrams

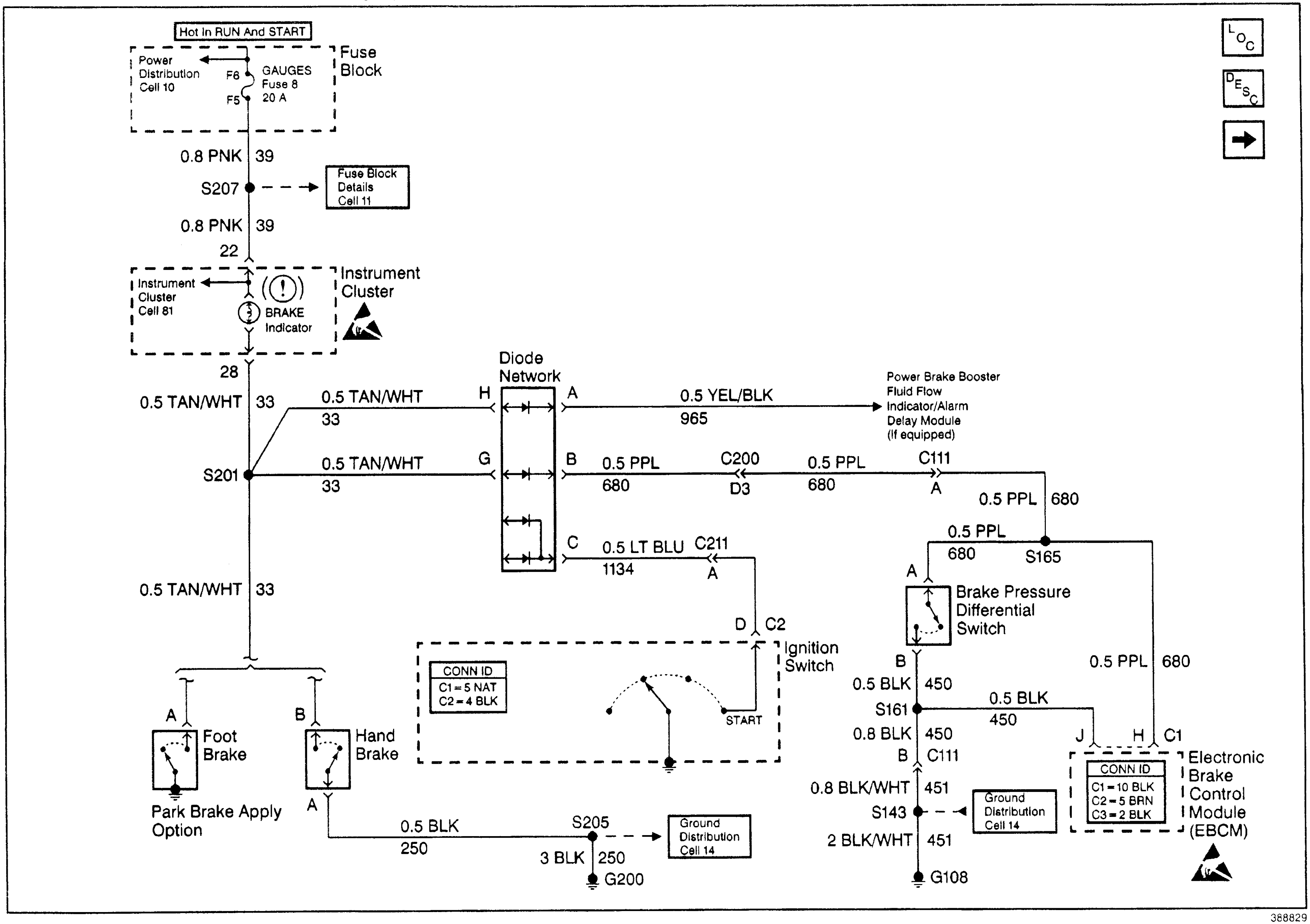
Hydraulic Brakes Schematic References

Reference on Schematic	Section Number - Subsection Name
Fuse Block Details Cell 11	8 — Wiring Systems
Ground Distribution Cell 14	8 — Wiring Systems
Headlights DRL Cell 102	8 — Lighting Systems
Instrument Cluster: Analog Cell 81	8 — Instrument Panel, Gauges and Console
Park Brake Cell 46	5 — Park Brake
Power Distribution Cell 10	8 — Wiring Systems

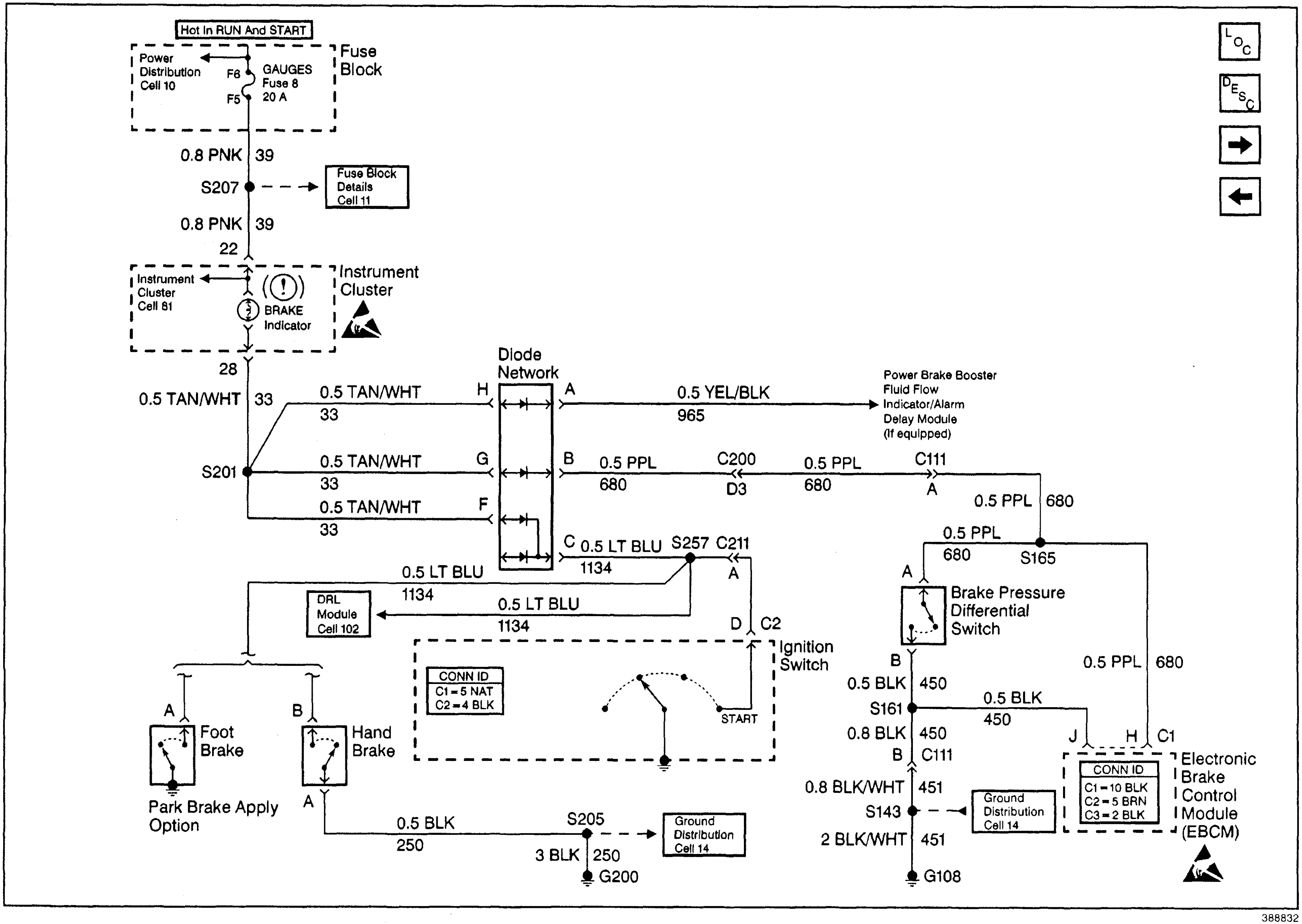
Hydraulic Brakes Schematic Icons

Icon	Icon Definition
 19384	Refer to *ESD Notice* in Cautions and Notices

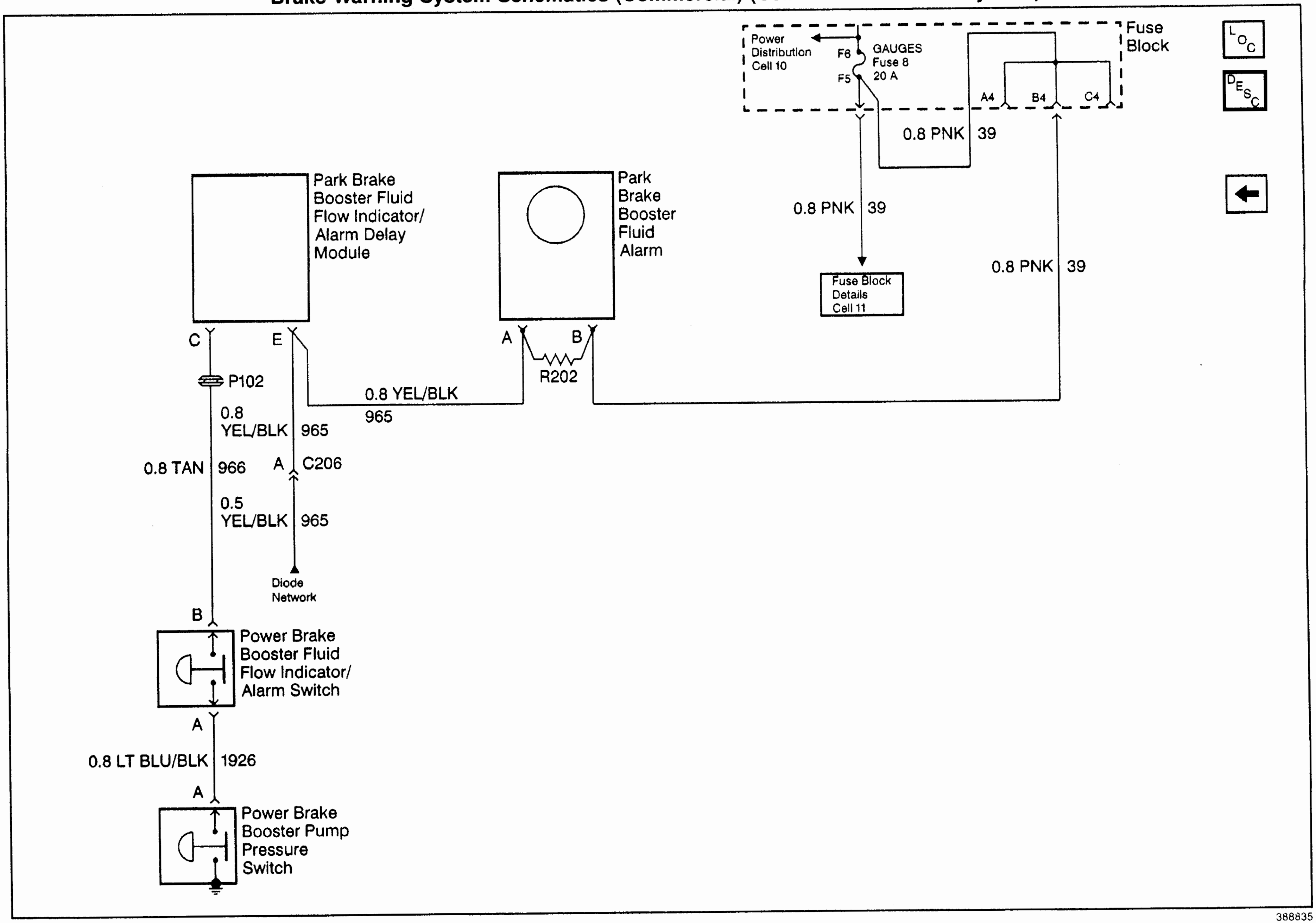
Brake Warning System Schematics (Commercial) (Cell 41: Brake Warning System – US)



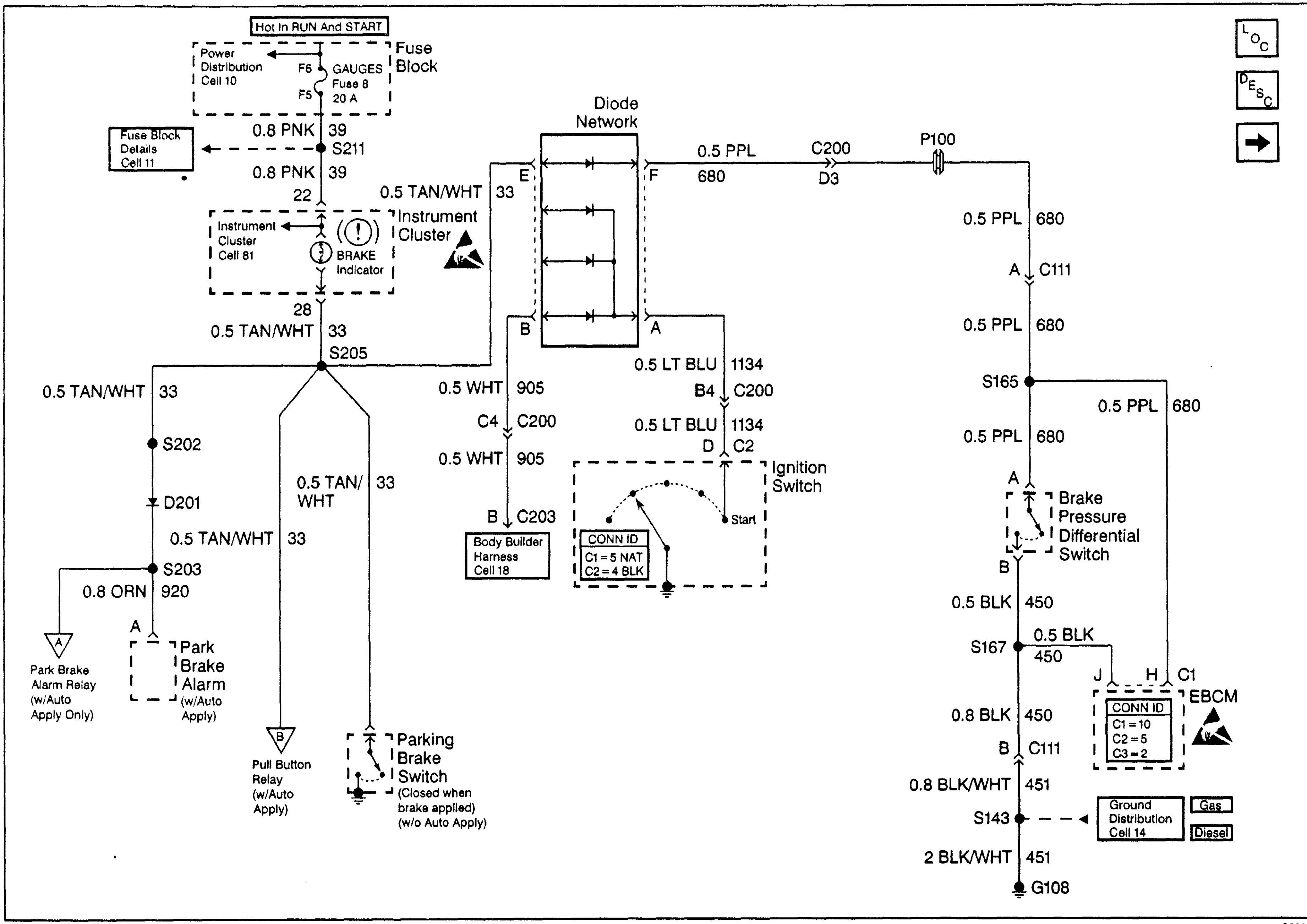
Brake Warning System Schematics (Commercial) (Cell 41: Brake Warning System – Canada)



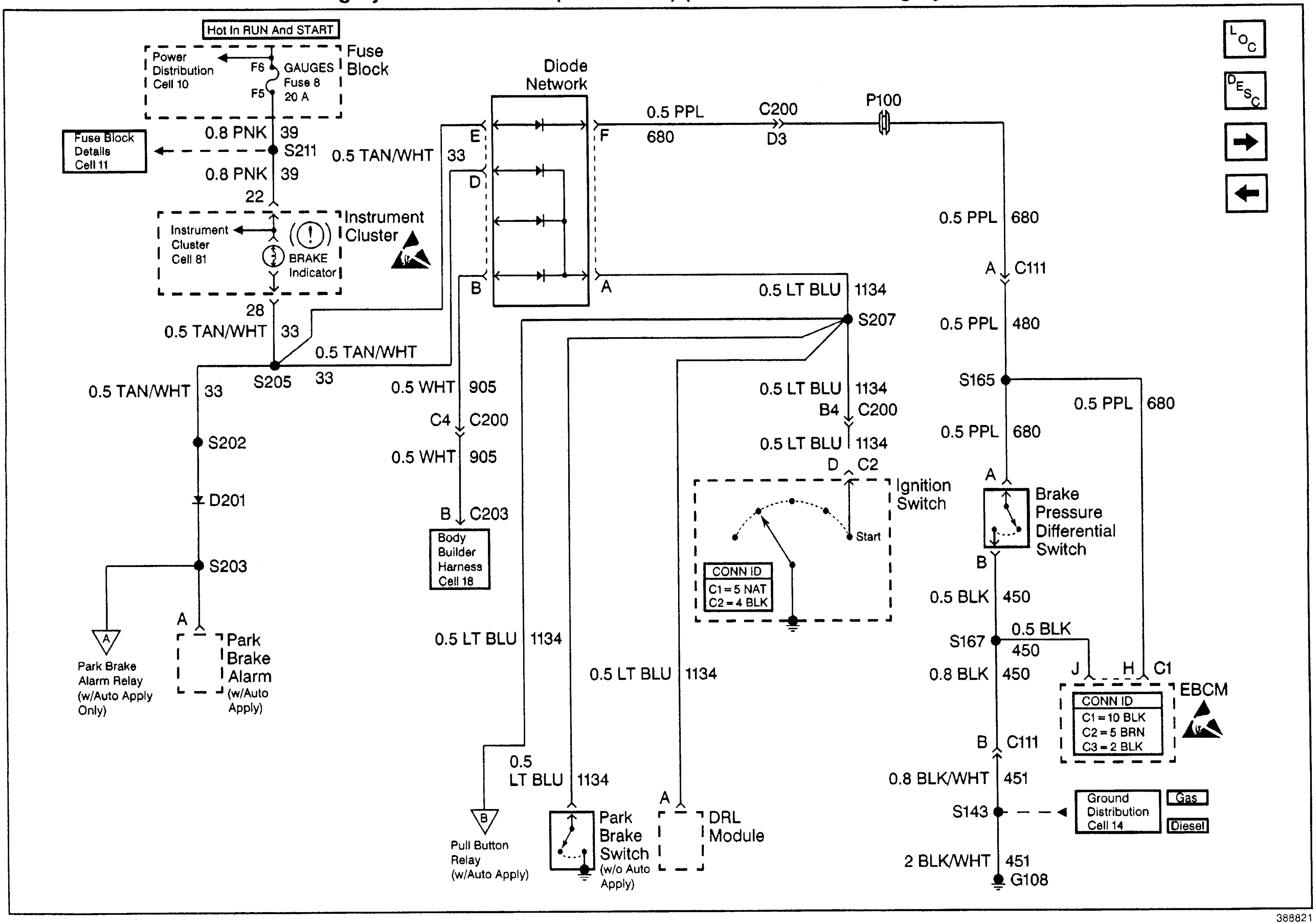
Brake Warning System Schematics (Commercial) (Cell 41: Brake Alarm System)



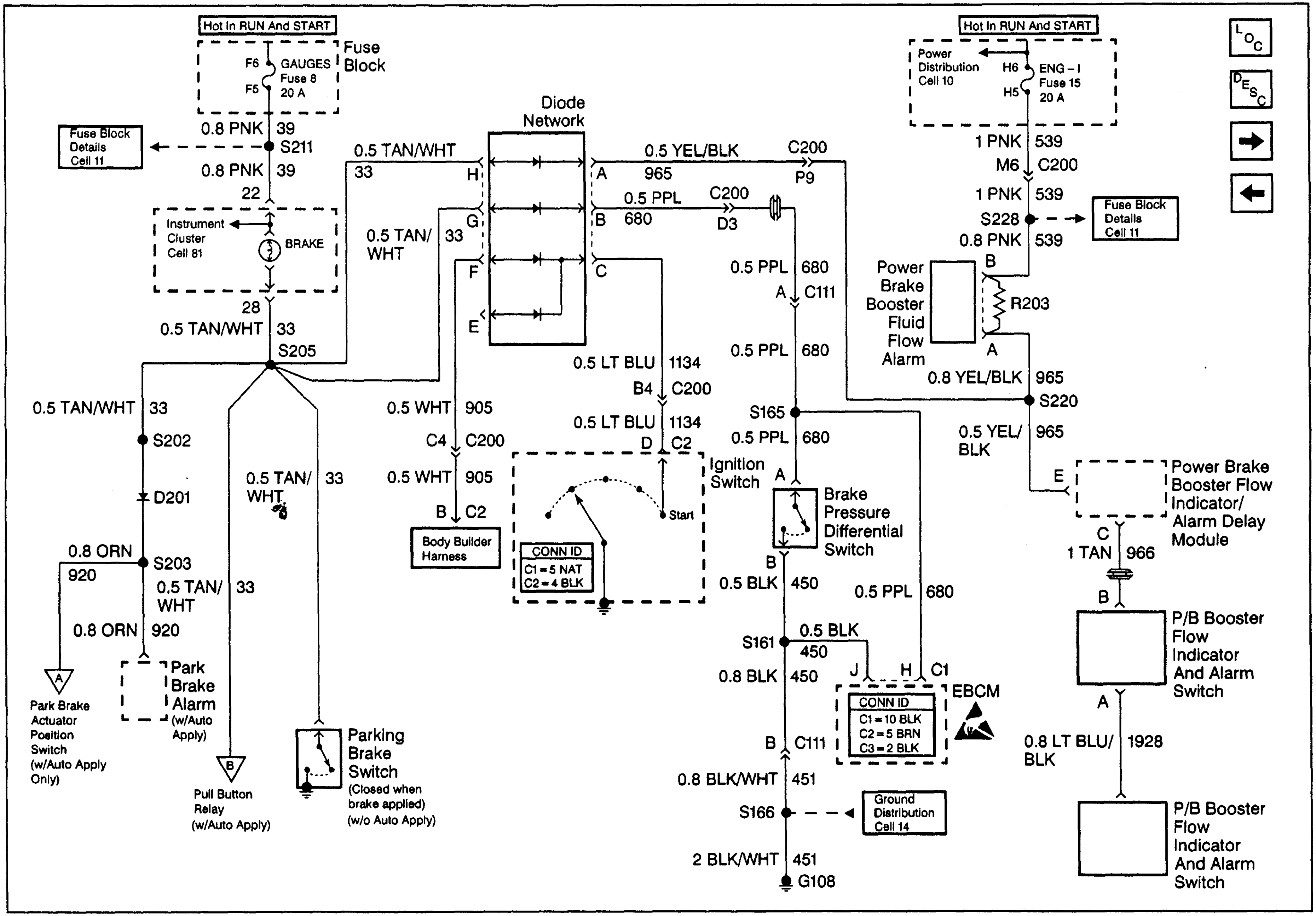
Brake Warning System Schematics (Motorhome) (Cell 41: Brake Warning System – US)



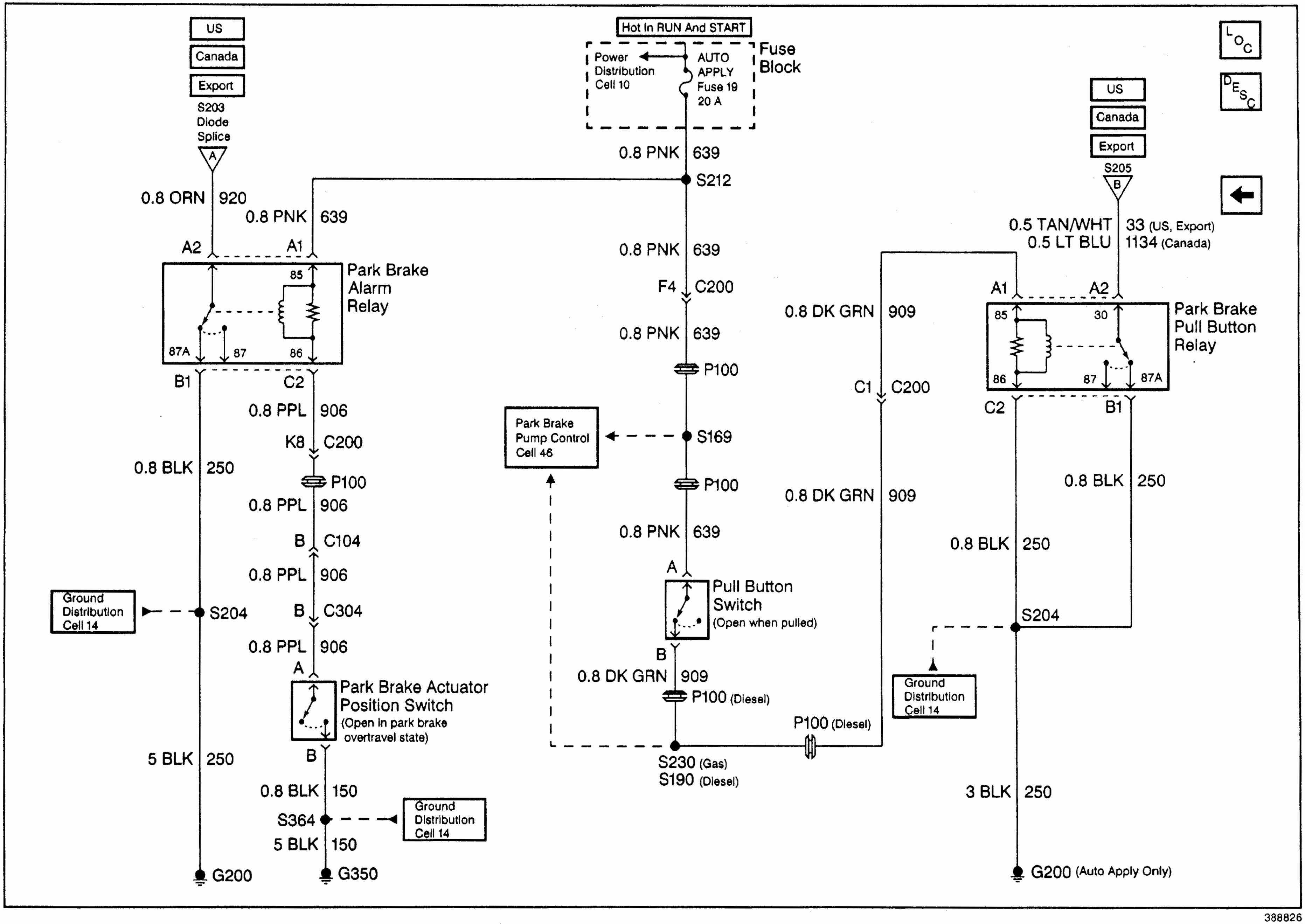
Brake Warning System Schematics (Motorhome) (Cell 41: Brake Warning System – Canada)



Brake Warning System Schematics (Motorhome) (Cell 41: Brake Warning System – Export)



Brake Warning System Schematics (Motorhome) (Cell 41: Auto Apply Relays)



Component Locator

Hydraulic Brake Components (Commercial)

Name	Location	Locator View	Connector End View
Brake Pressure Differential Switch	Bolted to the brake pressure modulator valve below the radiator on the lower crossmember	*Antilock Brakes System Component Views* in Antilock Brake System	*Antilock Brakes System Connector End Views* in Antilock Brake System
Daytime Running Lamps (DRL) Module	On the IP harness located by the body builder	—	*Lighting Systems Connector End Views (Commercial)* in Lighting Systems
Diode Network	On the IP harness located by the body builder	—	*Hydraulic Brakes Connector End Views*
Electronic Brake Control Module (EBCM)	Below the radiator on the lower crossmember	*Antilock Brakes System Component Views* in Antilock Brake System	*Antilock Brakes System Connector End Views* in Antilock Brake System
Ignition Switch	Lower RH side of the steering column below the support bracket	*Power and Grounding Component Views* in Wiring Systems	*Power and Grounding Connector End Views* in Wiring Systems
Instrument Cluster	Body builder installed	—	*Instrument Cluster Connector End Views* in Instrument Panel, Gauges and Console
IP Fuse Block	Located by the body builder	*Electrical Center Identification (Commercial)* in Wiring Systems	*Power and Grounding Connector End Views* in Wiring Systems
Power Brake Booster Fluid Flow Alarm	Provision installed by the body builder	—	*Hydraulic Brakes Connector End Views*
Power Brake Booster Fluid Flow Indicator/Alarm Delay Module	Provision installed by the body builder	—	*Hydraulic Brakes Connector End Views*
Power Brake Booster Fluid Flow Indicator/Alarm Switch	Provision for the body builder behind the LH radiator support	*Hydraulic Brakes Component Views*	*Hydraulic Brakes Connector End Views*
Power Brake Booster Pump Pressure Switch	Provision for the body builder behind the LH radiator support	*Hydraulic Brakes Component Views*	—
C111	Engine harness to the ABS harness, at the front of the LH frame rail above the steering gearbox	*Harness Routing Views (Commercial)* in Wiring Systems	*Inline Harness Connector End Views (Commercial)* in Wiring Systems
C200	Engine harness to the IP harness, in the bulkhead near P100	*Harness Routing Views (Commercial)* in Wiring Systems	*Inline Harness Connector End Views (Commercial)* in Wiring Systems
C206	Located by the body builder	—	—
C211	IP harness to the engine harness, on top of the steering column support	*Harness Routing Views (Commercial)* in Wiring Systems	*Inline Harness Connector End Views (Commercial)* in Wiring Systems
G108	On top of the thermostat housing	*Power and Grounding Component Views* in Wiring Systems	—
G200	LH interior bulkhead near the relay bracket	—	—
P102	On the bulkhead located by the body builder	*Harness Routing Views (Commercial)* in Wiring Systems	—
R202	At the connector to the power brake booster fluid flow alarm located by the body builder	—	—
S143 (EFI Diesel)	In the engine harness, approximately 16 cm (6 in) from the A/C compressor clutch breakout toward C200	—	—

Hydraulic Brakes Components (Commercial) (cont'd)

Name	Location	Locator View	Connector End View
S143 (MFI Diesel)	In the engine harness, approximately 17 cm (7 in) from P100	—	—
S165	In the ABS harness, approximately 10 cm (4 in) from the breakout for C110	—	—
S167	In the ABS harness, approximately 15 cm (6 in) from the RH wheel speed sensor breakout toward C110	—	—
S204	In the IP harness, approximately 8 cm (3 in) from the IP fuse block breakout toward C200	—	—
S205	In the IP harness, approximately 4 cm (2 in) before the fuse block breakout toward C200	—	—
S207	In the IP harness, approximately 40 cm (16 in) from the fuse block breakout toward the instrument cluster connector	—	—
S257	In the IP harness, approximately 24 cm (9 in) from the breakout for the IP fuse block toward C200	—	—

Hydraulic Brakes Components (Motorhome and Export)

Name	Location	Locator View	Connector End View
Brake Pressure Differential Switch	Bolted to the brake pressure modulator valve below the radiator on the lower crossmember	*Antilock Brakes System Component Views* in Antilock Brake System	*Antilock Brakes System Connector End Views* in Antilock Brake System
Daytime Running Lamps (DRL) Module	On the IP harness located by the body builder	—	*Lighting Systems Connector End Views (Motorhome)* in Lighting Systems
Diode Network	On the IP harness located by the body builder	—	*Hydraulic Brakes Connector End Views*
Electronic Brake Control Module (EBCM)	Below the radiator on the lower crossmember	*Antilock Brakes System Component Views* in Antilock Brake System	*Antilock Brakes System Connector End Views* in Antilock Brake System
Ignition Switch	Lower RH side of the steering column below the support bracket	*Power and Grounding Component Views* in Wiring Systems	*Power and Grounding Connector End Views* in Wiring Systems
Instrument Cluster	Body builder installed	—	*Instrument Cluster Connector End Views* in Instrument Panel, Gauges and Console
IP Fuse Block	Located by the body builder	*Electrical Center Identification (Motorhome)* in Wiring Systems	*Power and Grounding Connector End Views* in Wiring Systems
Park Brake Actuator Position Switch	In the auto apply park brake component box at the RH frame rail behind the transmission	*Park Brake System Component Views* in Park Brake	*Park Brake System Connector End Views* in Park Brake
Park Brake Alarm	On the IP harness located by the body builder	—	*Park Brake System Connector End Views* in Park Brake
Park Brake Alarm Relay	On the IP harness located by the body builder	—	*Park Brake System Connector End Views* in Park Brake
Park Brake Pull Button Relay	On the IP harness located by the body builder	—	*Park Brake System Connector End Views* in Park Brake

Hydraulic Brakes Components (Motorhome and Export) (cont'd)

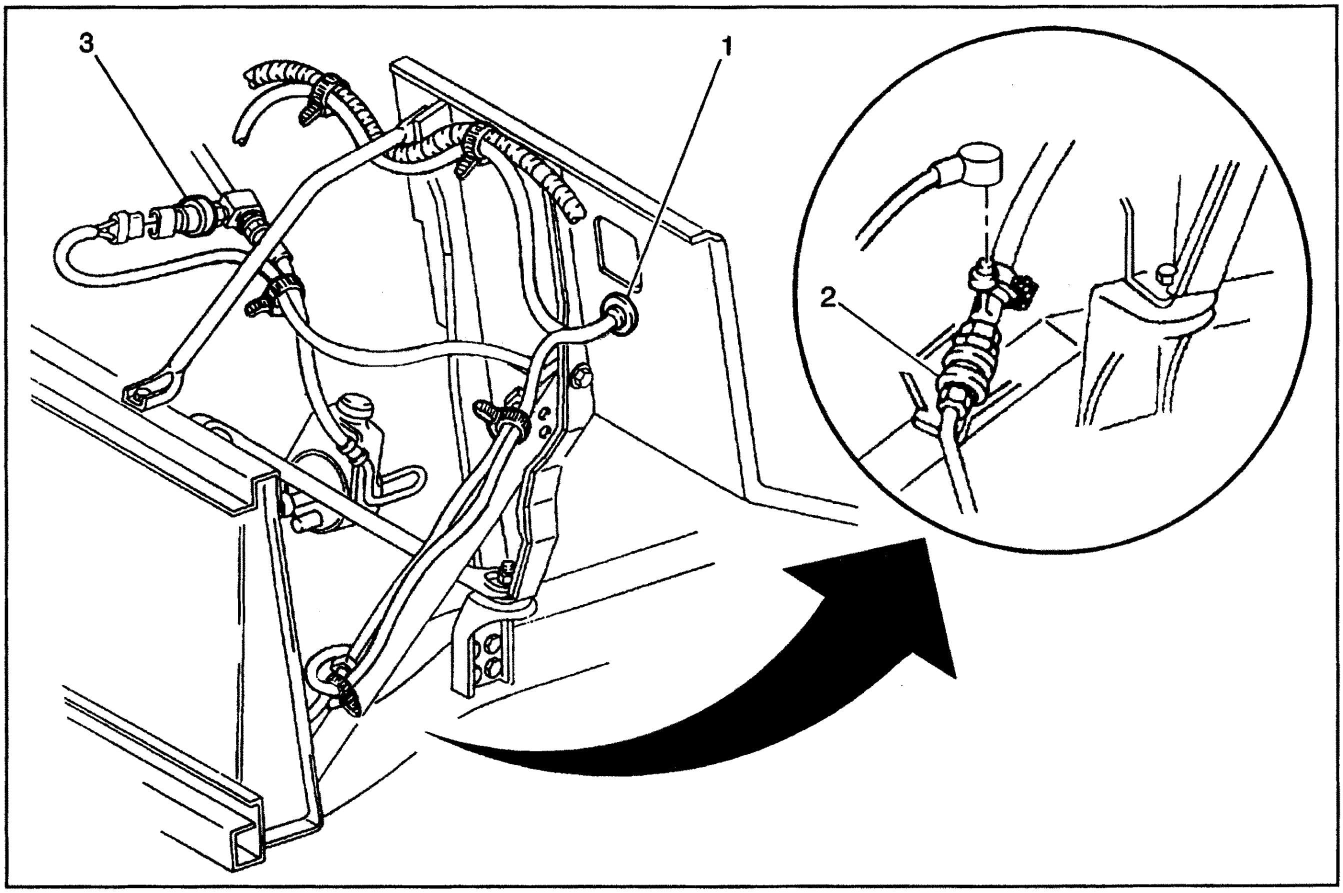
Name	Location	Locator View	Connector End View
Park Brake Pull Button Switch	Mounted to the IP	—	*Park Brake System Connector End Views* in Park Brake
Park Brake Switch (w/o Auto Apply)	On the IP harness located by the body builder	—	—
Power Brake Booster Fluid Flow Alarm	Provision installed by the body builder	—	*Hydraulic Brakes Connector End Views*
Power Brake Booster Fluid Flow Indicator/Alarm Delay Module	Provision installed by the body builder	—	*Hydraulic Brakes Connector End Views*
Power Brake Booster Fluid Flow Indicator/Alarm Switch	Provision installed by the body builder	—	*Hydraulic Brakes Connector End Views*
Power Brake Booster Pump Pressure Switch	Provision installed by the body builder	—	—
C104	On top of the transmission	*Harness Routing Views (Motorhome)* in Wiring Systems	*Inline Harness Connector End Views (Motorhome)* in Wiring Systems
C111	Above the front of the LH frame rail near the brake master cylinder	*Harness Routing Views (Motorhome)* in Wiring Systems	*Inline Harness Connector End Views (Motorhome)* in Wiring Systems
C200	At the top front of the steering column support near the park brake pull button switch	*Harness Routing Views (Motorhome)* in Wiring Systems	*Inline Harness Connector End Views (Motorhome)* in Wiring Systems
C304	Above the auto apply park brake component box at the RH frame rail behind the transmission	*Harness Routing Views (Motorhome)* in Wiring Systems	*Inline Harness Connector End Views (Motorhome)* in Wiring Systems
D201	In the IP harness, 14 cm (5 in) from the breakouts for the engine harness connector C200, and the horn relay	—	—
G108	On top of the thermostat housing	*Power and Grounding Component Views* in Wiring Systems	—
G200	Mounted to the top front of the steering column support plate	—	—
G350	In the auto apply park brake component box at the RH frame rail behind the transmission	—	—
P100	Main wiring pass through at the bulkhead	*Harness Routing Views (Motorhome)* in Wiring Systems	—
R203	At the connector to the power brake booster fluid flow alarm located by the body builder	—	—
S143 (Diesel)	In the engine harness, 2 cm (1 in) from the breakout for C100 and C207, toward the cooling fan connector	—	—
S143 (Gas)	In the engine harness, 5 cm (2 in) from the breakout for the ABS connectors C110 and C111, toward the P100	—	—
S150 (Diesel)	In the engine harness, 14 cm (6 in) from P100	—	—
S150 (Gas)	In the engine harness, 4 cm (2 in) from the breakout for the battery junction block	—	—
S165	In the ABS harness, approximately 10 cm (4 in) from the breakout for C110	—	—

Hydraulic Brakes components (Motorhome and Export) (cont'd)

Name	Location	Locator View	Connector End View
S167	In the ABS harness, approximately 19 cm (7 in) from the breakout for the RH wheel speed sensor toward C110	—	—
S169 (Diesel)	In the engine harness, 8 cm (3 in) from the breakout for the engine coolant level switch toward the starter relay breakout	—	—
S169 (Gas)	In the engine harness, 58 cm (23 in) from passthrough P100	—	—
S202/S203 (Diode Splice)	In the IP harness, approximately 14 cm (5 in) from the breakout for connector C200, and the horn relay	—	—
S204	In the IP harness, 16 cm (6 in) from the breakout for connector C200 toward the IP fuse block	—	—
S205	In the IP harness breakout for the instrument cluster connector, 10 cm (4 in) from the main harness	—	—
S207	In the IP harness, 20 cm (8 in) from the breakout for connector C200, toward the IP fuse block	—	—
S211	In the IP harness, 6 cm (2 in) from the dimmer switch and the IP cluster breakout, toward the IP fuse block	—	—
S212	In the IP harness, 10 cm (4 in) from the breakouts for the IP cluster connector and the IP dimmer switch toward the IP fuse block	—	—
S220 (Diesel)	In the IP side of the engine harness, 4 cm (1 in) from the breakout for the BTSI relay and the fan control relay	—	—
S228 (Diesel)	In the IP side of the engine harness, 28 cm (11 in) from P100	—	—
S230 (Gas)	In the IP side of the engine harness, 7 cm (2 in) from the breakout for the hazard lamp flasher and windshield wiper switch, toward P100	—	—
S364	In the auto apply park brake harness, 4 cm (1 in) from the breakouts for the park brake pump motor and the park brake pump relay connectors	—	—

Hydraulic Brakes Component Views

P/B Booster Warning System Wiring (School Bus) Engine View (Typical)



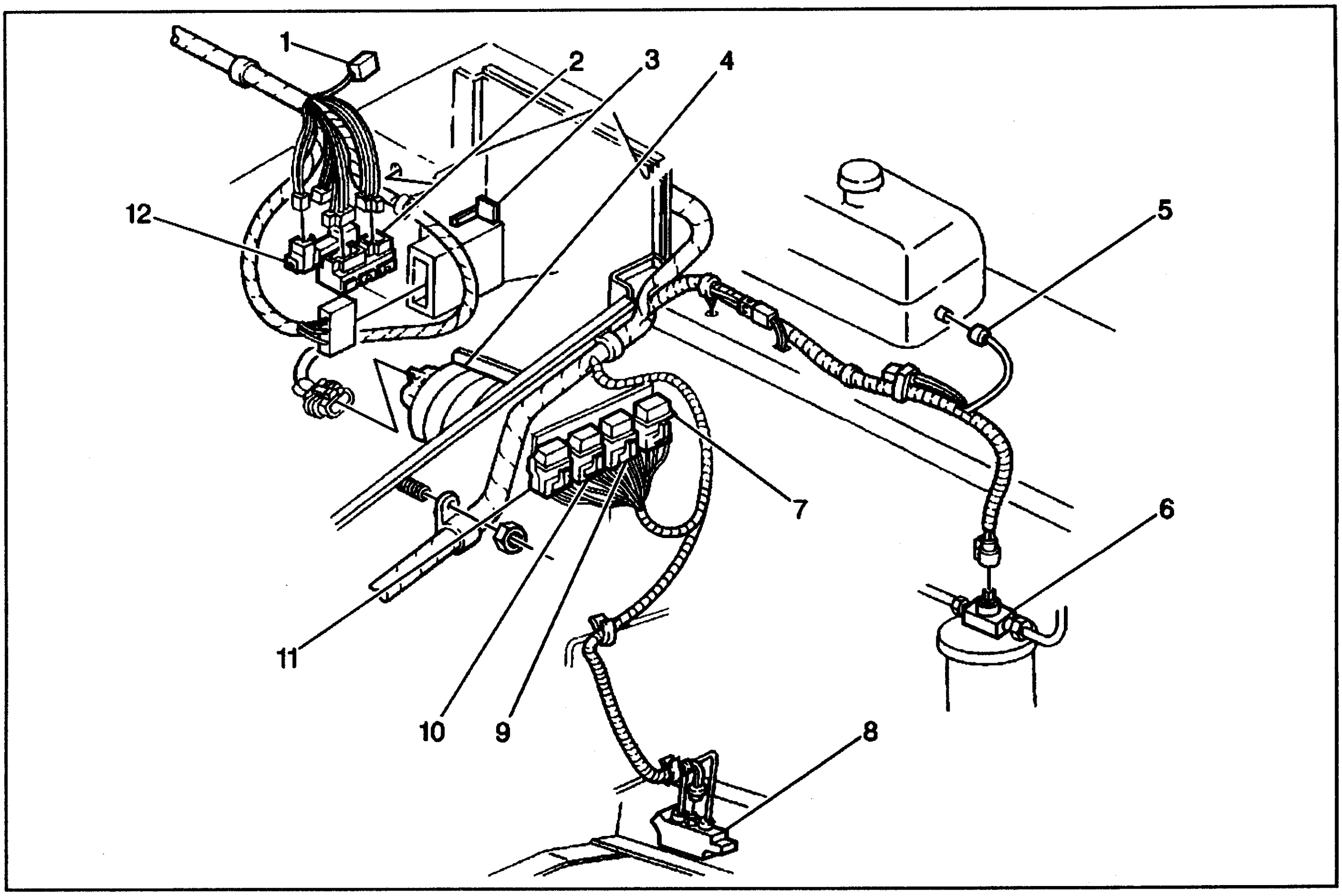
Legend

(1) P102

(2) Power Brake Booster Fluid Flow Indicator/Alarm Switch

(3) Power Brake Booster Pump Pressure Switch

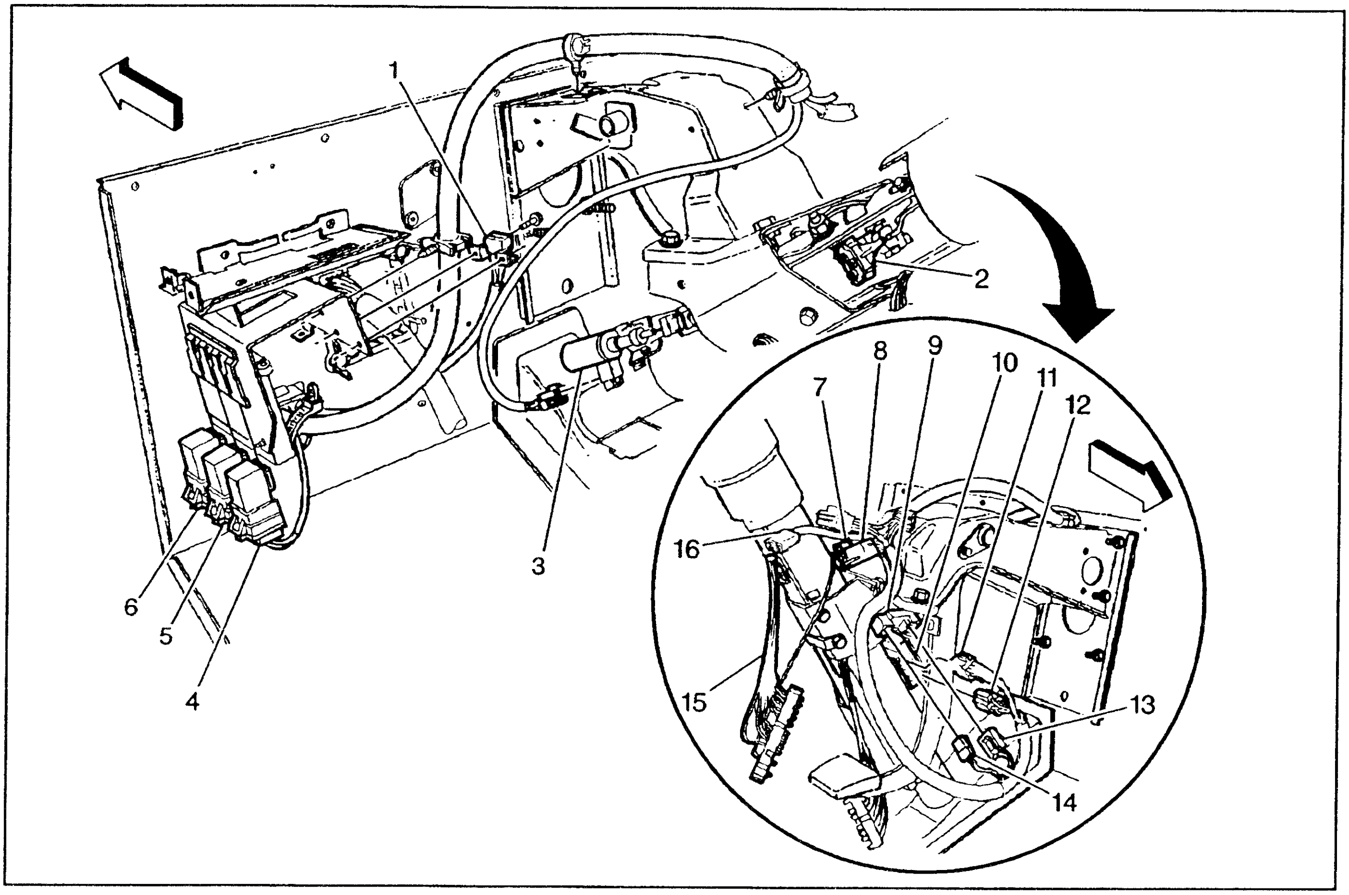
Radiator Support Wiring (L65)



Legend

- (1) C203
- (2) Torque Converter Clutch (TCC) and Stoplamps Switch
- (3) Vehicle Speed Sensor (VSS) Calibrator
- (4) Accelerator Pedal Position Module (APP) (Part of Accelerator Pedal Assembly)
- (5) Engine Coolant Level Switch
- (6) Auxiliary Engine Coolant Fan A/C Pressure Switch
- (7) Starter Relay
- (8) Brake Pressure Differential Switch
- (9) A/C Compressor Relay
- (10) Fuel Pump Relay
- (11) Park/Neutral Position (PNP) Switch Relay
- (12) Stoplamps Switch

IP Side of Engine Wiring – All Engines (Commercial)

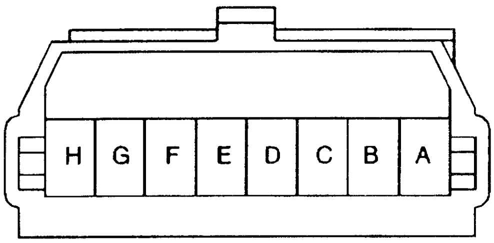


Legend

(1) Data Link Connector (DLC)
(2) Headlamps Dimmer Switch
(3) Brake Transmission Shift Interlock (BTSI) Solenoid
(4) Brake Transmission Shift Interlock (BTSI) Relay
(5) Horn Relay
(6) Daytime Running Lamps (DRL) Relay
(7) C210
(8) C211
(9) Torque Converter Clutch (TCC) and Stoplamps Switch
(10) Ignition Switch
(11) C1
(12) C2
(13) C1
(14) C2
(15) Turn Signal Switch Connector
(16) Crank Fuse

Hydraulic Brakes Connector End Views

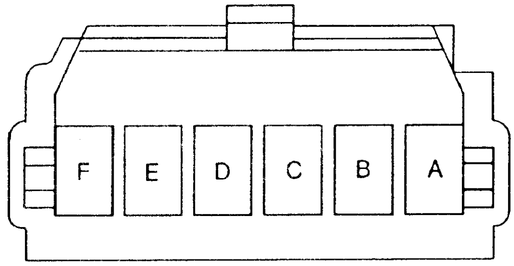
Diode Network (Commercial, Motorhome Export)



62422

Connector Part Information		• 12015308 • 8 Way Printed Circuit Edgeboard Series Standard (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	YEL/BLK	965	To Power Brake Booster Fluid Flow/Alarm Delay Module
B	PPL	680	ABS Pressure Differential Sensor Signal
C	LT BLU	1134	Park Brake Switch Signal
D-E	—	—	Not Used
F (DRL)	TAN/WHT	33	Brake Warning Indicator Lamp Output
F (WX7)	WHT	905	Body Builder Harness
F	—	—	Not Used
G	TAN/WHT	33	Brake Warning Indicator Lamp Output
H	TAN/WHT	33	Brake Warning Indicator Lamp Output

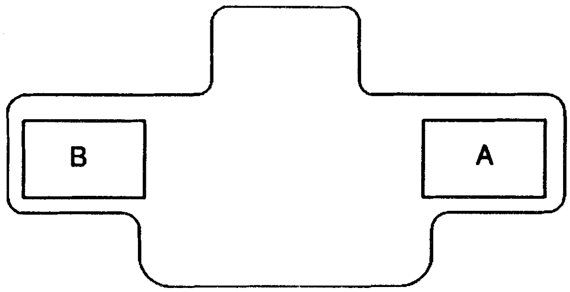
Diode Network (Motorhome)



95720

Connector Part Information		• 12040549 • 6 Way Printed Circuit Edgeboard Series Standard (GRY)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	1134	Park Brake Switch Signal
B	WHT	905	Body Builder Harness
C	—	—	Not Used
D (DRL)	TAN/WHT	33	Brake Warning Indicator Lamp Output
D	—	—	Not Used
E	TAN/WHT	33	Brake Warning Indicator Lamp Output
F	PPL	680	ABS Pressure Differential Sensor Signal

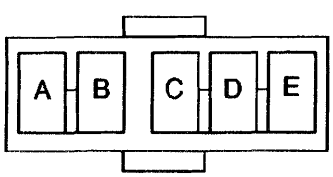
Power Brake Booster Fluid Flow Alarm



288713

Connector Part Information	• 08905825 • 2 Way F 56 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A (UJ1)	ORN	1651	Power Brake Booster Fluid Flow Indicator/Alarm Delay Module and Diode Network
A (WX7)	YEL/BLK	965	Power Brake Booster Fluid Flow Indicator/Alarm Delay Module
B (UJ1)	PNK	39	Fuse Output-Ignition 1-Type III Fuse
B (WX7)	PNK	539	Fuse Output-Ignition 1-Type III Fuse

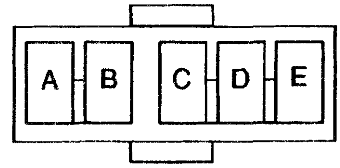
Power Brake (P/B) Booster Fluid Flow Indicator/Alarm Delay Module



62418

Connector Part Information	• 08900655 • 5 Way Printed Circuit Fork Series (NAT)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A-B	—	—	Not Used
C	TAN	966	To Power Brake Booster Fluid Flow Indicator/Alarm Switch

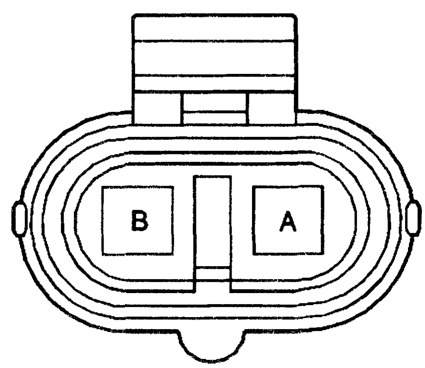
Power Brake (P/B) Booster Fluid Flow Indicator/Alarm Delay Module (cont'd)



62418

Connector Part Information	• 08900655 • 5 Way Printed Circuit Fork Series (NAT)		
Pin	**Wire Color**	**Circuit No.**	**Function**
D	—	—	Not Used
E (UJ1)	BLK/WHT	1651	Power Brake Booster Fluid Alarm and Diode Network
E (WX7)	YEL/BLK	965	Power Brake Booster Fluid Flow/Alarm Delay Module Output

Power Brake (P/B) Booster Fluid Flow Indicator/Alarm Switch



35430

Connector Part Information	• 12020599 • 2 Way F Metri-Pack 280 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU/ BLK	1928	Brake Booster Fluid Flow Switch Feed
B	TAN	966	Power Brake Booster Fluid Flow Indicator/Alarm Delay Module

Diagnostic Information and Procedures

Brake Warning Indicator Always On (Commercial)

Step	Action	Value(s)	Yes	No
1	Turn the ignition to RUN. Does the ABS lamp illuminate for a few seconds and then go off?	—	*Go to Step 2*	*Go to Step 16*
2	1. Start the engine. 2. Listen for an alarm. Does the power brake alarm sound while the BRAKE lamp isilluminated?	—	*Go to Step 15*	*Go to Step 3*
3	1. Turn the ignition to LOCK. 2. Open the end of the diode network housing. 3. Carefully remove the diode network circuit board from its connector. 4. Turn the ignition to RUN and check the BRAKE lamp. Is the BRAKE lamp illuminated?	—	*Go to Step 4*	*Go to Step 7*
4	1. Turn the ignition to LOCK. 2. Remove the connector from the instrument cluster. 3. Turn the ignition to RUN. 4. Use a test lamp from B+ to check for ground at terminal 28 of the connector. Is this terminal shorted to ground?	—	*Go to Step 6*	*Go to Step 5*
5	1. Turn the ignition to LOCK. 2. Replace the instrument cluster. Is the repair complete?	—	System OK	—
6	1. Turn the ignition to LOCK. 2. Examine the following areas for a short to ground or an electrical fault: • Between the instrument cluster terminal 28 and splice S205. • Between the diode network terminal H and splice S205. • Between the diode network terminal G and splice S205. • Between the diode network terminal F (if the vehicle has daytime running lamps) and splice S205. • Between splice S205 and the park brake switch. • Check for a faulty park brake switch. 3. Repair the fault found. Is the repair complete?	—	System OK	—
7	With the ignition in RUN, backprobe the diode network connector terminal A with a test lamp to B+. Does the lamp illuminate?	—	*Go to Step 15*	*Go to Step 8*
8	With the ignition in RUN, backprobe the diode network connector terminal B with a test lamp to B+. Does the lamp illuminate?	—	*Go to Step 12*	*Go to Step 9*
9	With the ignition in RUN, backprobe the diode network connector terminal C with a test lamp to B+. Does the lamp illuminate?	—	*Go to Step 11*	*Go to Step 10*
10	Replace the diode network. Is the repair complete?	—	System OK	—

Brake Warning Indicator Always On (Commercial) (cont'd)

Step	Action	Value(s)	Yes	No
11	1. Locate the fault in circuit 1134 (LT BLU). • If the vehicle has DRL: • A short to ground between the diode network terminal C and splice S257. • A short to ground between splice S257 and the ignition switch terminal D of C2. • The ignition switch. • A short to ground between splice S257 and the DRL module terminal A. • The DRL module. • A short to ground between splice S257 and the park brake switch. • The park brake switch. • If the vehicle does not have DRL: • A short to ground between the diode network terminal C and the ignition switch terminal D of C2. • The ignition switch. 2. Repair the fault found. Is the repair complete?	—	System OK	—
12	1. Turn the ignition LOCK. 2. Replace the diode network into its connector and close the housing. 3. Disconnect the connector from the brake pressure differential switch 4. Turn the ignition to RUN Is the BRAKE lamp illuminated?	—	*Go to Step 13*	*Go to Step 14*
13	1. Perform a brake system diagnostic to find the leak or other source of the pressure differential. 2. Repair and bleed the hydraulic system. 3. Reset the pressure differential switch. Is the repair complete?	—	System OK	—
14	Find and repair the short to ground in circuit 680 between the diode network, terminal B, and connector C1, terminal H of the EBCM, and the brake pressure differential switch, terminal A. Is the repair complete?	—	System OK	—

Brake Warning Indicator Always On (Commercial) (cont'd)

Step	Action	Value(s)	Yes	No
15	1. Turn the ignition to LOCK. 2. Locate the fault in circuit 965. • If the vehicle is not equipped with an power brake alarm circuit, check for a short to ground in circuit 965 (YEL/BLK) between the diode network terminal A and connector C206 terminal A. • If the vehicle is equipped with an alarm circuit, check the following areas for a short to ground or a faulty component: • Circuit 965 (YEL/BLK) between the diode network terminal A and connector C206 terminal A. • Circuit 1651 (BLK/WHT) between connector C206 terminal A and the Park Brake Booster Fluid Flow Indicator/Alarm Delay Module terminal E. • Circuit 1651 (BLK/WHT) between the Park Brake Booster Fluid Flow Indicator/Alarm Delay Module terminal E and the Power Brake Booster Fluid Flow Alarm terminal A. • Circuit 966 (TAN) between the Park Brake Booster Fluid Flow Indicator/Alarm Delay Module terminal C and the Power Brake Booster Fluid Flow Indicator/Alarm Switch terminal B. • The Park Brake Booster Fluid Flow Indicator/Alarm Delay Module. 3. Repair as needed. Is the repair complete?	—	System OK	—
16	Check for ABS DTCs and repair as indicated. Is the repair complete?	—	System OK	—

Brake Warning Indicator Always On (Motorhome US/Canada)

Step	Action	Value(s)	Yes	No
1	Turn the ignition to RUN. Does the ABS lamp illuminate for a few seconds and then go off?	—	*Go to Step 2*	*Go to Step 15*
2	1. Start the engine. 2. Listen for an alarm. Does the park brake alarm sound while the BRAKE lamp is on?	—	*Go to Step 14*	*Go to Step 3*
3	1. Turn the ignition to LOCK. 2. Open the end of the diode network housing. 3. Carefully remove the diode network circuit board from its connector. 4. Turn the ignition to RUN and check the BRAKE lamp. Is the BRAKE lamp illuminated?	—	*Go to Step 4*	*Go to Step 7*
4	1. Turn the ignition to LOCK. 2. Remove the connector from the instrument cluster. 3. Turn the ignition to RUN. 4. Use a test lamp from B+ to check for ground at terminal 28 of the connector. Is this terminal shorted to ground?	—	*Go to Step 6*	*Go to Step 5*

Brake Warning Indicator Always On (Motorhome US/Canada) (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Turn the ignition to LOCK. 2. Replace the instrument cluster. Is the repair complete?	—	System OK	—
6	1. Turn the ignition to LOCK. 2. Examine the following areas for a short to ground or an electrical fault: • Between the instrument cluster terminal 28 and splice S205. • Between the diode network terminal E and splice S205. • (US) Between splice S205 and the pull button relay or the park brake switch. • Check for a faulty park brake switch or pull button relay. • Between S205 and the park brake alarm relay (Auto Apply). • A faulty park brake alarm relay. • Between the diode network terminal D and splice S205 (Canada). 3. Repair the fault found. Is the repair complete?	—	System OK	—
7	With the ignition in RUN, backprobe the diode network connector terminal F with a test lamp to B+. Does the lamp illuminate?	—	*Go to Step 11*	*Go to Step 8*
8	With the ignition in RUN, backprobe the diode network connector terminal A with a test lamp to B+. Does the lamp illuminate?	—	*Go to Step 10*	*Go to Step 9*
9	Replace the diode network. Is the repair complete?	—	System OK	—
10	1. Locate the fault in circuit 1134 (LT BLU). • If the vehicle has DRL (Canada): • A short to ground between the diode network terminal C and splice S207. • A short to ground between splice S207 and the ignition switch terminal D of C2. • The ignition switch. • A short to ground between splice S207 and the DRL module terminal A. • The DRL module. • A short to ground between splice S207 and the park brake switch. • The park brake switch. • If the vehicle does not have DRL (US): • A short to ground between the diode network terminal C and the ignition switch terminal D of C2. • The ignition switch. 2. Repair the fault found. Is the repair complete?	—	System OK	—

Brake Warning Indicator Always On (Motorhome US/Canada) (cont'd)

Step	Action	Value(s)	Yes	No
11	1. Turn the ignition LOCK. 2. Replace the diode network into its connector and close the housing. 3. Disconnect the connector from the brake pressure differential switch 4. Turn the ignition to RUN Is the BRAKE lamp illuminated?	—	*Go to Step 13*	*Go to Step 12*
12	1. Perform a brake system diagnostic to find the leak or other source of the pressure differential. 2. Repair and bleed the hydraulic system. 3. Reset the pressure differential switch. Is the repair complete?	—	System OK	—
13	Find and repair the short to ground in circuit 680 (PPL) between the diode network, terminal F, and the EBCM, connector C1, terminal H, and the brake pressure differential switch, terminal A. Is the repair complete?	—	System OK	—
14	1. Check for a short to ground in circuit 920 (ORN) between diode D201 and the park brake alarm or the park brake alarm relay. 2. Check for a faulty park brake alarm relay. 3. Repair as required. Is the repair complete?	—	System OK	—
15	Check for ABS DTCs and repair as indicated. Is the repair complete?	—	System OK	—

Brake Warning Indicator Always On (Motorhome Export)

Step	Action	Value(s)	Yes	No
1	Turn the ignition to RUN. Does the ABS lamplight for a few seconds and then go off?	—	*Go to Step 2*	*Go to Step 20*
2	1. Start the engine. 2. Listen for an alarm. Do you hear an alarm sounding while the BRAKE lamp isilluminated?	—	*Go to Step 3*	*Go to Step 4*
3	Move the transmission range selector from Park to Neutral. Does the alarm stop sounding?	—	*Go to Step 19*	*Go to Step 16*
4	1. Turn the ignition to LOCK. 2. Open the end of the diode network housing. 3. Carefully remove the diode network circuit board from its connector. 4. Turn the ignition to RUN and check the BRAKE indicator. Is the BRAKE lampilluminated?	—	*Go to Step 5*	*Go to Step 8*
5	1. Turn the ignition to LOCK. 2. Remove the connector from the instrument cluster. 3. Turn the ignition to RUN. 4. Use a test lamp from B+ to check for ground at terminal 28 of the connector. Is this terminal shorted to ground?	—	*Go to Step 7*	*Go to Step 6*

Brake Warning Indicator Always On (Motorhome Export) (cont'd)

Step	Action	Value(s)	Yes	No
6	1. Turn the ignition to LOCK. 2. Replace the instrument cluster. Is the repair complete?	—	System OK	—
7	1. Turn the ignition to LOCK. 2. Examine the following areas for a short to ground or an electrical fault: • Between the instrument cluster terminal 28 and splice S205. • Between the diode network terminal H and splice S205. • Between the diode network terminal G and splice S205. • Between splice S205 and the pull button relay (or the park brake switch if not auto apply). • Check for a faulty pull button relay or park brake switch. • Check for an open in circuit 909 providing power to terminal A1 (85) of the pull button relay. • Between S205 and the park brake alarm and alarm relay • Check for a faulty park brake alarm relay. • Check for an open in circuit 639 providing power to the park brake alarm relay, terminal A1 (85). 3. Repair the fault found. Is the repair complete?	—	System OK	—
8	With the ignition in RUN, backprobe the diode network connector terminal A with a test lamp to B+. Does the lamp light?	—	*Go to Step 16*	*Go to Step 9*
9	With the ignition in RUN, backprobe the diode network connector terminal B with a test lamp to B+. Does the lamp light?	—	*Go to Step 13*	*Go to Step 10*
10	With the ignition in RUN, backprobe the diode network connector terminal C with a test lamp to B+. Does the lamp light?	—	*Go to Step 12*	*Go to Step 11*
11	Replace the diode network. Is the repair complete?	—	System OK	—

Brake Warning Indicator Always On (Motorhome Export) (cont'd)

Step	Action	Value(s)	Yes	No
12	1. Locate the fault in circuit 1134 (LT BLU). • If the vehicle has DRL: • A short to ground between the diode network terminal C and splice S257. • A short to ground between splice S257 and the ignition switch terminal D of C2. • The ignition switch. • A short to ground between splice S257 and the DRL module terminal A. • The DRL module. • A short to ground between splice S257 and the park brake switch. • The park brake switch. • If the vehicle does not have DRL: • A short to ground between the diode network terminal C and the ignition switch terminal D of C2. • The ignition switch. 2. Repair the fault found. Is the repair complete?	—	System OK	—
13	1. Turn the ignition LOCK. 2. Replace the diode network into its connector and close the housing. 3. Disconnect the connector from the brake pressure differential switch 4. Turn the ignition to RUN Is the BRAKE lampilluminated?	—	*Go to Step 14*	*Go to Step 15*
14	1. Perform a brake system diagnostic to find the leak or other source of the pressure differential. 2. Repair and bleed the hydraulic system. 3. Reset the pressure differential switch. Is the repair complete?	—	System OK	—
15	1. Find and repair the short to ground in circuit 680 (PPL) in one of the following areas: • Between the diode network, terminal B, and the brake pressure differential switch terminal A • Between the diode network, terminal B, and the EBCM, connector C1, terminal H 2. Repair the problem found. Is the repair complete?	—	System OK	—
16	1. Turn the ignition to LOCK. 2. Open the end of the diode network housing. 3. Carefully remove the diode network circuit board from its connector. 4. Turn the ignition to RUN and listen for the alarm. Is the alarm sounding?	—	*Go to Step 18*	*Go to Step 17*

Brake Warning Indicator Always On (Motorhome Export) (cont'd)

Step	Action	Value(s)	Yes	No
17	1. Turn the ignition to LOCK. 2. Locate the fault in circuit 965, the power brake booster fluid flow alarm circuit. • Check circuit 965 (YEL/BLK) for a short to ground in the following locations: • From the diode network terminal A to connector C200 terminal P9 • From terminal P9 of connector C200 to splice S220 • From splice S220 to the Power Brake Booster Fluid Flow Alarm terminal A • From splice S220 to the Park Brake Booster Fluid Flow Indicator/Alarm Delay Module terminal E • Check circuit 966 (TAN) between the Park Brake Booster Fluid Flow Indicator/Alarm Delay Module terminal C and the Power Brake Booster Fluid Flow Indicator/Alarm Switch terminal B. • Check circuit 1928 from the Power Brake Booster Fluid Flow Indicator/Alarm Switch terminal A to the Power Brake Boost Pump Pressure Switch terminal A. 3. Repair as needed. Is the repair complete?	—	System OK	—
18	1. Find and repair the short to ground in one of the following circuits: • Circuit 920 (ORN) between diode splice S203 and the park brake alarm relay terminal A2 • Circuit 920 (ORN) between diode splice S203 and the park brake alarm 2. Repair the problem found. Is the repair complete?	—	System OK	—
19	Adjust or repair the parking brake system as required. Is the repair complete?	—	System OK	—
20	Check for ABS DTCs and repair as indicated. Is the repair complete?	—	System OK	—

Brake Warning Indicator Inoperative

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to RUN. 2. Observe the volt meter in the instrument cluster. Does the meter indicate the presence of B+?	—	*Go to Step 5*	*Go to Step 2*
2	Check GAUGES fuse 8. Is the fuse blown?	—	*Go to Step 3*	*Go to Step 4*
3	Replace GAUGES fuse 8. Is the repair complete?	—	System OK	—
4	1. Find the open in circuit 39 (PNK) between GAUGES fuse 8 and instrument cluster terminal 22. 2. Repair circuit 39 as required. Is the repair complete?	—	System OK	—
5	Use a fused jumper wire *Using Fused Jumper Wires* to connect the instrument cluster terminal 28 to ground. Does the BRAKE lamp illuminate?	—	*Go to Step 6*	*Go to Step 7*

Brake Warning Indicator Inoperative (cont'd)

Step	Action	Value(s)	Yes	No
6	Find the open in circuit 33 (TAN/WHT) between instrument cluster terminal 28 and splice S205. Is the repair complete?	—	System OK	—
7	Examine the BRAKE lamp. Is the lamp OK?	—	*Go to Step 8*	*Go to Step 9*
8	Replace the BRAKE lamp. Is the repair complete?	—	System OK	—
9	Replace the instrument cluster. Is the repair complete?	—	System OK	—

Combination Valve Circuit

Step	Action	Value(s)	Yes	No
1	1. Disconnect the switch wire from the combination valve. 2. Connect a jumper wire from the switch wire to ground. 3. Turn the ignition switch to ON. Does the BRAKE lamp illuminate?	—	System OK	Go to *Step 2*
2	1. Turn the ignition switch to OFF. 2. Inspect the BRAKE lamp bulb. Is the bulb OK?	—	Go to *Step 3*	Go to *Step 4*
3	Inspect for an open in the circuit. Did you find and correct an open?	—	Go to *Step 5*	—
4	Replace the bulb. Is the repair complete?	—	Go to *Step 5*	—
5	Turn the ignition switch to ON. Does the BRAKE lamp illuminate?	—	System OK	Go to *Step 1*

Combination Valve Warning Switch

Step	Action	Value(s)	Yes	No
1	1. Raise the vehicle and support the vehicle with safety stands. 2. Attach a hose to a rear bleeder screw. 3. Immerse the other end of the hose in a container partly filled with clean brake fluid. 4. Ensure that the master cylinder is full. 5. Turn ON the ignition. 6. Apply the brake pedal with moderate pressure. Maintain the pressure on the pedal. Does the BRAKE lamp illuminate?	—	Go to *Step 2*	Go to *Step 4*
2	1. Close the bleeder screw. 2. Release the brake pedal. 3. Apply moderate pressure to the brake pedal. Does the BRAKE lamp remain illuminated?	—	Go to *Step 6*	Go to *Step 3*

Combination Valve Warning Switch (cont'd)

Step	Action	Value(s)	Yes	No
3	1. Attach a hose to a front bleeder screw. 2. Immerse the other end of the hose in a container partly filled with clean brake fluid. 3. Ensure that the master cylinder is full. 4. Apply the brake pedal with moderate pressure. Maintain the pressure on the pedal. 5. Open the bleeder valve. Does the BRAKE lamp illuminate?	—	Go to *Step 5*	Go to *Step 4*
4	1. Close the bleeder screw. 2. Release the brake pedal. 3. Replace the combination valve. Did you replace the combination valve?	—	Go to *Step 7*	—
5	1. Close the bleeder screw. 2. Release the brake pedal. 3. Apply moderate pressure to the brake pedal. Does the BRAKE lamp remain illuminated?	—	Go to *Step 6*	System OK
6	Replace the combination valve. Did you replace the combination valve?	—	Go to *Step 7*	—
7	Verify your repair. Is the repair complete?	—	System OK	Go to *Step 1*

Brake Pedal Travel

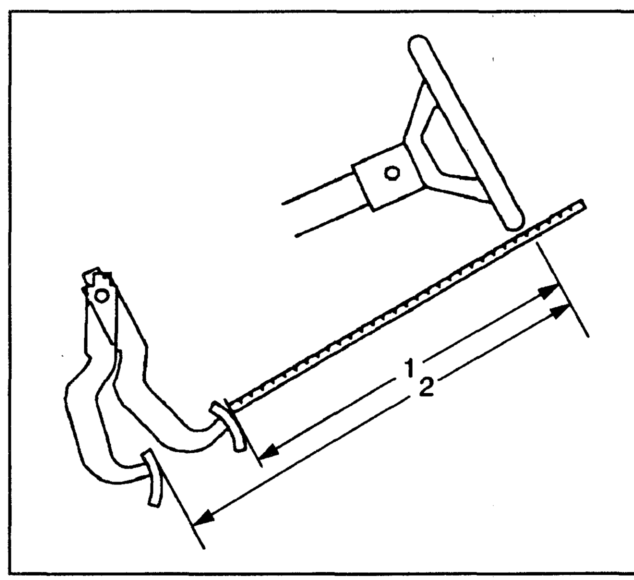
Tools Required

J 28662 Brake Pedal Effort Gauge

Check the brake pedal travel at frequent intervals. Brake pedal travel is the distance the brake pedal moves toward the floor from a fully released position. Make this check under the following conditions:

- Cold brakes
- About 400 N (90 lb) applied to the brake pedal using a *J 28662*

1. With the engine off, press the brake pedal and release the brake pedal. Do this five times in order to release vacuum from the vacuum booster.



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2. Measure the distance (1) from the bottom of the steering wheel to the brake pedal pad center with the brake pedal released.
3. Using the *J 28662*, apply approximately 400 N (100 lb) on the brake pedal.
4. Measure the distance (2) from the bottom of the steering wheel to the brake pedal pad center.
5. Subtract the first measurement (1) from the second measurement (2).

6. Compare the difference with the specifications below. If the brake pedal travel exceeds specifications, refer to *Brake System Diagnosis*.

System	Metric	English
Disc and Drum	102 mm	4.0 in
Four Wheel Disc Brakes	150 mm	6.0 in

Brake System Testing

Important: If the vehicle pulls to one side during braking, do not assume the cause is a brake system malfunction. Ensure that the front end alignment is correct before diagnosing the brake system.

Test the brakes at different speeds with light pedal pressure and with heavy pedal pressure. Avoid locking the wheels. Avoid sliding the tires on the roadway. Locked wheels and sliding tires do not show brake efficiency. A locked wheel and a sliding tire reduce the tire friction on the roadway. Heavily braked, turning wheels will stop the vehicle in less distance.

Test the brakes on a dry, clean, reasonably smooth and level roadway. You cannot accurately test brake performance without these conditions. The tires will not grip the roadway equally if the roadway is wet or greasy or covered with loose dirt. A crowned roadway causes the weight of the vehicle to shift toward one side. The wheels bounce on a rough roadway.

The following conditions also affect brake performance:

- Tires with unequal contact and unequal grip on the road will cause unequal braking.
  - The tires must be equally inflated.
  - The tread pattern of the right tires and the left tires must be about equal.
- When the vehicle is loaded unequally, the most heavily loaded wheels require more braking power than the other wheels.
- Loose front wheel bearings may cause the following:
  - Brake rotor tilt
  - Spotty contact with the brake linings
  - Erratic braking action
- The brakes will pull the vehicle to one side if the front suspension is not aligned correctly. This will be very noticeable if the caster and the camber are not within specifications.

External Conditions that Affect Brake Performance

Tires

Tires with unequal contact and grip on the road cause unequal braking. Make sure the inflation and tread pattern of the right and left tires is about equal. Refer to *Tire Inflation Description* in Tire and Wheels.

Vehicle Loading

When the vehicle has unequal loading, the most heavily loaded wheels require more braking force than the others.

Front Wheel Bearings

Loose front wheel bearings permit the rotor to tilt and to have poor contact with the linings. This causes eratic braking. Refer to *Wheel Bearing Adjustment (Independent)* and *Wheel Bearing Adjustment (I-Beam)* in Front Suspension.

Front End Alignment

Misalignment of the front end, particularly camber and caster, causes the brakes to pull to one side. Refer to *Front Caster Adjustment* and *Front Camber Adjustment* in Wheel Alignment.

Brake Fluid Leaks

Use the following procedure in order to test for brake problems that may be caused by fluid leaks:

1. Start the engine and run the engine at idle speed.
2. Shift the transmission into neutral.
3. Maintain constant foot pressure on the brake pedal. If the pedal slowly sinks to the floor, the hydraulic system may have internal leakage, external leakage or improperly adjusted components.
4. Check the fluid level of the master cylinder.
   - A slightly low fluid level in either reservoir can result from normal wear of the front brake lining.
   - An abnormally low fluid level indicates a leak in the hydraulic system.
5. Perform a visual inspection of the hydraulic system.

   If you find a leaking component, refer to the applicable replacement or overhaul procedure.

If you find no external leaks, internal leakage may be the cause. The master cylinder must be disassembled in order to diagnose internal leakage. Refer to *Master Cylinder Overhaul.*

Brake Hose And Pipe Inspection

Inspect the brake hoses and the brake pipes at least two times a year for the following conditions:

- Chafing of the outer cover
- Cracks
- Road damage
- Check that all hose and pipe mounting hardware is securely in place.

Replace any leaky or damaged hose or pipe. Repair any insecure mounting hardware.

Brake System Diagnosis

Step	Action	Normal Result(s)	Abnormal Result(s)*
1	Check the master cylinder fluid level.	Master cylinder fluid level between ADD and FULL.	Master Cylinder Reservior Filling.
2	Check the power steering fluid level.	Power steering fluid level between ADD and FULL.	Fluid Level Adjustment in Power Steering System.
3	Perform Hydraulic Booster Functional Test. Refer to *Hydraulic Booster Functional Test.*	Brake pedal falls away and then pushes back.	Accumulator Leak-Down System Not Holding Charge.
4	1. Turn ignition OFF. 2. Park brake not applied. 3. Start the engine.	Brake warning indicator illuminates briefly (approximately 5 seconds).	• Brake Warning Indicator Always ON. • Brake Warning Indicator Inoperative.
5	With the vehicle in PARK, perform Brake Pedal Travel Test. Refer to *Brake Pedal Travel.*	• Brake pedal moves steadily towards floor, approximately 2–3 in. • Brake pedal stops and is firm against the pressure (Hydraulic brake booster may hiss or clunk/click/clatter with high brake pedal effort).	• Brake Pedal Excessive Travel. • Brake Pedal Travel Gradually Increases. • Brake Pedal Excessive Effort. • Hydraulic Brake Booster Noisy.
6	Press the brake pedal.	Brake pedal returns to normal height.	Brake Pedal Slow Return.
7	1. Press the brake pedal. 2. Shift vehicle into DRIVE. 3. Perform Brake System Test. Refer to *Brake System Testing.*	• Braking action starts after applying the brakes. • Brakes do not grab - brake pedal does not vibrate. • Vehicle stops without excessive pedal effort. • Vehicle stops without pulling to one side. • Front and rear brakes apply evenly. • Vehicle stops without noise coming from the brakes. • Vehicle stops without noise coming from the hydraulic booster. • Brakes do not drag after releasing the brake pedal. • Brakes do not make noise while driving.	• Brake System Slow Response. • Brake Pedal Excessive Effort. • Braking Uneven - Side to Side. • Braking Uneven - Front to Rear. • Brake System Noise with Brakes Applied. • Brake System Groan at End of Stop. • Hydraulic Brake Booster Noisy. • Brakes Drag. • Brakes System Noise with Brakes Not Applied.
8	While driving the vehicle, turn the steering wheel without pressing the brake pedal.	Brakes do not apply while turning the steering wheel.	Brakes Self-Apply When Turning Steering Wheel.

* Refer to the appropriate symptom diagnostic table for the applicable abnormal result.

Brake Pedal Excessive Travel

Step	Action	Value(s)	Yes	No
1	Was the Hydraulic Brake Diagnostic System Check performed?	—	Go to *Step 2*	Go to *Brake System Diagnosis*
2	Inspect the disc brake pads and brake shoe linings for the following: • Excessive wear • Contaminated lining material • Uneven wear • Glazing • Abuse • Incorrect lining material Refer to *Brake Pads Replacement (Front)* or *Brake Pads Replacement (Rear)* in Disc Brakes or *Brake Shoe Inspection* in Drum Brakes. Do any of the above conditions apply?	—	Go to *Step 3*	Go to *Step 4*
3	Replace the brake linings. Refer to *Brake Pads Replacement (Front)* or *Brake Pads Replacement (Rear)* in Disc Brakes or *Brake Lining Replacement* in Drum Brakes. Is the repair complete?	—	Go to *Step 22*	—
4	Inspect the brake rotors for the following: • Hot spots • Scored rotor surface • Grooved rotor surface • Excessive lateral runout Refer to *Brake Rotor Lateral Runout Check.* Do any of the above conditions apply?	—	Go to *Step 5*	Go to *Step 6*
5	Resurface the brake rotor. Refer to *Refinishing Brake Rotors* in Disc Brakes. If refinishing the brake rotor results in a thickness that is less than the thinnest (refinishing) thickness, replace the rotor. Refer to *Brake Rotor Replacement* and *Component Specifications (Rotor Thickness)* in Disc Brakes. Is the repair complete?	—	Go to *Step 22*	—
6	Inspect the drum brakes for improper adjustment. Refer to *Drum Brake Adjustment* in Drum Brakes. Are the brakes improperly adjusted?	—	Go to *Step 7*	Go to *Step 8*
7	Adjust the drum brakes properly. Refer to *Drum Brake Adjustment* in Drum Brakes. Is the repair complete?	—	Go to *Step 22*	—
8	Inspect the axle seals for leakage. Is there any seal leakage?	—	Go to *Step 9*	Go to *Step 10*
9	Replace the axle oil seals. Refer to *Oil Seal and/or Bearing Replacement (Disc)* or *Oil Seal and/or Bearing Replacement (Drum)* in Rear Drive Axle. Is the repair complete?	—	Go to *Step 22*	—
10	Inspect the brake assembly for missing or loose attachments. Refer to *Brake Pad Inspection (Front)* or *Brake Pad Inspection (Rear)* in Disc Brakes or *Brake Shoe Inspection* in Drum Brakes. Are there any missing or loose attachments?	—	Go to *Step 11*	Go to *Step 12*
11	Replace or tighten the attachments as necessary. Is the repair complete?	—	Go to *Step 22*	—
12	Inspect the wheel cylinders and calipers for leakage. Are any of the components leaking?	—	Go to *Step 13*	Go to *Step 14*

Brake Pedal Excessive Travel (cont'd)

Step	Action	Value(s)	Yes	No
13	Replace the leaking components. Refer to *Brake Caliper Replacement (Front)* or *Brake Caliper Replacement (Rear)* in Disc Brakes or *Wheel Cylinder Replacement* in Drum Brakes. Is the repair complete?	—	Go to *Step 22*	—
14	Inspect the hydraulic brake system for leaks. Refer to *Brake Fluid Leaks.* Is there any sign of leakage?	—	Go to *Step 15*	Go to *Step 16*
15	Tighten the brake hose or pipe fittings. Refer to *Fastener Tightening Specifications.* Is the repair complete?	—	Go to *Step 22*	—
16	Inspect the master cylinder for leakage. Refer to *Master Cylinder Diagnosis.* Is the master cylinder leaking?	—	Go to *Step17*	Go to *Step 18*
17	Overhaul the master cylinder. Refer to *Master Cylinder Overhaul.* Is the repair complete?	—	Go to *Step 22*	—
18	Inspect the brake system for air. Refer to *Brake Fluid and Brake Fluid Handling.* Is there air in the system?	—	Go to *Step 19*	Go to *Step 20*
19	Bleed the brake system. Refer to *Hydraulic Brake System Bleeding.* Is the repair complete?	—	Go to *Step 22*	—
20	Inspect the brake fluid for contamination. Refer to *Brake Fluid and Brake Fluid Handling.* Is the brake fluid contaminated?	—	Go to *Step 21*	Go to *Step 22*
21	Flush the hydraulic brake system. Refer to *Hydraulic Brake System Flushing.* Is the repair complete?	—	Go to *Step 22*	—
22	Verify proper brake system operation. Does the original condition still exist?	—	Go to *Step 1*	System OK

Brake Pedal Travel Gradually Increases

Step	Action	Value(s)	Yes	No
1	Was the Hydraulic Brake Diagnostic System Check performed?	—	Go to *Step 2*	Go to *Brake System Diagnosis*
2	Observe if the operator was riding the brake pedal? Was the customer advised of the improper braking procedures?	—	System OK	Go to *Step 3*
3	Inspect the vehicle for overloading. Refer to Loading Your Vehicle in the Vehicle Owner's Manual. Is there excessive weight in the vehicle?	—	Go to *Step 4*	Go to *Step 5*
4	Remove the extra weight from the vehicle. Does the original condition still exist?	—	Go to *Step 5*	Go to *Step 19*
5	Inspect the brake pedal assembly for the following: • Bent or misaligned components • Binding or interference between the pedal and the booster input rod • Interference with other components Are the components misaligned or binding?	—	Go to *Step 6*	Go *Step 7*
6	Repair or replace the cause of misalignment. Is the repair complete?	—	Go to *Step 19*	—

Brake Pedal Travel Gradually Increases (cont'd)

Step	Action	Value(s)	Yes	No
7	Inspect the disc brake pads and brake shoe linings for the following: • Excessive wear • Uneven wear • Abuse • Glazing • Contaminated lining material • Incorrect lining material Refer to *Brake Pad Inspection (Front)* or *Brake Pad Inspection (Rear)* in Disc Brakes or *Brake Shoe Inspection* in Drum Brakes. Do any of the above conditions apply?	—	Go to *Step 8*	Go to *Step 9*
8	Replace the brake linings. Refer to *Brake Pads Replacement (Front)* or *Brake Pads Replacement (Rear)* in Disc Brakes or Brake Shoe Replacement in Drum Brakes. Is the repair complete	—	Go to *Step 19*	—
9	Inspect the brake rotors for the following: • Hot spots • Scored rotor surface Do any of the above conditions apply?	—	Go to *Step 10*	Go to *Step 11*
10	1. Refinish the brake rotor. Refer to *Refinishing Brake Rotors* in Disc Brakes. 2. If refinishing the brake rotor results in a thickness that is less than the thinnest (refinishing) thickness, replace the rotor. Refer to *Brake Rotor Replacement* and *Component Specifications (Rotor Thickness)* in Disc Brakes. Is the repair complete?	—	Go to *Step 19*	—
11	Inspect the vehicle brake booster for the following: • Leaks • Damage • Restricted passages Refer to *Hydraulic Brake Booster Noisy.* Do any of the above conditions apply?	—	Go to *Step 12*	Go to *Step 13*
12	Repair or replace the brake booster. Refer to *Hydraulic Brake Booster Replacement (Commercial)* or *Hydraulic Brake Booster Replacement (Motorhome).* Is the repair complete?	—	Go to *Step 19*	—
13	Inspect the vehicle for a leaking master cylinder (internal). Refer to *Master Cylinder Diagnosis* in Hydraulic Brakes. Is the master cylinder leaking?	—	Go to *Step 14*	Go to *Step 15*
14	Overhaul or replace the master cylinder. Refer to *Master Cylinder Replacement (Commercial)* or *Master Cylinder Replacement (Motorhome with JB7/JB8)* or *Master Cylinder Replacement (Motorhome with JF9)* or *Master Cylinder Overhaul.* Is the repair complete?	—	Go to *Step 19*	—
15	Check for leaking brake pipes, hoses or connections. Refer to *Brake Fluid Leaks.* Are any of the above components leaking?	—	Go to *Step 16*	Go to *Step 17*
16	Repair the cause of the leak. Is the repair complete?	—	Go to *Step 19*	—

Brake Pedal Travel Gradually Increases (cont'd)

Step	Action	Value(s)	Yes	No
17	Check the brake pipes and hoses for the following: • Low fluid or no fluid output • Spurting of fluid while pressing the brake pedal • Particles suspended in the fluid. Refer to *Hydraulic Brake System Flushing*. Do any of the above conditions apply?	—	Go to *Step 18*	Go to *Step 19*
18	1. Determine the area of the restriction. This will involve the disassembly of the individual brake lines and checking for low or no fluid output. 2. Flush the individual brake line or hose. Refer to *Hydraulic Brake System Flushing*. 3. If the restriction cannot be removed, replace the brake hose or pipe as necessary. 4. Flush the hydraulic brake system. Refer to *Hydraulic Brake System Flushing*. Is the repair complete?	—	Go to *Step 19*	—
19	Verify proper brake system operation. Does the original condition still exist?	—	Go to *Step 1*	System OK

Brake Pedal Excessive Effort

Step	Action	Value(s)	Yes	No
1	Was the Hydraulic Brake Diagnostic System Check performed?	—	*Go to Step 2*	Go to *Brake System Diagnosis*
2	Inspect the brake pedal assembly for the following: • Bent or misaligned components • Binding or interference between the pedal and booster input rod Are the components misaligned or binding?	—	*Go to Step 3*	*Go to Step 4*
3	Repair or replace the cause of misalignment, interference or binding. Is the repair complete?	—	*Go to Step 14*	—
4	Inspect the disc brake pads and brake shoe linings for the following: • Excessive wear • Uneven wear • Abuse • Glazing • Contaminated lining material • Incorrect lining material Refer to *Brake Pad Inspection (Front)* or *Brake Pad Inspection (Rear)* in Disc Brakes or *Brake Shoe Inspection* in Drum Brakes. Do any of the above conditions apply?	—	*Go to Step 5*	*Go to Step 6*
5	Replace the brake linings. Refer to *Brake Pads Replacement (Front)* or *Brake Pads Replacement (Rear)* in Disc Brakes or *Brake Lining Replacement* in Drum Brakes. Is the repair complete?	—	*Go to Step 14*	—
6	Inspect the brake rotor for the following: • Hot spots • Scored rotor surface • Grooved rotor surface Do any of the above conditions apply?	—	*Go to Step 7*	*Go to Step 8*

Brake Pedal Excessive Effort (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Refinish the brake rotor. Refer *Refinishing Brake Rotors* in Disc Brakes. 2. If refinishing the brake rotor results in a thickness that is less than the thinnest (refinishing) thickness, replace the rotor. Refer to *Brake Rotor Replacement* and *Component Specifications (Rotor Thickness)* in Disc Brakes. Is the repair complete?	—	*Go to Step 14*	—
8	Inspect the hydraulic brake booster for leaks. Refer to *Seal Leak Diagnosis.* Is the hydraulic brake booster leaking?	—	*Go to Step 9*	*Go to Step 10*
9	Repair or replace the Hydraulic Brake Booster. Refer to *Hydraulic Brake Booster Overhaul (Accumulator), Hydraulic Brake Booster Overhaul (Check Valve), Hydraulic Brake Booster Replacement (Commercial),* or *Hydraulic Brake Booster Replacement (Motorhome).* Is the repair complete?	—	*Go to Step 14*	—
10	Check the master cylinder outlet ports for restricted passages. Refer to *Hydraulic Brake System Bleeding.* Are the outlet ports restricted?	—	*Go to Step 11*	*Go to Step 12*
11	1. Overhaul the master cylinder. Refer to *Master Cylinder Overhaul.* 2. Flush the hydraulic brake system. Refer to *Hydraulic Brake System Flushing.* Is the repair complete?	—	*Go to Step 14*	—
12	Check the brake pipes and hoses for the following: • Low fluid or no fluid output • Spurting of fluid while pressing the brake pedal • Particles suspended in the fluid Refer to *Hydraulic Brake System Flushing.* Do any of the above conditions apply?	—	*Go to Step 13*	System OK
13	1. Determine the area of the restriction. This will involve the disassembly of individual brake lines and checking for low or no fluid output. 2. Flush the individual brake line or hose. Refer to *Hydraulic Brake System Flushing.* 3. If the restriction cannot be removed, replace the brake hose or pipe as necessary. 4. Flush the hydraulic brake system. Refer to *Hydraulic Brake System Flushing.* Is the repair complete?	—	*Go to Step 14*	—
14	Verify proper brake system operation. Does the original condition still exist?	—	*Go to Step 1*	System OK

Brake Pedal Excessive Action

Step	Action	Value(s)	Yes	No
1	Was the Hydraulic Brake System Diagnostic Check performed?	—	*Go to Step 2*	Go to *Brake System Diagnosis*
2	Inspect the vehicle for overloading. Refer to Loading Your Vehicle in the Vehicle Owner's Manual. Is there excessive vehicle weight?	—	*Go to Step 3*	*Go to Step 4*

Brake Pedal Excessive Action (cont'd)

Step	Action	Value(s)	Yes	No
3	Remove the extra weight from the vehicle. Has the excessive weight been removed?	—	*Go to Step 29*	—
4	Inspect the disc brake pads and brake shoe linings for the following: • Excessive wear • Uneven wear • Abuse • Contaminated lining material • Incorrect lining material Refer to *Brake Pad Inspection (Front)* or *Brake Pad Inspection (Rear)* in Disc Brakes and *Brake Shoe Inspection* in Drum Brakes. Do any of the above conditions apply?	—	*Go to Step 5*	*Go to Step 6*
5	Replace the brake linings. Refer to *Brake Pads Replacement (Front)* or *Brake Pads Replacement (Rear)* in Disc Brakes and Brake Shoe Replacement in Drum Brakes. Is the repair complete?	—	*Go to Step 29*	—
6	Inspect the brake rotor surface for excessive thickness variation. Refer to *Brake Rotor Thickness Variation Check* in Disc Brakes. Is the rotor thickness variation beyond specification?	—	*Go to Step 7*	*Go to Step 8*
7	1. Resurface the brake rotor. Refer to *Refinishing Brake Rotors* in Disc Brakes. 2. If refinishing the brake rotor results in a thickness that is less than the thinnest (Refinished) thickness, replace the rotor. Refer to *Brake Rotor Replacement* and *Component Specifications (Rotor Thickness)* in Disc Brakes. Is the repair complete?	—	*Go to Step 29*	—
8	Inspect the brake rotors for excessive lateral runout. Refer to *Brake Rotor Lateral Runout Check.* Is the brake rotor runout excessive?	—	*Go to Step 9*	*Go to Step 10*
9	1. Resurface the brake rotor. Refer to *Refinishing Brake Rotors* in Disc Brakes. 2. If refinishing the brake rotor results in a thickness that is less than the thinnest (refinished) thickness, replace the rotor. Refer to *Brake Rotor Replacement* in Disc Brakes. Is the repair complete?	—	*Go to Step 29*	—
10	Inspect brake assembly for missing or loose attachments. Refer to *Brake Pad Inspection (Front)* or *Brake Pad Inspection (Rear)* in Disc Brakes or *Brake Shoe Inspection* in Drum Brakes. Are there missing attachments?	—	*Go to Step 11*	*Go to Step 12*
11	Tighten or replace the attachments as necessary. Is the repair complete?	—	*Go to Step 29*	—
12	Inspect the drum brakes for improper adjustment. Refer to *Drum Brake Adjustment* in Drum Brakes. Are the brakes improperly adjusted?	—	*Go to Step 13*	*Go to Step 14*
13	Adjust the drum brakes properly. Refer to *Drum Brake Adjustment* in Drum Brakes. Is the repair complete?	—	*Go to Step 29*	—
14	Inspect the master cylinder for leakage. Refer to *Master Cylinder Diagnosis.* Is the master cylinder leaking?	—	*Go to Step 15*	*Go to Step 16*

Brake Pedal Excessive Action (cont'd)

Step	Action	Value(s)	Yes	No
15	Overhaul the master cylinder. Refer to *Master Cylinder Overhaul.* Is the repair complete?	–	*Go to Step 29*	—
16	Inspect the hydraulic brake system for leaks. Refer to *Brake Fluid Leaks.* Is there any sign of leakage?	—	*Go to Step 17*	*Go to Step 19*
17	1. Tighten the brake hose or pipe fittings. Refer to *Fastener Tightening Specifications.* 2. Start the engine. 3. Press the brake pedal several times. 4. Turn the engine to OFF. 5. Inspect the hydraulic brake system for leaks. Has the leak returned?	—	*Go to Step 18*	*Go to Step 19*
18	Replace the brake hose or pipe as necessary. Is the repair complete?	—	*Go to Step 29*	—
19	Inspect the brake system for air. Refer to *Hydraulic Brake System Bleeding.* Is there air in the system?	—	*Go to Step 20*	*Go to Step 21*
20	Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding.* Is the repair complete?	—	*Go to Step 29*	—
21	Inspect the brake fluid for contamination. Refer to *Brake Fluid and Brake Fluid Handling.* Is the brake fluid contaminated?	—	*Go to Step 22*	*Go to Step 23*
22	Flush the hydraulic brake system. Refer to *Hydraulic Brake System Flushing.* Is the repair complete?	—	*Go to Step 29*	-
23	Inspect the wheel cylinders for leakage. Does the wheel cylinder show signs of leakage?	—	*Go to Step 24*	*Go to Step 25*
24	Overhaul or replace the wheel cylinder. Refer to *Wheel Cylinder Overhaul* or *Wheel Cylinder Replacement* in Drum Brakes. Is the repair complete?	—	*Go to Step 29*	—
25	Inspect the rear axle oil seal for leakage. Is the seal leaking?	—	*Go to Step 26*	*Go to Step 27*
26	Replace the rear axle oil seal. Refer to *Oil Seal and/or Bearing Replacement (Disc)* or *Oil Seal and/or Bearing Replacement (Drum)* in Rear Drive Axle. Is the repair complete?	—	*Go to Step 29*	—
27	Inspect the brake caliper for leakage. Does the brake caliper show signs of leakage?	—	*Go to Step 28*	Go to *Step 29*
28	Overhaul or replace the brake caliper. Refer to *Brake Caliper Overhaul (Front), Brake Caliper Overhaul (Rear), Brake Caliper Replacement (Front),* or *Brake Caliper Replacement (Rear)* in Disc Brakes. Is the repair complete?	—	*Go to Step 29*	—
29	Verify proper brake system operation. Does the original condition still exist?	—	*Go to Step 1*	System OK

Brake Pedal Slow Return

Step	Action	Value(s)	Yes	No
1	Was the Hydraulic Brake System Diagnostic Check performed?	—	*Go to Step 2*	Go to *Brake System Diagnosis*
2	Inspect the brake pedal assembly for bent or misaligned components. Is the brake pedal components bent or misaligned?	—	*Go to Step 2*	*Go to Step 3*
3	1. Disassemble and realign components as necessary. 2. Replace the brake pedal assembly. • Refer to *Brake Pedal Replacement (Motorhome).* • *Brake Pedal Replacement (Motorhome),* • *Brake Pedal Replacement (Motorhome Linkage),* • *Brake Pedal Replacement (Commercial),* or • *Brake Pedal Replacement (Commercial Linkage).* Is the repair complete?	—	*Go to Step 10*	—
4	Inspect the following hydraulic brake booster components for damage: • Input rod bent • Piston return spring broken • Spool valve return spring broken • Swollen or elongated seals Do any of the above conditions apply?	—	*Go to Step 5*	*Go to Step 6*
5	Overhaul or replace the hydraulic brake booster. Refer to *Hydraulic Brake Booster Overhaul (Accumulator), Hydraulic Brake Booster Overhaul (Check Valve), Hydraulic Brake Booster Replacement (Commercial),* or *Hydraulic Brake Booster Replacement (Motorhome).* Is the repair complete?	—	*Go to Step 10*	—
6	Inspect the master cylinder for swollen or elongated primary piston seals. Refer to *Master Cylinder Diagnosis.* Are the master cylinder seals swollen or elongated?	—	*Go to Step 7*	*Go to Step 8*
7	Overhaul the master cylinder. Refer *Master Cylinder Overhaul.* Is the repair complete?	—	*Go to Step 10*	—
8	Check the power steering pump return hose for a restriction. Is the return line restricted?	—	*Go to Step 9*	System OK
9	Replace the hose. Refer to *Power Steering Hoses Replacement (4.3L and 5.7L Engines), Power Steering Hoses Replacement (6.5L (L57) Independent), Power Steering Hoses Replacement (6.5L (L57) I-Beam),* or *Power Steering Hoses Replacement (6.5L (L65) and 7.4L Engines)* in Power Steering System. Is the repair complete?	—	*Go to Step 10*	—
10	Verify proper brake system operation. Does the original condition still exist?	—	*Go to Step 1*	System OK

Brake System Slow Response

Step	Action	Value(s)	Yes	No
1	Was the Hydraulic Brake System Diagnostic Check performed?	—	*Go to Step 2*	Go to *Brake System Diagnosis*
2	Inspect the hydraulic brake system for leaks. Refer to *Brake Fluid Leaks.* Are there any leaks?	—	*Go to Step 3*	*Go to Step 5*
3	1. Tighten the brake hose or pipe fittings. Refer to *Fastener Tightening Specifications.* 2. Start the engine. 3. Press the brake pedal several times. 4. Turn the engine to OFF. 5. Inspect the hydraulic brake system for leaks. Has the leak returned?	—	*Go to Step 4*	*Go to Step 29*
4	Replace the brake hose or pipe as necessary. Is the repair complete?	—	*Go to Step 29*	—
5	Inspect the disc brake pads and brake shoe linings for the following: • Excessive wear • Uneven wear • Abuse • Glazing • Contaminated lining material • Incorrect lining material Refer to *Brake Pad Inspection (Front)* or *Brake Pad Inspection (Rear)* in Disc Brakes or *Brake Shoe Inspection* in Drum Brakes. Do any of the above conditions apply?	—	*Go to Step 6*	*Go to Step 7*
6	Replace the brake linings. Refer to *Brake Pads Replacement (Front)* or *Brake Pads Replacement (Rear)* in Disc Brakes or *Brake Lining Replacement* in Drum Brakes. Is the repair complete?	—	*Go to Step 29*	—
7	Inspect the following brake caliper assembly components for corrosion: • Mounting bolts • Sleeves • Steering knuckle • Brake caliper • Brake caliper piston Refer to *Brake Caliper Inspection* in Disc Brakes. Are any of the above components corroded or sticking?	—	*Go to Step 8*	*Go to Step 9*
8	Replace the corroded components. Refer to *Brake Caliper Overhaul (Front), Brake Caliper Overhaul (Rear), Brake Caliper Replacement (Front),* or *Brake Caliper Replacement (Rear)* in Disc Brakes. Is the repair complete?	—	*Go to Step 29*	—
9	Inspect the brake assembly for loose, missing or broken components. Refer to *Brake Pad Inspection (Front)* or *Brake Pad Inspection (Rear)* in Disc Brakes or *Brake Shoe Inspection* in Drum Brakes. Are there loose, missing or broken brake assembly components?	—	*Go to Step 10*	*Go to Step 11*

Brake System Slow Response (cont'd)

Step	Action	Value(s)	Yes	No
10	Tighten or replace the components as necessary. Refer to *Brake Pads Replacement (Front)* or *Brake Pads Replacement (Rear)* in Disc Brakes or *Brake Lining Replacement* in Drum Brakes. Is the repair complete?	—	*Go to Step 29*	—
11	Inspect the wheel cylinder for leakage or binding? Do the wheel cylinders show signs of leakage or binding?	—	*Go to Step 12*	*Go to Step 13*
12	Overhaul or replace the wheel cylinder. Refer to *Wheel Cylinder Overhaul* or *Wheel Cylinder Replacement* in Drum Brakes. Is the repair complete?	—	*Go to Step 29*	—
13	1. Inspect the brake pedal assembly for bent or misaligned components. 2. Inspect the brake pedal for interference (binding) between the pedal and the booster input rod. Is the brake pedal binding?	—	*Go to Step 14*	*Go to Step 15*
14	1. Disassemble and realign or replace components as necessary. 2. Replace the brake pedal if necessary. Refer to *Brake Pedal Replacement (Motorhome), Brake Pedal Replacement (Motorhome Linkage), Brake Pedal Replacement (Commercial)*, or *Brake Pedal Replacement (Commercial Linkage).* Is the repair complete?	—	*Go to Step 29*	—
15	Check the brake pedal for interference with other components. Inspect the brake pedal area for the following: • loose or misaligned the trim panels • loose components, wiring harnesses or aftermarket devices Are there any loose or interfering components?	—	*Go to Step 16*	*Go to Step 17*
16	Realign or reposition components as necessary. Is the repair complete?	—	*Go to Step 29*	—
17	Inspect the vehicle for collapsed, bent or kinked brake lines or hoses. Are the brake hoses or the brake pipes collapsed, bent, or kinked?	—	*Go to Step 18*	*Go to Step 19*
18	Reroute or replace the brake hoses or pipes as necessary. Is the repair complete?	—	*Go to Step 29*	—
19	1. Remove the master cylinder reservoir cover. 2. Rapidly apply the brake pedal 3 cm (1 in), observing the brake fluid in the reservoir. Does the fluid surface in the forward reservoir show movement or spouting?	—	*Go to Step 20*	*Go to Step 21*
20	1. Install the master cylinder reservoir cover. 2. Loosen the master cylinder mounting nuts 13 mm (½ in). 3. Separate the master cylinder from the hydraulic brake booster. 4. Apply the brake pedal 3 cm (1 in). Does the booster output rod move?	—	*Go to Step 21*	*Go to Step 22*
21	Replace the master cylinder. Refer to *Master Cylinder Replacement (Commercial), Master Cylinder Replacement (Motorhome with JB7/JB8)*, or *Master Cylinder Replacement (Motorhome with JF9).* Is the repair complete?	—	*Go to Step 29*	—

Brake System Slow Response (cont'd)

Step	Action	Value(s)	Yes	No
22	Replace the brake booster. Refer to *Hydraulic Brake Booster Replacement (Commercial)* or *Hydraulic Brake Booster Replacement (Motorhome).* Is the repair complete?	—	*Go to Step 29*	—
23	Remove the master cylinder cover and inspect the brake fluid for contamination. Is the brake fluid contaminated?	—	*Go to Step 24*	*Go to Step 25*
24	Flush the hydraulic brake system. Refer to *Hydraulic Brake System Flushing.* Is the repair complete?	—	*Go to Step 29*	—
25	Check the master cylinder outlet ports for restricted passages. Refer to *Hydraulic Brake System Bleeding.* Are the outlet ports restricted?	—	*Go to Step 26*	*Go to Step 27*
26	1. Overhaul the master cylinder. Refer to *Master Cylinder Overhaul.* 2. Flush the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding.* Is the repair complete?	—	*Go to Step 29*	—
27	Check the brake pipes and the brake hoses for restricted passages. Refer to *Hydraulic Brake System Bleeding.* Check for the following: • low fluid or no fluid output • spurting of fluid while pressing the brake pedal • particles suspended in the fluid Do any of the above conditions apply?	—	*Go to Step 29*	System OK
28	1. Determine the area of the restriction. This will involve the disassembly of individual brake lines and checking for low fluid output. 2. Flush the individual brake line or the brake hose. 3. If the restriction cannot be removed, replace the brake hose or the brake pipe as necessary. 4. Flush the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding.* Is the repair complete?	—	*Go to Step 29*	—
29	Verify proper brake system operation. Does the original condition still exist?	—	*Go to Step 1*	System OK

Brake System Slow Release

Step	Action	Value(s)	Yes	No
1	Was the Hydraulic Brake System Diagnostic Check performed?	—	*Go to Step 2*	Go to *Brake System Diagnosis*
2	Check the park brake lever for proper operation by doing the following: 1. Turn the ignition to ON. 2. Press the park brake pedal until it stops. Verify the brake warning lamp is ON. 3. Pull the park brake release lever. Verify the brake warning lamp is OFF. Did the park brake warning lamp turn OFF and the pedal return to its original height?	—	*Go to Step 4*	*Go to Step 3*

Brake System Slow Release (cont'd)

Step	Action	Value(s)	Yes	No
3	1. Check the park brake pedal assembly for interference, binding or for broken components. 2. Lubricate the park brake pedal assembly. 3. If lubricating the park brake pedal assembly does not solve the problem, replace the park brake pedal. Refer to *Park Brake Lever Replacement* in Park Brake. Is the repair complete?	—	*Go to Step 33*	—
4	1. Start the engine. 2. Shift the vehicle into DRIVE. 3. Attempt to move the vehicle by slowly pressing the accelerator pedal. Does the engine rpm increase without the vehicle moving?	—	*Go to Step 5*	*Go to Step 7*
5	Inspect the park brake cables for corrosion, kinks, or interference with other components. Are the park brake cables corroded, kinked, or interfering with other components?	—	*Go to Step 6*	*Go to Step 7*
6	Realign or replace the park brake cable(s). Refer to *Park Brake Cable Replacement (Front Pedal Type), Park Brake Cable Replacement (Front Lever Type), Park Brake Cable Replacement (Center), Park Brake Cable Replacement (Actuator)*, or *Park Brake Cable Replacement (Rear)* in Park Brake. Is the repair complete?	—	*Go to Step 33*	—
7	1. Remove the brake drum. 2. Inspect the brake linings for the following: • Excessive wear • Uneven wear • Abuse • Glazing • Contaminated lining material • Incorrect lining material Refer to *Brake Shoe Inspection* in Drum Brakes. Do any of the above conditions apply?	—	*Go to Step 8*	*Go to Step 9*
8	Replace the brake shoe linings. Refer to *Brake Lining Replacement* in Drum Brakes. Is the repair complete?	—	*Go to Step 9*	*Go to Step 10*
9	Inspect the brake shoe mounting hardware and springs for corrosion or binding. Is the mounting hardware or springs corroded or binding?	—	*Go to Step 10*	*Go to Step 11*
10	Replace the mounting hardware or springs as necessary. Is the repair complete?	—	*Go to Step 33*	—
11	Inspect the park brake lever for corrosion and free movement without binding. Does the park brake lever move freely without binding?	—	*Go to Step 12*	*Go to Step 13*
12	Clean the park brake lever components and check for proper movement. If the park brake lever still does not move freely, replace the park brake lever components. Refer to *Brake Lining Replacement* in Drum Brakes. Is the repair complete?	—	*Go to Step 33*	—
13	Inspect the disc brake caliper mounting bolts for corrosion. Refer to *Brake Caliper Inspection* in Disc Brakes. Are the sleeves or mounting bolts corroded?	—	*Go to Step 14*	*Go to Step 15*

Brake System Slow Release (cont'd)

Step	Action	Value(s)	Yes	No
14	Replace the mounting bolt sleeves and bolts as necessary. Is the repair complete?	—	*Go to Step 33*	—
15	1. Remove the caliper piston. Refer to *Brake Caliper Overhaul (Front)* or *Brake Caliper Overhaul (Rear)* in Disc Brakes. 2. Inspect the caliper bore and the piston for scoring, corrosion, plating damage or pitting. Is there damage to the piston or caliper bore?	—	*Go to Step 16*	*Go to Step 17*
16	Replace the piston or the caliper as needed. Refer to *Brake Caliper Overhaul (Front), Brake Caliper Overhaul (Rear), Brake Caliper Replacement (Front),* or *Brake Caliper Replacement (Rear)* in Disc Brakes. Is the repair complete?	—	*Go to Step 33*	—
17	1. Inspect the brake pedal assembly for bent or misaligned components. 2. Inspect the brake pedal for interference (binding) between the pedal and the booster input rod. Is the brake pedal binding or misaligned?	—	*Go to Step 18*	*Go to Step 19*
18	1. Disassemble and realign or replace components as necessary. 2. Replace the brake pedal. Refer to *Brake Pedal Replacement (Motorhome), Brake Pedal Replacement (Motorhome Linkage), Brake Pedal Replacement (Commercial),* or *Brake Pedal Replacement (Commercial Linkage).* Is the repair complete?	—	*Go to Step 33*	—
19	Check the brake pedal for interference with other components. Inspect the brake pedal area for the following: • loose or misaligned the trim panels • loose components, wiring harnesses or aftermarket devices Are there any loose or interfering components?	—	*Go to Step 20*	*Go to Step 21*
20	Realign or reposition components as necessary. Is the repair complete?	—	*Go to Step 33*	—
21	• Check for collapsed, dented, or bent brake pipes. • Check the brake hoses for sharp kinks. Are the brake hoses or the brake pipes collapsed, bent, or kinked?	—	*Go to Step 22*	*Go to Step 23*
22	Reroute or replace the brake hoses or pipes as necessary. Is the repair complete?	—	*Go to Step 33*	—
23	1. Remove the master cylinder reservoir cover. 2. Rapidly apply the brake pedal 3 cm (1 in), observing the brake fluid in the reservoir. Does the fluid surface in the forward reservoir show movement, or spouting?	—	*Go to Step 24*	*Go to Step 25*
24	1. Install the master cylinder reservoir cover. 2. Loosen the master cylinder mounting nuts 13 mm (½ in). 3. Separate the master cylinder from the brake booster. 4. Apply the brake pedal 3 cm (1 in). Does the booster output rod move?	—	*Go to Step 25*	*Go to Step 26*

Brake System Slow Release (cont'd)

Step	Action	Value(s)	Yes	No
25	Overhaul or replace the master cylinder. Refer to *Master Cylinder Overhaul* or *Master Cylinder Replacement (Commercial)*, *Master Cylinder Replacement (Motorhome with JB7/JB8)*, or *Master Cylinder Replacement (Motorhome with JF9)*. Is the repair complete?	—	*Go to Step 33*	—
26	Replace the brake booster. Refer to *Hydraulic Brake Booster Replacement (Commercial)*, or *Hydraulic Brake Booster Replacement (Motorhome)*. Is the repair complete?	—	*Go to Step 33*	—
27	1. Remove the master cylinder reservoir cover. 2. Inspect the brake fluid for contamination. Is the brake fluid contaminated?	—	*Go to Step 28*	*Go to Step 29*
28	1. Flush the hydraulic brake system. 2. Refer to *Hydraulic Brake System Flushing*. Is the repair complete?	—	*Go to Step 33*	—
29	Check the master cylinder outlet ports for restricted passages. Refer to *Hydraulic Brake System Bleeding*. Are the outlet ports restricted?	—	*Go to Step 30*	*Go to Step 31*
30	1. Overhaul the master cylinder. Refer to *Master Cylinder Overhaul*. 2. Flush the hydraulic brake system. Refer to *Hydraulic Brake System Flushing*. Is the repair complete?	—	*Go to Step 33*	—
31	Check the brake pipes and the brake hoses for restricted passages. Refer to *Hydraulic Brake System Flushing*. Check for the following: • low fluid or no fluid output • spurting of fluid while pressing the brake pedal • particles suspended in the fluid Do any of the above conditions apply?	—	*Go to Step 33*	System OK
32	1. Determine the area of the restriction. This will involve the disassembly of individual brake lines and checking for low fluid output. 2. Flush the individual brake line or the brake hose. 3. If the restriction cannot be removed, replace the brake hose or the brake as necessary. Is the repair complete?	—	*Go to Step 33*	—
33	Verify proper brake system operation. Does the original condition still exist?	—	*Go to Step 1*	System OK

Brakes Drag

Step	Action	Value(s)	Yes	No
1	Was the Hydraulic Brake System Diagnostic Check performed?	—	Go to *Step 2*	Go to *Brake System Diagnosis*
2	Is the operator riding the brake pedal? Observe if the operator is riding the brake pedal. Has the customer been advised of improper braking procedures?	—	System OK	Go to *Step 3*

Brakes Drag (cont'd)

Step	Action	Value(s)	Yes	No
3	Inspect the brake pedal assembly for the following: • Bent or misaligned components • Binding or interference between the pedal and the booster input rod • Interference with other components Are the components misaligned or binding?	—	Go to *Step 4*	Go to *Step 5*
4	Repair or replace the cause of the misalignment, interference or binding. Is the repair complete?	—	Go to *Step 19*	—
5	Inspect the brake linings for the following: • Excessive wear • Uneven wear Refer to *Brake Pad Inspection (Front)*, or *Brake Pad Inspection (Rear)* in Disc Brakes or *Brake Shoe Inspection* in Drum Brakes. Do any of the above conditions apply?	—	Go to *Step 6*	Go to *Step 7*
6	Replace the brake linings. Refer to *Brake Pads Replacement (Front)*, or *Brake Pads Replacement (Rear)* in Disc Brakes or *Brake Lining Replacement* in Drum Brakes. Is the repair complete?	—	Go to *Step 19*	—
7	Inspect the brake assembly for missing or loose attachments. Refer to *Brake Pad Inspection (Front)*, or *Brake Pad Inspection (Rear)* in Disc Brakes or *Brake Shoe Inspection* in Drum Brakes. Are there any loose or missing attachments?	—	Go to *Step 8*	Go to *Step 9*
8	Tighten or replace loose or missing components as necessary. Is the repair complete?	—	Go to *Step 19*	—
9	Check for an improperly adjusted park brake. Refer to *Park Brake Cable Service/Adjustment (Mechanical Park Brake)*, *Park Brake Cable Service/Adjustment (Electric Auto Park Brake)*, or *Park Brake Cable Service/Adjustment (Propeller Shaft Park Brake)* in Park Brake. Is the park brake improperly adjusted?	—	Go to *Step 10*	Go to *Step 11*
10	Adjust the park brake. Refer to *Park Brake Cable Service/Adjustment (Mechanical Park Brake)*, *Park Brake Cable Service/Adjustment (Electric Auto Park Brake)*, or *Park Brake Cable Service/Adjustment (Propeller Shaft Park Brake)* in Park Brake. Is the repair complete?	—	Go to *Step 19*	—
11	Inspect the front suspension for loose or missing attachments. Are there any loose or missing components?	—	Go to *Step 12*	Go to *Step 13*
12	Tighten or replace the loose or missing attachments. Is the repair complete?	—	Go to *Step 19*	—
13	Inspect the disc brake caliper for the following: • Sticking caliper pistons • Corroded mounting bolts. Refer to *Brake Caliper Inspection* in Disc Brakes. Do any of the above conditions exist?	—	Go to *Step 14*	Go to *Step 15*
14	Replace the components. Refer to *Brake Caliper Replacement (Front)* or *Brake Caliper Replacement (Rear)* in Disc Brakes. Is the repair complete?	—	Go to *Step 19*	—

Brakes Drag (cont'd)

Step	Action	Value(s)	Yes	No
15	Inspect the brake fluid for contamination. Refer to *Brake Fluid and Brake Fluid Handling* in Hydraulic Brakes. Is the brake fluid contaminated?	—	Go to *Step 16*	Go to *Step 17*
16	Flush the hydraulic brake system. Refer to *Hydraulic Brake System Flushing.* Is the repair complete?	—	Go to *Step 19*	—
17	Check the brake pipes and brake hoses for the following: • Low fluid or no fluid output • Particles suspended in the fluid Refer to *Hydraulic Brake System Flushing.* Do any of the above conditions exist?	—	Go to *Step 18*	Go to *Step 19*
18	1. Determine the area of restriction. This will involve the disassembly of individual brake lines and checking for low or no fluid output. Flush the individual brake line or hose. Refer to *Hydraulic Brake System Flushing.* 2. If the restriction cannot be removed, refer to *Brake Hose and Pipe Diagnosis.* Is the repair complete?	—	Go to *Step 19*	—
19	Verify proper brake system operation. Does the original condition still exist?	—	Go to *Step 1*	System OK

Braking Uneven - Side to Side

Step	Action	Value(s)	Yes	No
1	Was the Hydraulic Brake System Diagnostic Check performed?	—	*Go to Step 2*	Go to *Brake System Diagnosis*
2	Check the tires for incorrect pressure. Refer to *Tire Inflation Description* in Tires and Wheels. Is the tire pressure incorrect?	—	*Go to Step 3*	*Go to Step 4*
3	Adjust the tires to the correct pressure. Refer to *Tire Inflation Pressure Specifications* in Maintenance and Lubrication. Is the repair complete?	—	*Go to Step 22*	—
4	Inspect the front suspension for loose components. Are there loose components?	—	*Go to Step 4*	*Go to Step 5*
5	Tighten the loose components. Is the repair complete?	—	*Go to Step 22*	—
6	Inspect the brake linings for the following: • Excessive wear • Uneven wear • Abuse • Glazing • Contaminated lining material • Incorrect lining material Refer to *Brake Pad Inspection (Front)* or *Brake Pad Inspection (Rear)* in Disc Brakes or *Brake Shoe Inspection* in Drum Brakes. Do any of the above conditions apply?	—	*Go to Step 6*	*Go to Step 7*
7	Replace the brake linings. Refer to *Brake Pads Replacement (Front)* or *Brake Pads Replacement (Rear)* in Disc Brakes or *Brake Lining Replacement* in Drum Brakes. Is the repair complete?	—	*Go to Step 22*	—

Braking Uneven - Side to Side (cont'd)

Step	Action	Value(s)	Yes	No
8	Inspect the brake rotor for the following: • Hot spots • Scored rotor surface • Grooved rotor surface Do any of the above conditions apply?	—	*Go to Step 9*	*Go to Step 10*
9	1. Refinish the brake rotor. Refer to *Refinishing Brake Rotors* in Disc Brakes. 2. If refinishing the brake rotor results in a thickness that is less than the thinnest (Refinishing) thickness, replace the rotor. Refer to *Brake Rotor Replacement* and *Component Specifications (Rotor Thickness)* in Disc Brakes. Is the repair complete?	—	*Go to Step 22*	—
10	Inspect the brake assembly for loose, broken or missing components. Are there any loose, broken or missing brake assembly components?	—	*Go to Step 11*	*Go to Step 12*
11	Tighten or replace loose or missing brake assembly components. Refer to *Brake Pads Replacement (Front)* or *Brake Pads Replacement (Rear)* in Disc Brakes or *Brake Lining Replacement* in Drum Brakes. Is the repair complete?	—	*Go to Step 22*	—
12	Inspect the following brake caliper assembly components for corrosion: • Mounting bolts • Sleeves • Steering knuckle • Brake caliper • Brake caliper piston Refer to *Brake Caliper Inspection* in Disc Brakes. Are any of the above components corroded or sticking?	—	*Go to Step 12*	*Go to Step 13*
13	Replace the corroded components. Refer to *Brake Caliper Overhaul (Front)*, *Brake Caliper Overhaul (Rear)*, *Brake Caliper Replacement (Front)*, or *Brake Caliper Replacement (Rear)* in Disc Brakes. Is the repair complete?	—	*Go to Step 22*	—
14	Inspect the park brake for improper adjustment. Refer to *Park Brake Cable Service/Adjustment (Mechanical Park Brake)*, *Park Brake Cable Service/Adjustment (Electric Auto Park Brake)*, or *Park Brake Cable Service/Adjustment (Propeller Shaft Park Brake)* in Park Brake. Is the park brake adjusted improperly?	—	*Go to Step 15*	*Go to Step 16*
15	Adjust or replace the park brake cable. Refer to *Park Brake Cable Service/Adjustment (Mechanical Park Brake)*, *Park Brake Cable Service/Adjustment (Electric Auto Park Brake)*, or *Park Brake Cable Service/Adjustment (Propeller Shaft Park Brake)* in Park Brake. Is the repair complete?	—	*Go to Step 22*	—
16	Inspect the front suspension for incorrect alignment. Refer to *Wheel Alignment Specifications* in Wheel Alignment. Is the wheel alignment incorrect?	—	*Go to Step 17*	*Go to Step 18*
17	Correct the front wheel alignment. Refer to *Front Caster Adjustment* and *Front Camber Adjustment* in Wheel Alignment. Is the repair complete?	—	*Go to Step 22*	—

Braking Uneven - Side to Side (cont'd)

Step	Action	Value(s)	Yes	No
18	Inspect for contaminated or improper brake fluid. Refer to *Brake Fluid and Brake Fluid Handling.* Is the brake fluid contaminated or improper?	—	*Go to Step 19*	*Go to Step 20*
19	Flush the brake system. Refer to *Hydraulic Brake System Flushing.* Is the repair complete?	—	*Go to Step 22*	—
20	Inspect for a restricted brake fluid passage. Check for the following: • Low fluid or no fluid output • Spurting of fluid while pressing the brake pedal • Particles suspended in the fluid Refer to *Hydraulic Brake System Bleeding.* Is there a restricted brake fluid passage?	—	*Go to Step 21*	system OK
21	1. Determine the area of the restriction. This will involve the disassembly of individual brake lines and checking for low fluid output. 2. Flush the individual brake line or the brake hose. 3. If the restriction cannot be removed, replace the brake hose or the brake pipe as necessary. 4. Flush the hydraulic brake system. Refer to *Hydraulic Brake System Flushing.* Is the repair complete?	—	*Go to Step 22*	—
22	Verify proper brake system operation. Does the original condition still exist?	—	*Go to Step 1*	—

Braking Uneven - Front to Rear

Step	Action	Value(s)	Yes	No
1	Was the Hydraulic Brake Diagnosis System Check performed?	—	*Go to Step 2*	Go to *Brake System Diagnosis*
2	Inspect the disc brake rotors for the following: • Hot spots • Scored rotor surface • Grooved rotor surface Do any of the above conditions apply?	—	*Go to Step 2*	*Go to Step 3*
3	1. Refinish the brake rotor. Refer to *Refinishing Brake Rotors* in Disc Brakes. 2. If refinishing the brake rotor results in a thickness that is less than the thinnest (Refinishing) thickness, replace the rotor. Refer to *Brake Rotor Replacement* and *Component Specifications (Rotor Thickness)* in Disc Brakes. Is the repair complete?	—	*Go to Step 25*	—
4	Inspect the following brake caliper assembly components for corrosion: • Mounting bolts • Sleeves • Steering knuckle • Brake caliper • Brake caliper piston Refer to *Brake Caliper Inspection* in Disc Brakes. Are any of the above components corroded or sticking?	—	*Go to Step 5*	*Go to Step 6*

Braking Uneven - Front to Rear (cont'd)

Step	Action	Value(s)	Yes	No
5	Repair or replace calipers. Refer to *Brake Caliper Overhaul (Front)*, *Brake Caliper Overhaul (Rear)*, *Brake Caliper Replacement (Front)*, or *Brake Caliper Replacement (Rear)* in Disc Brakes. Is the repair complete?	—	*Go to Step 25*	—
6	Inspect the disc brake pads and brake shoe linings for the following: • Excessive wear • Uneven wear • Abuse • Glazing • Contaminated lining material • Incorrect lining material Refer to *Brake Pad Inspection (Front)* or *Brake Pad Inspection (Rear)* in Disc Brakes or *Front Caster Adjustment* or *Front Camber Adjustment* in Wheel Alignment. Do any of the above conditions apply?	—	*Go to Step 7*	*Go to Step 8*
7	Replace the brake linings. Refer to *Brake Pads Replacement (Front)* or *Brake Pads Replacement (Rear)* in Disc Brakes or *Brake Lining Replacement* in Drum Brakes. Is the repair complete?	—	*Go to Step 25*	—
8	Inspect the brake assembly for loose, missing or broken components. Refer to *Brake Pads Replacement (Front)* or *Brake Pads Replacement (Rear)* in Disc Brakes or *Brake Lining Replacement* in Drum Brakes. Are there missing or loose brake assembly components?	—	*Go to Step 9*	*Go to Step 10*
9	Tighten or replace loose or missing brake assembly components. Refer to *Brake Pads Replacement (Front)* or *Brake Pads Replacement (Rear)* in Disc Brakes or *Brake Lining Replacement* in Drum Brakes. Is the repair complete?	—	*Go to Step 25*	—
10	Inspect the hydraulic brake system for leaks. Refer to *Brake Fluid Leaks.* Are there brake fluid leaks?	—	*Go to Step 11*	*Go to Step 13*
11	1. Tighten the brake hose or pipe fittings. Refer to *Fastener Tightening Specifications.* 2. Start the engine. 3. Press the brake pedal several times. 4. Turn the engine to OFF. 5. Inspect the hydraulic brake system for leaks. Has the leak returned?	—	*Go to Step 12*	*Go to Step 13*
12	Replace the brake hose or pipe as necessary. Is the repair complete?	—	*Go to Step 25*	—
13	Inspect the brake caliper piston seal for leaks. Is the brake caliper piston seal leaking?	—	*Go to Step 14*	*Go to Step 15*
14	Replace the brake caliper piston seal or replace the caliper. Refer to *Brake Caliper Overhaul (Front)*, *Brake Caliper Overhaul (Rear)*, *Brake Caliper Replacement (Front)*, or *Brake Caliper Replacement (Rear)* in Disc Brakes. Is the repair complete?	—	*Go to Step 25*	—

Braking Uneven - Front to Rear (cont'd)

Step	Action	Value(s)	Yes	No
15	Inspect the park brake for improper adjustment. Refer to *Park Brake Cable Service/Adjustment (Mechanical Park Brake)*, *Park Brake Cable Service/Adjustment (Electric Auto Park Brake)*, or *Park Brake Cable Service/Adjustment (Mechanical Park Brake)* in Park Brake. Is the park brake improperly adjusted?	—	*Go to Step 16*	*Go to Step 17*
16	Adjust or replace the park brake cable. Refer to *Park Brake Cable Service/Adjustment (Mechanical Park Brake)*, *Park Brake Cable Service/Adjustment (Electric Auto Park Brake)*, or *Park Brake Cable Service/Adjustment (Mechanical Park Brake)* in Park Brake. Is the repair complete?	—	*Go to Step 25*	—
17	Inspect for an internal leak within the master cylinder. Refer to *Master Cylinder Diagnosis.* Is there an internal leak within the master cylinder?	—	*Go to Step 18*	*Go to Step 19*
18	Overhaul or replace the master cylinder. Refer to *Master Cylinder Overhaul* or *Master Cylinder Replacement (Commercial)*, *Master Cylinder Replacement (Motorhome with JB7/JB8)*, or *Master Cylinder Replacement (Motorhome with JF9).* Is the repair complete?	—	*Go to Step 25*	—
19	Inspect for contaminated or improper brake fluid. Refer to *Brake Fluid and Brake Fluid Handling.* Is the brake fluid contaminated or improper?	—	*Go to Step 20*	*Go to Step 21*
20	Flush the brake system. Refer to *Hydraulic Brake System Flushing.* Is the repair complete?	—	*Go to Step 25*	—
21	Inspect the brake pipes and hoses for a restricted brake fluid passage. Check for the following: • Low fluid or no fluid output • Spurting of fluid while pressing the brake pedal • Particles suspended in the fluid Refer to *Hydraulic Brake System Bleeding.* Is there a restricted brake fluid passage?	—	*Go to Step 22*	*Go to Step 23*
22	1. Determine the area of the restriction. This will involve the disassembly of individual brake lines and checking for low or no fluid output 2. Flush the individual brake line or hose. Refer to *Hydraulic Brake System Flushing.* 3. If the restriction cannot be removed, replace the brake line or hose as necessary. Is the repair complete?	—	*Go to Step 25*	—
23	Inspect for air in the brake system. Refer to *Hydraulic Brake System Bleeding.* Is there air in the brake system?	—	*Go to Step 24*	System OK
24	Bleed the brake system. Refer to *Hydraulic Brake System Bleeding.* Is the repair complete?	—	*Go to Step 25*	—
25	Verify proper brake system operation. Does the original condition still exist?	—	*Go to Step 1*	—

Brake System Noise with Brakes Applied

Step	Action	Value(s)	Yes	No
1	Was the Hydraulic Brake System Diagnostic Check performed?	—	*Go to Step 2*	Go to *Brake System Diagnosis*
2	Inspect the disc brake pads and brake shoe linings for the following: • Excessive wear • Uneven wear • Abuse • Glazing • Contaminated lining material • Incorrect lining material Do any of the above conditions apply?	—	*Go to Step 3*	*Go to Step 4*
3	Replace the brake linings. Refer to *Brake Pads Replacement (Front)* or *Brake Pads Replacement (Rear)* in Disc Brakes or *Brake Lining Replacement* in Drum Brakes. Is the repair complete?	–	*Go to Step 8*	—
4	Inspect the brake rotors for the following: heat spotting or scoring. • Hot spots • Scored rotor surface • Grooved rotor surface Do any of the above conditions apply?	—	*Go to Step 5*	*Go to Step 6*
5	1. Refinish the rotor. Refer to *Refinishing Brake Rotors* in Disc Brakes. 2. If refinishing the brake rotor results in a thickness that is less than the thinnest (refinishing) thickness, replace the rotor. Refer to *Brake Rotor Replacement* in Disc Brakes. Is the repair complete?	-	*Go to Step 8*	—
6	Inspect brake assembly for loose, broken or missing attachments. Refer to *Brake Pad Inspection (Front)* or *Brake Pad Inspection (Rear)* in Disc Brakes or *Brake Shoe Inspection* in Drum Brakes. Are there any loose, broken or missing attachments?	—	*Go to Step 7*	System OK
7	Tighten or replace the loose, broken or missing brake assembly components. Is the repair complete?	-	*Go to Step 8*	—
8	Verify proper brake system operation. Does the original condition still exist?	—	*Go to Step 1*	System OK

Brake System Noise with Brakes Not Applied

Step	Action	Value(s)	Yes	No
1	Was the Hydraulic Brake System Diagnostic Check performed?	—	*Go to Step 2*	Go to *Brake System Diagnosis*
2	Inspect the disc brake pads and brake shoe linings for the following: • Excessive wear • Uneven wear • Abuse • Contaminated lining material • Incorrect lining material Refer to *Brake Pad Inspection (Front)* or *Brake Pad Inspection (Rear)* in Disc Brakes or *Brake Shoe Inspection* in Drum Brakes. Do any of the above conditions apply?	—	*Go to Step 3*	*Go to Step 4*
3	Replace the brake linings. Refer to *Brake Pads Replacement (Front)* or *Brake Pads Replacement (Rear)* in Disc Brakes or *Brake Lining Replacement* in Drum Brakes. Is the repair complete?	—	*Go to Step 8*	–
4	Inspect the brake rotors for the following • Hot spots • Scored rotor surface • Grooved rotor surface Do any of the above conditions apply?	—	*Go to Step 5*	*Go to Step 6*
5	1. Refinish the brake rotor. Refer to *Refinishing Brake Rotors* in Disc Brakes. 2. If refinishing the brake rotor results in a thickness that is less than the thinnest (Refinishing) thickness, replace the rotor. Refer to *Brake Rotor Replacement* and *Component Specifications (Rotor Thickness)* in Disc Brakes. Is the repair complete?	—	*Go to Step 8*	-
6	Inspect brake assembly for loose, broken, or missing components. Refer to *Brake Pad Inspection (Front)* or *Brake Pad Inspection (Rear)* in Disc Brakes or *Brake Shoe Inspection* in Drum Brakes. Are there any loose, broken, or missing brake assembly components?	—	*Go to Step 7*	System OK
7	Tighten or replace the loose, broken or missing brake assembly components. Refer to *Brake Pads Replacement (Front)* or *Brake Pads Replacement (Rear)* in Disc Brakes or *Brake Lining Replacement* in Drum Brakes. Is the repair complete?	—	*Go to Step 8*	-
8	Verify proper brake system operation. Does the original condition still exist?	—	*Go to Step 1*	System OK

Hydraulic Brake Booster Noisy

Step	Action	Value(s)	Yes	No
1	Was the Hydraulic Brake System Diagnostic Check performed?	—	*Go to Step 2*	Go to *Hydraulic Brake Diagnostic System Check*
2	Verify the customer complaint. Define the type of noise, and when the noise occurs. Does a hissing noise occur?	—	*Go to Step 3*	*Go to Step 4*
3	A normal hissing noise, very noticeable when the vehicle is motionless, occurs when the brake pedal effort is 266 N·m (60 lb) or more and increases in intensity if the pedal effort increases above this norm or if the operating temperature increases. Does the hissing noise appear normal?	=/< 266 N·m(60 lb)	System OK	*Go to Step 5*
4	Normal clunk/click/clatter noises occur when you quickly release the brake pedal from hard efforts of 222-444 N·m (50-100 lb). Does the clunk, clatter, or clicking noises appear normal?	222-444 N·m (50-100 lb)	System OK	*Go to Step 5*
5	Does the noise occur under any of the following conditions? • Low brake pedal effort • With the engine idle and no brake pedal effort • Under normal driving conditions	—	*Go to Step 8*	*Go to Step 6*
6	A moan or low frequency hum noise may be the result of a problem within the power steering system. Refer to *Power Steering System Test Procedure* in Power Steering System. Was a repair performed on the power steering system?	—	*Go to Step 11*	*Go to Step 7*
7	Check the hydraulic brake booster accumulator for proper operation. Refer to *Accumulator Leak-Down Test.* Is the hydraulic brake booster accumulator operating properly?	—	*Go to Step 10*	*Go to Step 9*
8	1. Obtain a vehicle with a known acceptable brake booster system. 2. Run both vehicles until the engines reach normal operating temperature. 3. In both vehicles, duplicate the operating condition associated with the noise. Listen for the noise. 4. Compare the results. Does the acceptable system make the same noise?	—	System OK	*Go to Step 6*
9	Replace the accumulator. Refer to *Hydraulic Brake Booster Overhaul (Accumulator).* Is the repair complete?	—	*Go to Step 11*	—
10	Replace the hydraulic brake booster. Refer to *Hydraulic Brake Booster Replacement (Commercial).* Is the repair complete?	—	*Go to Step 11*	—
11	Verify proper brake system operation. Does the original condition still exist?	—	*Go to Step 1*	System OK

Accumulator Leak-Down System Not Holding Charge

Step	Action	Value(s)	Yes	No
1	Was the Hydraulic Brake System Diagnostic Check performed?	—	*Go to Step 2*	Go to *Brake System Diagnosis*
2	Perform the Accumulator Leak-Down test. Refer to *Accumulator Leak-Down Test.* Did the accumulator pass the leak-down test?	—	*Go to Step 4*	*Go to Step 3*
3	Replace the accumulator. Refer to *Hydraulic Brake Booster Replacement (Commercial)* or *Hydraulic Brake Booster Replacement (Motorhome).* Is the repair complete?	—	*Go to Step 7*	—
4	Inspect the following power steering system components for contamination: • Power steering gear • Power steering pump • Hydraulic brake booster • Power steering hoses Is the power steering system fluid contaminated?	—	*Go to Step 5*	*Go to Step 6*
5	1. Flush the power steering system. Refer to *Flushing the Power Steering System* in Power Steering System. 2. Replace the hydraulic brake booster. Refer to *Hydraulic Brake Booster Replacement (Commercial)* or *Hydraulic Brake Booster Replacement (Motorhome).* Is the repair complete?	—	*Go to Step 7*	—
6	Replace the hydraulic brake booster. Refer to *Hydraulic Brake Booster Replacement (Commercial)* or *Hydraulic Brake Booster Replacement (Motorhome).* Is the repair complete?	—	*Go to Step 7*	—
7	Verify proper brake system operation. Does the original condition still exist?	—	*Go to Step 1*	System OK

Brake System Groan at End of Stop

Step	Action	Value(s)	Yes	No
1	Was the Hydraulic Brake System Diagnostic Check performed?	—	*Go to Step 2*	Go to *Brake System Diagnosis*
2	Inspect the front suspension for loose or missing components. Are there any loose or missing components?	—	*Go to Step 3*	*Go to Step 4*
3	Tighten, repair, or replace the missing components as necessary. Refer to *Fastener Tightening Specifications* in Front Suspension. Is the repair complete?	–	*Go to Step 8*	—
4	Inspect the disc brake pads and brake shoe linings for the following: • Excessive wear • Uneven wear • Abuse • Glazing • Contaminated lining material • Incorrect lining material Do any of the above conditions exist?	—	*Go to Step 5*	*Go to Step 6*

Brake System Groan at End of Stop (cont'd)

Step	Action	Value(s)	Yes	No
5	Replace the brake linings. Refer to *Brake Pads Replacement (Front)* or *Brake Pads Replacement (Rear)* in Disc Brakes or *Brake Lining Replacement* in Drum Brakes. Is the repair complete?	—	*Go to Step 8*	—
6	Check the wheel assemblies for out of balance condition. Are any of the wheel assemblies out of balance?	—	*Go to Step 7*	System OK
7	Balance the wheel assembly. Refer to Balancing Tire and Wheels in Vibration Diagnosis and Correction. Is the repair complete?	—	*Go to Step 8*	—
8	Verify proper brake system operation. Does the original condition still exist?	—	*Go to Step 1*	System OK

Brakes Self Apply When Turning Steering Wheel

Step	Action	Value(s)	Yes	No
1	Was the Hydraulic Brake System Diagnostic Check performed?	—	*Go to Step 2*	Go to *Brake System Diagnosis*
2	Inspect the following power steering system components for contamination: • Power steering gear • Power steering pump • Hydraulic brake booster • Power steering hoses Is the power steering system fluid contaminated?	—	*Go to Step 3*	*Go to Step 4*
3	1. Flush the power steering system. Refer to *Flushing the Power Steering System* in Power Steering. 2. Replace the hydraulic brake booster. Refer to *Hydraulic Brake Booster Replacement (Commercial)* or *Hydraulic Brake Booster Replacement (Motorhome).* Is the repair complete?	—	*Go to Step 6*	—
4	Check the hydraulic brake booster to power steering pump hose for the following: • Kinks • Sharp bends • Restrictions Do any of the above conditions exist?	—	*Go to Step 5*	System OK
5	Reroute or replace the hose. Refer to *Power Steering Hoses Replacement (4.3L and 5.7L Engines), Power Steering Hoses Replacement (6.5L (L57) Independent), Power Steering Hoses Replacement (6.5L (L57) I-Beam),* and *Power Steering Hoses Replacement (6.5L (L65) and 7.4L Engines)* in Power Steering Systems. Is the repair complete?	—	*Go to Step 6*	—
6	Verify proper brake system operation. Does the original condition still exist?	—	*Go to Step 1*	System OK

Master Cylinder Diagnosis

These tests will not find all master cylinder malfunctions. If you cannot find the cause with these tests, refer to Brake System Diagnosis.

Visual Inspection

- Check for a cracked casting or brake fluid leaks around the master cylinder.

  A leak will have at least one drop of fluid. A damp condition is normal.
- Check the pedal linkage for binding and for incorrect pushrod length.

  Disassemble the master cylinder if no brake pedal binding or improper brake pedal travel is found. Refer to *Master Cylinder Overhaul.*
- Check the master cylinder for swollen or elongated primary piston seals.

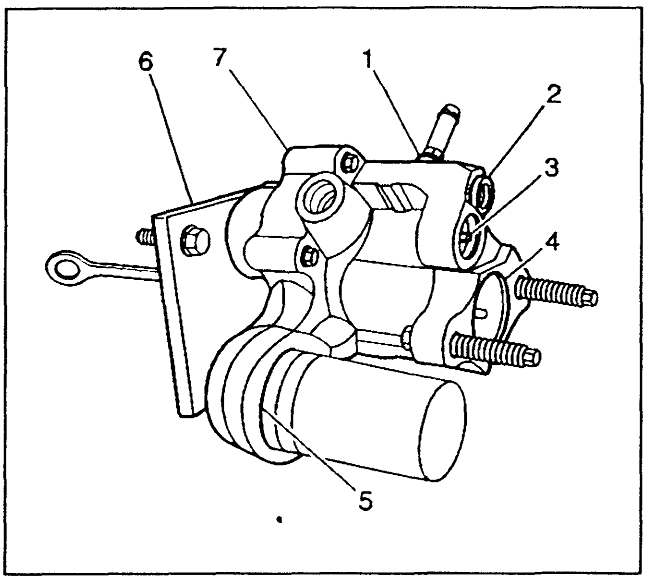
  If you find swollen seals, refer to *Brake Fluid and Brake Fluid Handling.*

Brake Hose and Pipe Diagnosis

Inspect all pipes, hoses, and fittings for leaks at regular intervals. The fittings must be tight. All clips, clamps, and unions supporting the pipes and hoses must be securely in place. Ensure that all hoses and tubes do not contact parts of the vehicle that could chafe or wear the hoses.

Wipe clean any area suspected of leaking. Leaking fluid will then be easily seen. If you find a leak, tighten, repair, or replace nearby fittings and bolts.

Seal Leak Diagnosis



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Replacement of the brake booster is required when any of the following seals are damaged: the input rod seal (6), the power piston seal (4), the housing seal (7), or the spool valve seal (3). The details of these and other booster components follow.

Input Rod Seal

A fluid leak from the inside of the driver's compartment at the power brake booster vent hole indicates a damaged input rod seal (6). Replace the hydraulic brake booster. Refer to *Hydraulic Brake Booster Replacement (Commercial)* or *Hydraulic Brake Booster Replacement (Motorhome).*

Power Piston Seal

Fluid leaking between the brake master cylinder and the power brake booster indicates damage of the power piston seal (4). This can possibly reduce the power assist. Replace the hydraulic brake booster. Refer to *Hydraulic Brake Booster Replacement (Commercial)* or *Hydraulic Brake Booster Replacement (Motorhome).*

Housing Seal

A fluid leak between the two housings indicates a damaged housing seal (7). Replace the hydraulic brake booster. Refer to *Hydraulic Brake Booster Replacement (Commercial)* or *Hydraulic Brake Booster Replacement (Motorhome).*

Relief Valve

Damage to the relief valve seal (2) causes fluid to leak past the relief valve. Replace the relief valve. Refer to

Spool Valve Plug Seal

Damage to the spool valve plug seal (3) causes fluid to leak past the spool valve. Replace the hydraulic brake booster. Refer to *Hydraulic Brake Booster Replacement (Commercial)* or *Hydraulic Brake Booster Replacement (Motorhome).*

Accumulator Seal

Damage to the accumulator seal (5) causes fluid to leak past the accumulator cap. Replace the accumulator seal (5) with the power brake booster on the vehicle. Refer to *Hydraulic Brake Booster Replacement (Commercial)* or *Hydraulic Brake Booster Replacement (Motorhome).*

Return Port Fitting

Tighten the return port fitting (1) to 10 N•m (88 lb in). Refer to *Fastener Notice.* If the leak continues, replace the seal ring under the return port fitting.

For information on diagnosing the brake warning system, refer to *Brake Warning System Description (Motorhome), Brake Warning System Description (Commercial),* or *Brake Warning System Description (Motorhome Export).*

Hydraulic System Fluid Loss

Notice: Do not run the engine without fluid in the power steering pump reservoir. Doing so could damage the pump bearing and seals. The belt that drives the power steering pump also drives the coolant pump and other components. Do not disconnect the belt and run the engine. A malfunctioning power steering pump and/or system still serves as an idler pulley for the belt. If the pump is allowed to run without fluid in it, the bearings will seize up and cause the coolant pump to stop. This can cause damage to the engine.

If the hydraulic booster system fails because of fluid loss, take the following steps before starting the vehicle.

1. If the failed component is not the power steering pump, route the pressure pipe back to the fluid reservoir.
2. Make all necessary repairs.
3. Replace the power steering fluid.
4. Bleed the power steering system. Refer to Bleeding the Power Steering System in Power Steering System.

Metal shavings from a worn power steering pump often contaminate the system. If you replace the power steering pump, clean and flush the hydraulic booster system. Disassemble and clean the booster head. Replace all the seals and O-rings. Remove the pipes and hoses. Blow the pipes and hoses clean of all metal shavings. Refer to Flushing the Power Steering System in Power Steering System.

Hydraulic Booster Functional Test

System Tests

The hydraulic booster uses fluid pressure from the power steering system. A malfunctioning power steering system can affect the hydraulic booster. A malfunctioning booster can affect the steering system. Before beginning extensive testing, perform the following procedure.

1. Check all power steering and brake pipe connections for leaks and restrictions.

Notice: Power steering fluid and brake fluid cannot be mixed. If brake seals contact power steering fluid or steering seals contact brake fluid, seal damage will result.

2. Ensure that the master cylinder is properly filled.

Notice: Power steering fluid and brake fluid cannot be mixed. If brake seals contact power steering fluid or steering seals contact brake fluid, seal damage will result.

3. Ensure that the power steering pump reservoir is properly filled.

   If the power steering fluid contains air, refer to Diagnosis of the Power Steering System in Power Steering System.
4. Check the power steering pump belt for wear and improper tension. Refer to Diagnosis of the Drive Belt System in Engine Cooling.
5. Check the power steering pump pressure. Refer to Power Steering System Test in Power Steering System.

Functional Test

1. With the ignition OFF, apply and release the brake pedal several times. This will empty the accumulator.
2. Apply and hold the brake pedal with 180 N (40 lb) of force.
3. Start the engine.

The pedal should fall away, and then push back against your foot.

Accumulator Leak-Down Test

System Tests

The hydraulic booster uses fluid pressure from the power steering system. A malfunctioning power steering system can affect the hydraulic booster. A malfunctioning booster can affect the steering system. Before beginning extensive testing, perform the following procedure.

1. Check all power steering and brake pipe connections for leaks and restrictions.

Notice: Power steering fluid and brake fluid cannot be mixed. If brake seals contact power steering fluid or steering seals contact brake fluid, seal damage will result.

2. Ensure that the master cylinder is properly filled.

Notice: Power steering fluid and brake fluid cannot be mixed. If brake seals contact power steering fluid or steering seals contact brake fluid, seal damage will result.

3. Ensure that the power steering pump reservoir is properly filled.

   If the power steering fluid contains air, refer to Diagnosis of the Power Steering System in Power Steering System.
4. Check the power steering pump belt for wear and improper tension. Refer to Diagnosis of the Drive Belt System in Engine Cooling.
5. Check the power steering pump pressure. Refer to Power Steering System Test in Power Steering System.

Leak-Down Test

1. Start the engine.
2. Apply the brake pedal, or turn the steering wheel from stop to stop. Either action charges the accumulator.
3. Turn the engine OFF.
4. Allow the vehicle to sit for one hour.
5. Do not start the engine. Apply and release the brake pedal several times.

   Two or more applications should be power assisted.

6. Start the engine.
7. Charge the accumulator again.
8. Turn the engine OFF.
9. Do not start the engine. Apply and release the brake pedal several times.

   Two or more applications should be power assisted.

   - If the accumulator will not hold a charge for one hour, but functions normally after charging, the accumulator valves are faulty. Replace the accumulator valves. Refer to *Hydraulic Brake Booster Overhaul (Accumulator)* or *Hydraulic Brake Booster Overhaul (Check Valve).*
   - If the accumulator does not hold a charge, but can be heard charging and discharging, the accumulator valves are faulty. Replace the accumulator valves. Refer to *Hydraulic Brake Booster Overhaul (Accumulator)* or *Hydraulic Brake Booster Overhaul (Check Valve).*
10. Apply the brake pedal several times. This will empty the accumulator.
11. If the accumulator's gas charge is exhausted, the accumulator can will rotate or wobble. If the accumulator's gas charge is exhausted, replace the accumulator assembly.

Repair Instructions

Master Cylinder Reservoir Filling

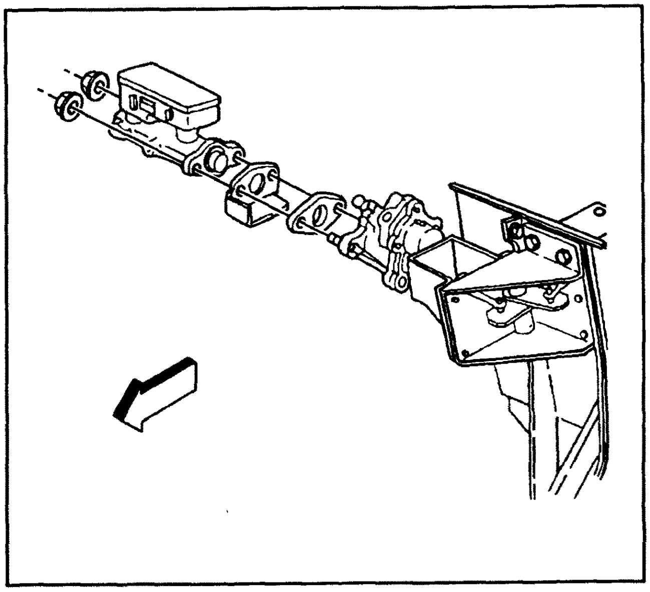
Notice: Do not use fluid that has a petroleum base. Do not use a container that has been used for petroleum based fluids or is wet with water. Petroleum-based fluids cause swelling and distortion of rubber parts in the hydraulic brake system and water lowers the brake fluid's boiling point. Keep all fluid containers capped to prevent contamination.

Thoroughly clean the master cylinder reservoir cover before removal. This prevents dirt from entering the reservoirs.

1. Remove the cover and the diaphragm.
2. Add brake fluid in order to fill the reservoirs to the full mark. The full mark is typically located inside the reservoir. Use Hydraulic Brake Fluid P/N 12377967 or equivalent DOT 3 motor vehicle brake fluid.

Master Cylinder Replacement (Commercial)

Removal Procedure



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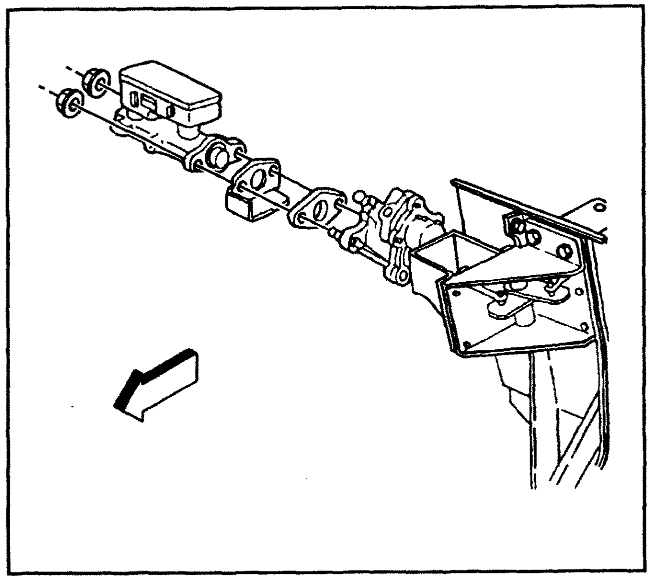
1. Apply the parking brake.
2. Disconnect the brake pipes.
3. Plug the pipe ends in order to prevent contaminates from entering the system.
4. Remove the master cylinder mounting nuts.
5. Remove the master cylinder.
6. Remove the bracket and the spacer.

Installation Procedure



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1. Bench bleed the master cylinder before installation. Refer to *Master Cylinder Bench Bleeding.*
2. Install the bracket and the spacer.
3. Install the master cylinder.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the master cylinder mounting nuts.

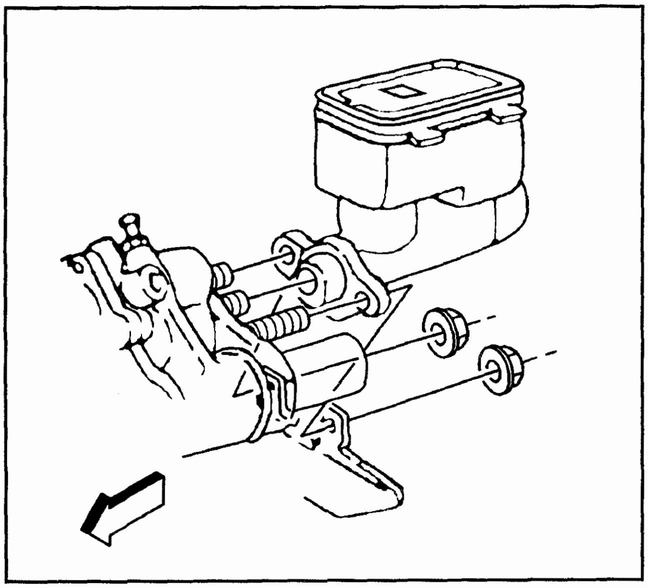
   Tighten

   Tighten the nuts to 29 N·m (21 lb ft).
5. Connect the brake pipes.

   Tighten

   Tighten the brake pipe fittings to 24 N·m (18 lb ft).
6. Bleed the brakes. Refer to *Hydraulic Brake System Bleeding.*
7. Release the parking brake.

Master Cylinder Replacement (Motorhome with JB7/JB8)



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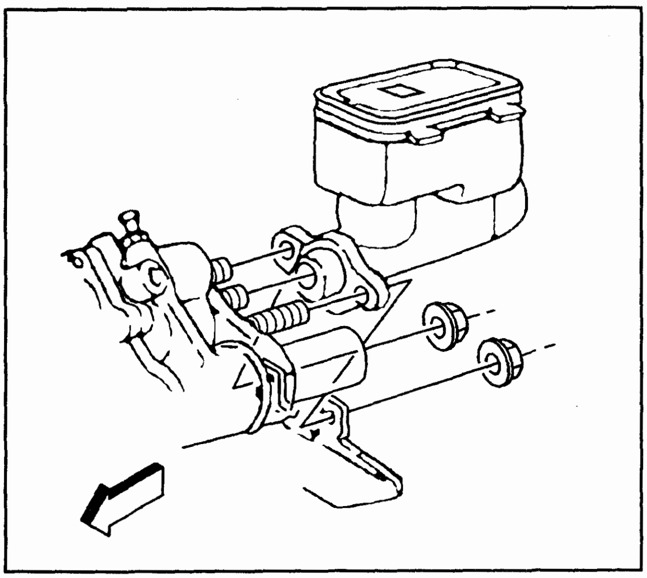
Removal Procedure

1. Apply the parking brake.
2. Disconnect the brake pipes.
3. Plug the pipe ends in order to prevent contaminates from entering the system.
4. Remove the master cylinder mounting nuts.
5. Remove the master cylinder.
6. Remove the bracket.



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Installation Procedure

1. Bench bleed the master cylinder before installation. Refer to *Master Cylinder Bench Bleeding.*
2. Install the bracket.
3. Install the master cylinder.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the master cylinder mounting nuts.

   Tighten

   Tighten the nuts to 29 N·m (21 lb ft).
5. Connect the brake pipes.

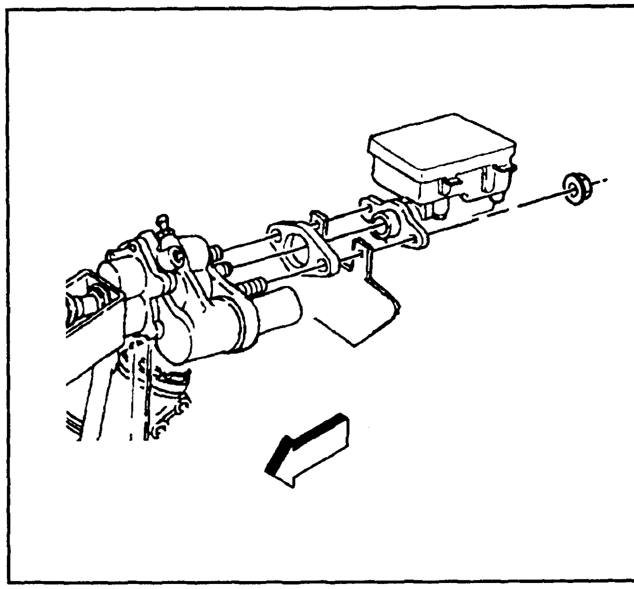
   Tighten

   Tighten the brake pipe fittings to 24 N·m (18 lb ft).
6. Bleed the brakes. Refer to *Hydraulic Brake System Bleeding.*
7. Release the parking brake.

Master Cylinder Replacement (Motorhome with JF9)

Removal Procedure

1. Apply the parking brake.
2. Disconnect the brake pipes.
3. Plug the pipe ends in order to prevent contaminates from entering the system.
4. Remove the master cylinder mounting nuts.
5. Remove the master cylinder.
6. Remove the bracket and the spacer.



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Installation Procedure

1. Bench bleed the master cylinder before installation. Refer to *Master Cylinder Bench Bleeding*.
2. Install the bracket and the spacer.
3. Install the master cylinder.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

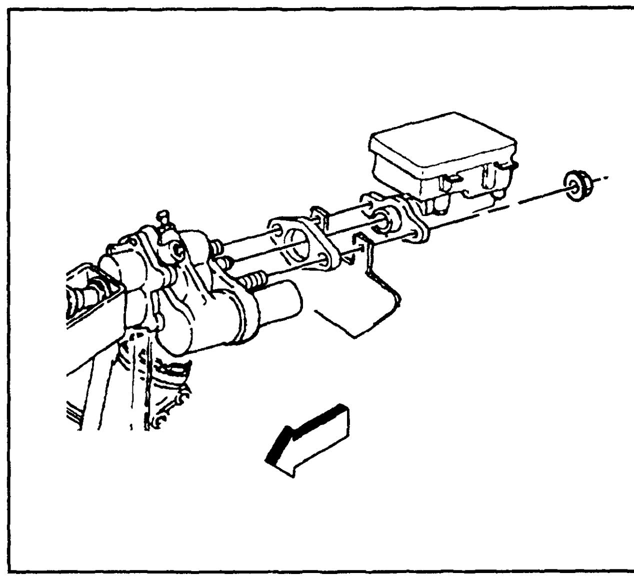
4. Install the master cylinder mounting nuts.

   Tighten

   Tighten the nuts to 29 N·m (21 lb ft).
5. Connect the brake pipes.

   Tighten

   Tighten the brake pipe fittings to 24 N·m (18 lb ft).
6. Bleed the brakes. Refer to *Hydraulic Brake System Bleeding*.
7. Release the parking brake.



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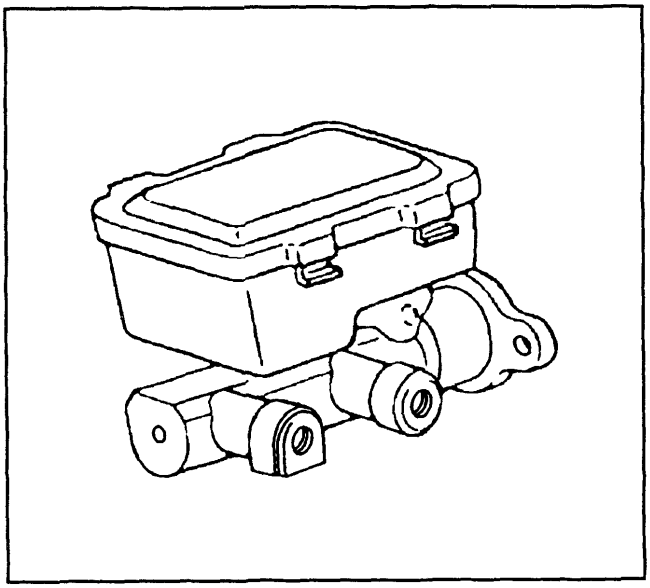
Master Cylinder Overhaul

Disassembly Procedure



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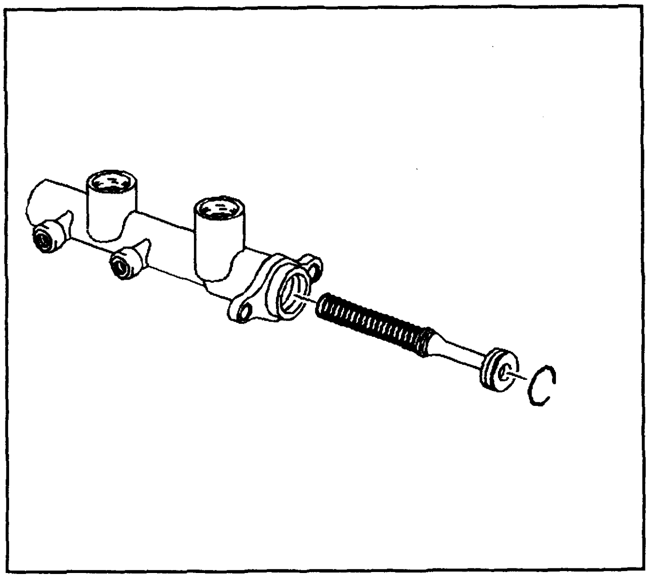
Notice: Do not hone the master cylinder bore. When the brake master cylinder is overhauled, it is recommended that the cylinder body be replaced rather than CLEANED UP by honing the bore. The master cylinder has a hard, highly polished BEARINGIZED surface, which is produced by diamond boring followed by ball or roller burnishing under heavy pressure. Honing will destroy this hard smooth surface and cause rapid wear of the rubber cups.

1. Remove the reservoir cap.
2. Drain the brake fluid from the reservoir.
3. Remove the reservoir and two grommets from the master cylinder body.
4. Clamp the master cylinder mounting flange in a vise.



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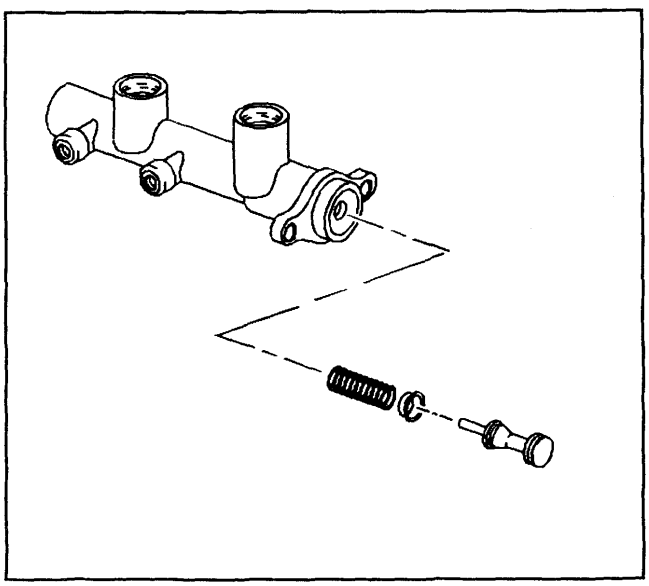
5. Remove the snap ring.
6. Remove the primary piston assembly from the master cylinder body.
7. Remove the seal.



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Caution: If air pressure is used to remove the secondary piston, place the open end of the cylinder bore approximately 25 mm (1 in) from a padded workbench or other surface to catch the piston when it comes out of the bore. Apply low air pressure very carefully to ease the piston out of the bore. Never point the open end of the bore at anyone when applying air pressure. The piston may come out of the bore with considerable force and cause personal injury.

8. Remove the secondary piston from the master cylinder body.

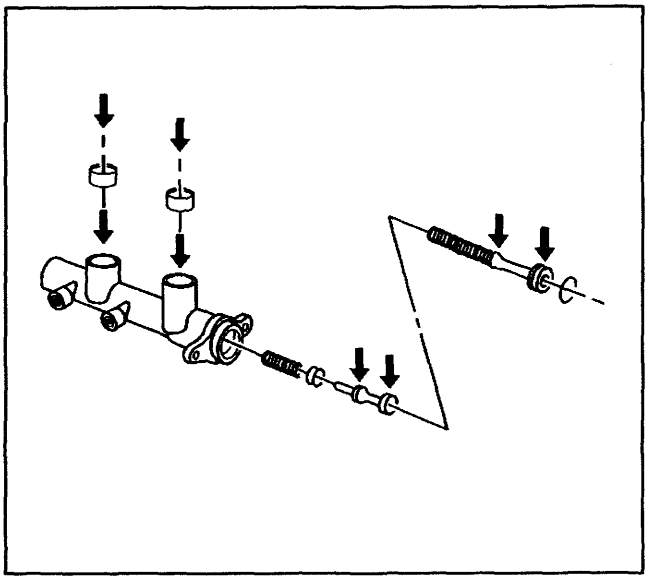
   Plug the rear port. Apply a small amount of air pressure to the front port.
9. Remove the seals.
10. Remove the spring retainer and the spring from the master cylinder body.

Notice: Use approved solvents only when cleaning or flushing the master cylinder and related components. The use of these liquids as cleaning solvent will damage the rubber parts in the system if they have any trace of mineral oil or other contaminants.

11. Clean all the parts using the following procedure:
    - Clean the metal parts in denatured alcohol.
    - Clean the rubber parts in clean brake fluid.
12. Inspect the diaphragm for cuts, cracks, or swelling.
13. Inspect the cylinder bore for scoring or corrosion.
    - Replace the master cylinder if corrosion is present.
    - Do not attempt to hone the cylinder bore.
14. Inspect the reservoir for cracks.

Assembly Procedure

1. Lubricate the grommets, seals, and the cylinder bore with clean DOT 3 motor vehicle brake fluid.
2. Use new seals when assembling the master cylinder.
3. Install the secondary piston spring.
4. Install the spring retainer.



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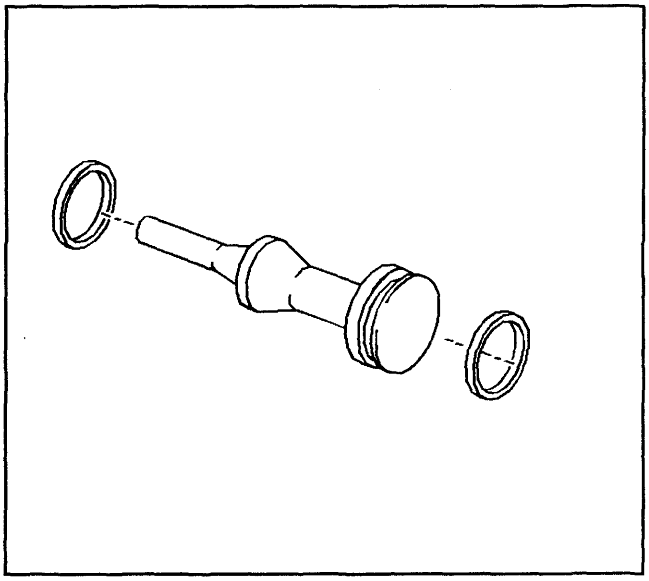
5. Install the primary seal on the secondary piston.
6. Install the secondary seal on the secondary piston.



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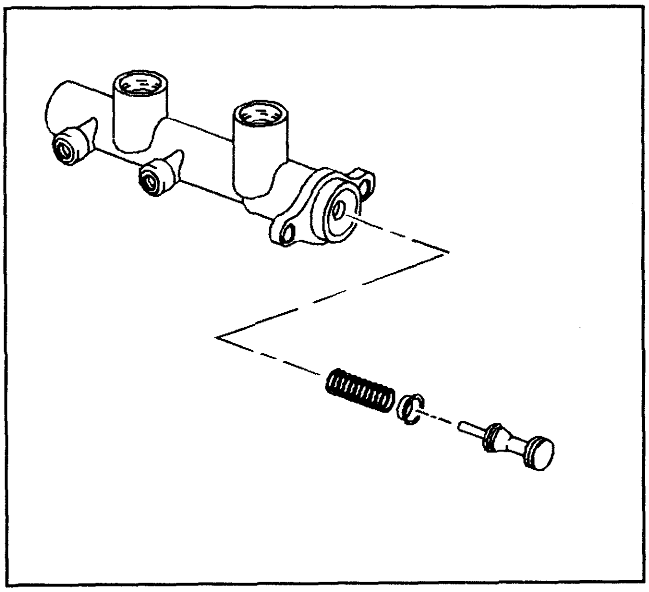

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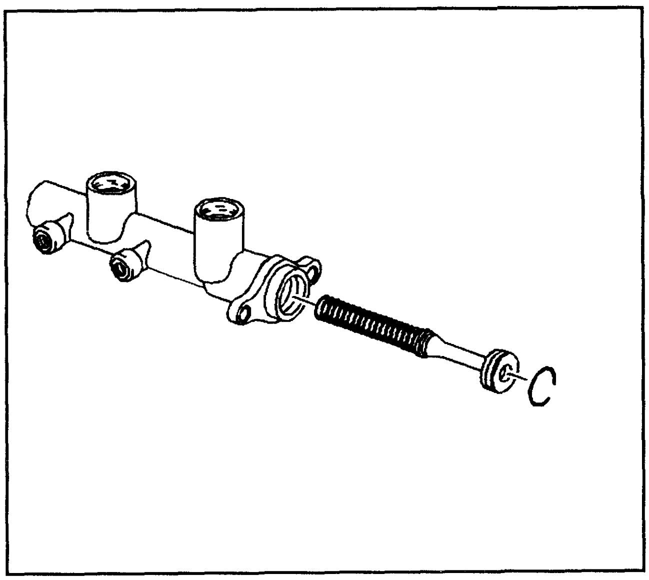
7. Install the secondary piston in the master cylinder body.



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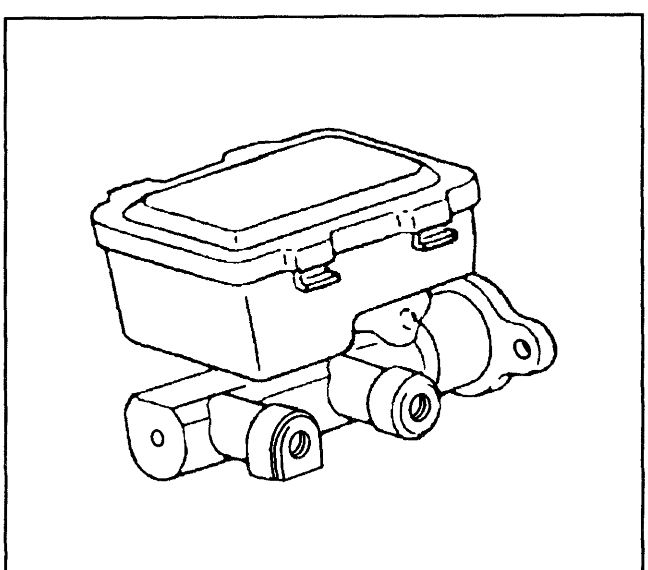
8. Install the seal on the primary piston.
9. Install the primary piston assembly in the master cylinder body.
10. Install the snap ring.
11. Compress the primary piston in order to install the snap ring.



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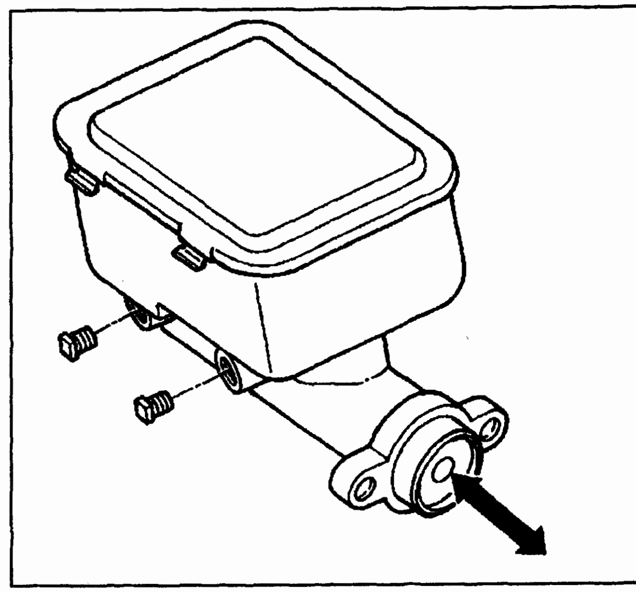
12. Install two new grommets to the master cylinder.
13. Install the reservoir on the master cylinder body.
14. Install the reservoir cap.

Master Cylinder Bench Bleeding

The purpose of bench bleeding is to remove the air from the master cylinder prior to installation. This reduces the amount of bleeding that the hydraulic system will need after the master cylinder is installed on the vehicle.

1. Plug the outlet ports on the master cylinder.



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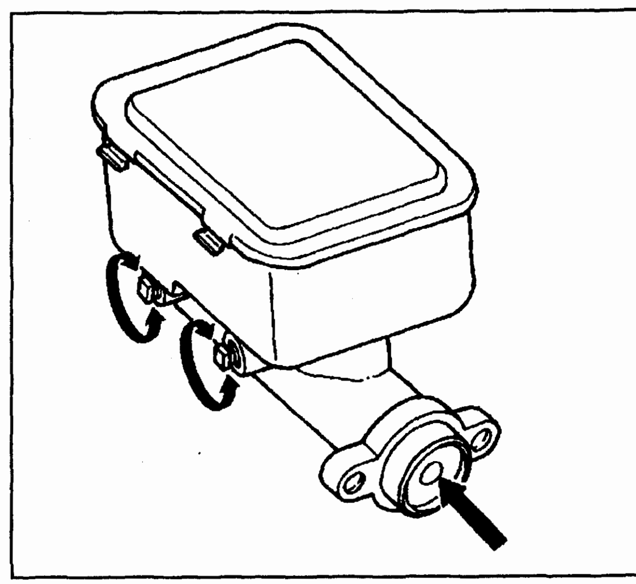
2. Mount the master cylinder in a vise with the front end tilted slightly downward
3. Fill the reservoir with clean brake fluid.
4. Using a tool with a smooth rounded end, stroke the primary piston about 25 mm (1 in) several times.

   As the air is bled from the master cylinder, the primary piston will resist travel and will not allow the full 25 mm (1 in) stroke.
5. Reposition the master cylinder in the vise with the front end tilted slightly upward.
6. Stroke the primary piston about 25 mm (1 in) several times.
7. Reposition the master cylinder in the vise so that the master cylinder is level.
8. Loosen one of the plugs.
9. Push the piston into the bore to force the air from the cylinder.

   In order to prevent air from being sucked back into the cylinder, tighten the plug before allowing the piston to return to its original position.
10. Loosen the other plug.
11. Push the piston into the bore to force the air from the cylinder.

    In order to prevent air from being sucked back into the cylinder, tighten the plug before allowing the piston to return to its original position.
12. Fill the reservoir.

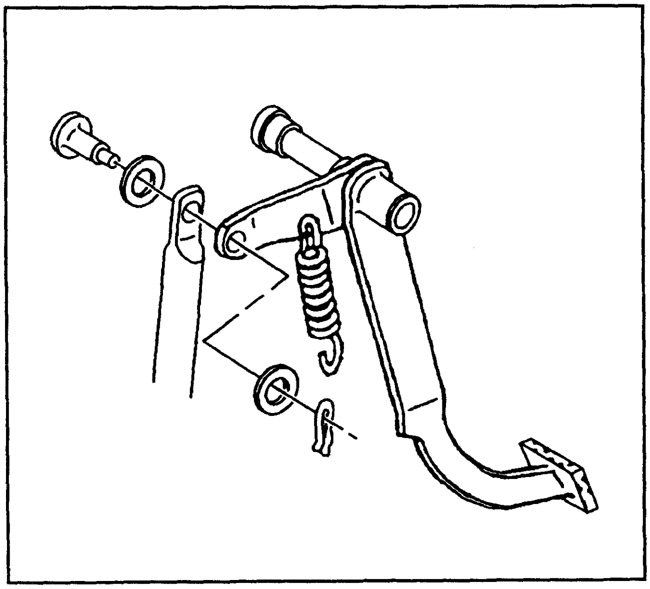
    Perform normal bleeding procedures after the master cylinder is installed. Refer to *Hydraulic Brake System Bleeding.*



30819

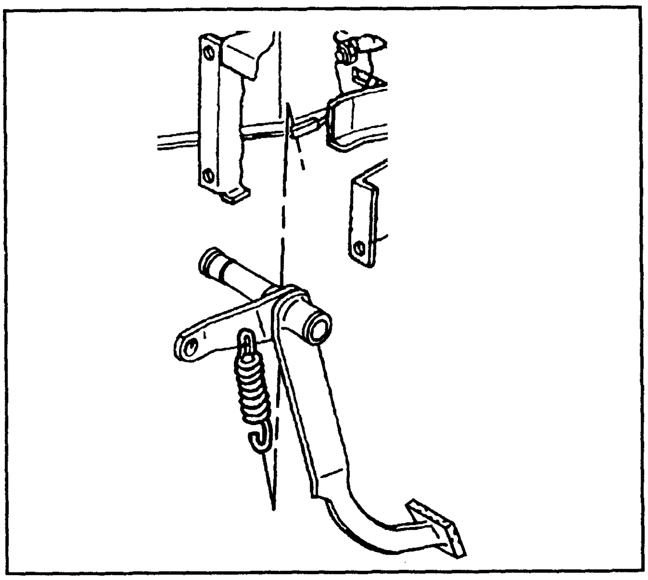
Brake Pedal Replacement (Motorhome)

Removal Procedure



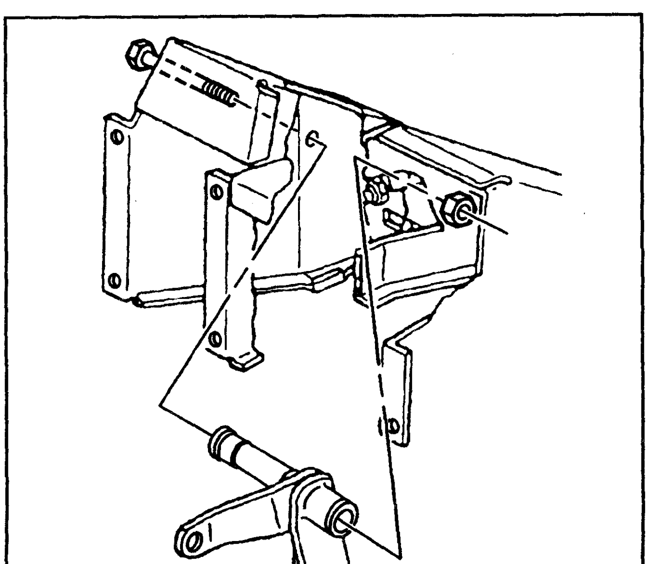
171994

1. Remove the retainer.
2. Remove the washer.
3. Remove the pin and washer.
4. Remove the brake rod.



171999

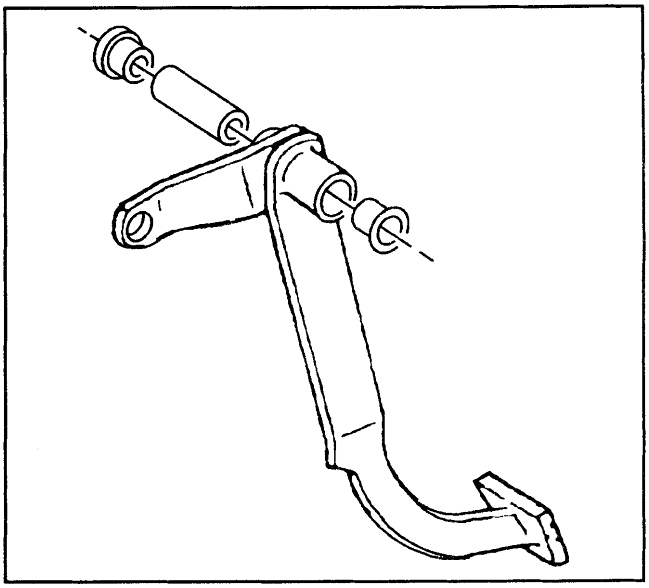
5. Remove the return spring.



172030

6. Remove the nut and bolt.

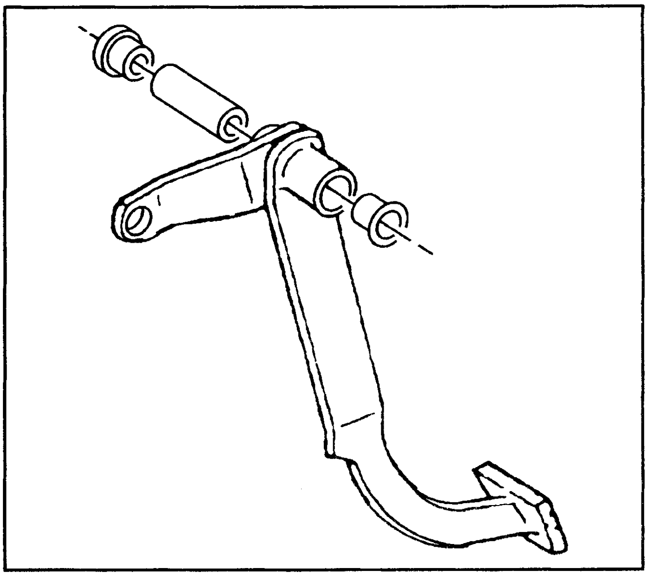
7. Remove the brake pedal.
8. Remove the bushings.
9. Remove the spacer.



172039

Installation Procedure

1. Install the spacer.
2. Install the bushings.
3. Install the brake pedal.



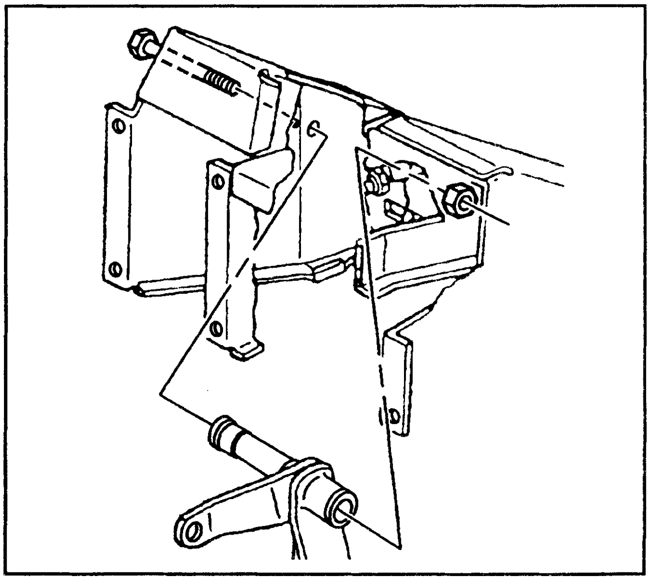
172039

Notice: Refer to *Fastener Notice* in Cautions and Notices.

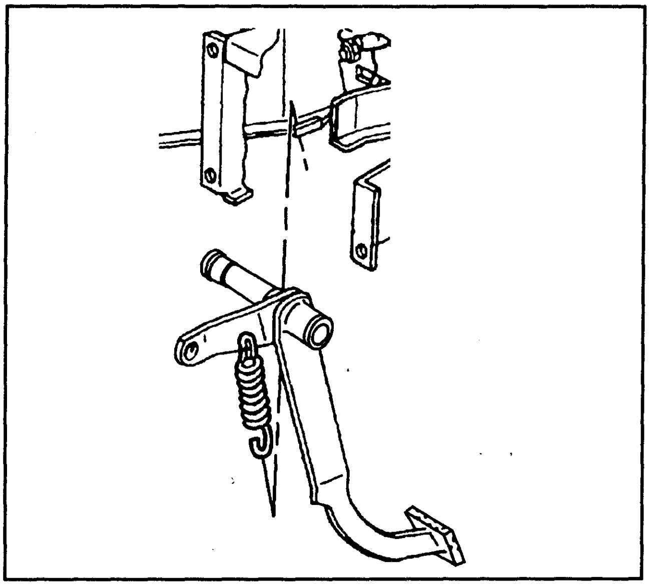
4. Install the bolt and nut.

   Tighten

   Tighten the nut to 10 N·m (89 lb in).

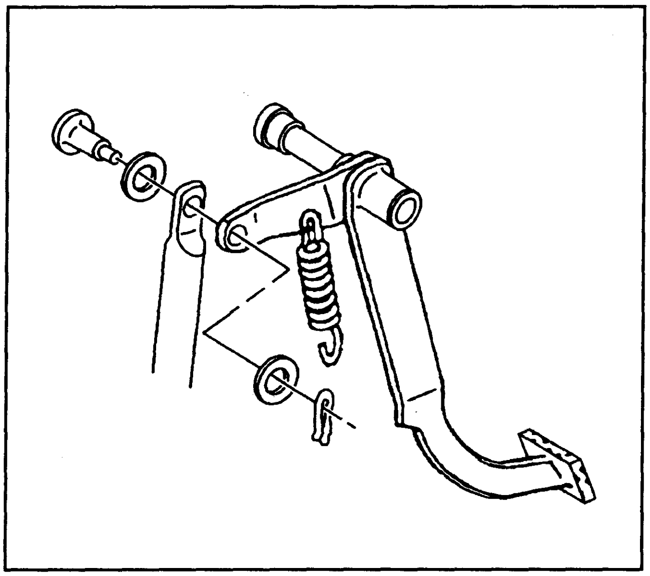


172030



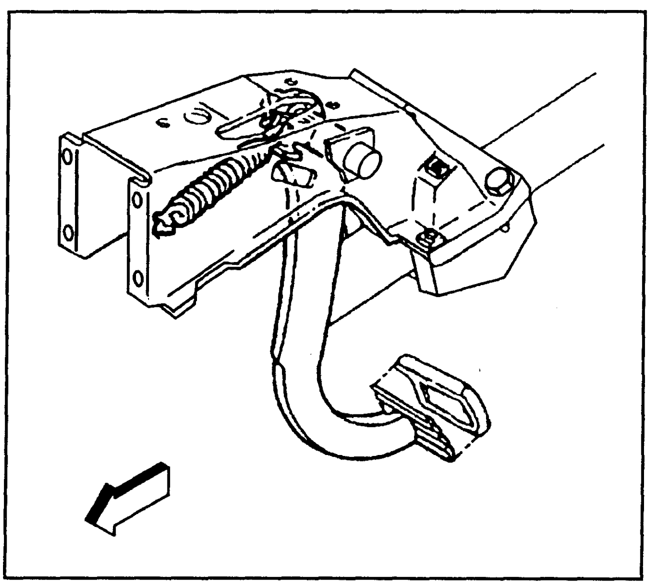
171999

5. Install the return spring.



171994

6. Install the washer and pin.
7. Install the brake rod.
8. Install the washer and the retainer.
9. Check the Stoplamp Switch Adjustment. Refer to *Stoplamp Switch Adjustment.*



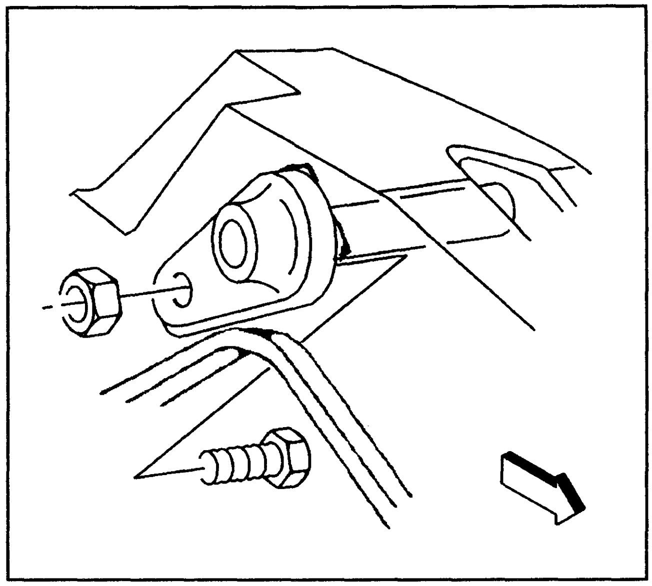
172045

Brake Pedal Replacement (Commercial)

Removal Procedure

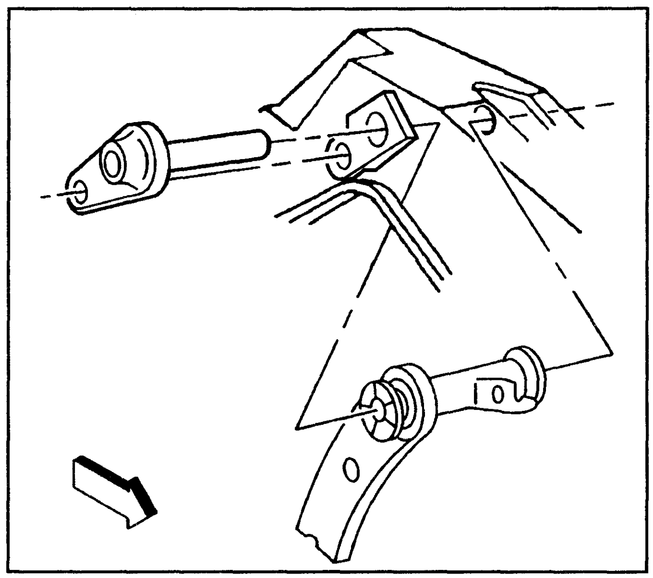
1. Remove the pin.
2. Remove the nut.
3. Remove the bolt.
4. Remove the pushrod.
5. Remove the clutch attaching components, if equipped.
6. Remove the clutch pedal, if equipped.

7. Remove the return spring.
8. Remove the nut and bolt.



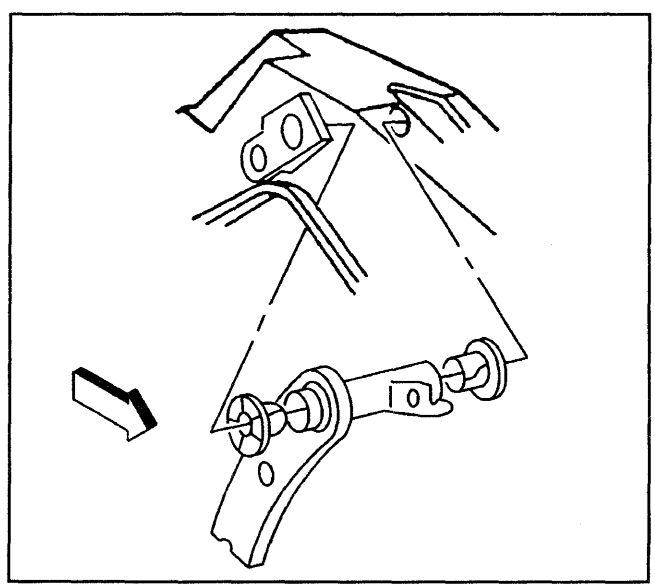
172065

9. Remove the shaft.

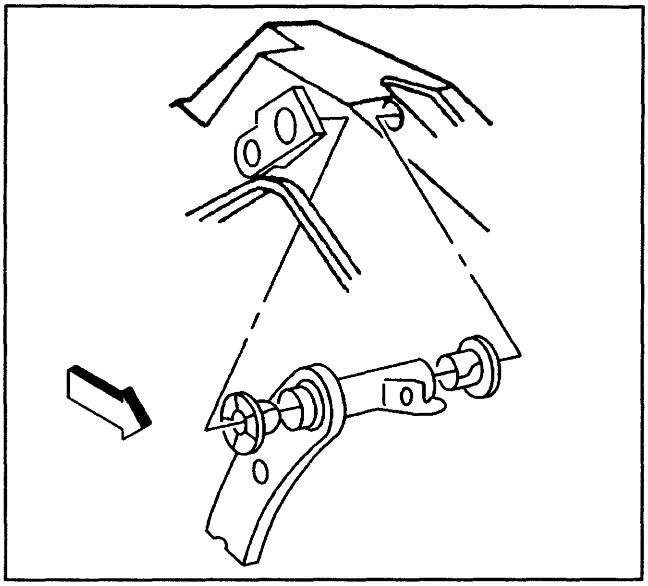


172084

10. Remove the brake pedal.
11. Remove the bushings.



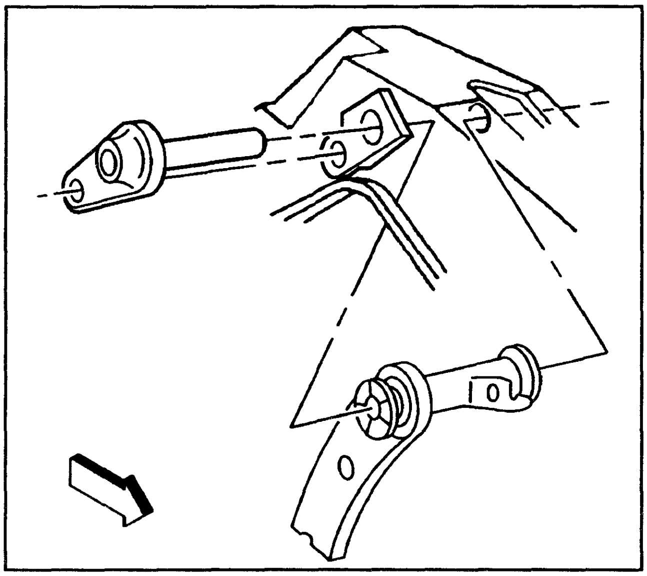
172097



172097

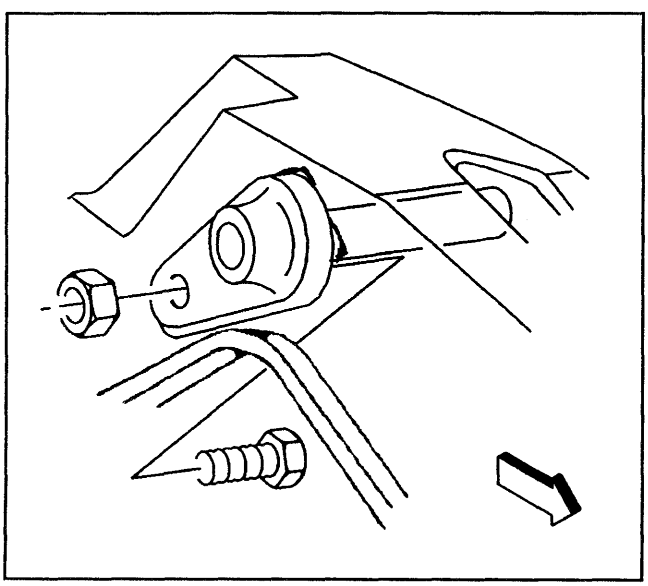
Installation Procedure

1. Lubricate the pivot points with Lubriplate GM P/N 1050109, or equivalent.
2. Install the bushings.
3. Install the brake pedal.



172084

4. Install the shaft.



172065

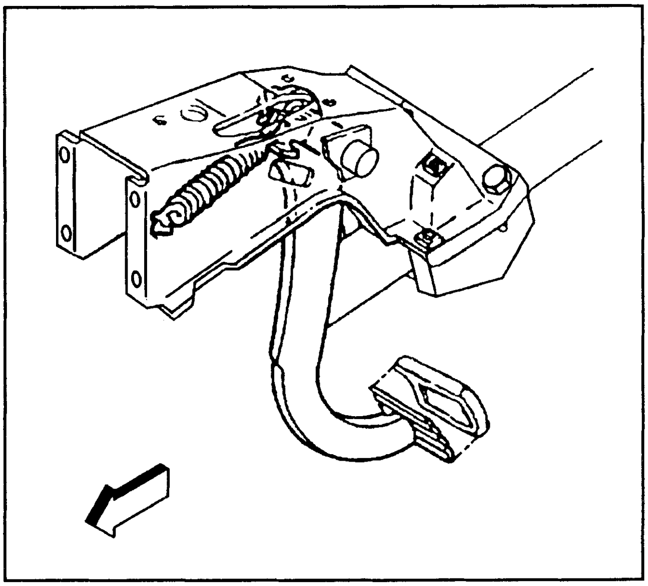
Notice: Refer to *Fastener Notice* in Cautions and Notices.

5. Install the bolt and nut.

   Tighten

   Tighten the nut to 10 N·m (89 lb in).

6. Install the clutch pedal, if equipped.
7. Install the return spring.
8. Install the clutch attaching components, if equipped.
9. Install the pushrod.
10. Install the bolt.
11. Install the nut.
12. Install a new pin.
13. Check the stoplamp switch adjustment. Refer to *Stoplamp Switch Adjustment.*

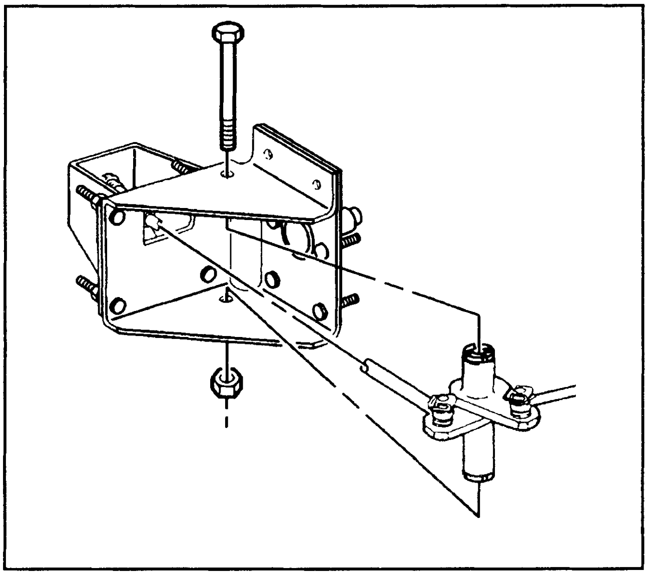


172045

Brake Pedal Replacement (Commercial Linkage)

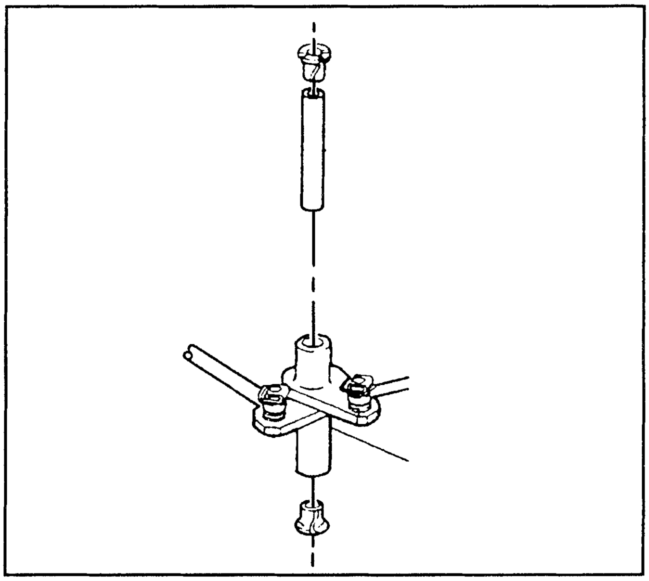
Removal Procedure

1. Disconnect the rod from the brake pedal.
2. Remove the bolt and nut.
3. Remove the lever assembly. The rod will pull out of the booster.

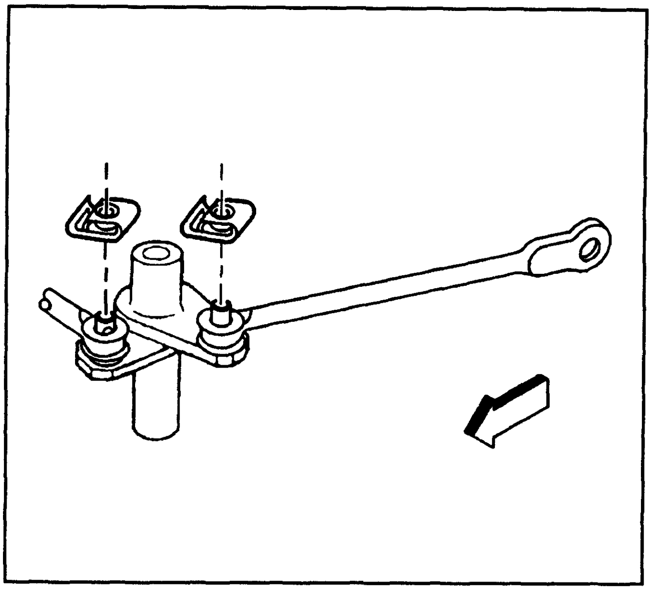


172135

4. Remove the bushings and spacer.
5. Remove the bolt, nut, and washer.
6. Remove the retainer.

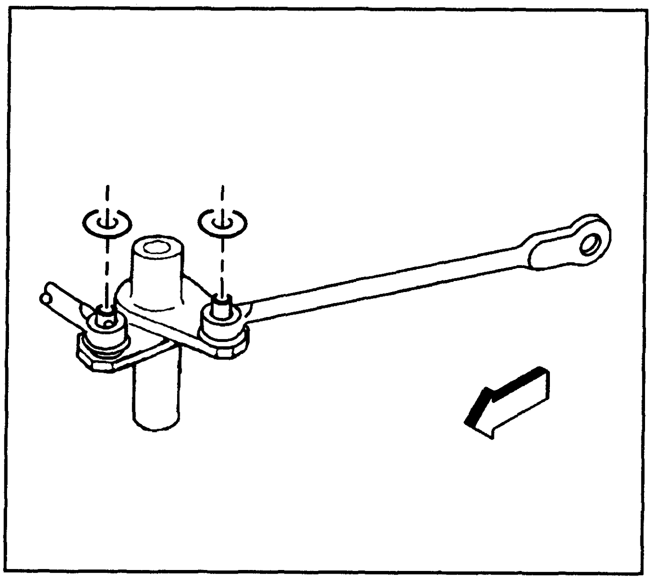


172139



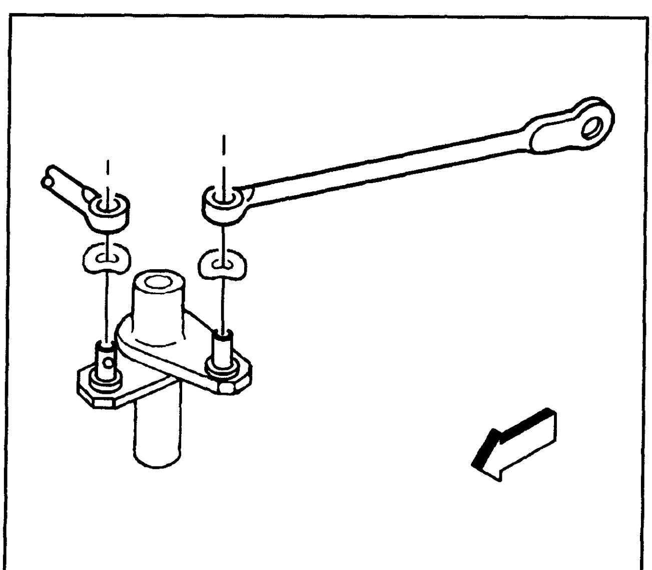
172143

7. Remove the retainers.



172151

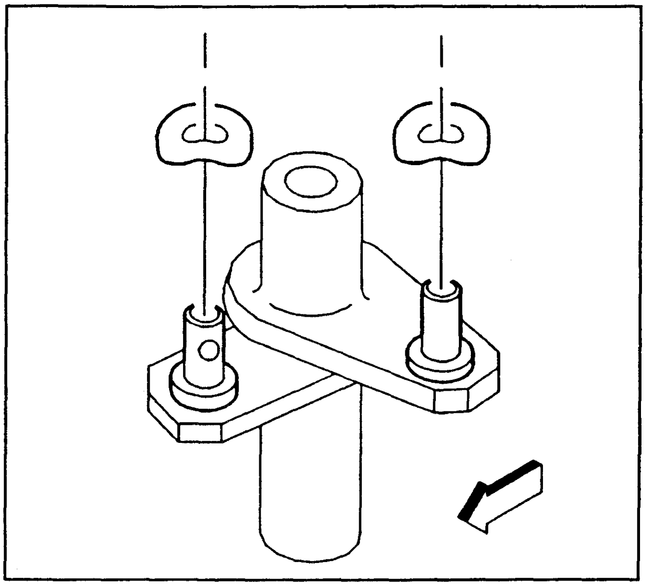
8. Remove the washers.



172156

9. Remove the brake pedal rod and the booster rod.

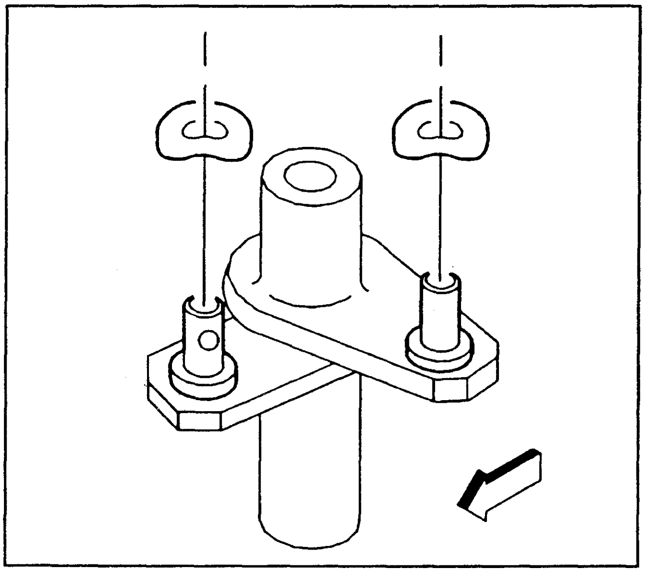
10. Remove the wave washers.



172158

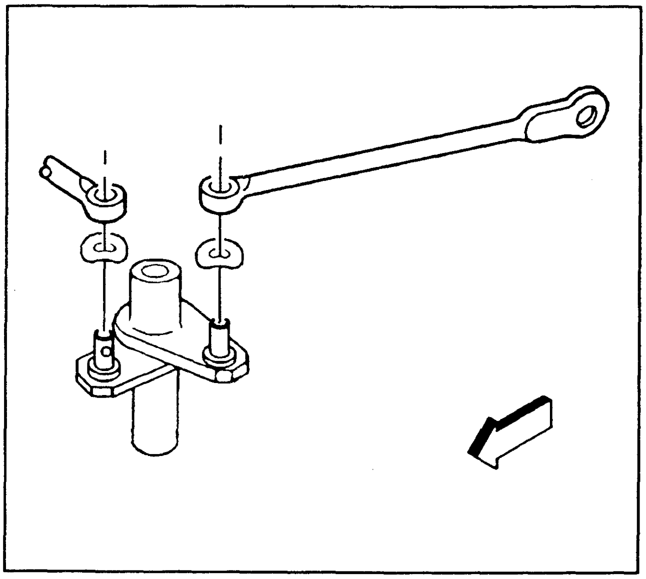
Installation Procedure

1. Lubricate the pivot points with Lubriplate P/N 1050109 or equivalent.
2. Install the wave washers.

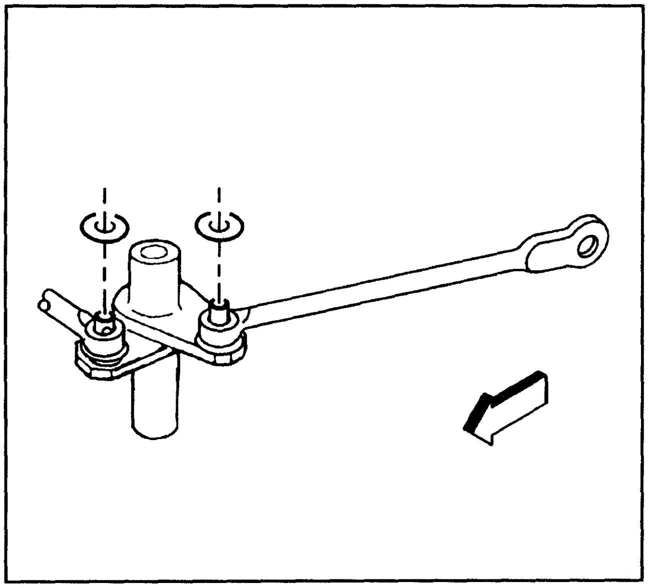


172158

3. Install the brake pedal rod and the booster rod to the lever.

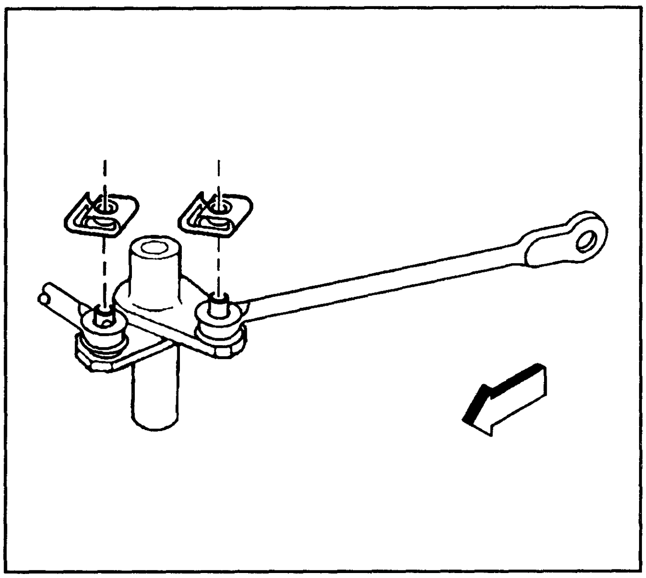


172156



172151

4. Install the washers.



172143

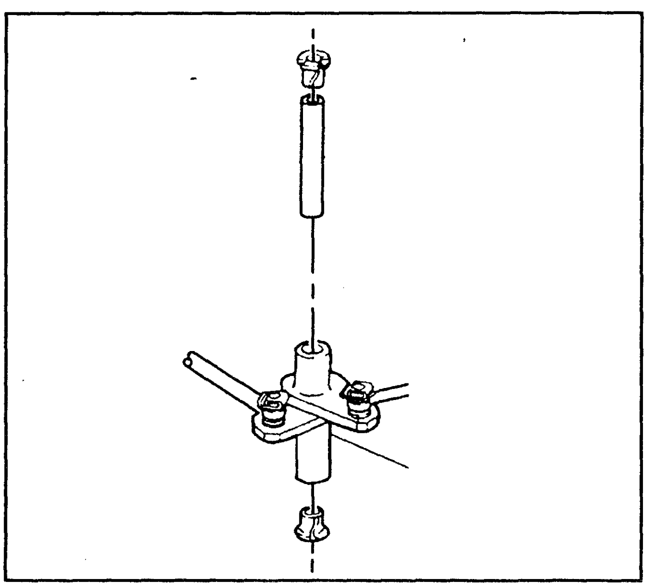
5. Install the retainers.
6. Install the retainer.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

7. Install the bolt washer and nut.

   Tighten

   Tighten the nut to 34 N·m (25 lb ft).



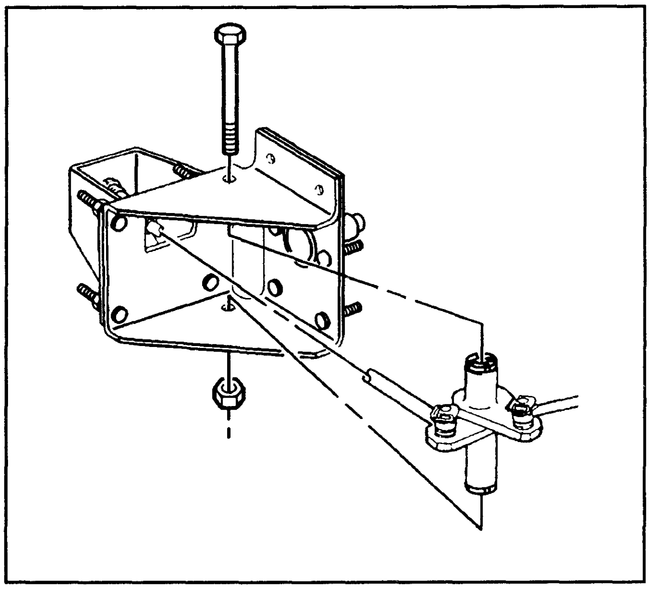
172139

8. Install the spacer.
9. Install the bushings.

10. Install the lever assembly. Insert the rod into the booster. Push the rod until it seats.
11. Install the bolt and nut.

    Tighten

    Tighten the nut to 55 N·m (41 lb ft).
12. Connect the rod to the brake pedal.

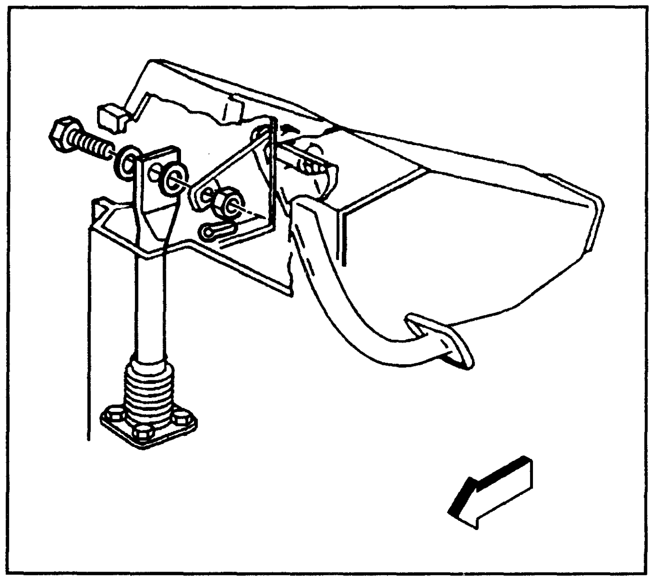


172135

Brake Pedal Replacement (Motorhome Linkage)

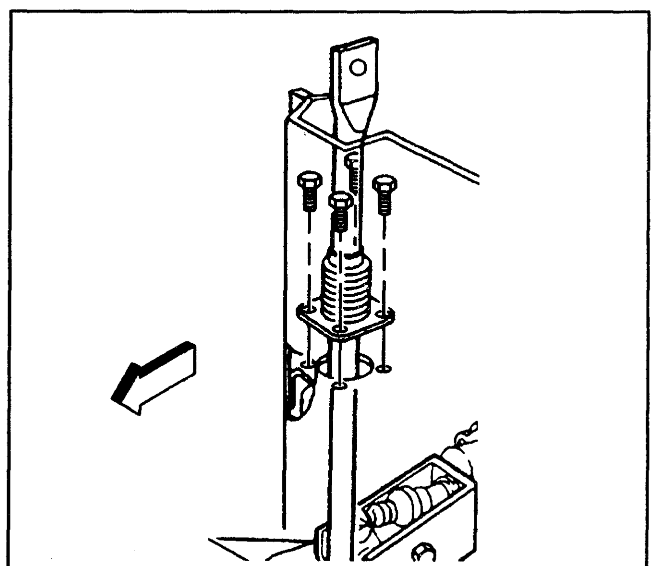
Removal Procedure

1. Remove the retainer.
2. Remove the nut.
3. Remove the bolt and washers.

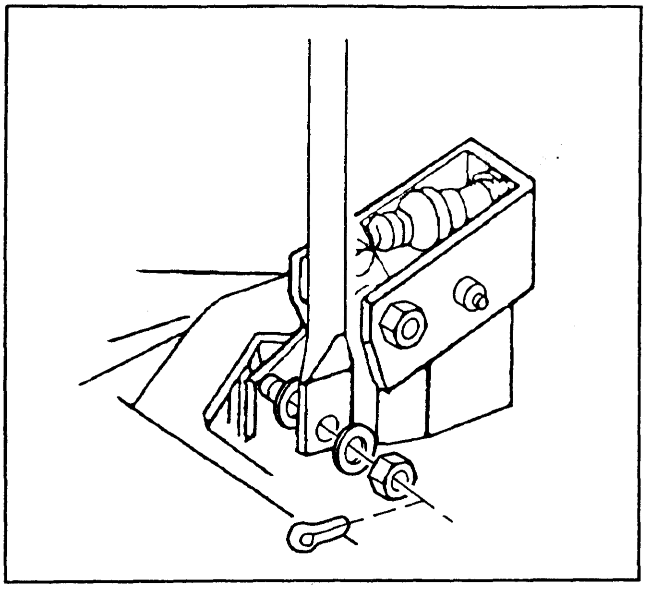


172113

4. Remove 4 screws.
5. Raise the vehicle and support the vehicle with safety stands.

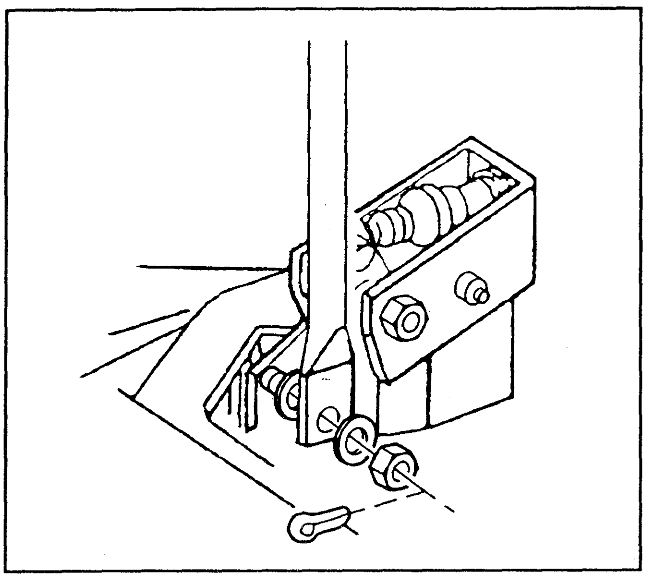


172126



172131

6. Remove the retainer.
7. Remove the nut.
8. Remove the washer.
9. Remove the brake rod.
10. Remove the boot.



172131

Installation Procedure

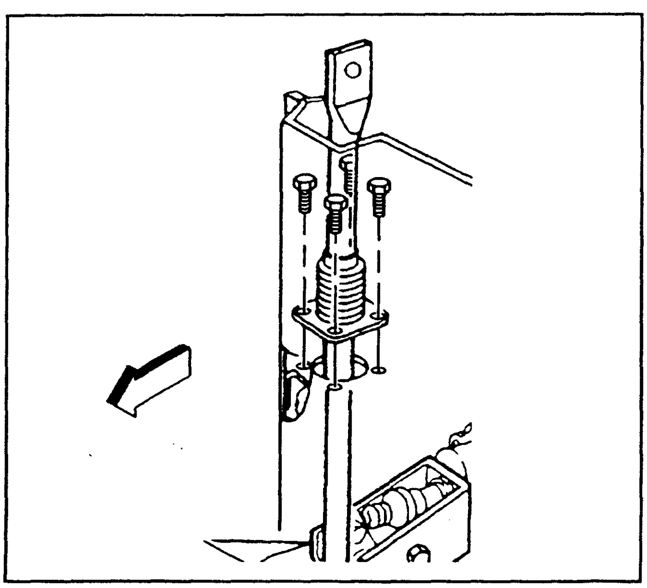
1. Lubricate the pivot points with Lubriplate P/N 1050109 or equivalent.
2. Install the boot.
3. Install the brake rod.
4. Install the washer.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

5. Install the nut.

   Tighten

   Tighten the nut to 34 N·m (25 lb ft).
6. Install the retainer.
7. Lower the vehicle.



172126

8. Install 4 boot screws.

   Tighten

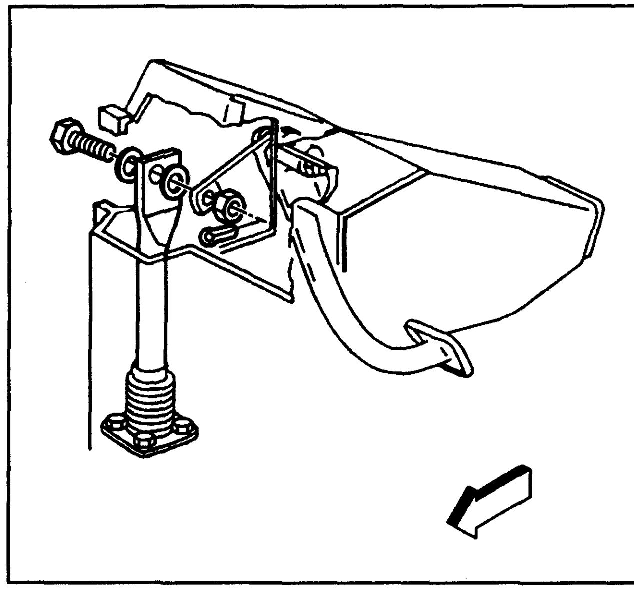
   Tighten the screws to 1.7 N·m (15 lb in).

9. Install the bolt and washers.
10. Install the nut.

Tighten

Tighten the nut to 34 N·m (25 lb ft).

11. Install the retainer.



172113

Combination Valve Replacement

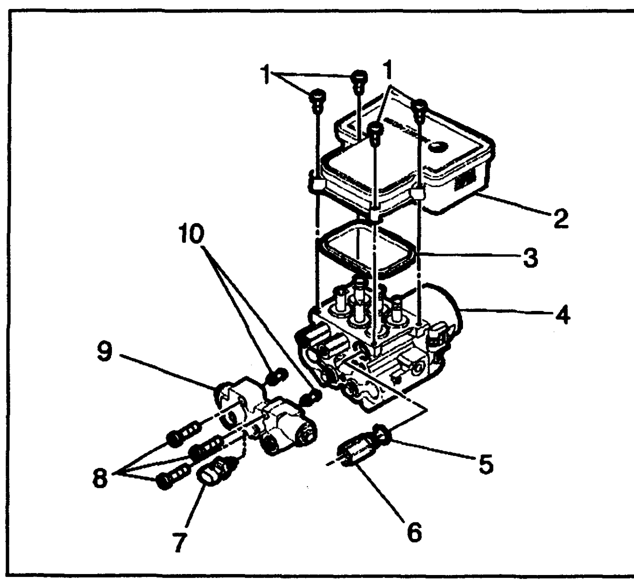
Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

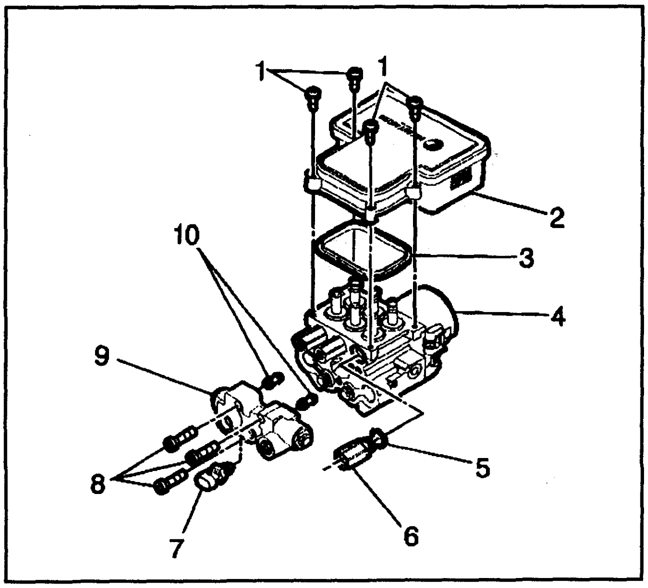
Notice: Brake fluid will damage electrical connections and painted surfaces. Use shop cloths, suitable containers, and fender covers to prevent brake fluid from contacting these areas. Always re-seal and wipe off brake fluid containers to prevent spills.

Important: The combination valve is not repairable. The combination valve must be replaced as an assembly.

1. Raise and suitably support the vehicle.
2. Remove the negative battery cable.
3. Remove the electrical connectors.
4. Remove the hydraulic brake lines.
5. Plug the pipes in order to prevent loss of fluid or contamination.
6. Remove the bolts (8).
7. Remove the combination valve (9).



184187



184187

Installation Procedure

1. Install the combination valve (9).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

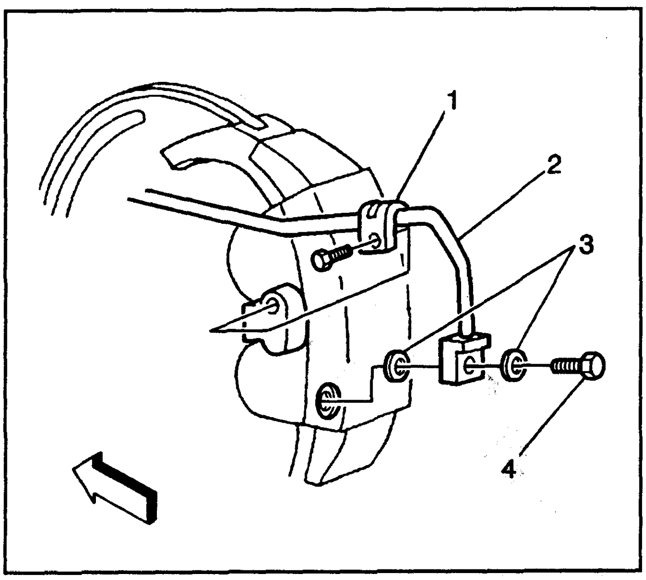
2. Install the bolts.

   Tighten

   Tighten the three combination fastening bolts (8) to 8 N·m (71 lb in) and then to 12 N·m (106 lb in).
3. Connect the electrical connectors..
4. Connect the hydraulic lines.

   Tighten

   Tighten the hydraulic lines to 30 N·m (22 lb ft).
5. Lower the vehicle.
6. Connect the negative battery cable.
7. Bleed the brake hydraulic system. Refer to *Hydraulic Brake System Bleeding.*



172245

Brake Hose Replacement - Front (Motorhome JF9)

Caution: Always use double walled steel brake pipe when replacing brake pipes. Always use the correct fasteners and the original routing when replacing brake pipes. Failure to properly route and fasten brake pipes may cause brake system failure.

Important: Maintain a 6 mm (1/4 in) clearance between parallel brake pipes.

Removal Procedure

1. Clean the hose fittings at both ends. Remove all dirt, grease, and foreign material.
2. Disconnect the steel pipe from the top of the bracket.
3. Remove the retainer.
4. Remove the support bracket.
5. Remove the bolt (4).
6. Remove the gaskets (3).
7. Remove the hose bracket nut.
8. Remove the hose (2) and unclip from the wheel speed sensor cable, if applicable.

Installation Procedure

1. Install the hose (2).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

Important: Use new brass gaskets.

2. Install the new brass gaskets (3).
3. Install the bolt (4).

   Tighten

   Tighten the bolt to 44 N·m (32 lb ft).
4. Install the bracket (1).

   Tighten

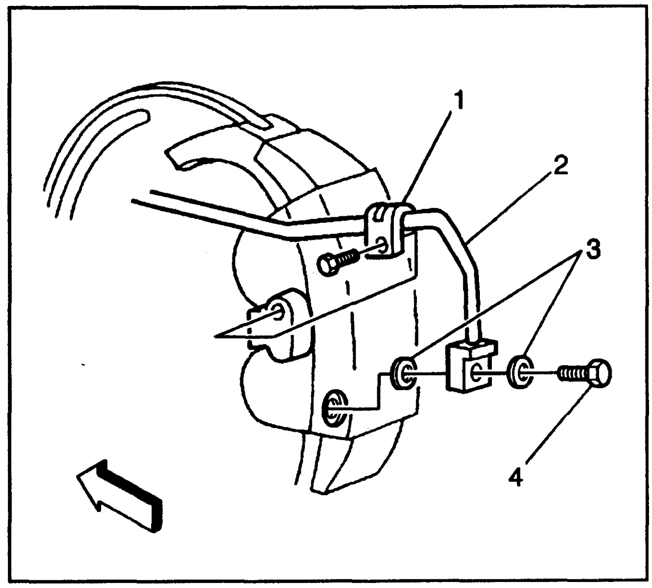
   Tighten the bolt to 18 N·m (13 lb ft).
5. Secure the support bracket with bolt and nut.

   Tighten

   Tighten the nut to 18 N·m (13 lb ft).

Important: The hose must not be twisted. The hose must not contact any suspension components.

6. Install the retainer.
7. Connect the steel pipe and install the wheel speed sensor cable, if applicable.
8. Bleed the brake system. Refer to *Hydraulic Brake System Bleeding.*



172245

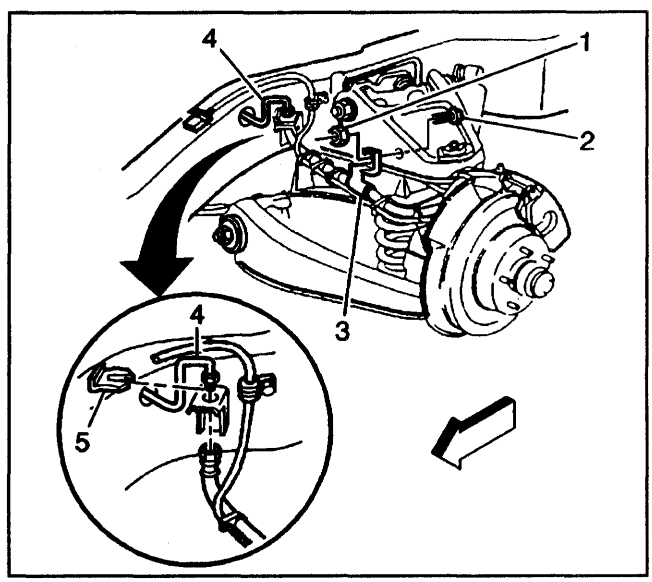
Brake Hose Replacement - Front (Motorhome JB7/JB8)

Caution: Always use double walled steel brake pipe when replacing brake pipes. Always use the correct fasteners and the original routing when replacing brake pipes. Failure to properly route and fasten brake pipes may cause brake system failure.

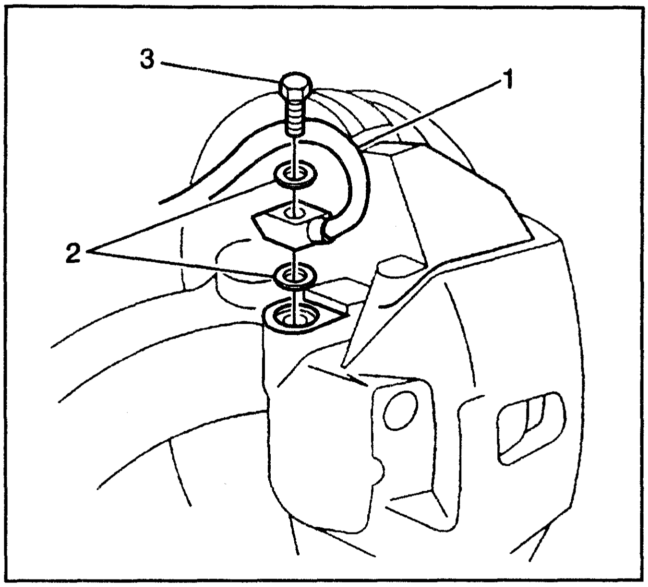
Important: Maintain a 6 mm (1/4 in) clearance between parallel brake pipes.

Removal Procedure

1. Clean the hose fittings at both ends. Remove all dirt, grease, and foreign material.
2. Disconnect the steel pipe (4) from the top of the bracket.
3. Remove the retainer (5).
4. Remove the hose to speed sensor harness ties.
5. Remove the support bracket (3).

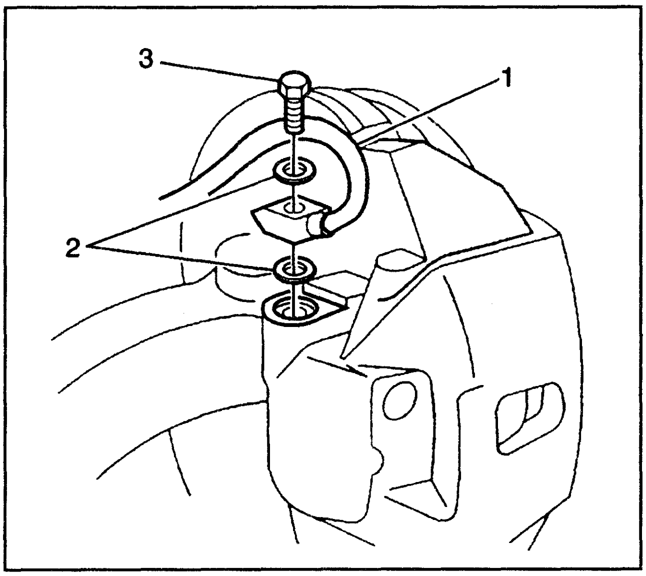


172244



172248

6. Remove the bolt.
7. Remove the gaskets.
8. Remove the hose.



172248

Installation Procedure

1. Install the hose (1) at the brake caliper, if applicable.

Important: Use new brass gaskets.

2. Install the new brass gaskets (2).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the bolt (3).

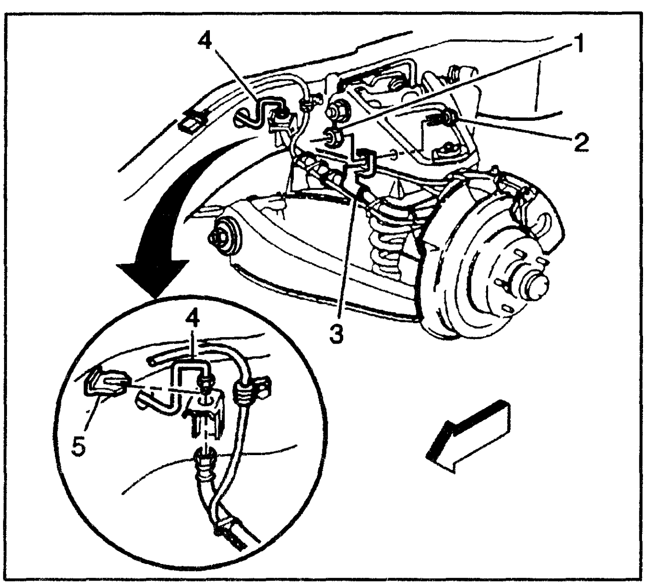
   Tighten

   Tighten the bolt to 44 N·m (32 lb ft).

4. Install the support bracket.

   Tighten

   Tighten the support bracket nut to 18 N·m (13 lb ft).



172244

5. Install the retainer (5).
6. Connect the front brake steel pipe (4) to the hose.

Important: The hose must not be twisted. The hose must not contact any suspension components.

7. Join the brake hose to the speed sensor harness, if applicable. Use new ties.
8. Bleed the brake system. Refer to *Hydraulic Brake System Bleeding*.

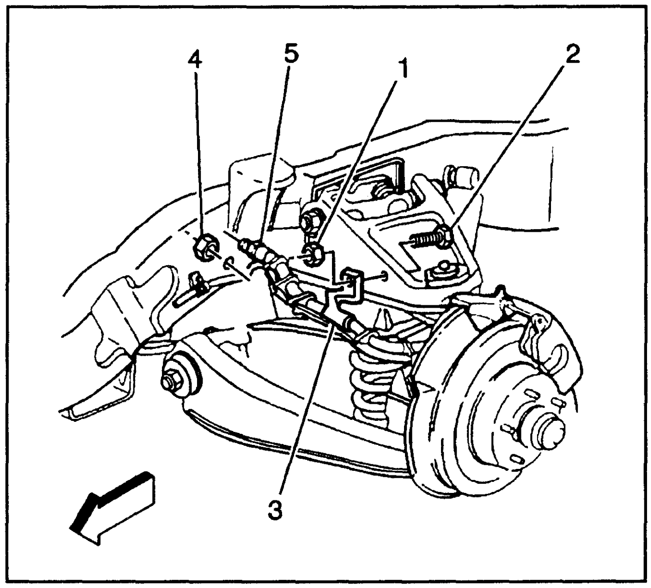
Brake Hose Replacement - Front (Commercial FL7 and FL9)

Caution: Always use double walled steel brake pipe when replacing brake pipes. Always use the correct fasteners and the original routing when replacing brake pipes. Failure to properly route and fasten brake pipes may cause brake system failure.

Important: Maintain a 6 mm (1/4 in) clearance between parallel brake pipes.

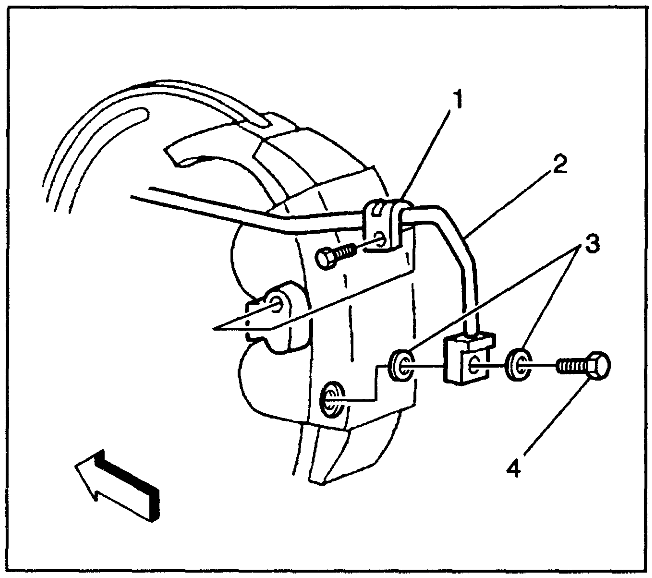
Removal Procedure

1. Clean the hose fittings at both ends. Remove all dirt, grease, and foreign material.
2. Disconnect the pipe from the frame fitting and remove the hose nut (4).
3. Remove the hose bracket nut (1) and remove the hose from the support bracket (3).



172252

4. Remove the bolt (4).
5. Remove the gaskets (3).
6. Remove the hose bracket nut.
7. Remove the hose (2) and separate the hose from the wheel speed sensor cable, if applicable.



172245

Installation Procedure

1. Position the hydraulic fitting (2).

Important: Use new brass gaskets.

2. Install the new brass gaskets (3).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

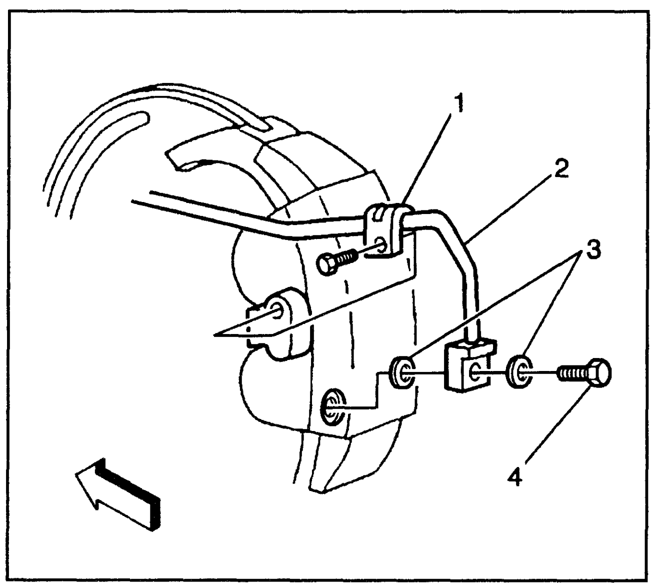
3. Install the bolt (4).

   Tighten

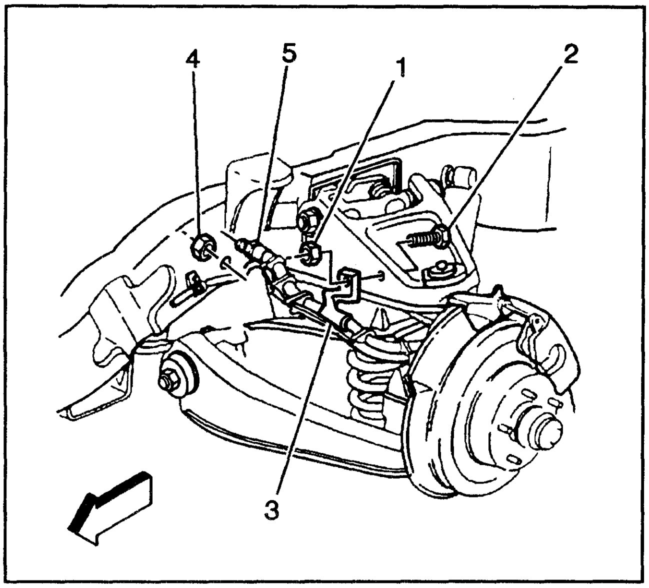
   Tighten the bolt to secure the fitting to 44 N·m (32 lb ft.)
4. Install the support bracket (1) bolt.

   Tighten

   Tighten the bolt to 18 N·m (13 lb ft).



172245



172252

5. Clip the hose to the wheel speed sensor cable and secure to the support bracket (3) with the bolt (2) and nut (1).

   Tighten

   Tighten the nut to 18 N·m (13 lb ft).

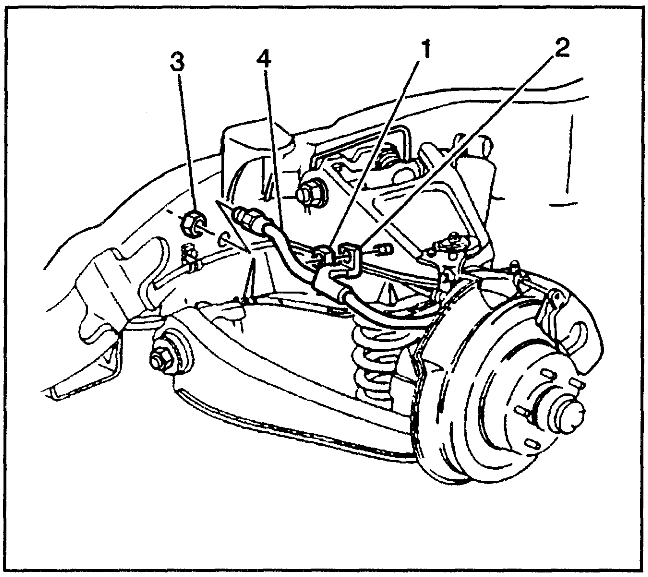
Important: The hose must not be twisted. The hose must not contact any suspension components.

6. Secure the hose to the frame fitting with the nut (4) and connect the pipe.

   Tighten

   - Tighten the nut (4) to 9.0 N·m (80 lb in) for FL7 units with four-wheel disc brakes.
   - Tighten the nut (4) to 9.5 N·m (84 lb in) for all other units.

7. Bleed the brake system. Refer to *Hydraulic Brake System Bleeding*.



172255

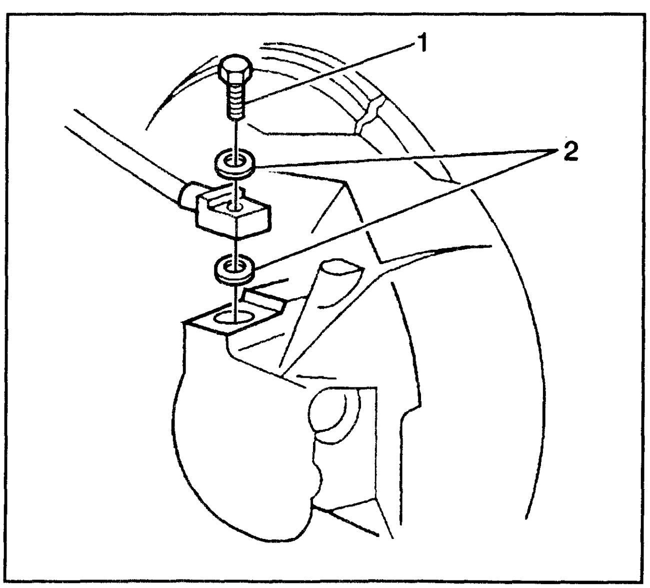
Brake Hose Replacement - Front (Comm. FL5/6 JB7/8 Mtrhome JB8)

Caution: Always use double walled steel brake pipe when replacing brake pipes. Always use the correct fasteners and the original routing when replacing brake pipes. Failure to properly route and fasten brake pipes may cause brake system failure.

Important: Maintain a 6 mm (1/4 in) clearance between parallel brake pipes.

Removal Procedure

1. Clean the hose fittings at both ends. Remove all dirt, grease, and foreign material.
2. Disconnect the pipe from the frame fitting and remove the hose nut (3).
3. Remove the hose bracket nut (1) and remove the hose from the support bracket (2).



172250

4. Remove the bolt (1).
5. Remove the gaskets (2).
6. Remove the hose, and separate the hose from the wheel speed sensor cable, if applicable.

Installation Procedure

1. Install the fitting.

Important: Use new brass gaskets.

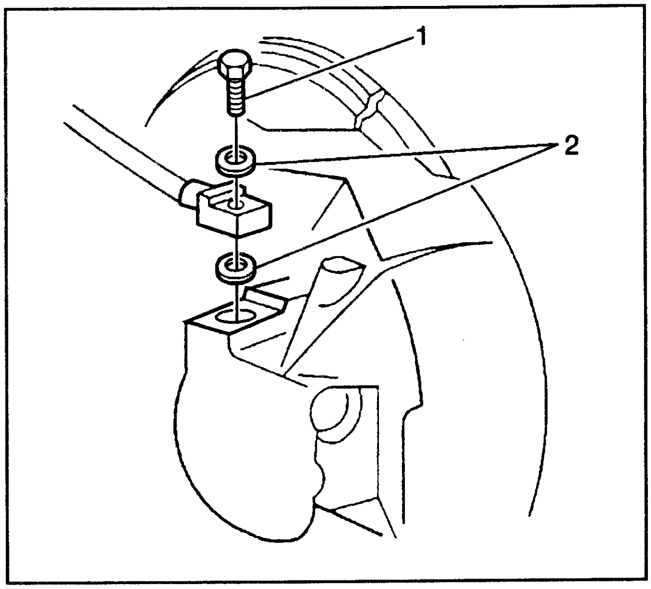
2. Install the new brass gaskets (2).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the bolt (1).

   Tighten

   Tighten the bolt to secure the fitting to 44 N·m (32 lb ft).



172250

4. Clip the hose to the wheel speed sensor cable and secure the hose to the support bracket (2) with the nut (3).

   Tighten

   Tighten the nut to 18 N·m (13 lb ft).

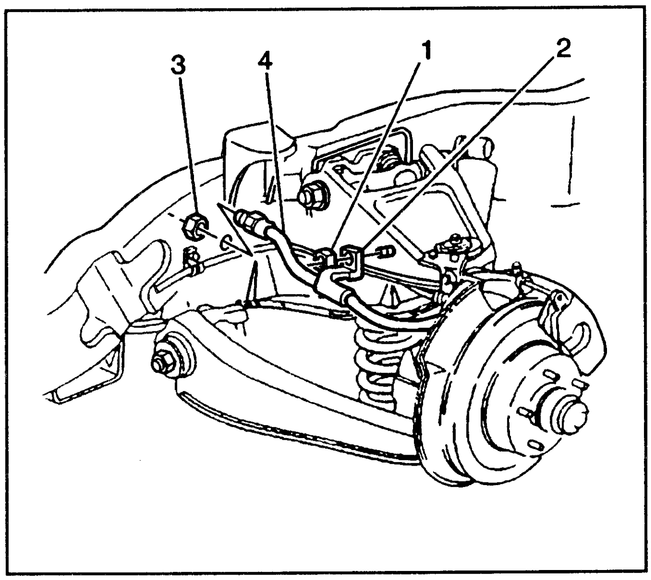
Important: The hose must not be twisted. The hose must not contact any suspension components.

5. Secure the hose to the frame fitting with the nut (3) and connect the pipe.

   Tighten

   Tighten the nut to 9.5 N·m (84 lb in).

6. Bleed the brake system. Refer to *Hydraulic Brake System Bleeding.*



172255

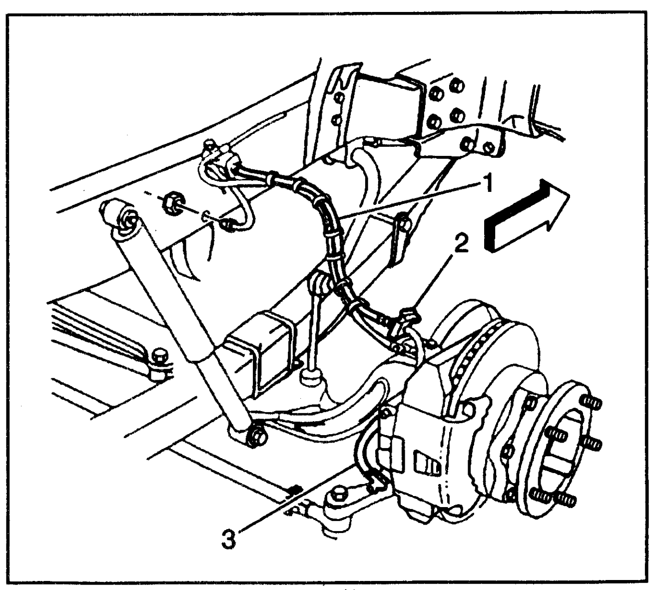
Brake Hose Replacement - Front (Commercial FK4/FK5 and JF9)

Caution: Always use double walled steel brake pipe when replacing brake pipes. Always use the correct fasteners and the original routing when replacing brake pipes. Failure to properly route and fasten brake pipes may cause brake system failure.

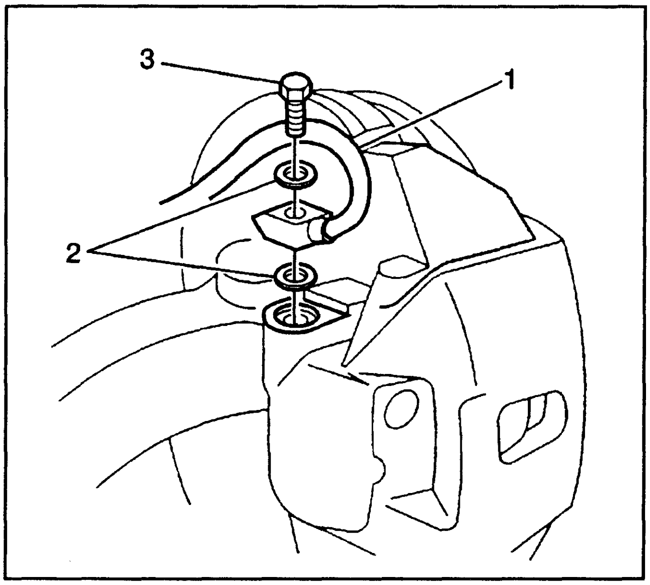
Important: Maintain a 6 mm (1/4 in) clearance between parallel brake pipes.

Removal Procedure

1. Clean the hose fittings at both ends. Remove all dirt, grease, and foreign material.
2. Disconnect the pipe at the frame fitting and remove the nut to dislodge the hose.

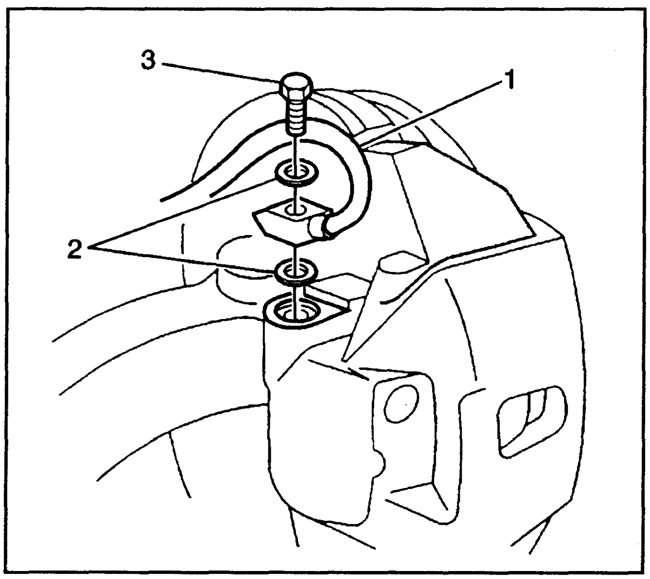


172253



172248

3. Remove the retainer from the frame bracket and unclip the hose (1) from the wheel speed sensor cable.
4. Remove the caliper support bracket retainer (2) and dislodge the hose from this bracket.
5. Remove the bolt (3) to disconnect the fitting from the caliper (FK4 configuration shown; FK5,and JF9 similar).
6. Remove the gaskets (2).
7. Remove the hose (1).



172248

Installation Procedure

1. Position the fitting to the caliper (FK4 configuration shown; FK5 and JF9 similar)

Important: Use new brass gaskets.

2. Install the new brass gaskets (2).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the bolt (3).

   Tighten

   Tighten the bolt to 44 N·m (32 lb ft).

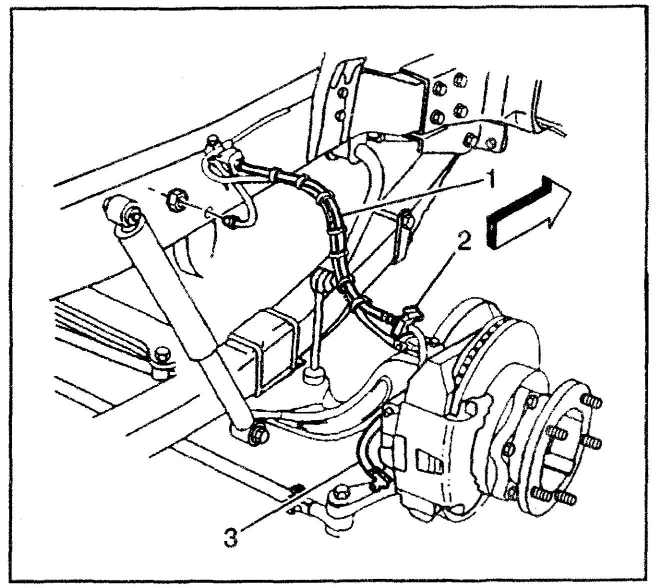
4. Position the hose into the caliper support bracket and secure with the retainer (2).

Important: The hose must not be twisted. The hose must not contact any suspension components.

5. Clip the hose to the wheel speed sensor cable and insert the hose into the frame support bracket and fasten with the retainer.
6. Install the hose into the frame and secure it with the nut.

   Tighten

   Tighten the nut to 9.5 N·m (84 lb in).
7. Connect the pipe.
8. Bleed the brake system. Refer to *Hydraulic Brake System Bleeding.*



172253

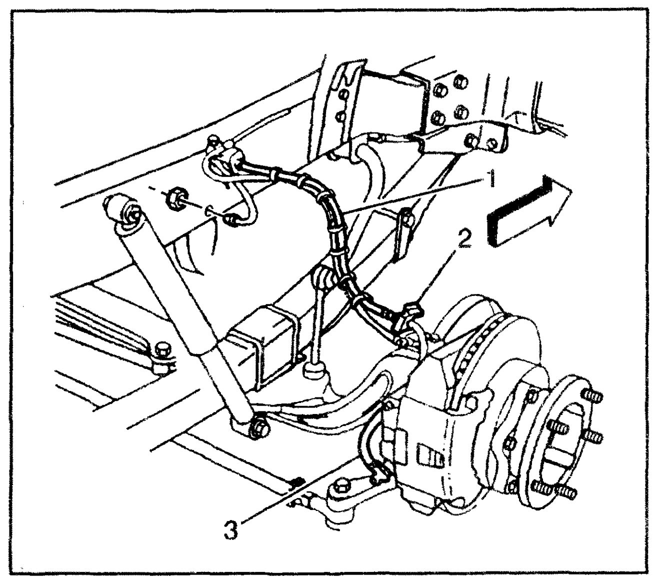
Brake Hose Replacement - Front (Commercial FK4/FK5 and JB8)

Caution: Always use double walled steel brake pipe when replacing brake pipes. Always use the correct fasteners and the original routing when replacing brake pipes. Failure to properly route and fasten brake pipes may cause brake system failure.

Important: Maintain a 6 mm (1/4 in) clearance between parallel brake pipes.

Removal Procedure

1. Clean the hose fittings at both ends. Remove all dirt, grease, and foreign material.
2. Disconnect the pipe at the frame fitting and remove the nut to dislodge the hose.
3. Remove the retainer from the frame bracket and dislodge the hose (1) from the wheel speed sensor cable, if applicable.
4. Remove the caliper support bracket retainer (2) and dislodge the hose from this bracket.



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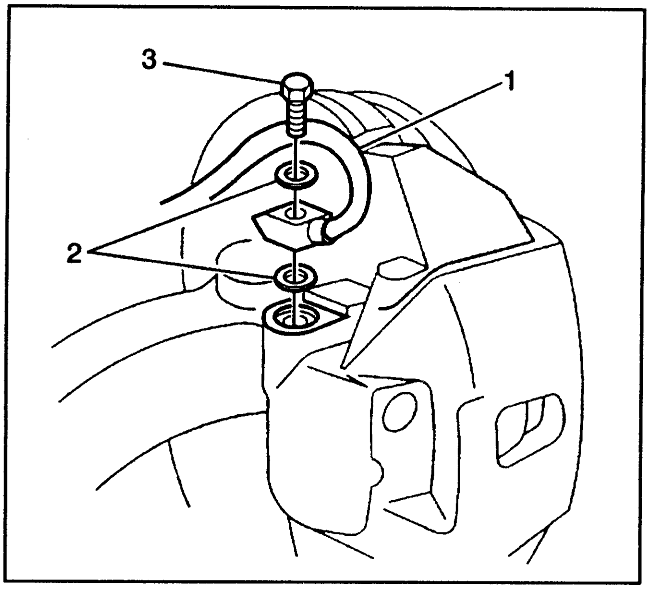
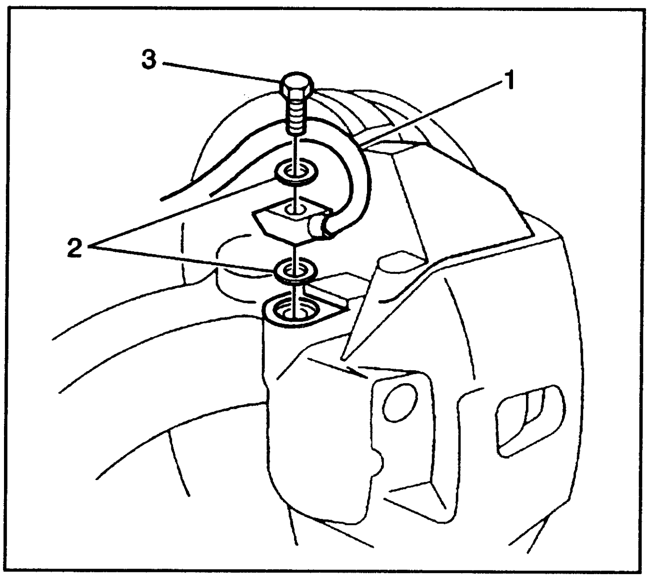


172248

5. Remove the bolt (3) to disconnect the fitting from the caliper (FK4 and JB8 configuration shown; FK5 similar).
6. Remove the gaskets (2).
7. Remove the hose (1).



172248

Installation Procedure

1. Position the fitting to the caliper (FK4 and JB8 configuration shown; FK5 similar).

Important: Use new brass gaskets.

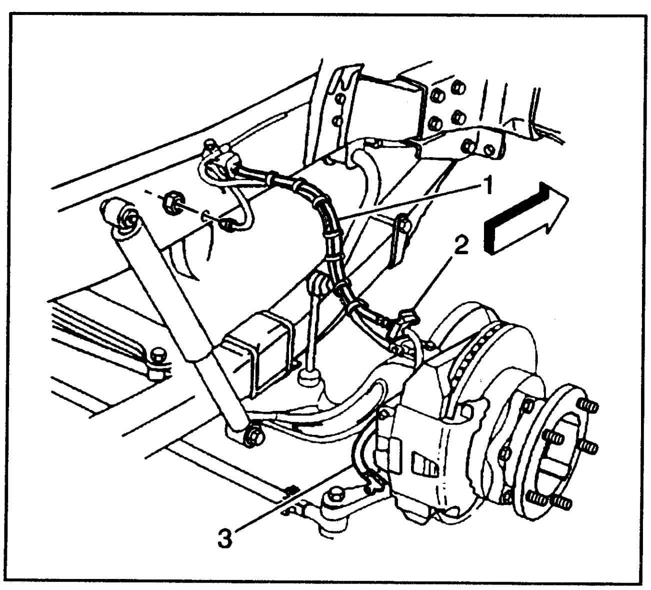
2. Install the new brass gaskets (2).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the bolt (3).

   Tighten

   Tighten the bolt to 44 N·m (32 lb ft).



172253

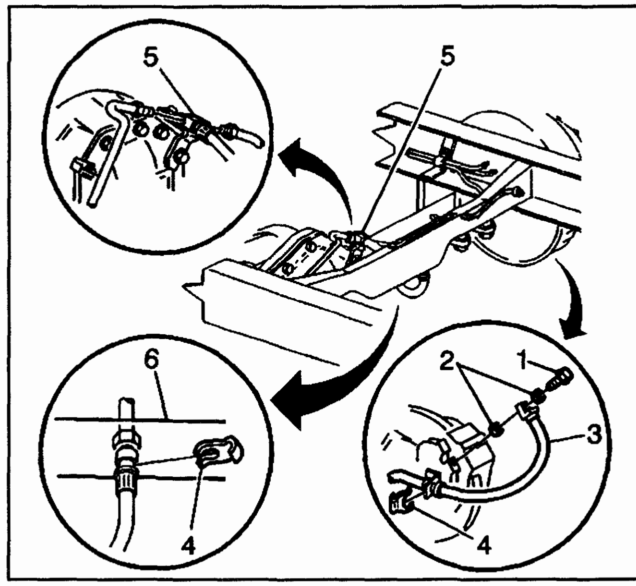
Important: The hose must not be twisted. The hose must not contact any suspension components.

4. Position the hose into the caliper support bracket and secure with the retainer (2).
5. Clip the hose to the wheel speed sensor cable and insert the hose into the frame support bracket and fasten with the retainer.
6. Install the hose into the frame and secure it with the nut.

   Tighten

   Tighten the nut to 9.5 N·m (84 lb in).
7. Connect the pipe.
8. Bleed the brake system. Refer to *Hydraulic Brake System Bleeding.*

Brake Hose Replacement - Rear



423702

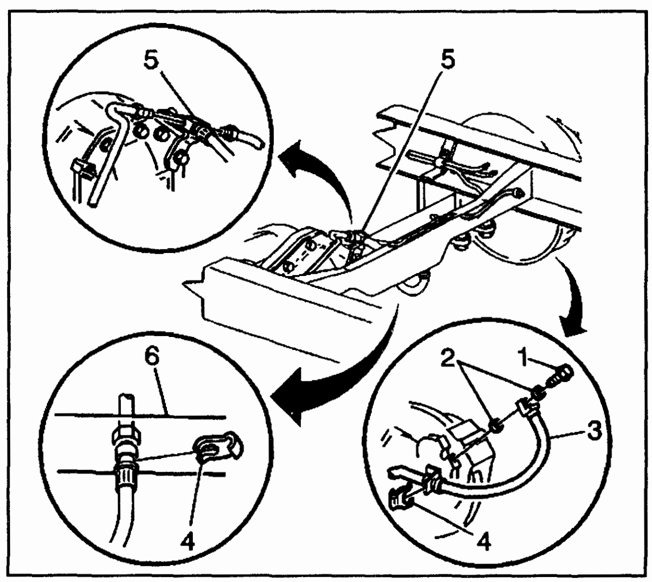
Caution: Always use double walled steel brake pipe when replacing brake pipes. Always use the correct fasteners and the original routing when replacing brake pipes. Failure to properly route and fasten brake pipes may cause brake system failure.

Important: Maintain a 6 mm (1/4 in) clearance between parallel brake pipes.

Removal Procedure

1. Disconnect the pipe from the fitting at the cross member bracket (6).
2. Remove the retainer.
3. Disconnect the brake pipe from each end of the hose fitting at the rear axle bracket (5).
4. Remove the bolt which secures the hose to the rear axle bracket.
5. Remove the hose.
6. Remove the retainer (4) at the caliper bracket and disconnect the pipe from the hose on each side of the vehicle equipped with rear disc brakes. For vehicles equipped with rear drum brakes, disconnect the brake pipe(s) from the rear brakes.
7. Remove the bolt (1) and washers (2) from the caliper hose fitting.
8. Remove the the hose (3).

Installation Procedure



423702

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the hose (3) at the rear caliper(s) for vehicles equipped with rear disc brakes.

   Tighten

   Tighten the bolt (1) with the washers (2) to 44 N·m (32 lb ft).
2. For vehicles equipped with rear drum brakes, install the brake pipes to the rear brakes.
3. Install the brake pipe(s) and retainer(s) (4).

   Tighten

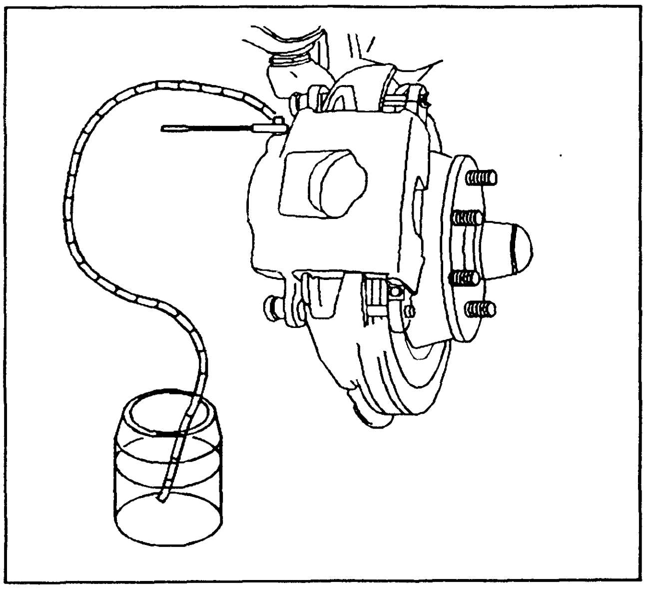
   Tighten the brake pipes to 23 N·m (17 lb ft).

Important: The hose must not be twisted or contact any suspension components after installation.

4. Secure the hose fitting (5) at the rear axle bracket.

   Tighten

   Tighten the bolt to 17 N·m (13 lb ft).
5. Secure the brake pipe to the hose at the cross member (6) junction.
6. Install the retainer (4).
7. Bleed the brake hydraulic system. Refer to *Hydraulic Brake System Bleeding*.


897

Hydraulic Brake System Bleeding

If air has entered the hydraulic brake system, bleed the system. Bleed the hydraulic brake system at all four wheels under any of the following conditions:

- Air entered the system due to a low fluid level.
- The brake pipes have been disconnected at the master cylinder.
- The brake pipes have been disconnected at the combination valve.

If a pipe is disconnected at one wheel, then only bleed that wheel.

If the master cylinder has been removed, bleed the master cylinder before installing it on the vehicle. This will reduce the time required to bleed the system. Refer to *Master Cylinder Bench Bleeding*.

Notice: Brake fluid will damage electrical connections and painted surfaces. Use shop cloths, suitable containers, and fender covers to prevent brake fluid from contacting these areas. Always re-seal and wipe off brake fluid containers to prevent spills.

Manual Bleeding

1. Fill the master cylinder reservoir. Use Hydraulic Brake Fluid P/N 1052535, or equivalent DOT 3 motor vehicle brake fluid.

   Maintain the fluid level during bleeding.
2. If the master cylinder has air in the bore, bleed the master cylinder using the following procedure:
   - 2.1. Disconnect the forward brake pipe connector at the master cylinder.
   - 2.2. Allow the brake fluid to flow from the connector port.
   - 2.3. Connect the brake pipe connector. Do not tighten the brake pipe connector.
   - 2.4. Slowly apply the brake pedal. Allow the air to bleed from the loose connector.
   - 2.5. Tighten the connector before releasing the brake pedal.
   - 2.6. Release the brake pedal.
   - 2.7. Wait 15 seconds.
   - 2.8. Repeat this sequence, including the 15-second wait, until you purge all the air from the master cylinder bore.
   - 2.9. Repeat this procedure for the rear brake pipe after you purge all the air from the forward pipe connection.
3. Bleed each wheel cylinder in the following sequence:
   - 3.1. Right rear wheel cylinder.
   - 3.2. Left rear wheel cylinder.
   - 3.3. Right front wheel caliper.
   - 3.4. Left front wheel caliper.

4. Attach a hose to the wheel cylinder/caliper bleeder valve.
5. Immerse the opposite end of the hose into a container partially filled with clean brake fluid.
6. Slowly apply the brake pedal one time and hold.
7. Loosen the bleeder valve in order to purge the air from the wheel cylinder/caliper.
8. Tighten the bleeder valve.
9. Slowly release the brake pedal.
10. Wait 15 seconds.
11. Repeat this sequence, including the 15-second wait, until you purge all the air from the wheel cylinder or caliper.
12. Repeat steps 4–11 at each wheel until you purge all the air from the brake system.
13. Check the brake pedal for sponginess. Check the brake warning lamp for an indication of unbalanced pressure. Repeat the bleeding procedure in order to correct either of these conditions.

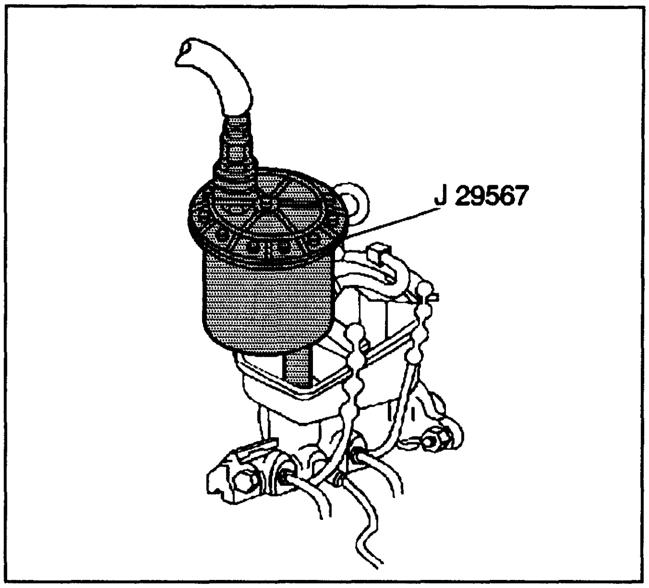
Pressure Bleeding

Tools Required

- *J 29567* Brake Bleeder Adapter
- *J 23709* Combination Valve Depressor.

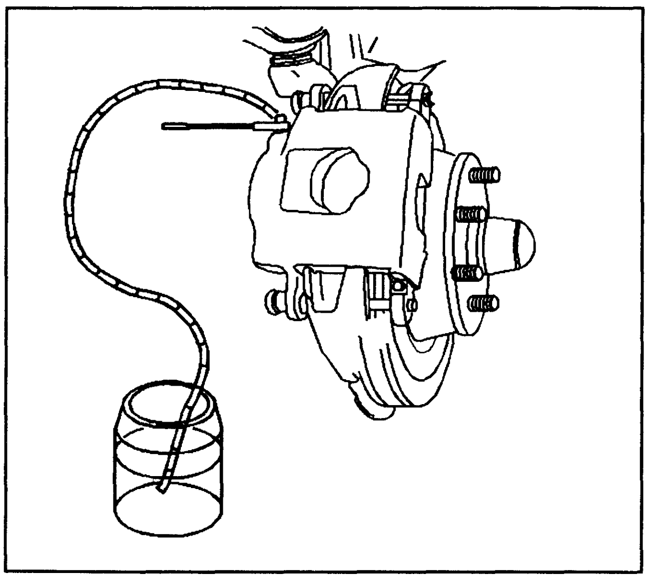
Use a diaphragm-type pressure bleeder. The pressure bleeder must have a rubber diaphragm between the air supply and the brake fluid. This prevents air, moisture, oil and other contaminants from entering the brake hydraulic system.

1. Fill the pressure tank at least 2/3 full of brake fluid.
2. Bleed the bleeder each time you add fluid.
3. Charge the bleeder to 140–170 kPa (20–25 psi).
4. Use the *J 23709* in order to depress and hold the valve stem on the combination valve.
5. Bleed each wheel cylinder or caliper in the following sequence:
   - 5.1. Right rear wheel cylinder.
   - 5.2. Left rear wheel cylinder.
   - 5.3. Right front wheel caliper.
   - 5.4. Left front wheel caliper.
6. Connect the hose from the bleeder to the adapter at the master cylinder.
7. Open the tank valve.



908

8. Attach a hose to the bleeder valve.


897

9. Immerse the opposite end of the hose into a container partially filled with clean brake fluid.
10. Slowly open the bleeder valve at least 3/4 of a turn. Allow the fluid to flow until you see no air in the fluid.
11. Close the bleeder valve.
12. Repeat steps 9–12 at every wheel.
13. Check the brake pedal for sponginess. Repeat the bleeding procedure if the brake pedal is spongy.
14. Remove the *J 23709.*
15. Disconnect the hose from the bleeder adapter.
16. Remove the *J 29567* brake bleeder adapter.
17. Fill the master cylinder to the proper level.

Hydraulic Brake System Flushing

To flush the hydraulic brake system at each bleeder valve use the following procedure:

1. Open the valve 1 1/2 turns.
2. Force brake fluid through the pipes, hoses and bleeder valves until the brake fluid comes out clear in color.

   Refer to *Hydraulic Brake System Bleeding.*
3. Check the master cylinder fluid level after you flush at each bleeder valve.
4. After flushing, refill the master cylinder to the correct fluid level, as required.

Hydraulic Brake Booster Replacement (Commercial)

Bleeding the Hydraulic Booster System

Notice: Power steering fluid and brake fluid cannot be mixed. If brake seals contact power steering fluid or steering seals contact brake fluid, seal damage will result.

Bleed the hydraulic booster system any time you open the system. Refer to *Bleeding Power Steering System (Process)* -Process or *Bleeding Power Steering System (Special Conditions)* -Special Conditions in Power Steering System.

Flushing the Hydraulic Booster System

Refer to *Flushing the Power Steering System* in Power Steering System.

Hydraulic Booster System Pipes, Hoses, and Fittings

Refer to:

- *Power Steering Hoses Replacement (4.3L and 5.7L Engines)*
- *Power Steering Hoses Replacement (6.5L (L57) Independent)*
- *Power Steering Hoses Replacement (6.5L (L57) I-Beam)*
- *Power Steering Hoses Replacement (6.5L (L65) and 7.4L Engines)*

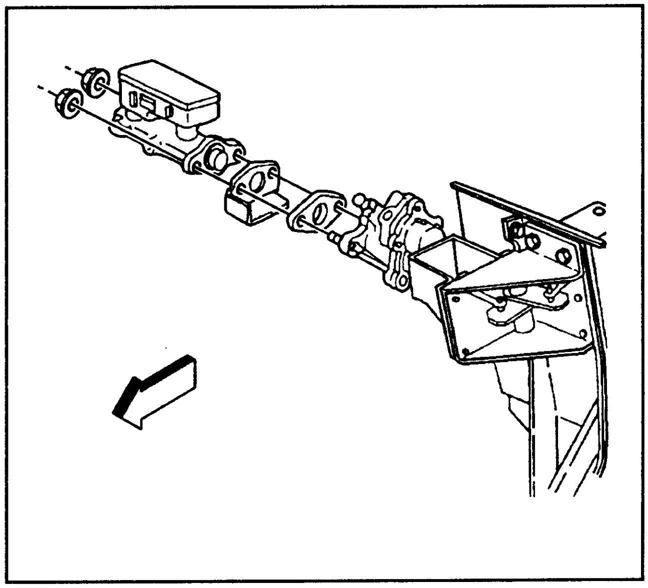
Power Steering Pump Service

Refer to *Power Steering Pump Replacement (4.3L And 5.7L Engines)* -4.3L and 5.7L, *Power Steering Pump Replacement (6.5L Diesel Engine)* -6.5L (Diesel), or *Power Steering Pump Replacement (7.4L Engine)* -7.4L.

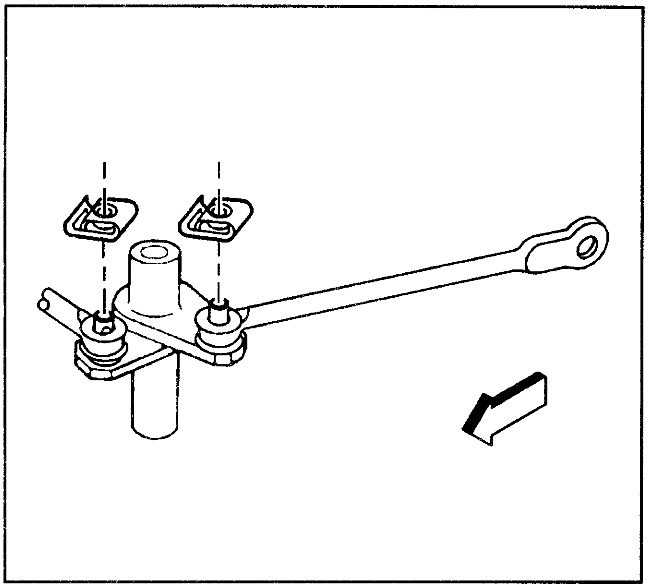
Removal Procedure

1. Apply the parking brake.
2. Disconnect the hoses from the booster assembly.
3. Remove the master cylinder mounting nuts.
4. Remove the master cylinder.

   Support the master cylinder.



173646



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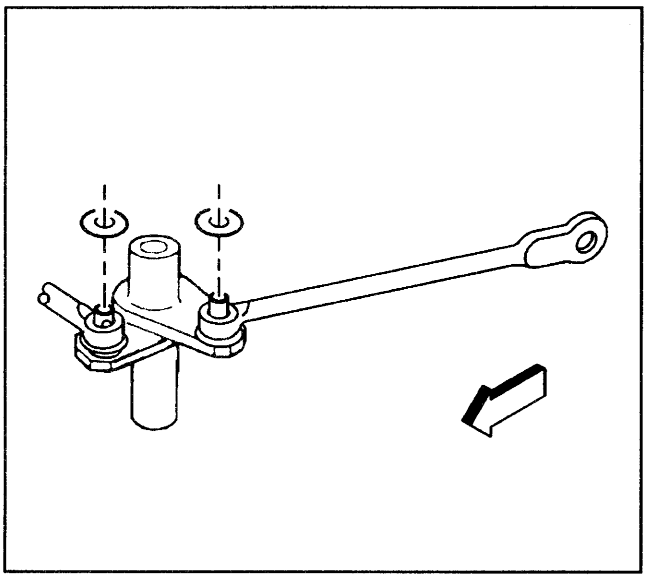
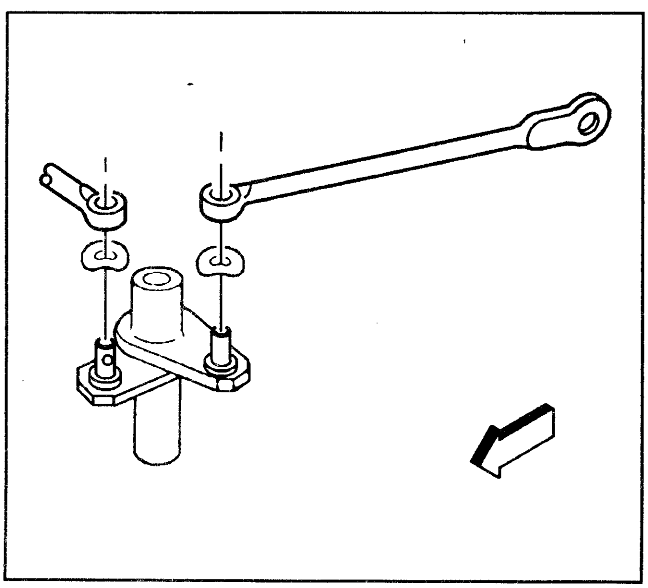
5. Remove the pushrod retainer.
6. Remove the retaining clip.



172151

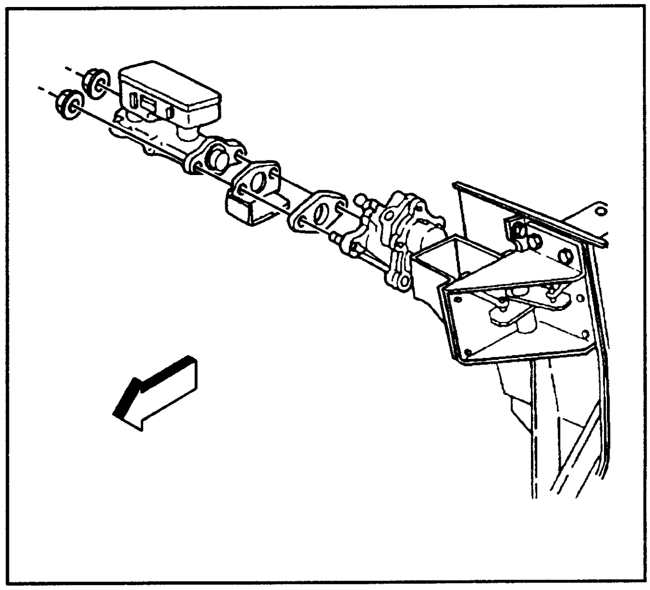
7. Remove the washer.



172156

8. Remove the booster pushrod.

9. Remove the booster mounting nuts.
10. Remove the booster assembly.



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Installation Procedure

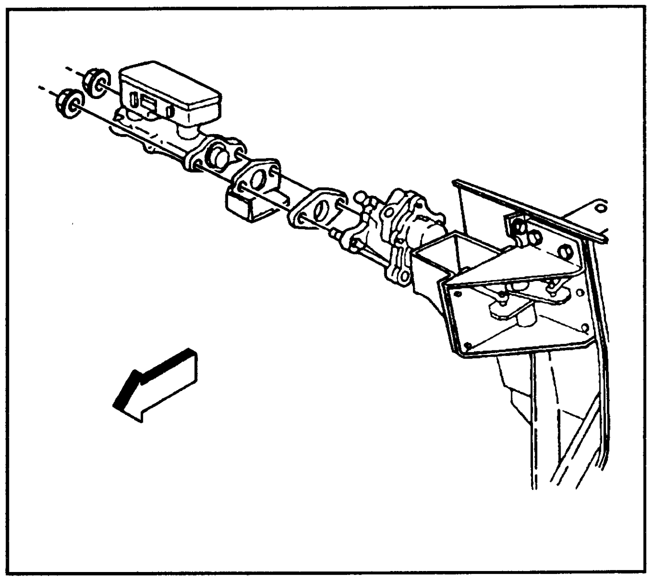
1. Install the booster assembly.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the booster mounting nuts.

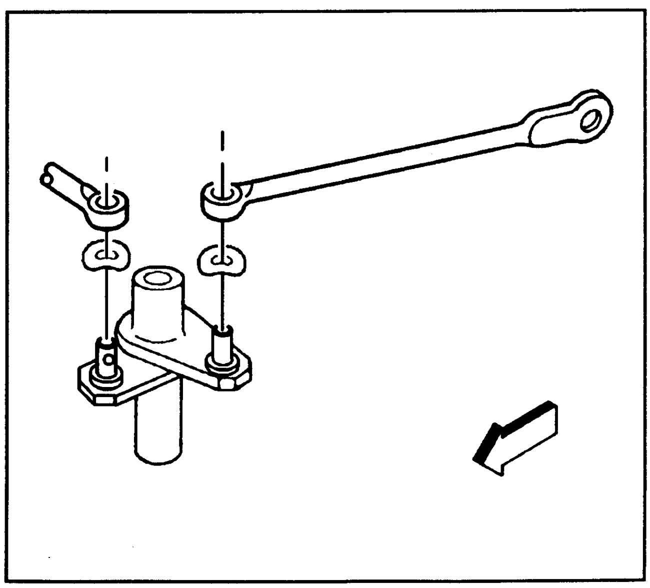
   Tighten

   Tighten the nuts to 36 N·m (27 lb ft).



173646

3. Install the booster pushrod.



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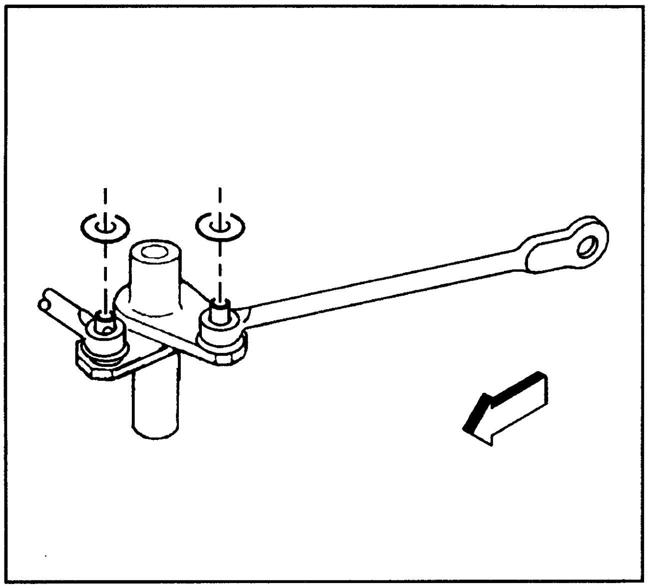
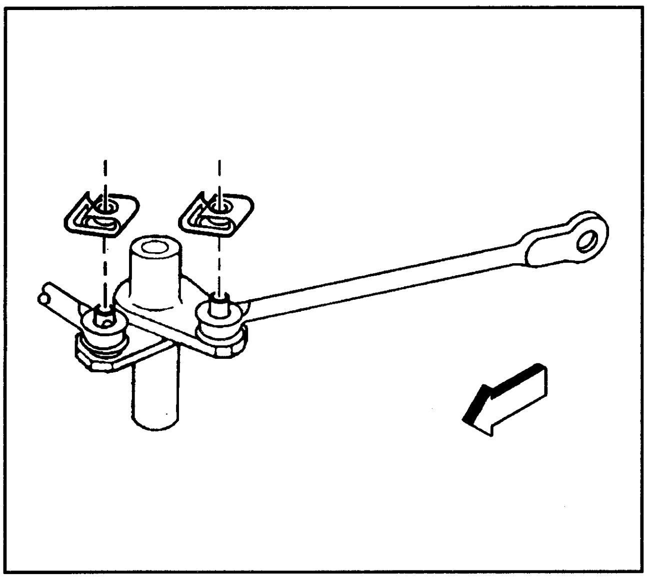
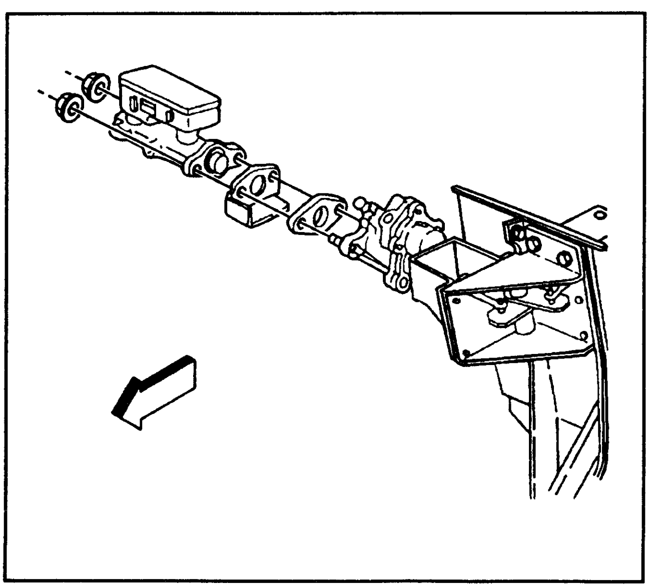

172151

4. Install the washer.


172143

5. Install the retaining clip.
6. Install the pushrod retainer.


173646

7. Install the master cylinder.
8. Install the master cylinder mounting nuts.

   Tighten

   Tighten the nuts to 36 N·m (27 lb ft).
9. Install the hoses.

   Tighten

   Tighten the hoses to 27 N·m (20 lb ft).
10. Bleed the booster. Refer to *Bleeding Power Steering System (Process)* in Power Steering System.
11. Release the parking brake.

Hydraulic Brake Booster Replacement (Motorhome)

Bleeding the Hydraulic Booster System

Notice: Power steering fluid and brake fluid cannot be mixed. If brake seals contact power steering fluid or steering seals contact brake fluid, seal damage will result.

Bleed the hydraulic booster system any time you open the system. Refer to *Bleeding Power Steering System (Process)* -Process or *Bleeding Power Steering System (Special Conditions)* -Special Conditions in Power Steering System.

Flushing the Hydraulic Booster System

Refer to *Flushing the Power Steering System* in Power Steering System.

Hydraulic Booster System Pipes, Hoses, and Fittings

Refer to:

- *Power Steering Hoses Replacement (4.3L and 5.7L Engines)*
- *Power Steering Hoses Replacement (6.5L (L57) Independent)*
- *Power Steering Hoses Replacement (6.5L (L57) I-Beam)*
- *Power Steering Hoses Replacement (6.5L (L65) and 7.4L Engines)*

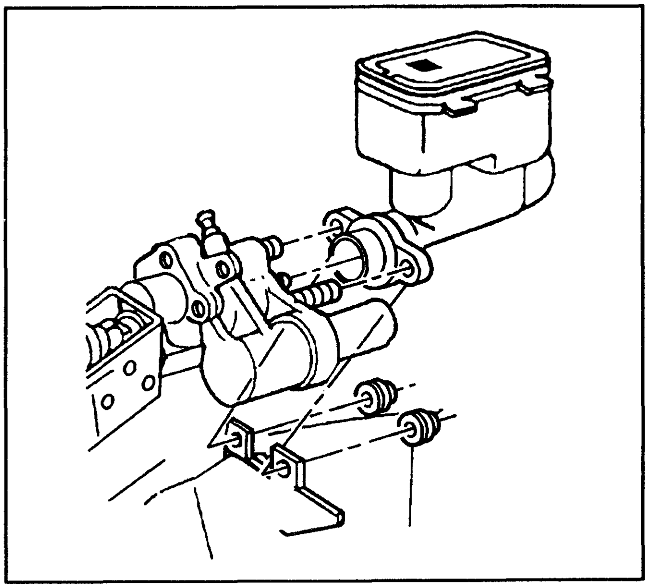
Power Steering Pump Service

Refer to *Power Steering Pump Replacement (4.3L And 5.7L Engines)* -4.3L and 5.7L, *Power Steering Pump Replacement (6.5L Diesel Engine)* -6.5L (Diesel), or *Power Steering Pump Replacement (7.4L Engine)* -7.4L in Power Steering System.

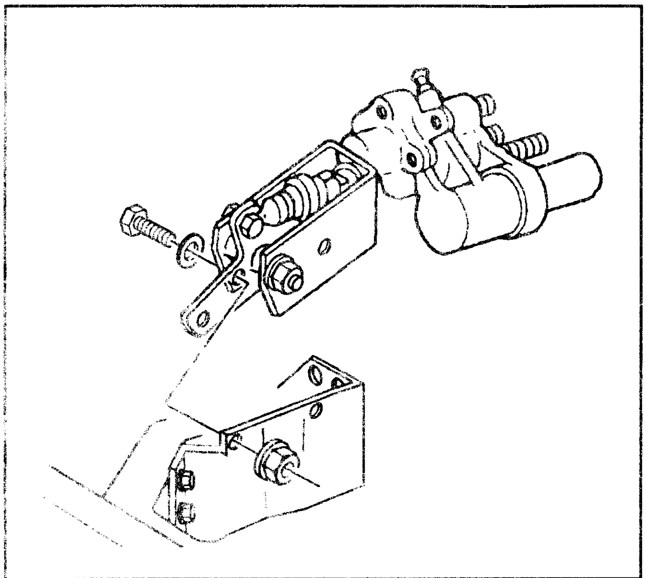
Removal Procedure

1. Apply the parking brake.
2. Disconnect the hoses from the booster assembly.
3. Remove the master cylinder mounting nuts.
4. Remove the master cylinder.

   Support the master cylinder.
5. Remove the brake pedal rod.

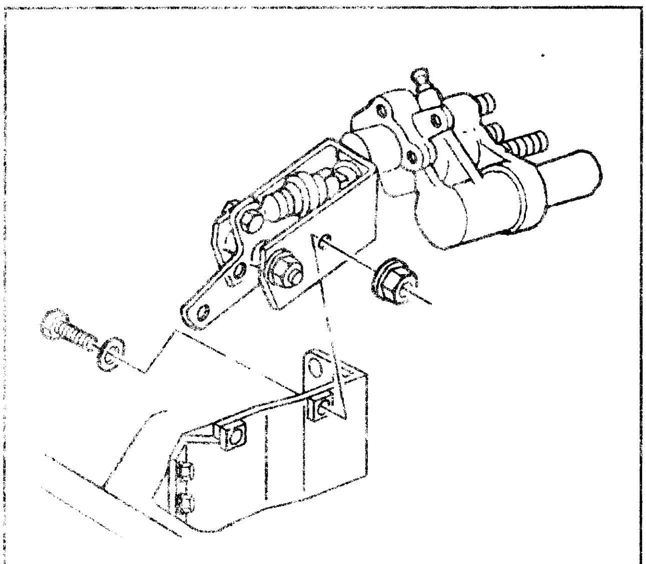


172229



172232

6. Remove the brake-booster-to-frame mounting nut.
7. Remove the brake-booster-to-frame mounting bolt and washer.



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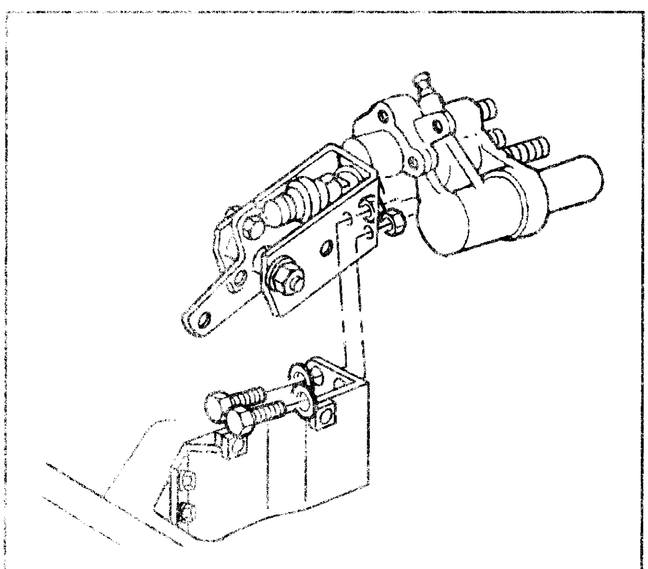
8. Remove the brake-booster-to-frame mounting nut.
9. Remove the brake-booster-to-frame mounting bolt and washer.



172237

10. Remove the brake-booster-to-frame mounting nuts.
11. Remove the brake-booster-to-frame mounting bolts and washers.
12. Remove the booster assembly.

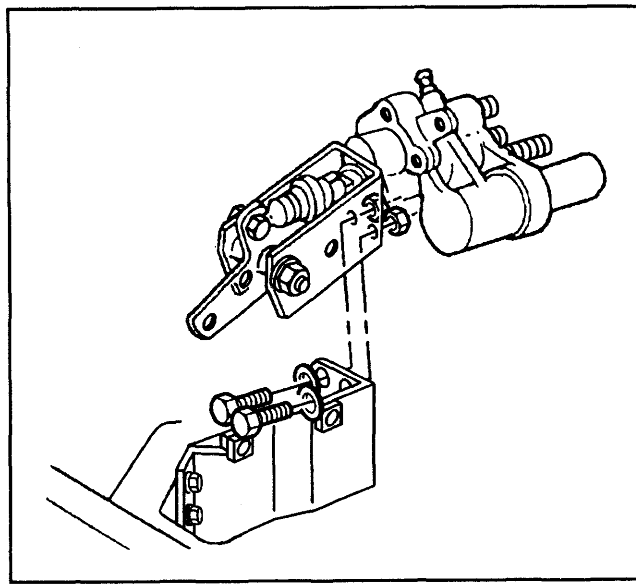
Installation Procedure

1. Install the booster assembly.
2. Install the brake-booster-to-frame mounting bolts and washers.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the brake-booster-to-frame mounting nuts.

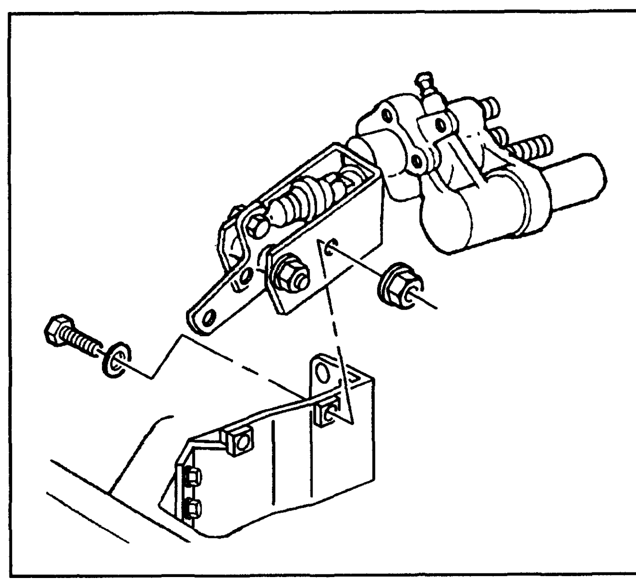
   Tighten
   Leave the nuts finger tight.



172237

4. Install the brake-booster-to-frame mounting bolt and washer.
5. Install the brake-booster-to-frame mounting nut.

   Tighten
   Leave the nut finger tight.



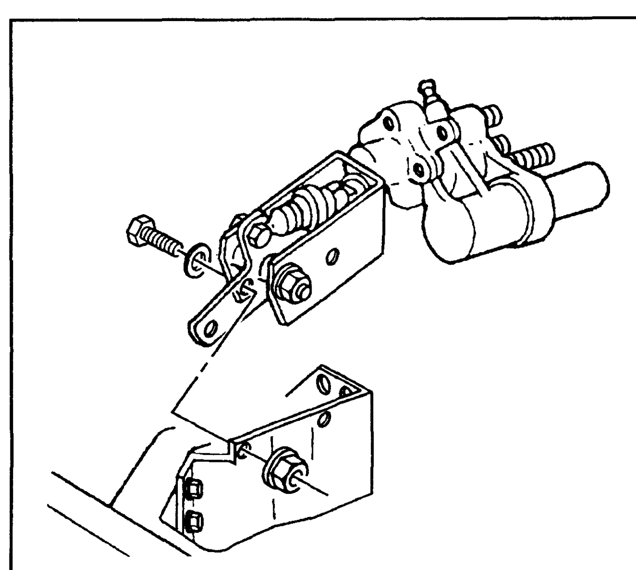
172235

6. Install the brake-booster-to-frame mounting bolt and washer.

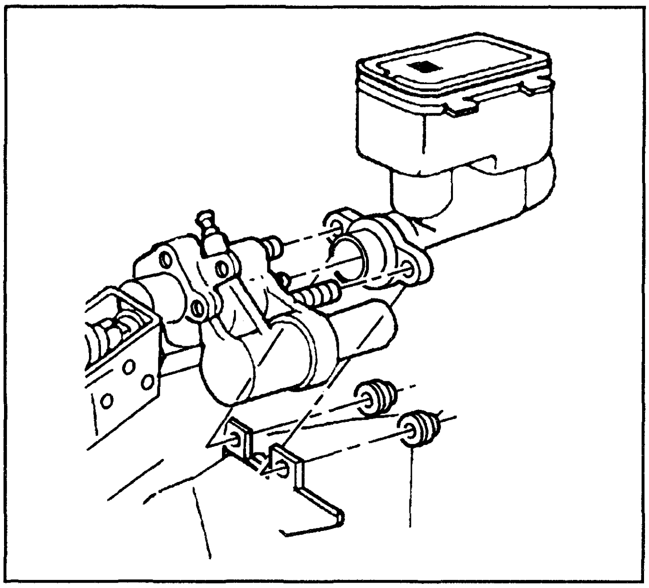
Important: Install the brake-booster-to-frame mounting bolt with the head on the inboard side of the vehicle.

7. Install the brake-booster-to-frame mounting nut.

   Tighten
   Leave the nut finger tight and tighten all of the brake-booster-to-frame mounting nuts to 36 N·m (27 lb ft).
8. Install the brake pedal rod.



172232



172229

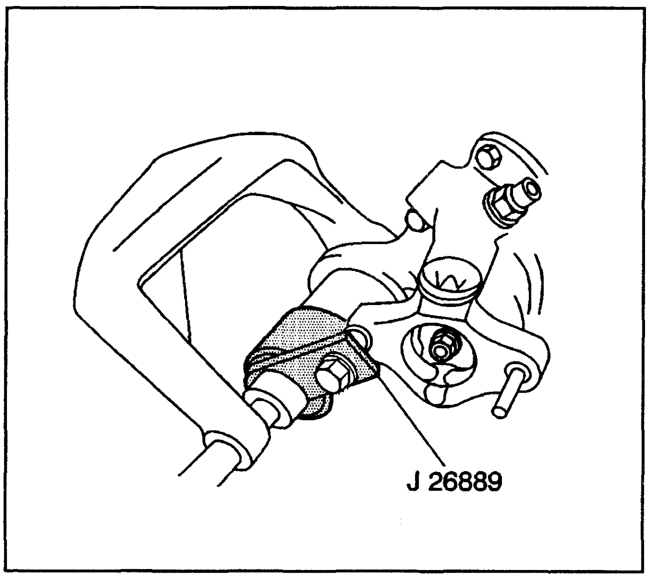
9. Install the master cylinder.
10. Install the master cylinder mounting nuts.

    Tighten

    Tighten the master cylinder mounting nuts to 36 N·m (27 lb ft).
11. Install the hoses.

    Tighten

    Tighten the hoses to 27 N·m (20 lb ft).
12. Bleed the booster. Refer to *Bleeding Power Steering System (Process)* in Power Steering System.
13. Release the parking brake.



156561

Hydraulic Brake Booster Overhaul (Accumulator)

Removal Procedure

Caution: The accumulator contains compressed gas. Always use the proper tools and follow the recommended procedures or personal injury may result. Do not apply heat to accumulator. Do not attempt to repair an inoperative accumulator. Always replace an inoperative accumulator with a new one. Dispose of an inoperative accumulator by drilling a 1.5 mm (1/16 in) diameter hole through the end of the accumulator can, opposite the O-ring.

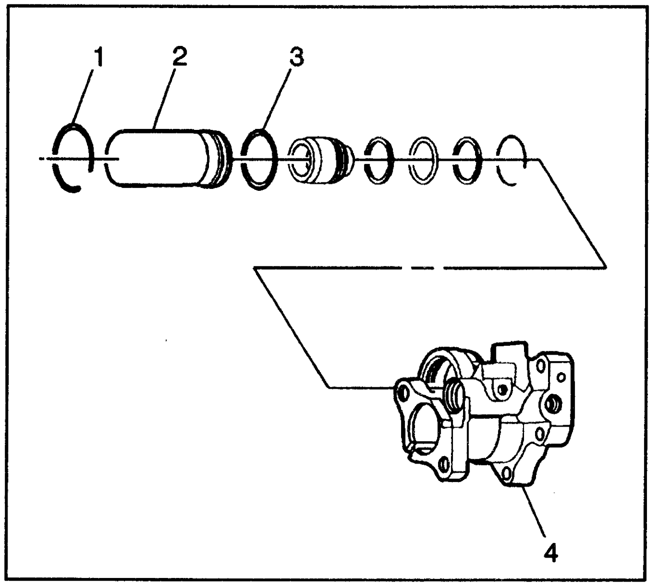
Caution: Push rod removal is not recommended. Improper staking of the push rod to the Hydroboost reaction piston can result in a loss of brakes. If the rod or seals require service, the entire unit must be replaced.

Tools Required

J 26889 Accumulator Piston Compressor.

1. Place the *J 26889* over the end of the accumulator.
2. Install the nuts on the stud.
3. Depress the accumulator with a C-clamp.

4. Remove the accumulator retainer ring (1).



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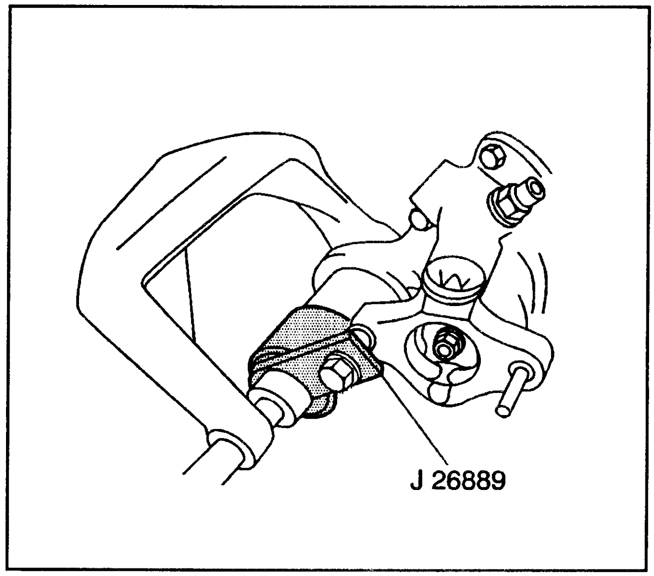
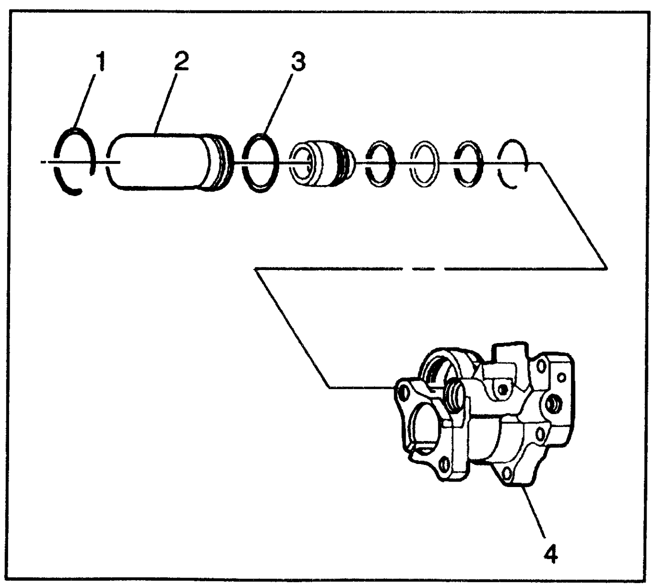
5. Release the C-clamp.
6. Remove the nut from the stud.
7. Remove the *J 26889*.



156561

8. Remove the accumulator (2) and O-ring seal (3).



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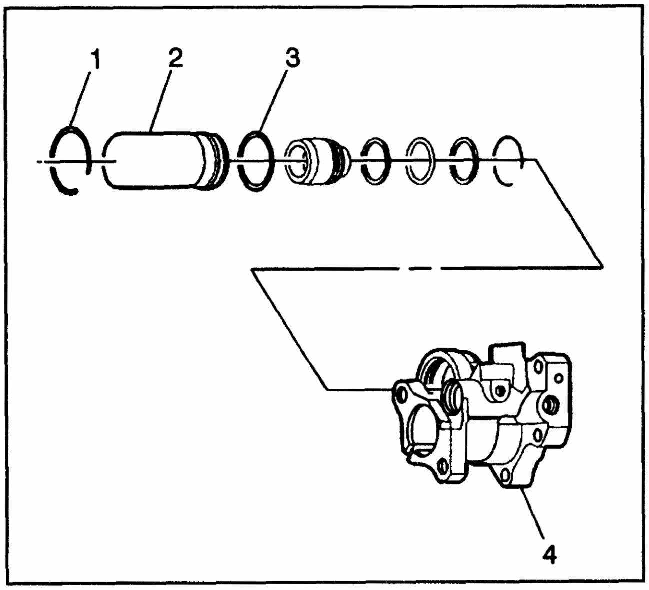


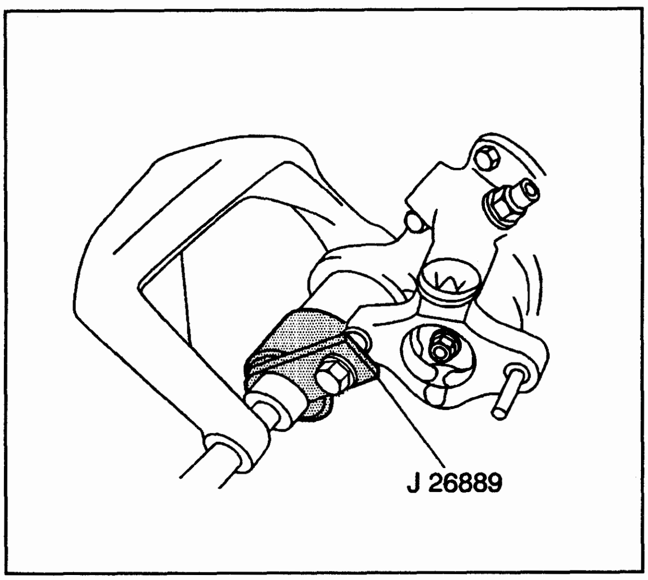
156554

Installation Procedure

Tools Required

J 26889 Accumulator Piston Compressor.

1. Lubricate all seals and metal friction points with power steering fluid.
2. Install the accumulator (2) and O-ring seal (3).



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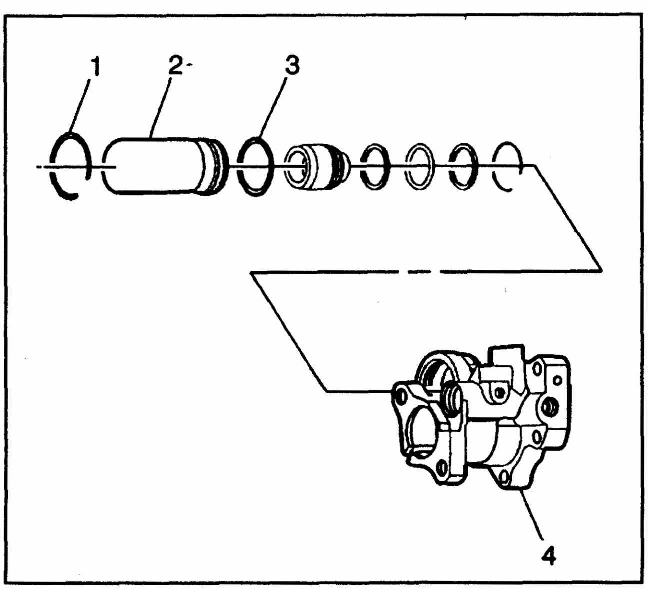
3. Place the *J 26889* over the end of the accumulator.
4. Install the nuts on the stud.
5. Depress the accumulator with a C-clamp.



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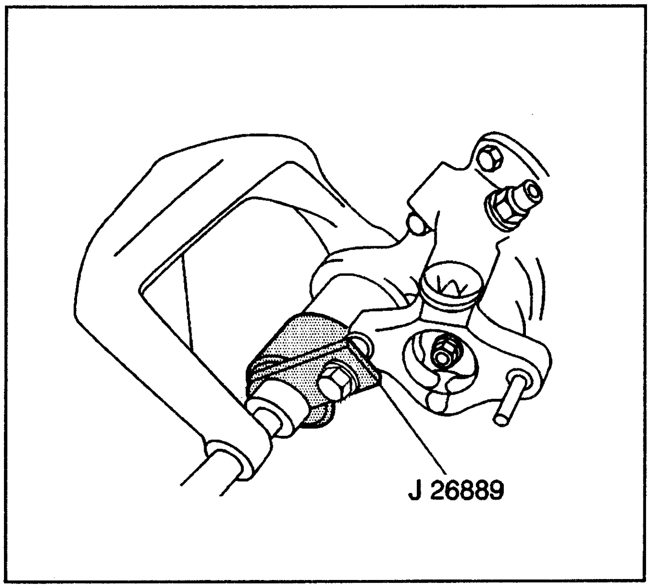
6. Install the accumulator retainer ring (1).

7. Release the C-clamp.
8. Remove the nut from the stud.
9. Remove the *J 26889*.



156561

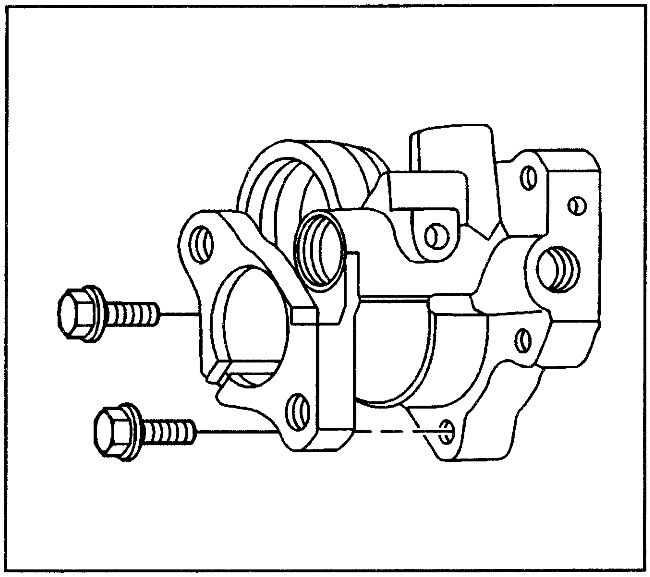
Hydraulic Brake Booster Overhaul (Check Valve)

Removal Procedure

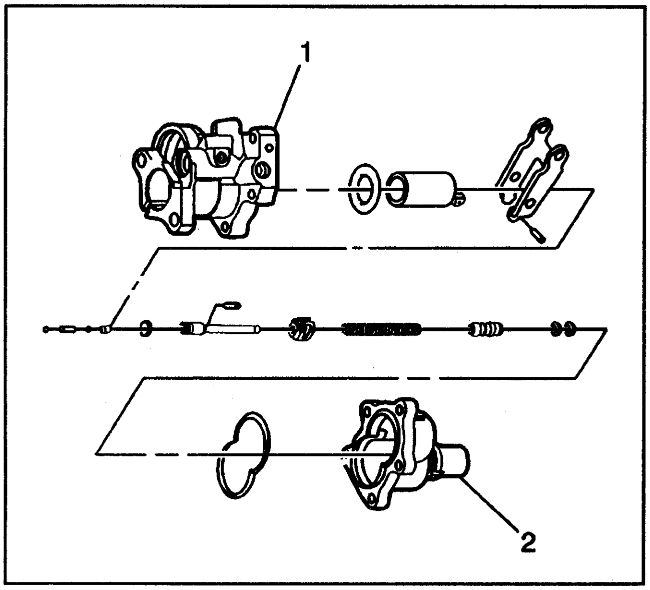
Caution: The accumulator contains compressed gas. Always use the proper tools and follow the recommended procedures or personal injury may result. Do not apply heat to accumulator. Do not attempt to repair an inoperative accumulator. Always replace an inoperative accumulator with a new one. Dispose of an inoperative accumulator by drilling a 1.5 mm (1/16 in) diameter hole through the end of the accumulator can, opposite the O-ring.

Caution: Push rod removal is not recommended. Improper staking of the push rod to the Hydroboost reaction piston can result in a loss of brakes. If the rod or seals require service, the entire unit must be replaced.

1. Remove the bolts fastening the booster cover to the booster housing.

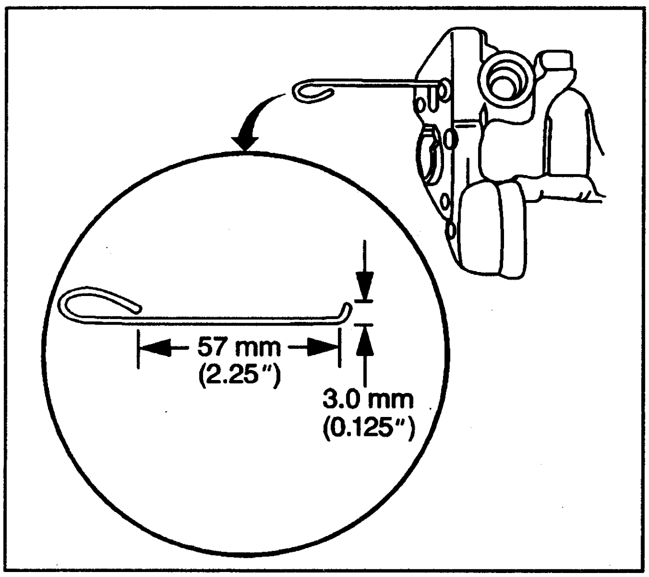


156556



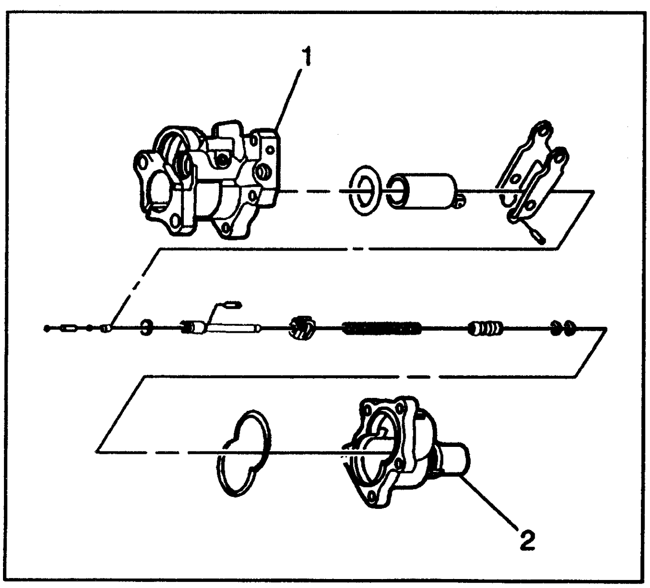
156559

2. Separate the booster cover (2) from the booster housing (1).



156569

3. Remove the check valve. Use a locally fabricated wire hook with dimensions as shown.



156559

Installation Procedure

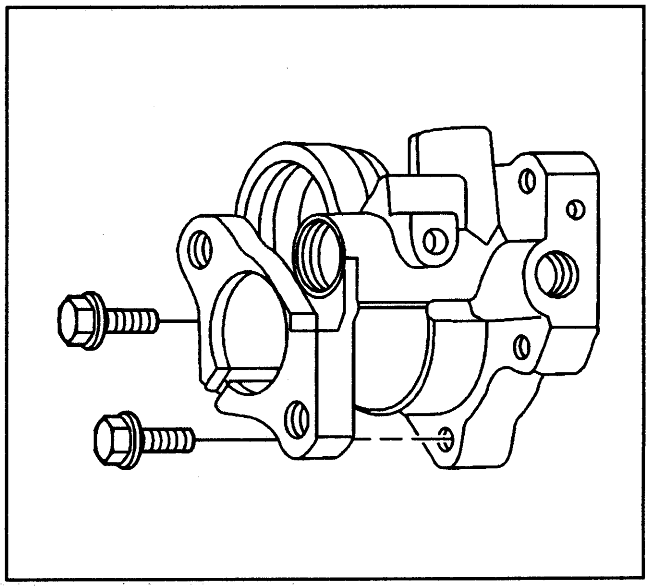
1. Install the check valve.
2. Assemble the booster cover (2) to the booster housing (1).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the bolts fastening the booster cover to the booster housing.

   Tighten

   Tighten the bolts to 30 N·m (20 lb ft).



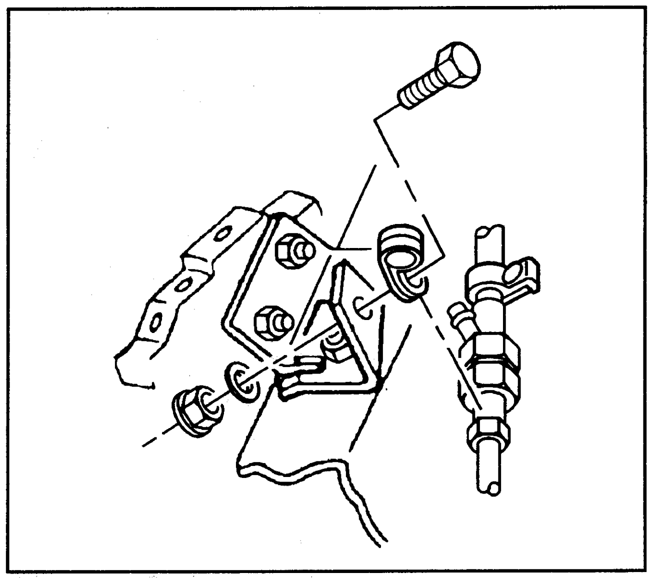
156556

Fluid Flow Switch Replacement

Removal Procedure

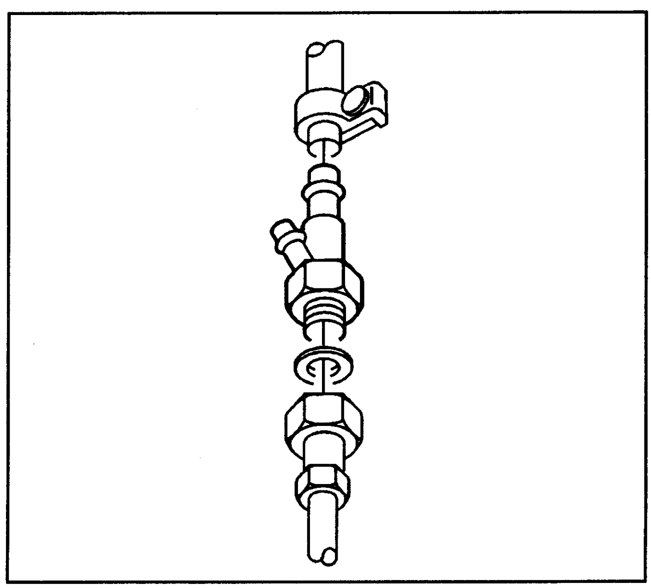
Refer to *Hydraulic Brake Booster Description* for an illustration of the Fluid Flow Switch location.

1. Remove the hose clamps.

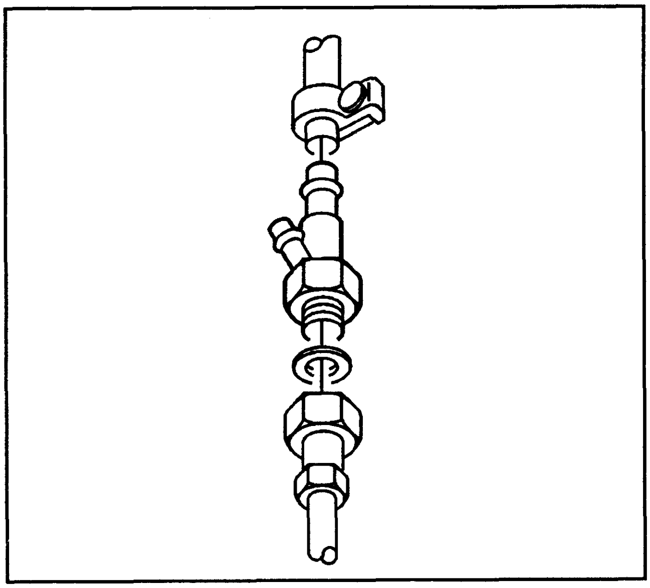


172240

2. Remove the switch.
3. Remove the fitting.
4. Remove the gasket.



172243



172243

Installation Procedure

1. Install the gasket to the switch.

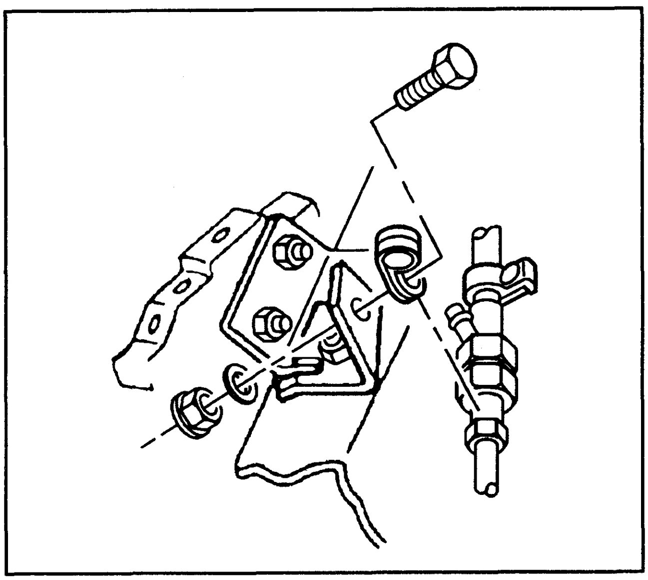
Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the fitting to the switch.

   Tighten

   Tighten the fitting to 27 N·m (20 lb ft).

3. Install the switch to the hoses.



172240

4. Install the clamps.
5. Bleed the system. Refer to *Bleeding Power Steering System (Process)* and *Bleeding Power Steering System (Special Conditions)* in Power Steering System.

Alarm Switch Replacement

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector from the Fluid Pressure Indicator/Alarm Switch. Refer to *Hydraulic Brakes Component Views.*
3. Remove the Fluid Pressure Indicator/Alarm Switch.

Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the Fluid Pressure Indicator/Alarm Switch. Refer to *Hydraulic Brakes Component Views.*

   Tighten

   Tighten the Fluid Pressure Indicator/Alarm Switch to 11 N·m (97 lb in).
2. Connect the electrical connector to the Fluid Pressure Indicator/Alarm Switch.
3. Connect the negative battery cable to the battery.

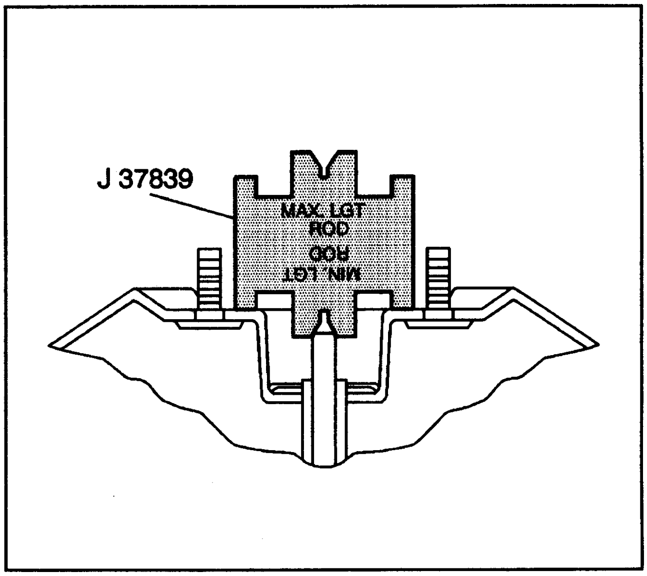
Brake Booster Push Rod Gauging Procedure (Hydraulic Brake Booster)

Tools Required

J 37839 Push Rod Height Gauge

Gauge the piston rod. Use the J 37839. Check the maximum and minimum rod length.

If the piston rod is not within limits, replace the rod with a service adjustable piston rod. Adjust the replacement rod to the correct measurement.



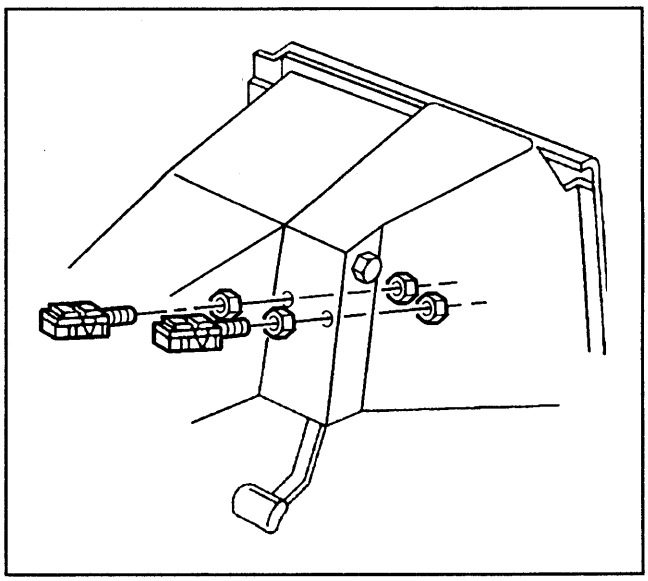
913

Stoplamp Switch Replacement (Commercial)

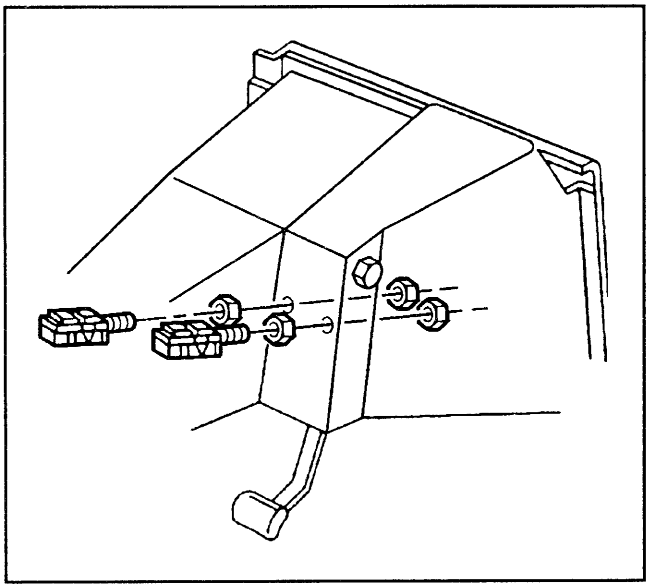
Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Disconnect the electrical connectors.
3. Remove the switch.



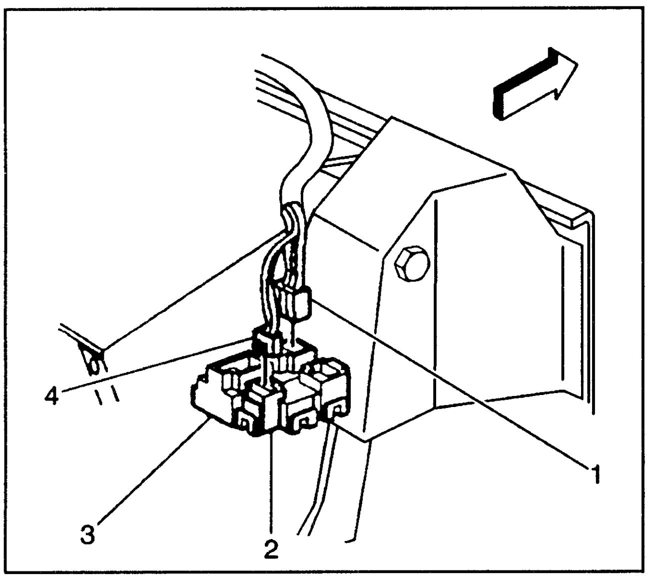
172210



172210

Installation Procedure

1. Install the switch.
2. Adjust the switch. Refer to *Stoplamp Switch Adjustment.*
3. Connect the electrical connectors.
4. Connect the negative battery cable.



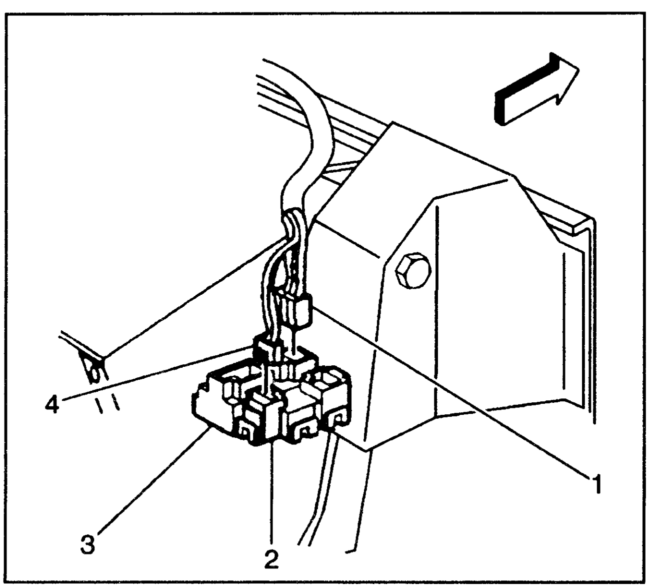
172208

Stoplamp Switch Replacement (Motorhome)

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Disconnect the electrical connectors (1 and 4).
3. Remove the switch (2 and 3).



172208

Installation Procedure

1. Install the switch (2 and 3).
2. Adjust the switch. Refer to *Stoplamp Switch Adjustment.*
3. Connect the electrical connectors (1 and 4).
4. Connect the negative battery cable.

Stoplamp Switch Adjustment

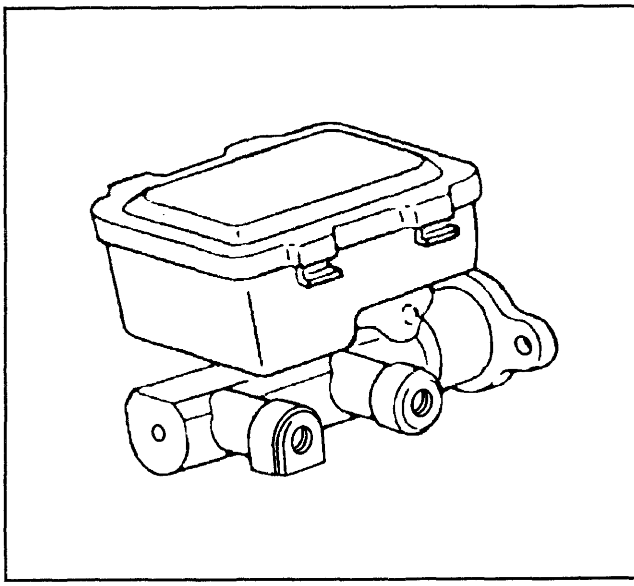
The stoplamp switch will self-adjust the first time the brake pedal returns to its stop after you install the switch.

1. Apply the brake pedal.
2. Push the switch in until the switch seats firmly in the clip.

   Clicks can be heard as the threaded portion of the switch is pushed through the clip.
3. Pull the brake pedal against the pedal stop until you no longer hear a click.
4. Electrical contact should occur when you apply the brake pedal for a distance of 11–24 mm (0.45–0.95 in).

Description and Operation

Master Cylinder Description



156292

The master cylinder is a Delco aluminum unit. The system uses a conventional front-to-rear brake split. The primary piston provides fluid pressure to the front brakes. The secondary piston provides fluid pressure to the rear brakes. If pressure is lost in either system, the remaining system is capable of stopping the vehicle.

Reservoir and Cover

The reservoir is made of plastic. Two clips snap the cap onto the reservoir. A diaphragm between the cover and the reservoir keeps contaminants out of the brake fluid.

Keep the master cylinder reservoir properly filled with brake fluid. This ensures adequate reserve brake fluid and prevents air from entering the hydraulic system. Do not over fill the reservoir. The brake fluid absorbs heat from the brakes, and expands. An over-filled reservoir cannot allow fluid expansion.

Master Cylinder Identification

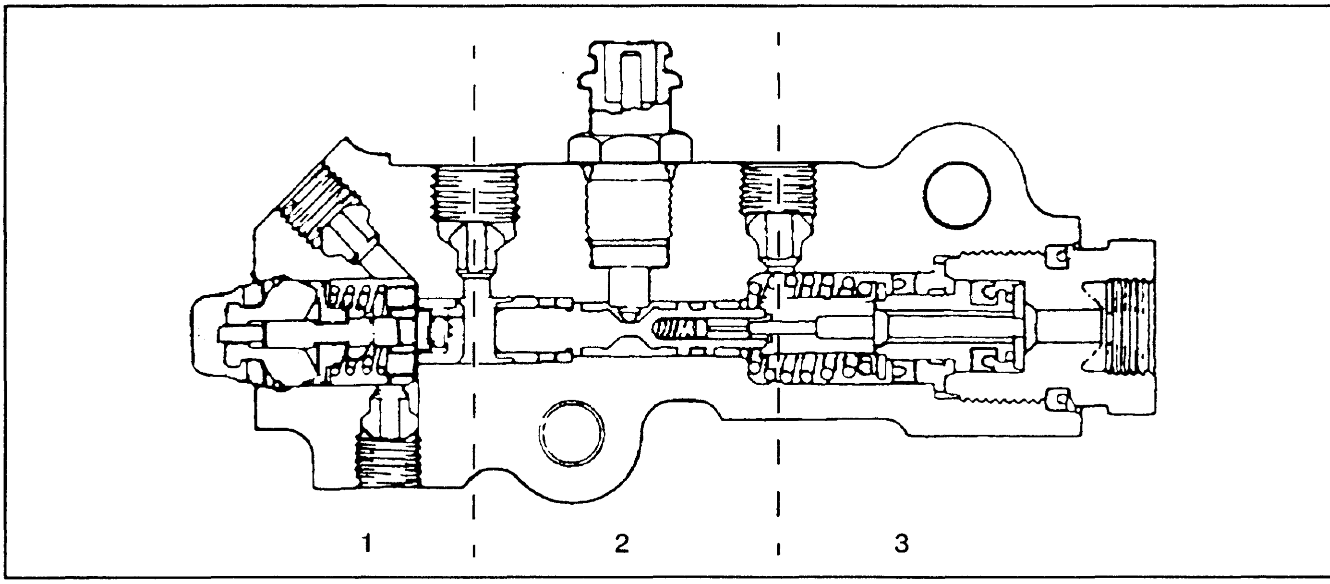
Identifying information is stamped into the master cylinder.

A Delphi master cylinder has the following information stamped into the front surface:

- The first two digits are the build code.
- The third digit indicates the year the master cylinder was built (Example: 5 means 1995).
- The last digits indicate the day the master cylinder was built (Example: 271 means the 271st day of the production year).

Combination Valve Description

Combination Valve



Legend

(1) Metering Valve
(2) Warning Switch
(3) Proportioner

The combination valve has three sections. Each section serves a different function.

- The metering, or hold off, section limits front disc brake pressure, allowing just enough pressure to overcome the rear brake shoe springs. When the inlet pressure is below 200 kPa (30 psi), there is no restriction. This allows for pressure equalization when the brakes are not applied.
- The pressure differential warning switch constantly compares front and rear brake pressures from the master cylinder. The switch closes if the front or rear brake systems lose pressure, completing the circuit to ground. This illuminates the BRAKE lamp on the instrument panel. The switch latches in the WARNING position after a malfunction occurs. To turn off the BRAKE lamp you must repair the malfunction and apply enough pedal pressure in order to develop about 3100 kPa (450 psi) brake line pressure.
- The proportioning section limits brake line pressure to the rear brakes after the rear brakes reach a predetermined rear input brake line pressure. This minimizes rear wheel lockup on vehicles with light rear wheel loads.

The combination valve has a bypass feature. The bypass feature ensures full system pressure to the rear brakes when there is a malfunction in the front brake system. The bypass feature ensures full system pressure to the front brakes when there is a malfunction in the rear brake system.

Brake Fluid and Brake Fluid Handling

Caution: Brake fluid may be irritating to the skin or eyes. In case of contact, take the following actions:

- ***Eye contact—rinse eyes thoroughly with water.***
- ***Skin contact—wash skin with soap and water.***

Notice: Brake fluid will damage electrical connections and painted surfaces. Use shop cloths, suitable containers, and fender covers to prevent brake fluid from contacting these areas. Always re-seal and wipe off brake fluid containers to prevent spills.

Use Brake Fluid P/N 1052535, or an equivalent DOT-3 motor vehicle brake fluid. Always store brake fluid in a closed, sealed container. Never use previously opened, improperly sealed containers of stored brake fluid. Always use new brake fluid, or fluid from a properly sealed container.

Re-seal brake fluid containers immediately after use. Brake fluid left in open or improperly sealed containers will absorb moisture. Moisture can lower the brake fluid boiling point, causing the following problems:

- Brake system contamination.
- Corrosion.
- Deterioration of rubber components.

Substandard Or Contaminated Brake Fluid

Notice: Power steering fluid and brake fluid cannot be mixed. If brake seals contact power steering fluid or steering seals contact brake fluid, seal damage will result.

Use the correct fluids. The master cylinder and brake system use brake fluid. The hydraulic booster system uses power steering fluid.

If the brake fluid contains improper fluid, water, or other contaminants, the brake fluid may boil or corrode rubber components in the hydraulic brake system.

Evidence of rubber deterioration occurs in the following areas:

- Swollen master cylinder piston seals
- Swelling of the wheel cylinder boots
- Swelling of caliper boots
- Swelling of the master cylinder reservoir diaphragm

If you find rubber deterioration, replace all rubber parts in the brake system, including the hoses. Check for brake fluid on the brake linings. Replace brake linings that are contaminated with brake fluid.

If the brake fluid is contaminated and the master cylinder piston seals are good, check for leaks and excessive heat conditions. If no leaks or excessive heat conditions are found, perform the following procedure:

1. Drain the brake system.
2. Flush the system.
   Refer to *Hydraulic Brake System Flushing.*
3. Refill the system.
4. Bleed the system.
   Refer to *Hydraulic Brake System Bleeding.*

Flushing the Brake Hydraulic System

Flushing the brake hydraulic system involves running new brake fluid through the system and out the open bleeder valves, until the fluid runs clear. Use Brake Fluid P/N 1052535, or an equivalent DOT-3 motor vehicle brake fluid.

Flush the brake hydraulic system for the following reasons:

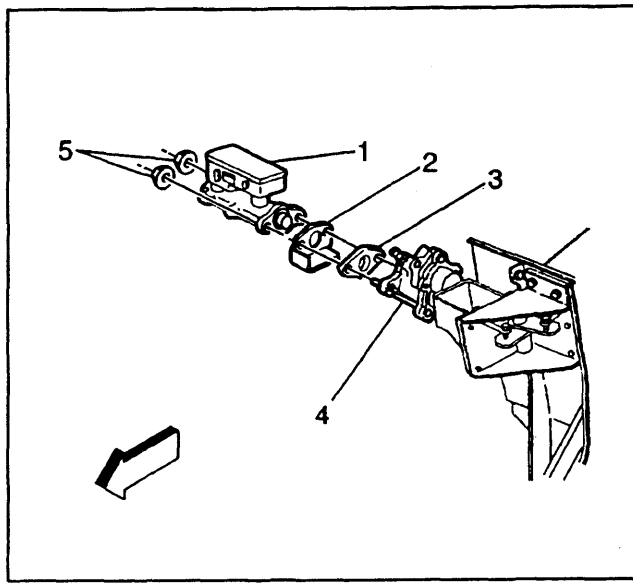
- When new hydraulic brake parts are installed
- When contamination may be present. Flushing is the only way to clean contaminated fluid out of the system
- When you do not know the grade of brake fluid in the brake system.
- When mineral oil is present in the brake fluid

Refer to *Hydraulic Brake System Flushing.*

Hydraulic Brake Booster Description

The hydraulic booster provides power assist using fluid pressure from the power steering pump.

Commercial

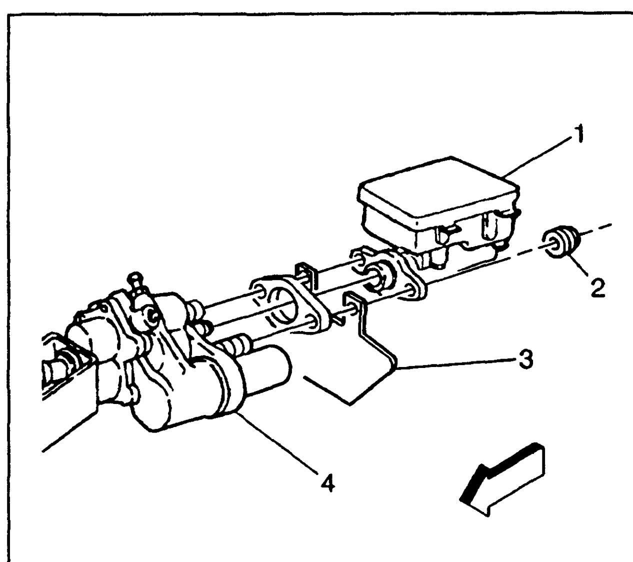


172219

Legend

(1) Master Cylinder
(2) Bracket
(3) Spacer
(4) Hydraulic Booster
(5) Nuts

Motorhome with JF9

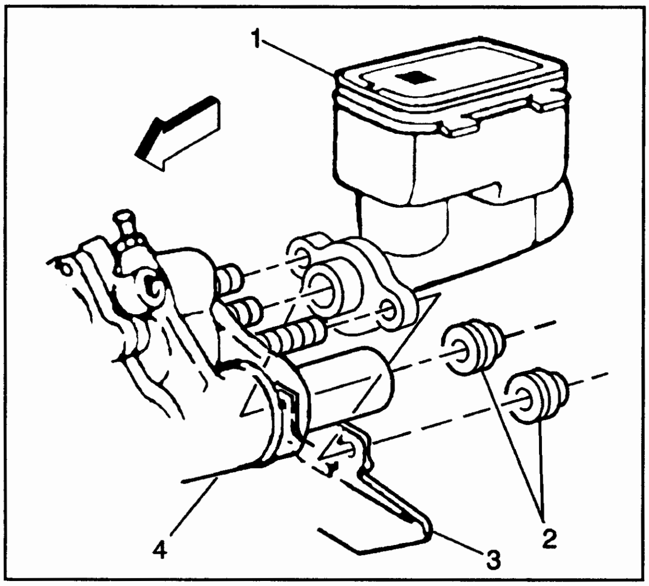


172221

Legend

(1) Master Cylinder
(2) Nuts
(3) Support
(4) Hydraulic Booster

Motorhome with JB8



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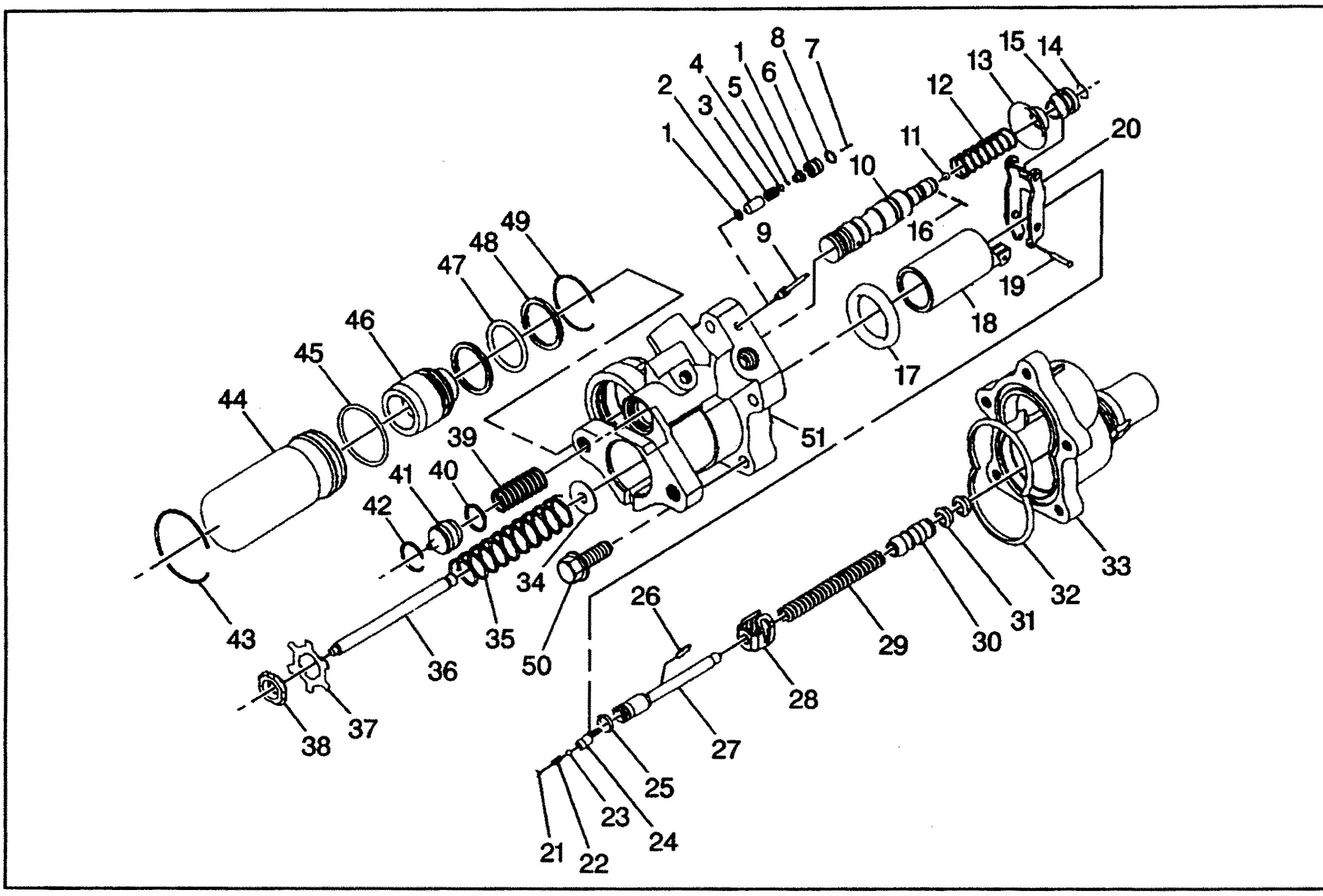
Legend

(1) Master Cylinder
(2) Nuts
(3) Support
(4) Hydraulic Booster

Hydraulic Booster Assembly



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Legend

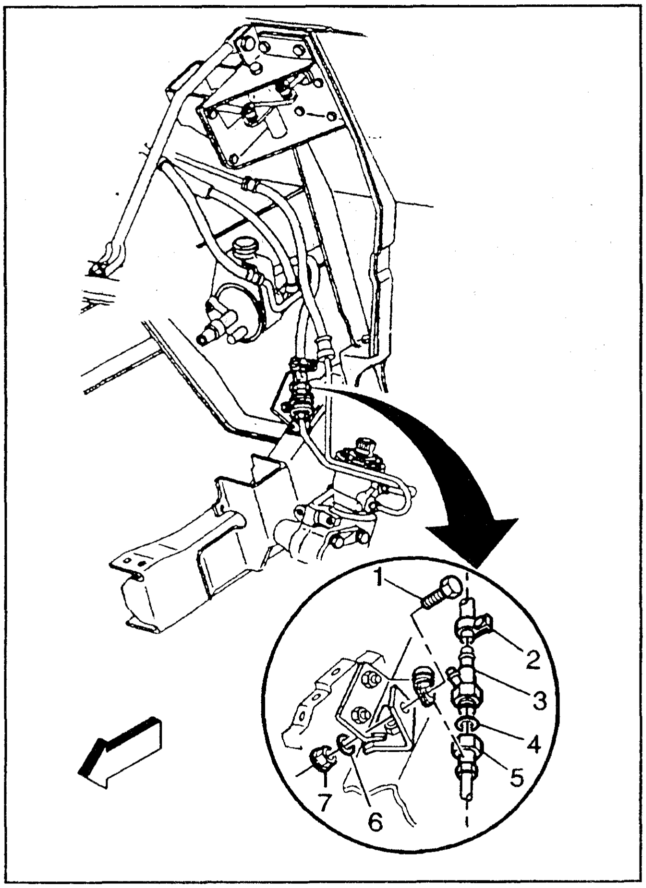
(1) Check Valve Seat
(2) Check Valve Body
(3) Check Valve Relief Spring
(4) Check Valve Washer
(5) Checkball
(6) Body Insert
(7) Plunger
(8) O-ring
(9) Housing Plug
(10) Spool Valve
(11) Spool Valve Checkball
(12) Sleeve Spring
(13) Actuator
(14) External Retainer Ring
(15) Spool Sleeve
(16) Spool Valve Pin
(17) Piston Seal
(18) Piston
(19) Input Lever Pin
(20) Input Lever
(21) Retainer Spring
(22) Relief Valve Spring
(23) Relief Valve Checkball
(24) Relief Valve Seat
(25) Input Rod Ring
(26) Rod and Plunger
(27) Input Rod
(28) Input Rod Bracket
(29) Input Rod Spring
(30) Input Rod End
(31) Input Rod Seals
(32) Housing/Cover Seal
(33) Booster Cover
(34) Output Push Rod Retainer
(35) Piston Return Spring
(36) Output Push Rod
(37) Piston Retainer Spring
(38) Baffle Retainer Spring
(39) Spool Spring
(40) Spool Plug O-ring
(41) Spool Plug
(42) Spool Plug Retaining Ring
(43) Accumulator Retainer Ring
(44) Accumulator
(45) Accumulator Ring
(46) Accumulator Piston
(47) Accumulator Piston O-ring
(48) Accumulator Piston Rings
(49) Retainer Ring
(50) Housing/Cover Bolts
(51) Booster Housing

Power Steering Pump

The power steering pump provides a continuous fluid flow to the booster, when the engine is running. The hydraulic booster provides power assist to the brake master cylinder using the fluid pressure.

Flow Switch

Fluid Flow Switch Location



Legend

(1) Bolt
(2) Clamp
(3) Flow Switch
(4) Gasket
(5) Fitting
(6) Washer
(7) Nut

A flow switch in the hydraulic booster pressure hose closes when the pressure becomes too low for hydraulic booster operation. When the switch closes, the BRAKE Lamp lights on the instrument cluster.

Power Steering Fluid, Brake Fluid, and Fluid Handling

Notice: Hydraulic brake systems use two distinct and incompatible fluids. Power steering fluid is used in the hydraulic brake booster system. Brake fluid is used in the master cylinder and brake pipes. Use extreme care when selecting brake system fluids, or seal damage can result. Refer to General Information to select the correct fluid.

Use the correct fluids. The master cylinder and brake system use brake fluid. The power steering pump and the hydraulic booster system use power steering fluid.

Check the fluid level in the power steering pump reservoir at regular intervals. Add fluid when necessary. Refer to Maintenance and Lubrication.

Do not reuse brake system fluids. Do not mix power steering fluid with brake fluid. Fluid contamination may result in swelling and deterioration of rubber parts. This can lead to reduced brake performance and the eventual loss of braking capability.

If contamination occurs, flush the hydraulic booster system. Flushing the system involves draining the old fluid and replacing that fluid with clean fluid. Refer to Flushing the Power Steering System in Power Steering System.

Service booster components in a clean work area separate from the brake servicing area. Wash hands before changing work areas. Do not use the same containers for brake and power steering fluids.

Flushing the Hydraulic Booster System

Flushing is required when you find dirt, sludge, or water in the system. Flushing is running clean fluid through the system until the draining fluid appears the same as clean fluid. Contaminated fluid in the booster system can cause rubber parts to deteriorate.

Brake Warning System Description (Commercial)

BRAKE Lamp

Battery voltage is applied through the GAUGES fuse 8 to the BRAKE indicator when the ignition switch is in the RUN or START positions. The BRAKE indicator is lit by having ground applied to it by one of the following circuits:

- The brake pressure differential switch
- The ABS system
- The park brake pedal (or handle) switch
- The ignition switch, bulb check in START (Canada)

Brake Warning Indicator System (if equipped with the UJ1 option)

This system uses a pair of switches in the hydraulic system to sense whether there is sufficient hydraulic pressure and/or fluid flow for effective brake operation. If either switch opens, the parking brake booster fluid flow indicator/alarm delay module provides a ground to the brake indicator as well as the brake booster fluid flow and pressure alarm, sounding the alarm and lighting the BRAKE indicator to alert the driver that the vehicle's brake system is experiencing a failure.

ABS Lamp and AUTO PARK Lamp

These lamps indicate brake related problems, but not in the foundation brakes. Their functions and circuits are covered in the Antilock Brake System and Park Brake sections respectively.

Brake Warning System Description (Motorhome)

BRAKE Lamp

Battery voltage is applied through the GAUGES fuse 8 to the BRAKE indicator when the ignition switch is in the RUN or START positions. The BRAKE indicator is lit by having ground applied to it by one of the following circuits:

- The brake pressure differential switch
- The ABS system
- The park brake pull button switch
- The park brake actuator switch
- The ignition switch, bulb check in START (Canada)

ABS Lamp and AUTO PARK Lamp

These lamps indicate brake related problems, but not in the foundation brakes. Their functions and circuits are covered in the Antilock Brake System and Park Brake sections respectively.

Brake Warning System Description (Motorhome Export)

BRAKE Lamp

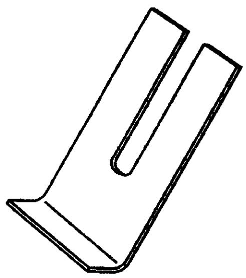
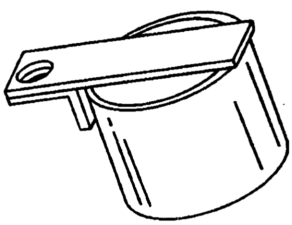
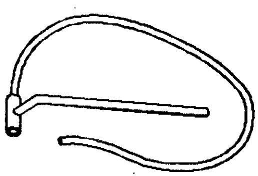
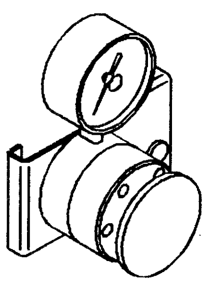
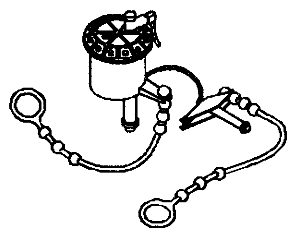
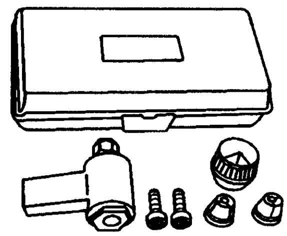
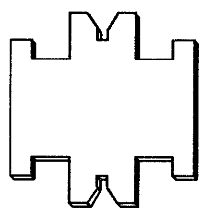
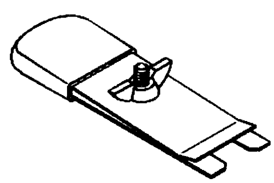
Battery voltage is applied through the GAUGES fuse 8 to the BRAKE indicator when the ignition switch is in the RUN or START positions. The BRAKE indicator is lit by having ground applied to it by one of the following circuits:

- The brake pressure differential switch
- The ABS system
- The park brake pull button switch
- The park brake actuator switch
- The power brake booster fluid flow alarm circuit

ABS Lamp and AUTO PARK Lamp

These lamps indicate brake related problems, but not in the foundation brakes. Their functions and circuits are covered in the Antilock Brake System and Park Brake sections respectively.

Special Tools and Equipment

Illustration	Tool Number/Description
 176099	J 23709 Combination Valve Depressor
 156598	J 26889 Accumulator Piston Compressor
 1007	J 28434 Wheel Cylinder Bleeder Wrench
 1006	J 28662 Brake Pedal Effort Gauge
 1005	J 29567 Brake Bleeder Adapter
 1089	J 29803-A ISO Flaring Tool Kit
 1008	J 37839 Push Rod Height Gauge
 1004	J 39177 Proportioning Valve Depressor

Disc Brakes

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Bleeder Valve	17 N·m	13 lb in
Brake Caliper Brake Hose Bracket Nut	32 N·m	24 lb ft
Brake Caliper Brake Hose Nut	19 N·m	14 lb ft
Brake Caliper Mounting Plate Bolt	280 N·m	206 lb ft
Brake Caliper Retainer Screw	40 N·m	29 lb ft
Brake Rotor to Hub Bolt 9/16 inch OD (10 Bolt Pattern)	152 N·m	112 lb ft
Brake Rotor to Hub Bolt 5/8 inch OD (5 Bolt Pattern)	256 N·m	189 lb ft
Brake Shield Bolt	32 N·m	24 lb ft
Support Key Bolt	20 N·m	15 lb ft

Brake Lathe Specifications (AMMCO)

Data	Rough Cut	Finish Cut
Spindle Speed	150 RPM	150 RPM
Depth of Cut (per side)	0.127 mm (0.005 in)	0.051 mm (0.002 in)
Total Cross Feed (per revolution)	0.152–0.254 mm (0.006–0.01 in)	0.051 mm max. (0.002 in)
Vibration Dampener	Yes	Yes
Swirl Pattern 120 Grit	No	Yes

Brake Lathe Specifications (ACCU TURN)

Data	Cut Information
Spindle Speed	150 RPM
Tool Cross Feed (per revolution)	0.076 mm (0.003 in)
Tool Bit Nose Radius	0.396 mm (0.003 in)
Vibration Dampener	Yes
Swirl Pattern 120 Grit	Yes

Component Specifications (Brake Systems)

System	Master Cylinder Dia.	Front Brakes (Disc)	Rear Brakes (Drum)	Rear Brakes (Disc)	Brake Assist
JB7	31.8 mm 1.25 in	318.8x39.3 mm 12.50×1.54 in	331.5x64 mm 13.00×2.5 in	—	Hydraulic Hydro-Boost
JB8	31.8 mm 1.25 in	318.8x39.3 mm 12.50×1.54 in	331.5x89.3 mm 13.00×3.50 in	—	Hydraulic Hydro-Boost
JF9	40.00 mm 1.57 in	357.0x36.7 mm 14.00×1.44 in	—	936.2x36.7 mm 13.60×1.44 in	Hydraulic Hydro-Boost

Component Specifications (Rotor Thickness)

Original	Maximum Refinish	Replacement (Discard)
32.51 mm (1.28 in)	31.25 mm (1.23 in)	30.86 mm (1.215 in)
39.11 mm (1.54 in)	37.59 mm (1.48 in)	37.21 mm (1.456 in)

Component Specifications (Bendix Caliper Replacement Key)

Bumper Gap	Replacement Key	P/N
0.0–0.060 in	Std. Size–I	14023439
0.061–0.100 in	0.040 Oversize–II	14026793
0.101–0.140 in	0.080 Oversize–II	14026794
0.141–0.180 in	0.120 Oversize–III	14026795
0.181–0.220 in	0.160 Oversize	14026796
0.221 in	Replace Caliper and Anchor Plate or Steering Knuckle	—

Component Specifications (Shim Selection)

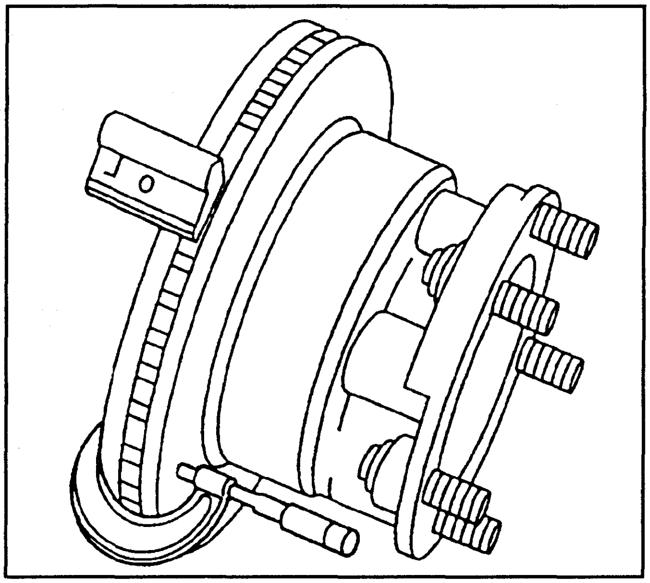
Gap Measurement	**0.0–1.47 mm** (0.0–0.058 in)	**1.50–2.57 mm** (0.059–0.101 in)	**2.59–3.68 mm** (0.102–0.145 in)
Shim Thickness	No Shim	0.64 mm (0.025 in)	1.14 mm (0.045 in)

Component Specifications (Dimensional)

Application	Metric	English
Brake Lining Replacement Thickness	1.60 mm	0.063 in
Brake Lining to Brake Rotor Maximum Clearance	0.13 mm	0.005 in
Brake Rotor OD Runout	0.76 mm	0.030 in
Brake Rotor Thickness Variation	0.05 mm	0.002 in
Brake Rotor Total Indicated Runout (TIR)	0.13 mm	0.005 in
Rear Hub and Bearing Assembly Lateral Runout	0.040 mm	0.0016 in

Diagnostic Information and Procedures

Brake Rotor Thickness Variation Check



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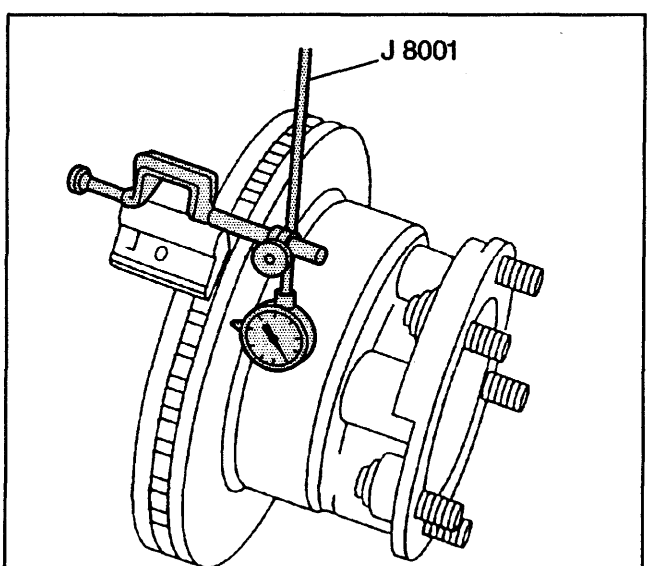
Check thickness variation by measuring the brake rotor thickness at four or more points around the circumference of the brake rotor. Use a micrometer calibrated in ten-thousands of an inch. Make all measurements about 25.4 mm (1 in) in from the edge of the brake rotor.

A brake rotor that varies in thickness by more than 0.05 mm (0.002 in) can cause brake pedal pulsation and/or front end vibration during brake applications. Refinish or replace a brake rotor that does not meet these specifications.

Brake Rotor Lateral Runout Check

Tools Required

J 8001 Dial Indicator Set



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The best way to check lateral runout is with the *wheels still installed* on the vehicle. This gives a much more accurate reading of the Total Indicated Runout (TIR) under real braking conditions. If equipment is not available to perform the check with the wheels installed, *the next best reading can be made with the* wheels removed but with the brake caliper still installed.

In some cases, excessive lateral runout can be improved by indexing the brake rotor on the hub that is one or two bolt positions from the original position. If the lateral runout cannot be corrected by indexing the brake rotor, check the hub and bearing assembly for excessive lateral runout or looseness. If the hub and bearing assembly lateral runout exceeds 0.040 mm (0.0016 in), replace the hub and/or bearing assembly if necessary. If the lateral runout is not within specifications, refinish or replace the brake rotor as necessary.

1. Set the parking brake.
2. Block the vehicle wheels.
3. Raise the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
4. Support the vehicle with safety stands.
5. Remove the tires and wheels. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
6. Clean the brake rotor surface.
7. Tighten the wheel bearings to zero end play.
8. Fasten a dial indicator to the steering knuckle so that the indicator button contacts the brake rotor surface about 25.4 mm (1 in) from the outer edge.
9. Set the dial indicator to zero.
10. Turn the wheel one complete revolution.
11. Observe the runout indicated on the dial.
12. The (TIR) must not exceed 0.13 mm (0.005 in).
13. Adjust the wheel bearings. Refer to *Wheel Bearing Adjustment (Independent)* or *Wheel Bearing Adjustment (I-Beam)*.

Brake Rotor Tolerance

During the manufacture of the brake rotor, tolerances of the braking surfaces for flatness, parallelism, and lateral runout are closely held. The maintenance of close tolerances on the shape of the braking surfaces is necessary in order to prevent brake roughness or brake pedal pulsation.

In addition to these tolerances, the surface finish must be held to a specified range of 60 Ra roughness or less. Controlling the braking surface finish avoids problems of hard pedal application, excessive brake fade, brake and steering pulls, and erratic performance. In addition, control of the surface finish can improve brake lining life.

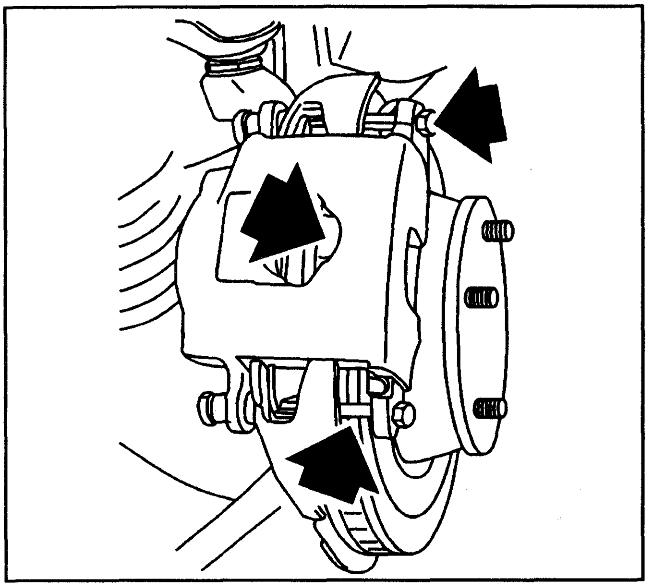
Light scoring of the brake rotor surfaces not exceeding 1.5 mm (0.06 in) in depth is normal and not detrimental to brake operation.

Repair Instructions

Brake Pad Inspection (Front)

Inspect the brake linings every 10 000 km (6,000 miles) and any time the wheels are removed. Check the following:

- Inspect the outer brake lining at each end of the caliper. The highest rate of wear occurs at this point.



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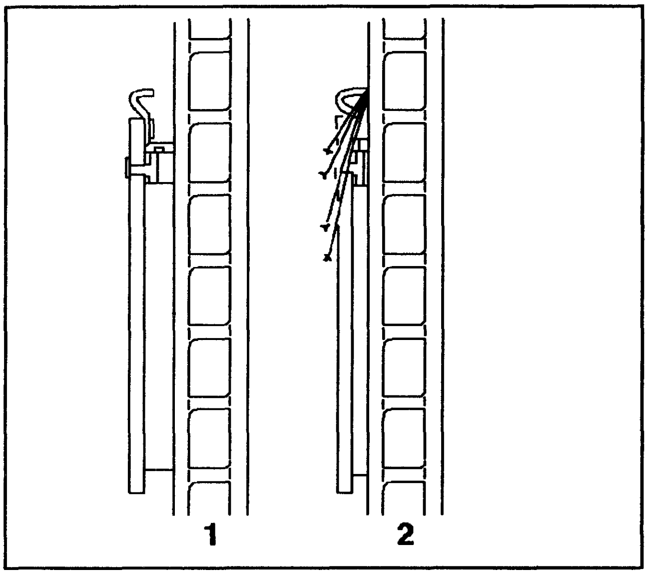

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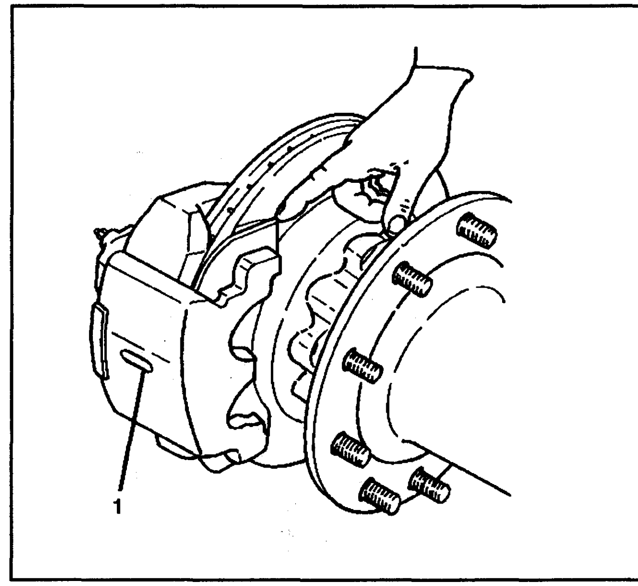
- Check the inner brake lining thickness for premature wear. Some inboard shoes and brake linings have a thermal layer against the shoe that is integral to the lining. Do not confuse this extra layer with uneven inboard-outboard brake lining wear.
- Look down through the inspection hole on top of the caliper and inspect the inner brake linings. Replace bonded brake shoe and lining assemblies when the thickness of any lining is worn within 0.76 mm (0.030 in) of the shoe. Replace riveted shoe and lining assemblies when the thickness of any lining is worn within 0.76 mm (0.030 in) of any rivet head. Always replace the disc brake shoe and lining assemblies as a complete axle set.
- Check the flatness of new or used brake linings. Place the inboard and the outboard brake lining surfaces together. Check for a gap between the brake lining surfaces. The gap should not exceed 0.13 mm (0.005 in) at the middle of the lining surfaces.

The outboard brake shoe and lining assembly has a wear indicator that contacts the rotor and makes noise when the lining needs replacement (2). This noise is a loud scraping.

Brake Pad Inspection (Rear)

Lining Inspection

1. Inspect the brake linings every 9656 km (6,000 mi) and any time the wheels are removed (tire rotation, etc.). The preliminary inspection can be made with a mirror and flashlight (1).
2. Remove the wheels in order to measure the linings.
3. Measure the linings with the brake caliper installed. The outer lining on brake calipers is exposed for easy inspection.
4. Check the inner lining on brake calipers through the inspection hole in the brake caliper housing.
5. Replace the brake pad assemblies when the lining is worn to 1.6 mm (0.063 in).
6. Measure the linings at their thinnest point.



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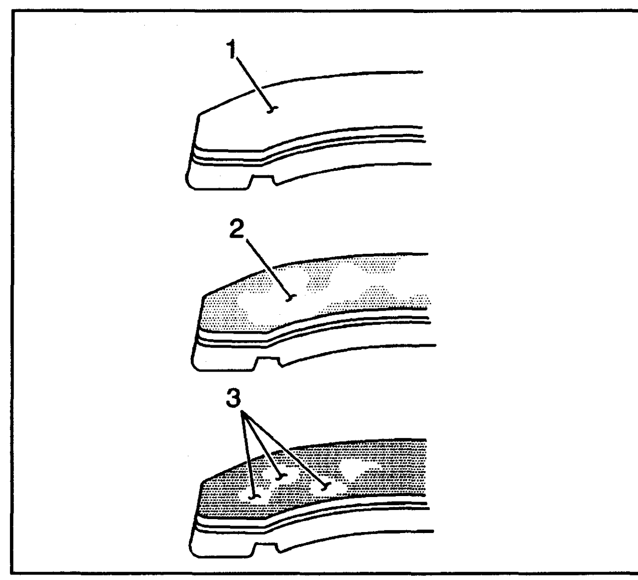
Brake linings should lightly contact the brake rotor or have no more than 0.13 mm (0.005 in) clearance. It is normal for the brakes to drag if the brakes were applied shortly before checking the brake clearance.

- If the brake linings are more than 0.13 mm (0.005 in) from the brake rotor, pump the brake pedal several times and recheck the lining clearance.
- If the lining clearance is still not within specifications, check for unevenly worn surfaces on the brake rotor, brake linings, or brake caliper pistons. New brake linings may have more clearance until they have worn to match the brake rotor.
- If the gap between either brake caliper piston face and the brake pad is more than 1.8 mm (0.071 in), overhaul the brake caliper.
- Remove the brake caliper in order to inspect the brake lining surface conditions. The brake linings must be free of grease and oil.
- The brake linings should show at least 70 percent wear (2) over the braking surface compared to a new lining (1) in order to indicate good lining contact.



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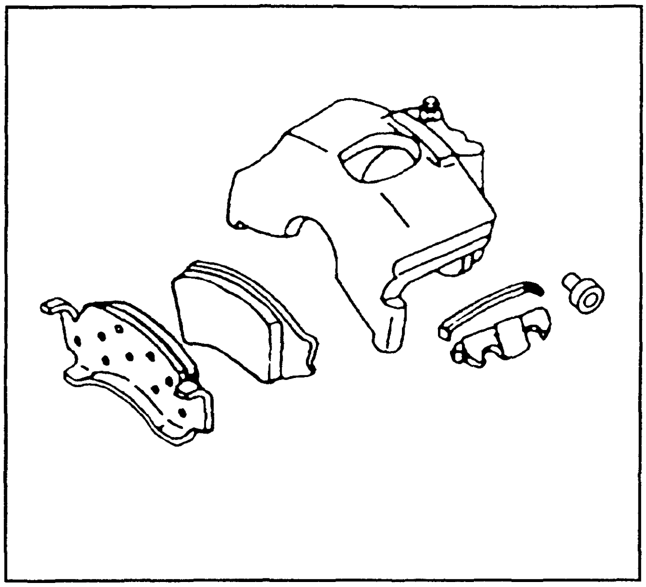
Knock-back is a condition that occurs when a turning brake rotor pushes the brake linings and brake caliper pistons farther into the bores than normal. Excessive clearance results from the knock-back and the driver will notice increased pedal travel with the next brake application. Loose or worn suspension parts, especially the wheel bearings, can increase knock-back. Refer to *Wheel Bearings Diagnosis.*



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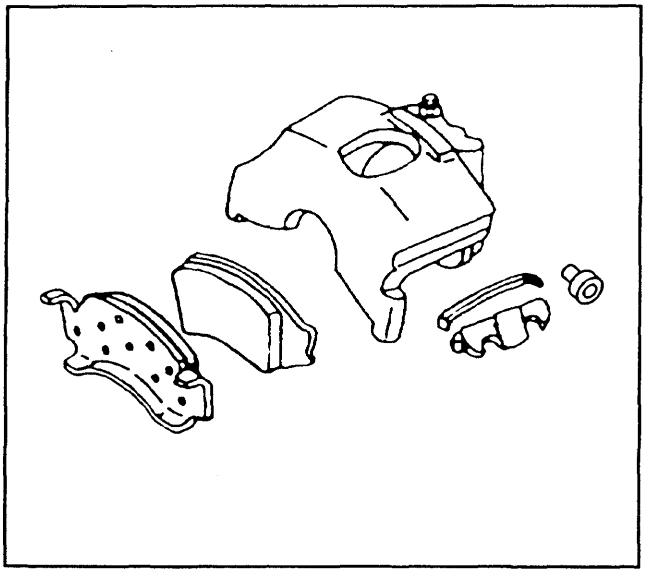
Brake Pads Replacement (Front)

Removal Procedure

Notice: Do not allow calipers to hang from the flexible hoses. Doing so can damage the hoses.

1. Remove the caliper assembly.
2. Suspend the caliper.
3. Remove the inboard pad.
4. Remove the anti-rattle spring.
5. Remove the outboard pad.
6. Inspect the inside of the caliper assembly for signs of fluid leakage. If any is found, refer to *Brake Caliper Overhaul (Front).*
7. Clean away any corrosion from the machined surfaces of the steering knuckle and caliper with a wire brush.



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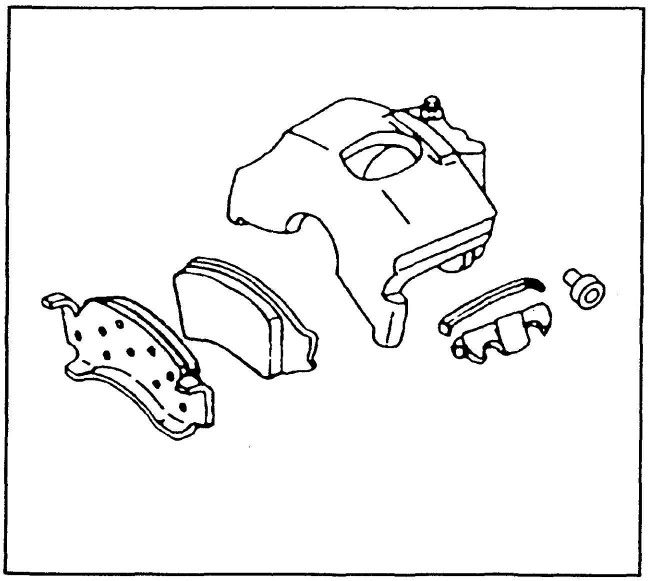
Installation Procedure

Notice: Make sure the brake hose is not twisted or kinked after installation. Damage to the hose could result.

1. Lubricate the caliper and anchor plate sliding surfaces with Silicone Lube P/N 18010909 or the equivalent.
2. Install the inboard pad and anti-rattle spring.
3. Install the outboard pad.
4. Install the caliper assembly.

Important: Before moving the vehicle, pump the brake pedal several times in order to make sure the pedal is firm. Do not move the vehicle until you obtain a firm pedal. Check the brake fluid level in the master cylinder after pumping the brakes.



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Brake Pads Replacement (Rear)

Workhorse replacement brake lining material is recommended for this vehicle in order to maintain the balance between front and rear brake performance. Workhorse replacement brake parts have been carefully selected to provide the proper brake balance for purposes of stopping distance and control over the full range of operating conditions. Installation of front or rear brake lining material with performance different from the recommended Workhorse replacement parts can change the intended brake balance of this vehicle.

Removal Procedure

1. Remove the brake caliper. Refer to *Brake Caliper Replacement (Front)* or *Brake Caliper Replacement (Rear).*
2. Remove the inner brake pad from the brake caliper mounting plate.

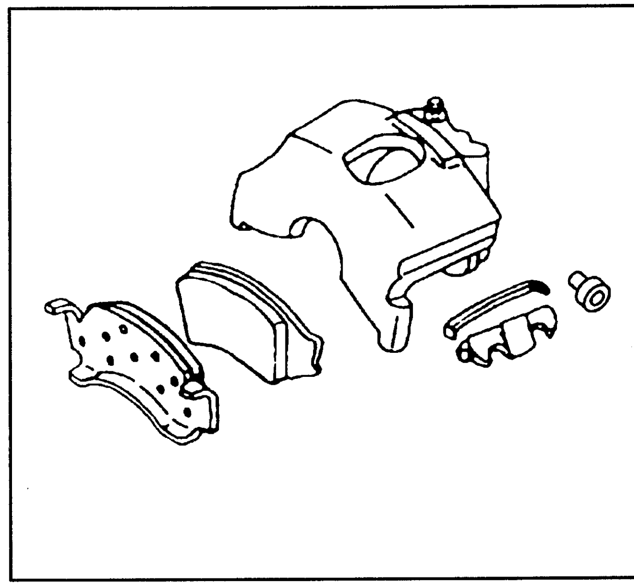
3. Slide the outer brake pad along the rail in the brake caliper housing to the notches.
4. Lift the outer brake pad out.
5. Inspect the brake caliper. Refer to *Brake Caliper Inspection.*

Installation Procedure

1. Slide the outer brake pad into the brake caliper housing.
2. Install the inner brake pad onto the brake caliper mounting plate.
3. Install the brake caliper. Refer to *Brake Caliper Replacement (Front)* or *Brake Caliper Replacement (Rear).*

Burnishing Linings and Brake Rotors

After the brake linings have been replaced and/or the brake rotors have been refinished, the new braking surface should be broken in, or burnished. Make 20 stops from 48 km/h (30 mph) using medium to firm brake pedal pressure. During this procedure, avoid overheating the brakes.



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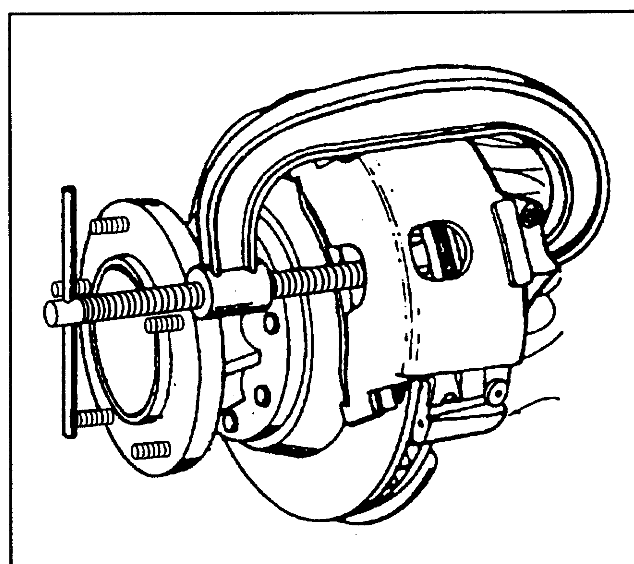
Brake Caliper Replacement (Front)

Removal Procedure

1. Remove two-thirds of the brake fluid from the master cylinder.
2. Raise the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Support the vehicle with safety stands.
4. Mark the relationship of the wheel to hub.
5. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation.*
6. Position a C-clamp and tighten until the piston bottoms in the bore.
7. Remove the C-clamp.
8. Remove the brake hose.
9. Remove the screw.



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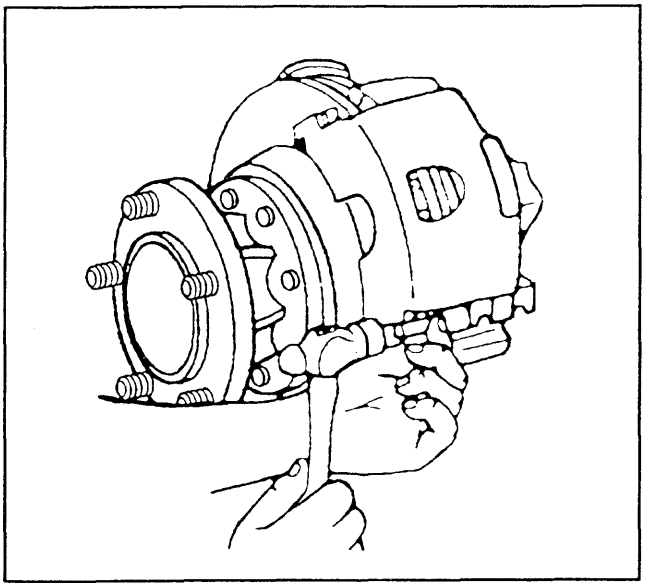

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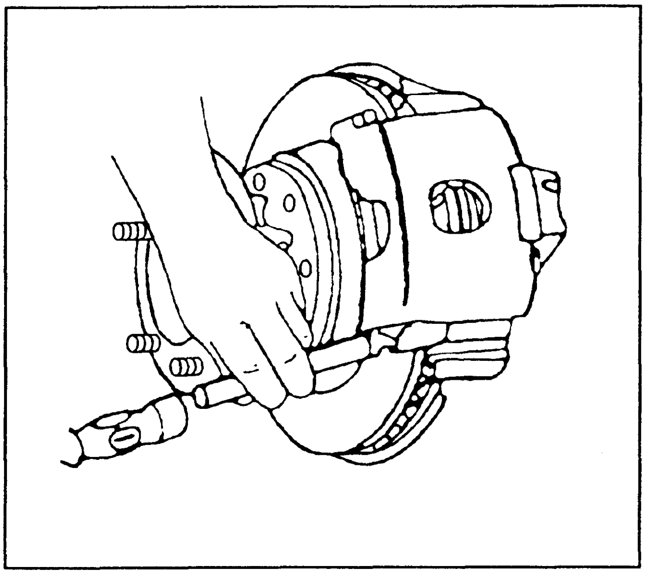
10. Remove the support key using a brass punch and hammer.
11. Remove the spring.
12. Remove the caliper assembly.
13. Inspect the inside of the caliper assembly for signs of fluid leakage. If any is found, refer to *Brake Caliper Inspection*.
14. Clean the machined surfaces of the anchor plate and caliper with a wire brush.



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Installation Procedure

1. Lubricate the caliper and anchor plate sliding surfaces with Silicone Lube P/N 18010909, or equivalent.

Notice: Make sure the brake hose is not twisted or kinked after installation. Damage to the hose could result.

2. Install the caliper assembly.
3. Install the spring.
4. Install the support key with a brass punch and hammer.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

5. Install the bolt into the circular cutout in the key.

   Tighten

   Tighten the bolt to 20 N·m (15 lb ft).
6. Install the brake hose.
   - Refer to *Brake Hose Replacement - Front (Commercial FL7 and FL9)*
   - *Brake Hose Replacement - Front (Commercial FK4/FK5 and JF9)*
   - *Brake Hose Replacement - Front (Comm. FL5/6 JB7/8 Mtrhome JB8)*
   - *Brake Hose Replacement - Front (Commercial FK4/FK5 and JB8)*
   - *Brake Hose Replacement - Front (Motorhome JF9)*
   - *Brake Hose Replacement - Front (Motorhome JB7/JB8)*
   - *Brake Hose Replacement - Rear.*
7. Bleed the brake system. Refer to *Hydraulic Brake System Bleeding*.
8. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation.*

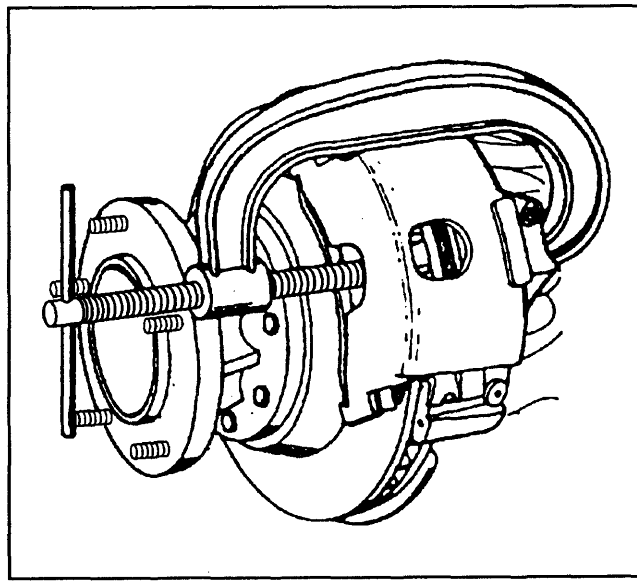
Important: Before moving the vehicle, pump the brake pedal several times in order to make sure the pedal is firm. Do not move the vehicle until a firm pedal is obtained. Check the brake fluid level in the master cylinder after pumping the brakes.

9. Lower the vehicle.

Brake Caliper Replacement (Rear)

Removal Procedure

1. Block the vehicle wheels.
2. Drain approximately 2/3 of the brake fluid from the master cylinder.
   - Drain brake fluid from the bleeder valve at the brake caliper.
   - Do not completely drain the reservoir.
   - Discard the drained brake fluid.
3. Raise the vehicle. Refer to Vehicle Lifting and Jacking in General Information.
4. Support the vehicle with safety stands.
5. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
6. Remove the brake caliper retainer screw.
7. Remove the brake caliper retainer and brake caliper retainer spring with a brass punch.



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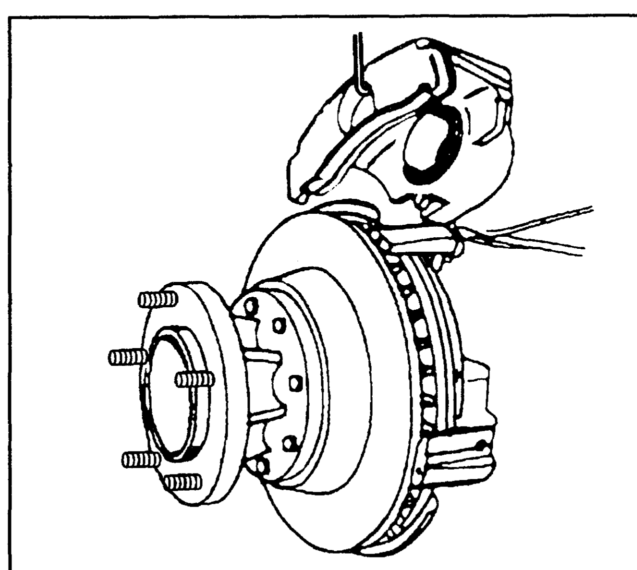
8. Compress the brake caliper pistons.
   - Use a C-clamp between the inner brake caliper housing and the outer brake pad, or use screwdrivers in order to pry between the outer brake caliper housing and the other brake pad.
   - Watch for possible fluid overflow at the reservoir during this step.
   - The inner brake pad may stay on the brake caliper mounting plate.

Notice: Do not allow calipers to hang from the flexible hoses. Doing so can damage the hoses.

Important:

- Do not let the brake caliper hang from the brake hose. Suspend the brake caliper with a wire or cord.
- It is not always necessary to remove the brake hose from the brake caliper when replacing the brake pad assemblies.
- Clean the area around the brake hose on the brake caliper.
- Cap or tape the fitting in order to prevent dirt from entering the brake hose.

9. Disconnect the brake hose.
10. Remove the brake caliper.
11. Inspect the inside of the brake caliper for hydraulic fluid leaks. Overhaul the brake caliper if leaks are found. Refer to *Brake Caliper Overhaul (Front)* or *Brake Caliper Overhaul (Rear)*.



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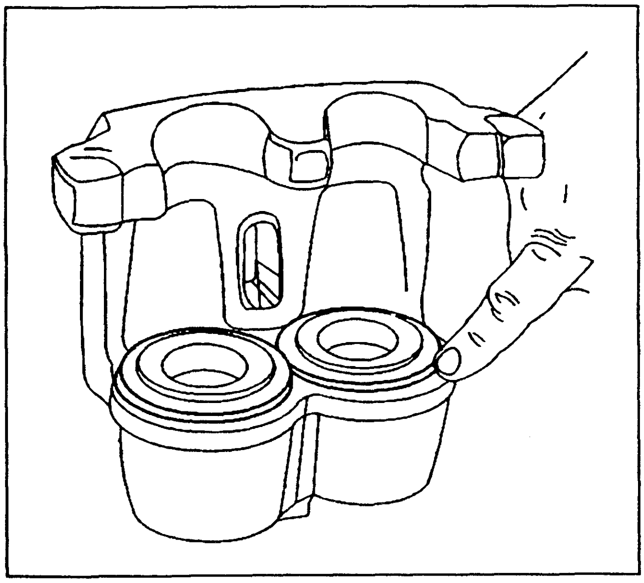

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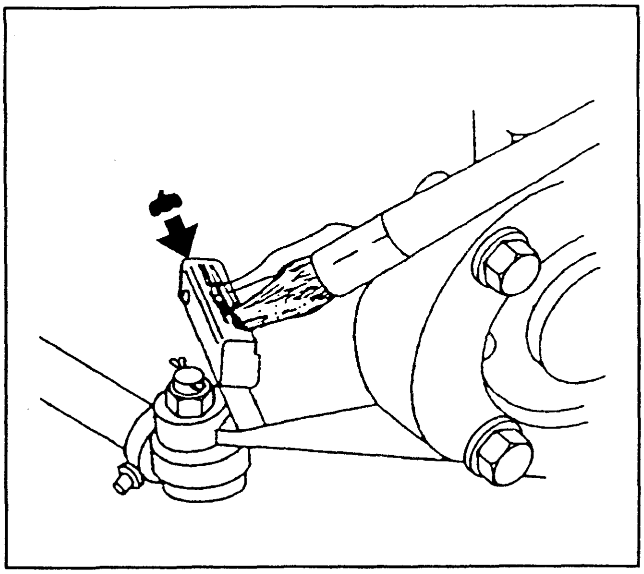

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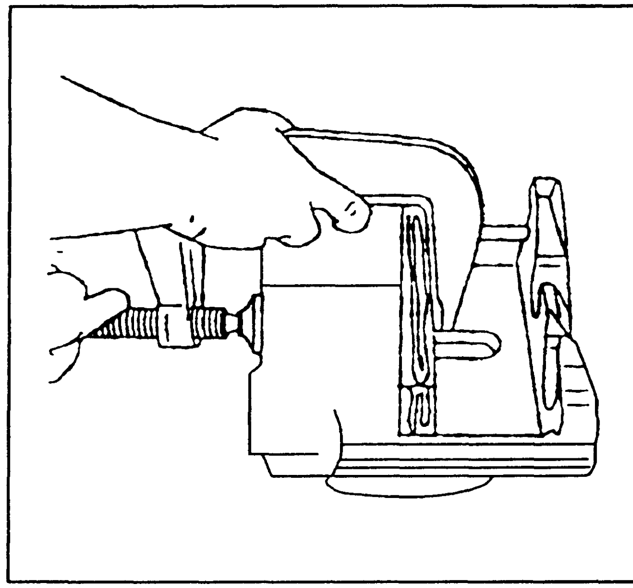
12. Inspect the piston seal for leaks and fluid around the following components:
    - The dust boot
    - The heat shield
    - The inboard brake pad
13. Inspect the piston dust boots for the following conditions:
    - Burns
    - Tears
    - Damage
14. Overhaul the brake caliper if you find damage. Refer to *Brake Caliper Overhaul (Front)* or *Brake Caliper Overhaul (Rear).*
15. Inspect the V-way surfaces on the brake caliper.
16. Inspect the support rail surfaces on the brake caliper mounting plate.
17. Replace the dust shields if they are loose.
18. Inspect under the boots for leakage. Overhaul the brake caliper if leakage is found. Refer to *Brake Caliper Overhaul (Front)* or *Brake Caliper Overhaul (Rear).*
19. Clean the following surfaces with a wire brush:
    - The V-way surfaces of the brake caliper
    - The support rail surfaces on the brake caliper mounting plate
20. File smooth any deep nicks or gouges.
21. Lubricate the brake caliper V-way surfaces and the support rail surfaces with brake caliper slide lubricant P/N 123776969 or equivalent.

Installation Procedure

Important: Never drive the pistons in with a mallet or metal tools. If the piston cannot be pushed by hand, place a small block of wood over the pistons and the boots. Use a C-clamp around the wood block and the brake caliper housing in order to push in the pistons.

1. Install the brake caliper pistons to the bottom of the bores.



171534

2. Install the brake caliper.

Notice: Make sure the brake hose is not twisted or kinked after installation. Damage to the hose could result.

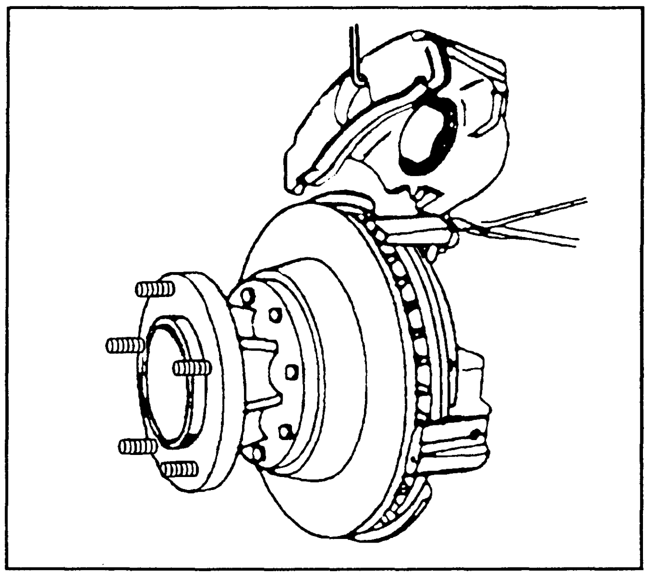
3. Install the brake hose (if disconnected).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Loosely assemble the brake hose nut to the brake caliper.
5. Loosely assemble the brake hose bracket to the brake caliper.

   Tighten

   - Tighten the brake hose nut to 19 N·m (14 lb ft).
   - Tighten the brake hose bracket bolts to 32 N·m (24 lb ft).
6. Install the brake caliper retainer and brake caliper retainer spring in the support rail.
7. Refer to *Brake Caliper and Anchor Plate Wear Adjustment (Shim Selection).*
8. Lubricate the brake caliper retainer and the brake retainer spring with brake caliper slide lubricant P/N 12377969 or equivalent.



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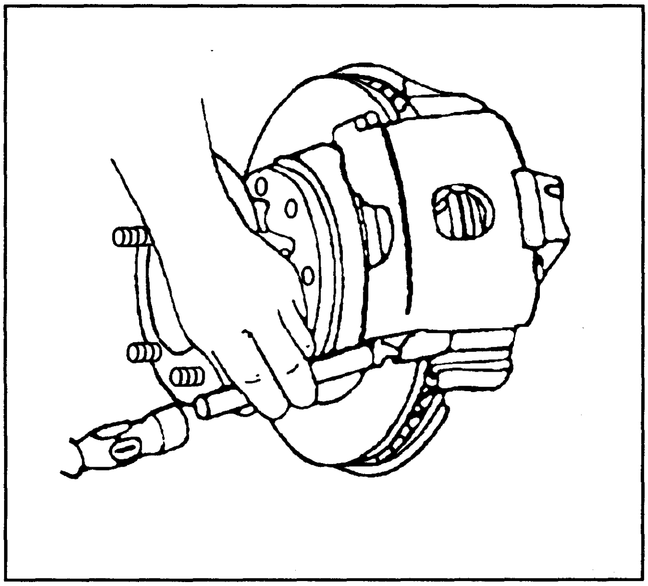

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9. Tap the brake caliper retainer and the brake caliper retainer spring into place using a brass punch and a light weight hammer.

Important:

- The brake caliper retainer screw boss must fit in the circular hole in the brake caliper retainer.
- The brake caliper retainer screw may be reused only 4 times. Replace the screw if the screw has been reused 4 times.

10. Install the caliper retainer screw.

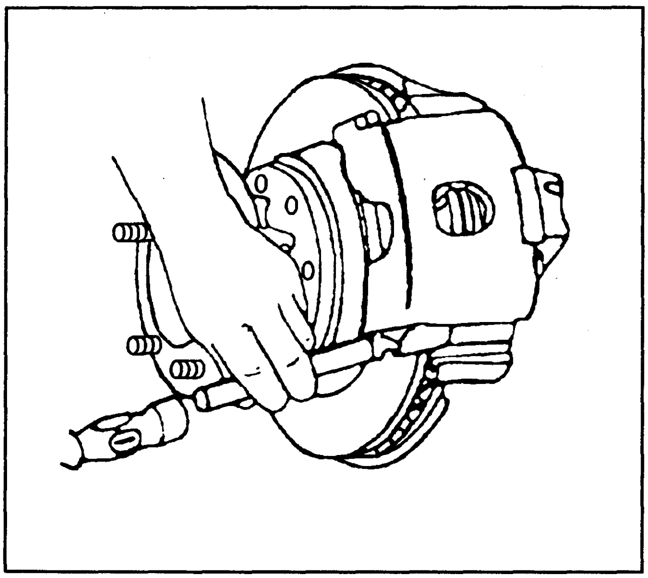
    Tighten

    Tighten the brake caliper retainer screw to 40 N·m (29 lb ft).

11. Fill the master cylinder with brake fluid. Refer to *Master Cylinder Reservoir Filling.*

Important: Pump the brake pedal several times in order to make sure the pedal is firm and the brake pads are adjusted. Check the master cylinder fluid level after pumping the brake pedal.

12. If any pipes or hoses are disconnected, bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding.*
13. Install the tire and wheel assembly.
14. Lower the vehicle.
15. Remove the wheel blocks.



156336

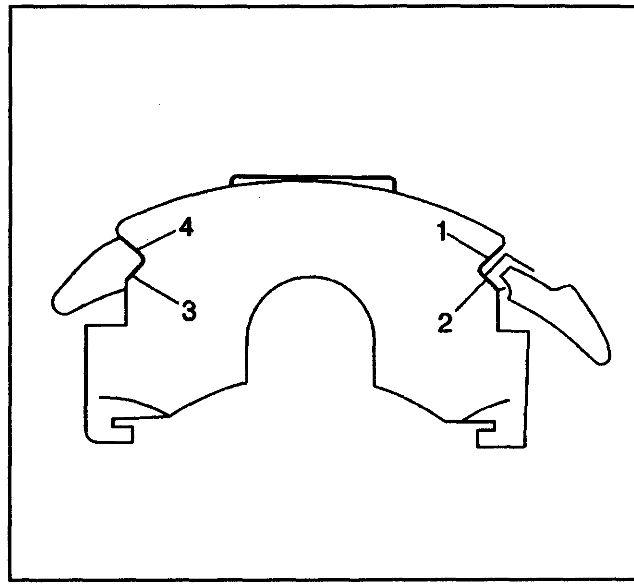
Brake Caliper and Anchor Plate Wear Adjustment (Front)

(JB7/JB8)

Bendix® calipers have oversize replacement keys available in order to compensate for wear at the caliper to anchor plate contact points. If the wear is excessive, a rattle sound can be heard from the front brake area.

Use the following procedure to measure and correct the condition:

1. Remove the caliper. Refer to *Brake Caliper Replacement (Front)* or *Brake Caliper Replacement (Rear)*.
2. Clean the surfaces (1,2,3, and 4) with a wire brush.
3. Smooth any deep nicks or gouges with a file.



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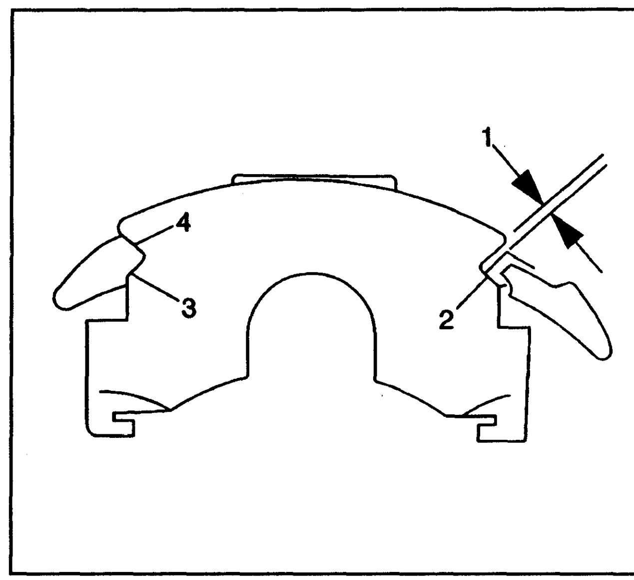
4. Lay a straight edge across the caliper surfaces (1).
5. Measure the maximum depth of any wear on these surfaces using the feeler gauges.
6. Replace calipers worn to a depth of 1.27 mm (0.050 in) or more.
7. Install the caliper back in the knuckle.



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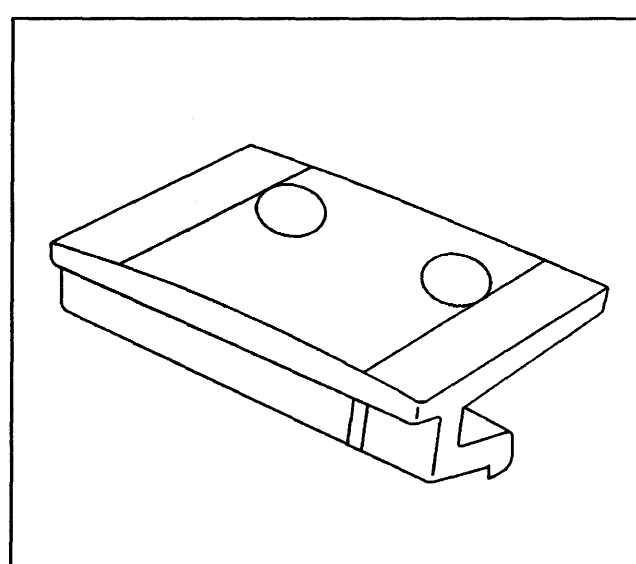
8. Install a new standard size key without the spring.
9. Install the key retention screw.
10. Insert a screw driver into the center of the key bumper gap.



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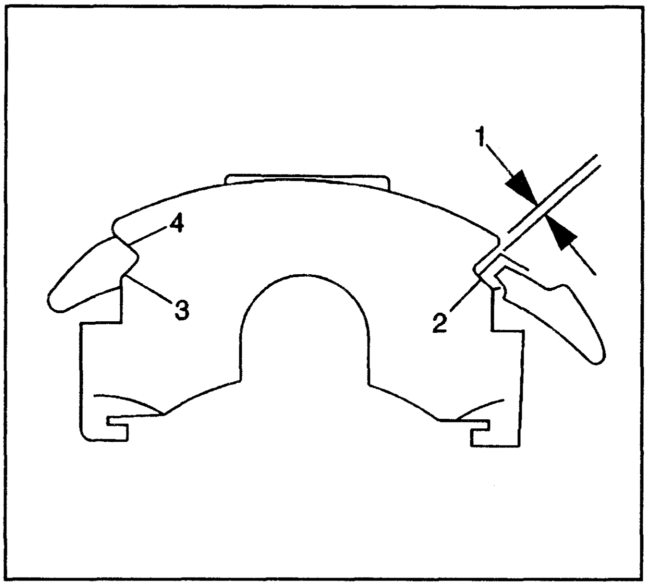

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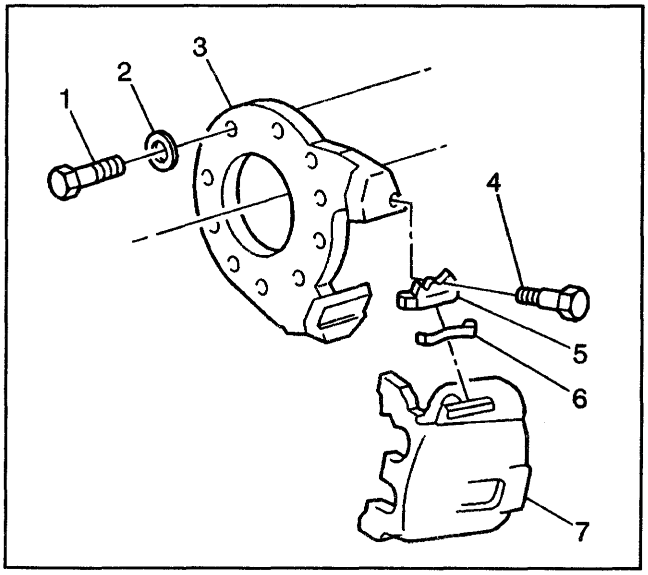
11. Pry firmly in order to ensure that the caliper is seated at surfaces (2,3,4).
12. In order to measure the caliper to anchor plate wear, measure the bumper gap with the largest feeler gauge(s) that will fit full length into the gap.
13. Select a replacement key. Refer to *Component Specifications (Bendix Caliper Replacement Key).*
14. Install the caliper. Refer to *Brake Caliper Replacement (Front)* or *Brake Caliper Replacement (Rear).*



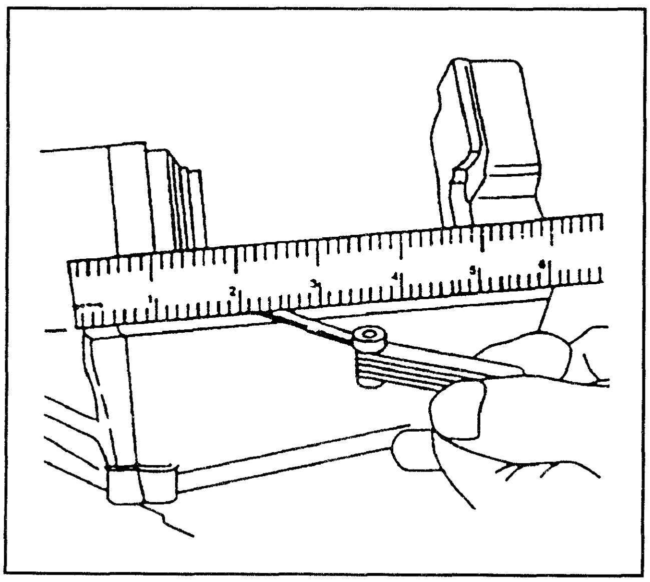
171584

Brake Caliper and Anchor Plate Wear Adjustment (Rear)

The brake caliper V-ways and the brake caliper mounting plate support rails will wear and eventually cause the brake caliper to fit loosely. Shims are used to adjust for this wear.

Use the following steps to replace the linings:

1. Remove the brake caliper retainer screw (4).
2. Tap out the brake caliper retainer (5) and brake caliper retainer spring (6). Refer to *Brake Caliper Replacement (Front)* or *Brake Caliper Replacement (Rear).*
3. Remove the brake caliper (7).
4. Clean the V-way surfaces of the brake caliper and the support rail surfaces on the brake caliper mounting plate (3) with a wire brush.
5. Smooth any deep nicks and gouges.



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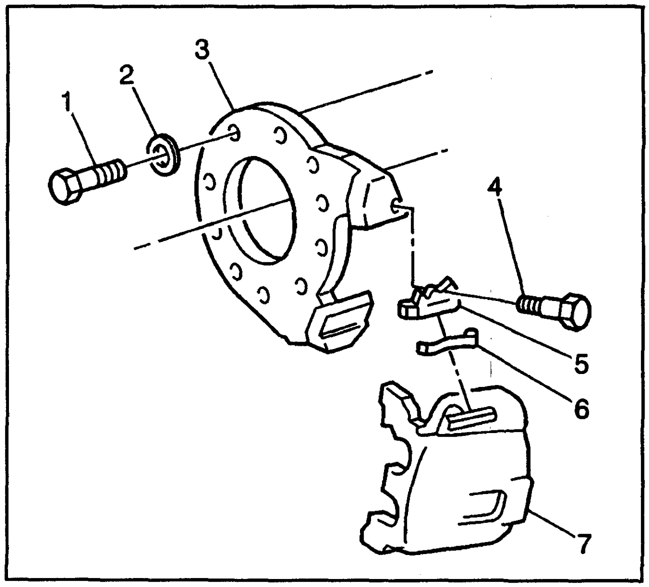
6. Lay a straight edge across the brake caliper V-way surfaces.
7. Measure the maximum depth of the brake caliper V-way surfaces.
8. If the brake caliper V-way surfaces are worn to a depth of 1.27 mm (0.050 in) or more, replace the brake caliper. Refer to *Brake Caliper Replacement (Front)* or *Brake Caliper Replacement (Rear).*

9. Temporarily mount the brake caliper (7) on the brake caliper mounting plate (3).
10. Install a new brake caliper retainer (5).

Important: Do not install the spring at this time.

11. Install the brake caliper retainer screw.
12. Insert a screwdriver between the brake caliper and brake caliper retainer. Make sure that the tool is equally distant from each edge of the brake caliper.
13. Pry firmly in order to ensure the brake caliper is seated against all side surfaces.



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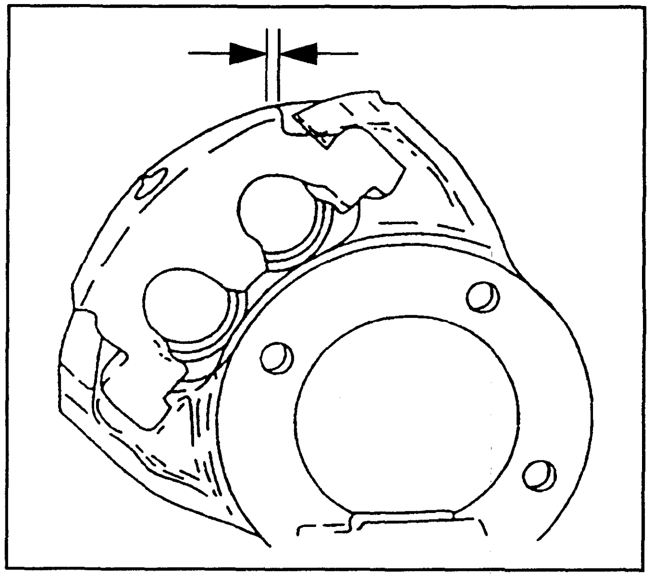
14. Measure the bumper gap with the largest feeler gauge that fits the gap on either side of the screwdriver.
15. Based on the measurement, select a shim. Refer to *Component Specifications (Shim Selection).*

Important: Use a new brake caliper retainer spring in order to assemble the new components.

16. If the gap exceeds 3.68 mm (0.145 in), replace with a new brake caliper and re-measure the gap.
    - If the bumper gap with the new brake caliper is 1.49–3.68 mm (0.059–0.145 in), refer to step 12.
    - If the bumper gap with the new brake caliper exceeds 3.68 mm (0.145 in), replace the brake caliper mounting plate.



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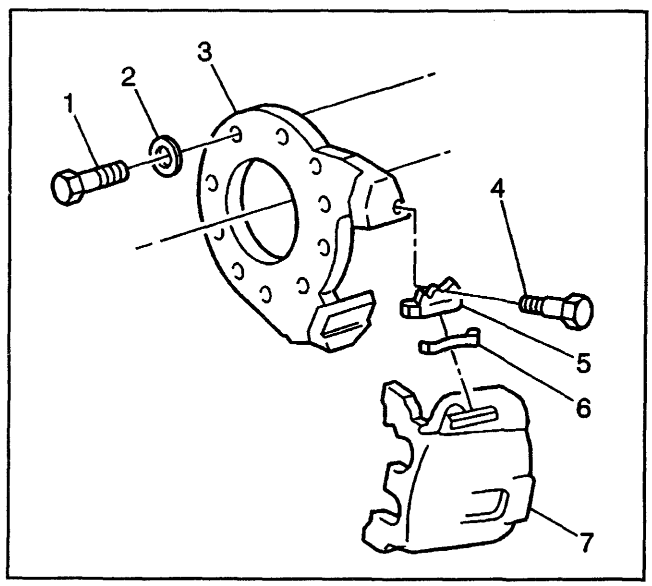
17. Remove the brake caliper (7).
18. Install the selected shim on the brake caliper mounting plate support rail opposite the brake caliper retainer (5) and the spring V-way.
19. Install the brake caliper.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

20. Install the brake caliper retainer screw.

    Tighten

    Tighten the screw to 40 N·m (29 lb ft).



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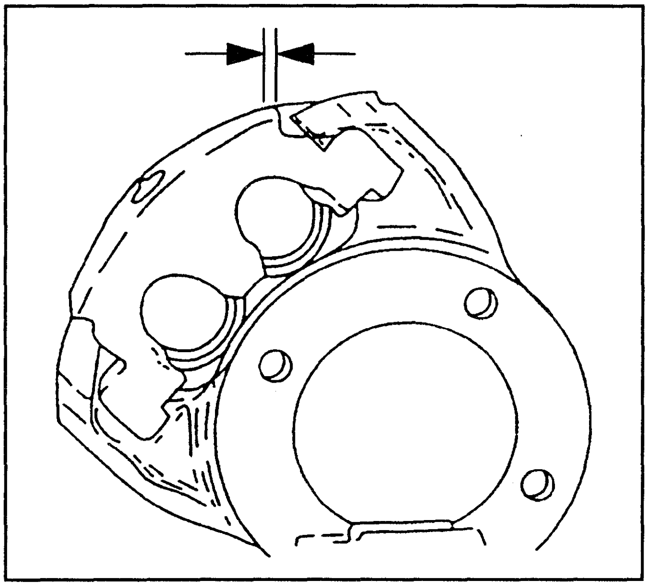

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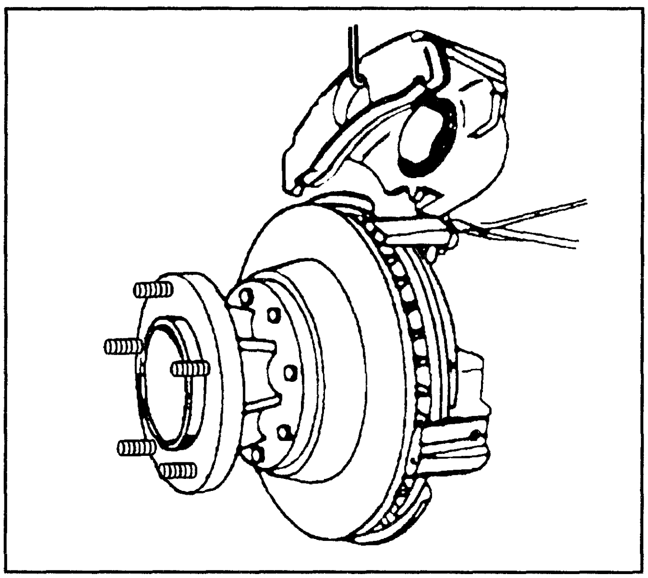

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21. Measure the bumper gap.
22. If the gap exceeds 1.47 mm (0.058 in), install a thicker shim or replace components as necessary. Refer to *Component Specifications (Shim Selection)*.

Brake Caliper and Anchor Plate Wear Adjustment (Shim Selection)

Shim Selection (JF9)

Important: Do not let the front brake caliper hang from the front brake hose. Suspend the brake caliper with a wire or cord.

1. Remove the front brake caliper. Refer to *Brake Caliper Replacement (Front)* or *Brake Caliper Replacement (Rear)*.
2. Clean the support rail surfaces of the front brake caliper and the support rail surfaces on the front brake caliper mounting plate with a wire brush, filing smooth any deep nicks and gouges.
3. Lay a straight edge across the front brake caliper support rail surfaces.
4. Measure the maximum depth of the front brake caliper support rail surfaces.
5. If the front brake caliper support rail surfaces are worn to a depth of 1.27 mm (0.050 in) or more, replace the front brake caliper.
6. Temporarily install the front brake caliper on the front brake caliper mounting plate.

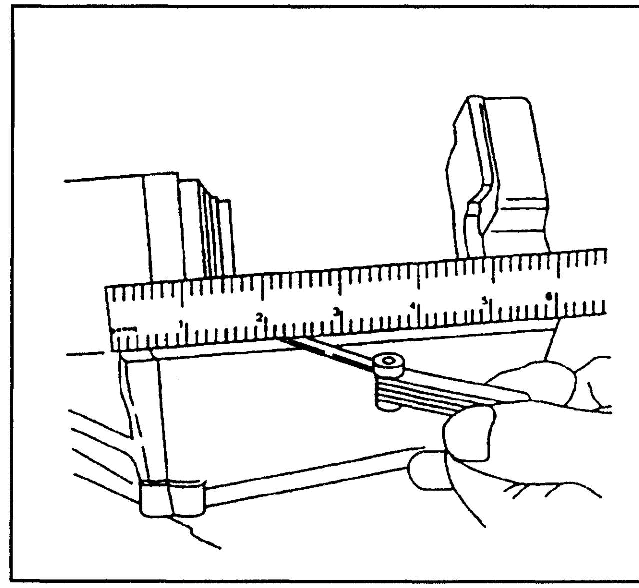
Important: Do not install the front brake caliper spring at this time.

7. Install a new front brake caliper retainer.
8. Install the front brake caliper retainer bolt.
9. Insert a screwdriver between the front brake caliper and the front brake caliper retainer.
10. Make sure the screwdriver is equally distant from each edge of the front brake caliper.
11. Pry firmly in order to ensure the front brake caliper is seated against all three remaining side surfaces.

12. Measure the bumper gap formed between the front brake caliper retainer and the front brake caliper with the largest feeler gauge that fits in the bumper gap on both sides of the screwdriver.
13. Based on the measurement, select a shim. Refer to *Component Specifications (Shim Selection).*
14. If the bumper gap exceeds 3.68 mm, (0.145 in), replace with a new front brake caliper and re-measure the bumper gap.
    - If the bumper gap with the new front brake caliper is between 1.49 mm (0.059 in) and 3.68 mm (0.145 in), refer to step 7.
    - If the bumper gap with the new front brake caliper exceeds 3.68 mm (0.145 in), replace the front brake caliper mounting plate. Refer to *Brake Caliper Mounting Plate Replacement.*
15. Remove the front brake caliper. Refer to *Brake Caliper Replacement (Front)* or *Brake Caliper Replacement (Rear).*

Important: Always use a new front brake caliper retainer and front brake caliper spring in order to assemble the new components.

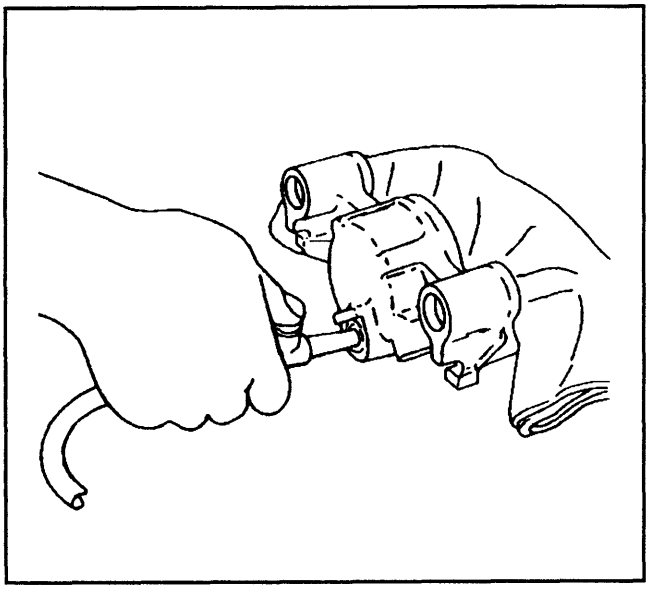
16. Install the selected shim on the front brake caliper mounting plate support rail opposite the front brake caliper retainer and front brake caliper support rail.
17. Install the front brake caliper. Refer to *Brake Caliper Replacement (Front)* or *Brake Caliper Replacement (Rear).*



171507

Brake Caliper Inspection

1. Inspect the inside of the caliper assembly for signs of fluid leakage. If any is found, overhaul the caliper as outlined in *Brake Caliper Overhaul (Front).*
2. Inspect the mounting bolts and sleeves for corrosion. Replace any corroded bolts and sleeves. Do not attempt to polish away the corrosion.
3. Measure the clearance between the caliper and steering knuckle. The clearance at each end of the caliper should be measured individually and added together. This total should be 0.26–0.60 mm (0.010–0.024 in). If clearance is excessive, refer to *Brake Caliper and Anchor Plate Wear Adjustment (Front).*



142258

Brake Caliper Overhaul (Front)

Removal Procedure

Tools Required

J 24548 Piston Ring Compressor

1. Remove the fluid from the caliper.
2. Pad the interior of the caliper with clean shop towels.

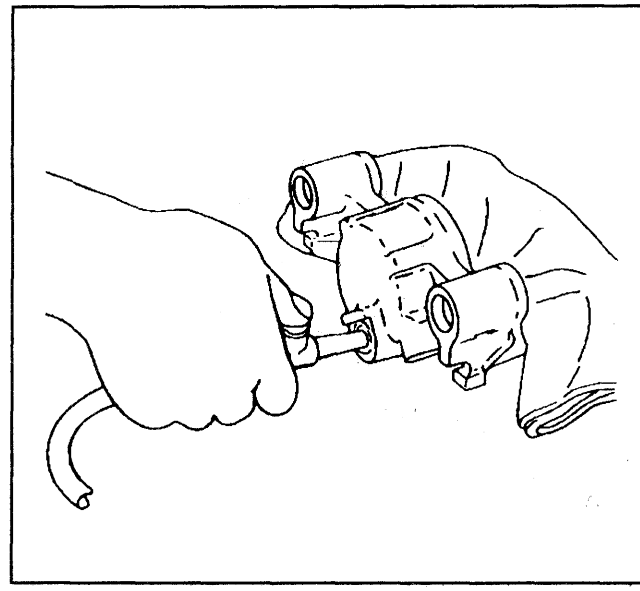
Caution: Do not place your fingers in front of the piston in an attempt to catch or protect it when applying compressed air. This could result in serious injury.

Notice: Use only enough air to ease the piston out of the bore. If the piston is blown out, even with the padding, it can be damaged.

3. Remove the piston by directing compressed air into the caliper fluid inlet.
4. Remove the boot.
5. Remove the piston seal with a non metal tool.
6. Remove the bleeder valve.
7. Clean the following components with denatured alcohol:
   - The bleeder valve
   - The caliper bore
   - The caliper passages
   - The piston
8. Dry the parts and blow out the passages with dry, filtered, compressed air.
9. Inspect the piston for the following conditions:
   - Scoring
   - Pitting
   - Damage to the chrome plating
10. Inspect the caliper bore for the following conditions:
    - Scoring
    - Pitting
    - Corrosion
11. Replace as necessary.
12. Use crocus cloth to polish out any light corrosion.
13. Replace the caliper if the corrosion cannot be removed. Refer to *Brake Caliper Replacement (Front)* or *Brake Caliper Replacement (Rear).*

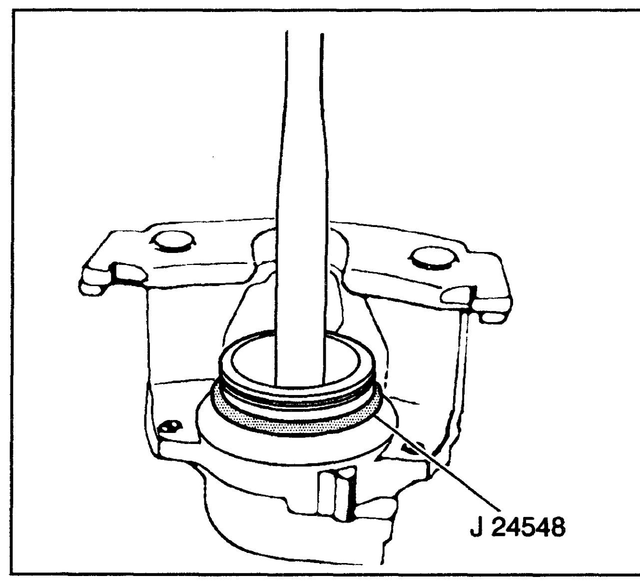
Installation Procedure

1. Lubricate the new piston seal, caliper bore, and piston.
2. Seal the lips on the boot with clean brake fluid.
3. Install the piston seal.
4. Make sure the seal is not twisted in the caliper groove.
5. Install the boot on the *J 24548*.
   - 5.1. Place the large diameter of the boot over the tool.
   - 5.2. Carefully work the small diameter over the tool.
   - 5.3. Slide the large diameter off of the tool.
6. Install the large lip of the boot in the caliper bore groove. The lip of the boot must firmly seat in the groove.



142258

7. Install the piston inside the *J 24548*.
8. Install the piston halfway into the bore.
   - 8.1. Remove the *J 24548*.
   - 8.2. Make sure the boot is firmly seated.
9. Install the bleeder valve.



156403

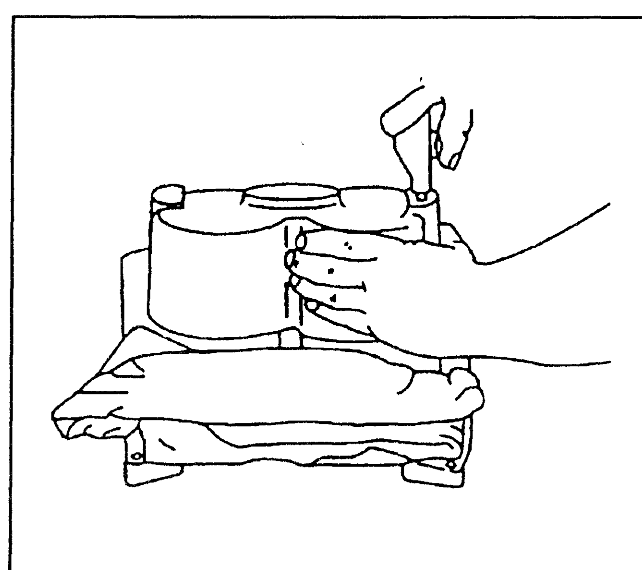
Brake Caliper Overhaul (Rear)

Disassembly Procedure

1. Remove the brake fluid from the brake caliper.
2. Clean the exterior of the brake caliper.
3. Pad the exterior of the brake caliper with a clean shop towel.

Important: Use just enough air pressure to ease the piston out of the bore. If only one piston is blown loose, you may have to reinsert the piston part way and block the piston in position. Apply air pressure in order to free the remaining position.

Caution: Do not place your fingers in front of the piston in order to catch or protect the piston while applying compressed air. This could result in serious injury.



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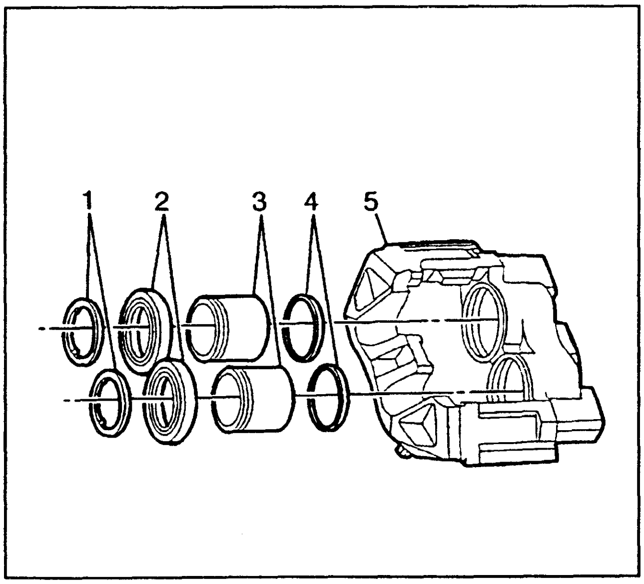
Notice: Use only enough air to ease the piston out of the bore. If the piston is blown out, even with the padding, it can be damaged.

4. Remove the pistons from the bore by directing compressed air into the brake caliper fluid inlet.
5. Remove the heat shields (1).
6. Remove the dust boots (2).



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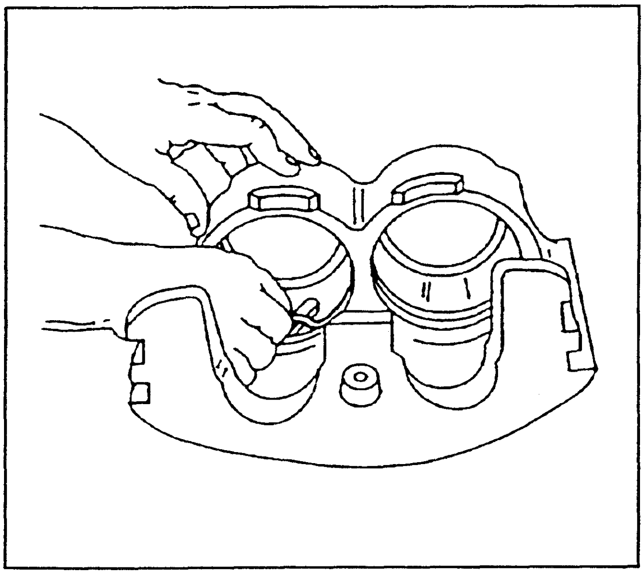


171569

7. Remove the piston seals from the groove in the brake caliper bore using a pointed piece of wood or plastic.
8. Remove the bleeder valve.
9. Clean all parts with brake parts cleaner P/N 12345754 or equivalent, or use new brake fluid.
10. Use dry, filtered, nonlubricated compressed air to dry parts and blow out all of the passages in the brake caliper housing and the bleeder screw valve.
11. Clean the V-ways with a wire brush.
12. Inspect the surfaces of the support rails for rust or corrosion.
13. Inspect the brake caliper housing for cracks or other damage.

    Replace the brake caliper housing if necessary.
14. Inspect the outside diameter of the pistons for the following conditions:
    - Scoring
    - Nicks
    - Corrosion
    - Wear
    - Damage

Important: The outside diameter of the piston is the primary sealing surface of the brake caliper. The piston diameter is manufactured to very close tolerances. Refinishing by any means or the use of abrasives is not acceptable.

15. If any surface defects are found, replace the piston.

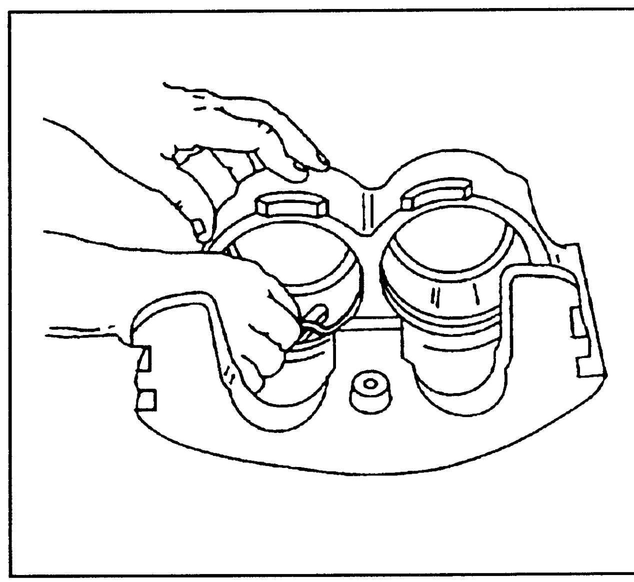
16. Inspect the brake caliper bore for the following conditions:
    - Scoring
    - Nicks
    - Corrosion
    - Wear
    - Damage
17. The piston bore is not plated. Polish out stains or minor corrosion with crocus cloth.

    Do not use emery cloth or any form of abrasive.
18. Clean the brake caliper after using the crocus cloth.
19. If the bore cannot be cleaned in this manner, replace the brake caliper. Refer to *Brake Caliper Replacement (Front)* or *Brake Caliper Replacement (Rear)*.

Assembly Procedure

1. Place the brake caliper housing on a clean work bench with the open ends of the bores facing up.
2. Install a new piston seal in the seal groove of the piston bore using the following procedure:
   - 2.1. Dip the new piston seal in clean brake fluid.
   - 2.2. Gently work the piston seal around the piston bore with a finger until the seal seats in the groove.
   - 2.3. Be sure the piston seal is not twisted or rolled in the groove.
3. Lubricate the piston and the bore with new brake fluid.

   Gently push the piston into the bore.
4. Rotate the piston slightly in order to prevent dislodging the seal.



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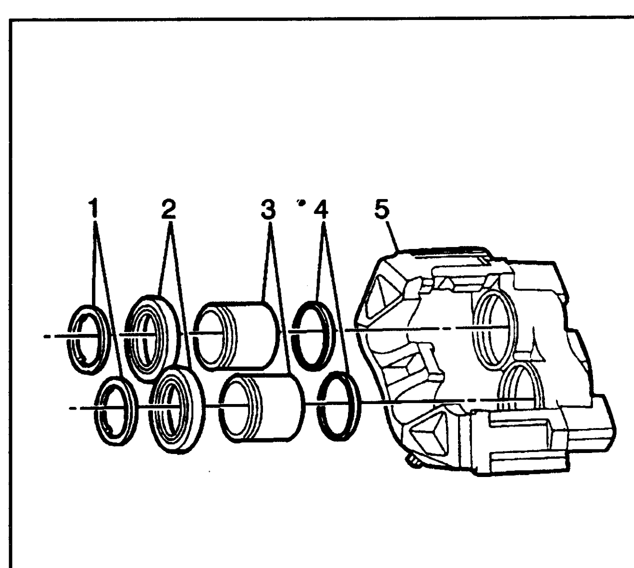
5. Press the dust boot (2) into the counterbore in the brake caliper housing (5).
6. The dust boot overlaps the stepped edge of the piston (3).
7. Install the heat shield (1) on the piston with the chamfer facing out.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

8. Install the bleeder valve.

   Tighten

   Tighten the bleeder valve to 17 N·m (13 lb in).



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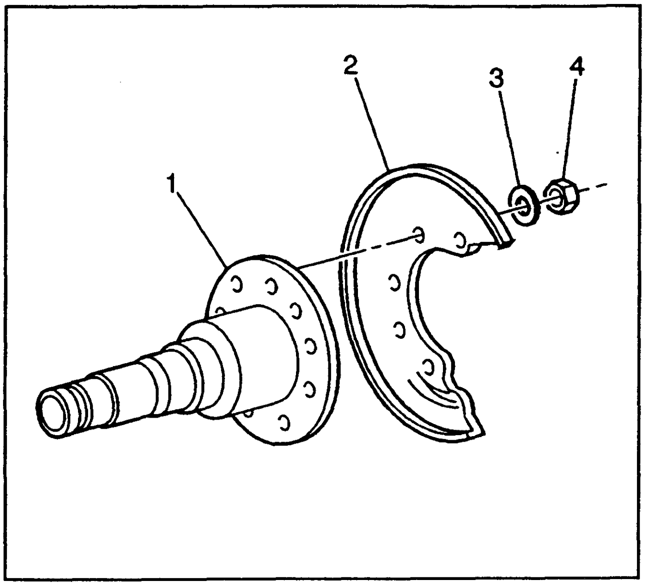

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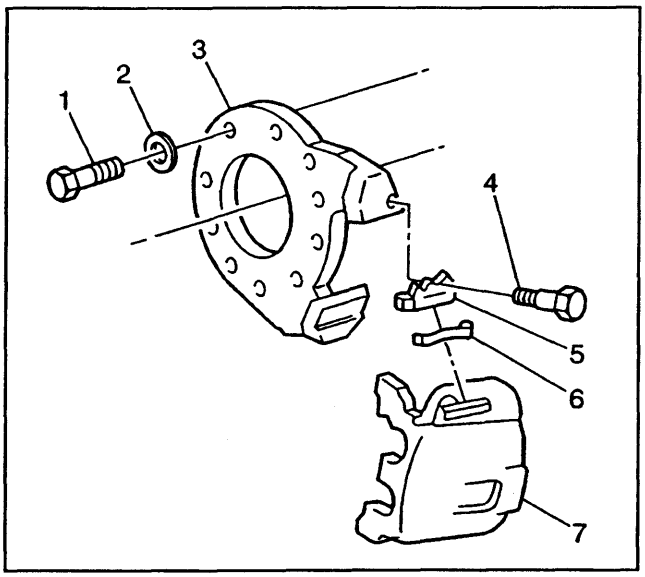


171584

Brake Caliper Mounting Plate Replacement

The brake caliper mounting plate is used to mount all of the stationary brake components. An L or an R following the part number cast on the back of the plates indicates the left or the right side mounting. Some plates may also have an L or an R painted on the front.

Removal Procedure

1. Block the vehicle wheels.
2. Remove the brake caliper. Refer to *Brake Caliper Replacement (Front)* or *Brake Caliper Replacement (Rear)*.
3. Remove the hub and brake rotor assembly. Refer to *Wheel Hub, Bearing, and Seal Replacement (Independent), Wheel Hub, Bearing, and Seal Replacement (I-Beam)* and *Hub and Rotor Assembly Replacement.*
4. Remove the bolts, the nuts (4), and the washers (3).
5. Remove the brake caliper mounting plate.
6. Inspect the support rails for the following conditions:
   - Rust
   - Corrosion
   - Wear
7. Clean the rails with a wire brush if necessary.
8. Inspect the support rails for cracks or elongated bolt holes.
9. Replace the brake caliper mounting plate if necessary.

Installation Procedure

1. Return the caliper mounting plate (3) to the axle flange.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

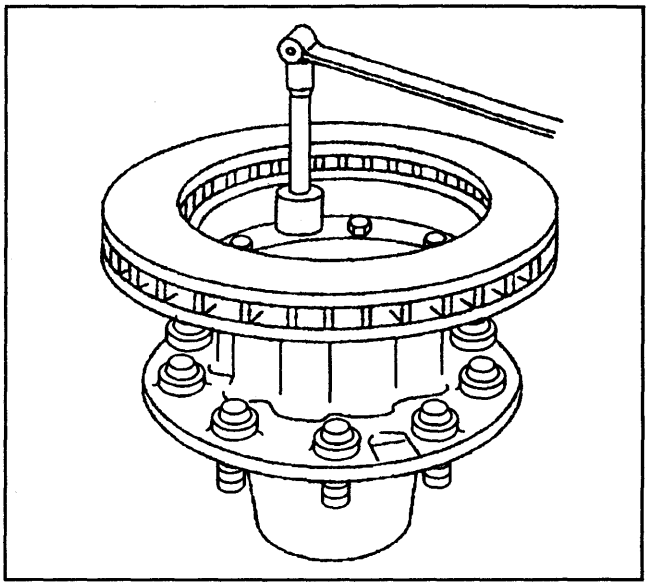
Important: Threads must be clean and free of grease. Apply 272 Threadlocker P/N 12345493, or equivalent, to the threads of each brake caliper mounting bolt.

2. Install the washers, nuts, and bolts.

   Tighten

   - Tighten the shield bolts (if equipped) to 32 N·m (24 lb ft).
   - Tighten the brake caliper mounting plate bolts to 280 N·m (206 lb ft).

3. Install the hub and brake rotor assembly.
4. Install the brake caliper. Refer to *Brake Caliper Replacement (Front)* or *Brake Caliper Replacement (Rear).*
5. Lower the vehicle.
6. Remove the wheel blocks.

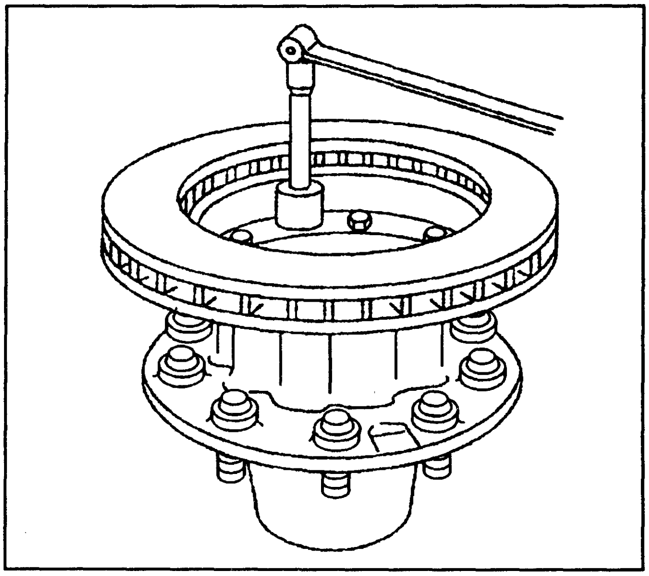


171547

Brake Rotor Replacement

Removal Procedure

1. Block the vehicle wheels.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Remove the brake caliper. Refer to *Brake Caliper Replacement (Front)* or *Brake Caliper Replacement (Rear).*
4. Remove the hub and brake rotor assembly. Refer to *Wheel Hub, Bearing, and Seal Replacement (Independent)* or *Wheel Hub, Bearing, and Seal Replacement (I-Beam)*; and *Hub and Rotor Assembly Replacement.*
5. Remove the bolts that mount the brake rotor to the hub.
6. Remove the brake rotor.



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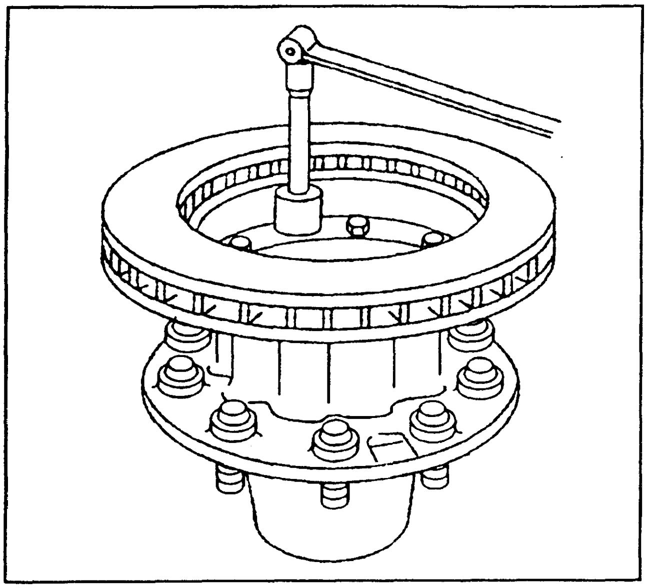


171547

Installation Procedure

Notice: Any new rotor must have the protective coating removed from the friction surfaces before being placed in service. Use Brake Parts Cleaner P/N 12345754 or the equivalent, and wipe the surface clean with clean cloths. Do not use gasoline, kerosene, or other oil base solvents which may leave an oily residue. This residue is damaging to the brake lining and is flammable.

1. Install the brake rotor.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

Important: Threads must be clean and free of grease. Apply 272 Threadlocker P/N 12345493 or the equivalent to the threads of each brake rotor mounting bolt.

2. Insert the bolts that mount the brake rotor to the hub.

   Tighten

   - Tighten the 9/16 inch OD bolts (10 bolt pattern) to 152 N·m (112 lb ft).
   - Tighten the 5/8 inch OD bolts (10 bolt pattern to 152 N·m (189 lb ft).

3. Install the hub and brake rotor assembly. Refer to *Wheel Hub, Bearing, and Seal Replacement (Independent)* or *Wheel Hub, Bearing, and Seal Replacement (I-Beam)*; and *Hub and Rotor Assembly Replacement.*
4. Inspect the brake rotor for runout after you assemble the rotor. Refer to *Brake Rotor Lateral Runout Check.*
5. Clean both sides of the brake rotor with Brake Parts Cleaner P/N 12345754 or the equivalent.
6. Grease the cap or the cover (if used).
7. Coat the inside with the wheel grease. Do not fill the cap.
8. Replace the brake caliper. Refer to *Brake Caliper Replacement (Front)* or *Brake Caliper Replacement (Rear).*
9. Replace the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
10. Lower the vehicle.

Important: Pump the brake pedal several times in order to make sure the pedal is firm and the brake pads are adjusted. Check the master cylinder fluid level after pumping the brake pedal.

11. Test the brakes for firmness by pumping the brake pedal.
12. Remove the wheel blocks.

Refinishing Brake Rotors

You do not need to refinish brake rotors when doing routine brake maintenance such as replacing worn brake pad assemblies. Refinish brake rotors only under the following circumstances:

- There is a complaint of brake pulsation.
- There is scoring greater than 1.5 mm (0.060 in).

Brake rotors have a minimum thickness dimension cast into them. This dimension is the minimum wear dimension and not a refinish dimension. Do not use a rotor that will not, after refinishing, meet the specifications shown on the brake rotor. Always replace the rotor with a new rotor. It may be necessary to replace the brake rotors in pairs in order to assure an even braking balance on both wheels.

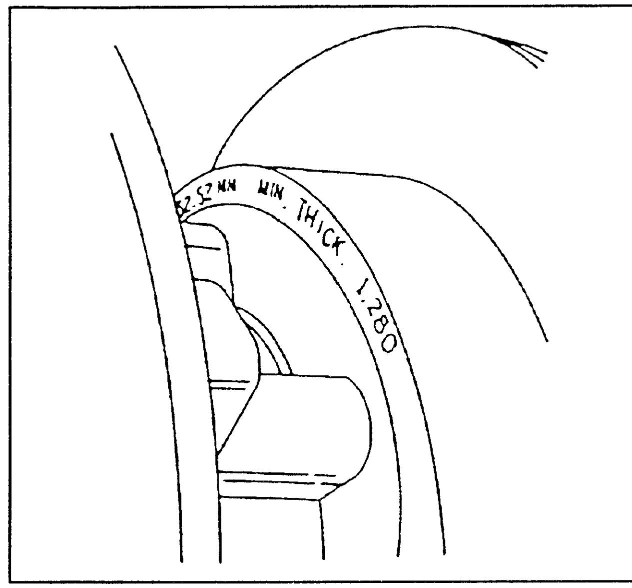
Accurate control of brake rotor tolerance is necessary for the proper performance of disc brakes. Machining should be done only with precision equipment. Service the machining equipment on a regular basis following the manufacturer's recommended maintenance procedures.

When refinishing brake rotors, make sure the attaching adapters, the tool holders, the vibration dampeners, and the tool bits are in good condition. Always use sharp cutting tools or bits. Use only the replacement cutting bits recommended by the equipment manufacturer. Dull or worn tools leave a poor surface finish that will affect braking performance. Always use vibration dampening attachments when refinishing braking surfaces. These attachments eliminate tool chatter in order to allow for a better surface finish. Make sure these adapters are clean and free of nicks.

The following are two recommended procedures that achieve adequate results using two different off vehicle drum/disc brake lathes. If any other lathe is used, follow that manufacturer's instructions and recommendations.

Accu-turn Brake Lathe

1. Mount the brake rotor to the brake lathe. Refer to the brake lathe manufacturer's recommended procedure.
2. Locate the deepest score and turn the micrometer knobs until the tool bit bottoms out at the deepest point of the score.
3. Zero the scale.
4. Back out the tool bits.
5. Advance the cutter hand-wheel until the bits have cleared the inner edge of the brake rotor face.
6. Adjust the micrometer knobs for approximately 0.0127 mm (0.005 in) more than the first reading. This will ensure clearing the brake rotor in one cut.
7. Perform one cut procedure. For refinishing information, refer to the *Brake Lathe Specifications (ACCU TURN)*.



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8. Perform swirl refinishing to the brake rotor. Refer to Non Directional Refinishing below.
9. Remove the brake rotor from the brake lathe.
10. Clean the brake rotor using Brake Parts Cleaner P/N 12345754 or the equivalent.

Ammco Brake Lathe Method

1. Mount the brake rotor to the brake lathe. Refer to the brake lathe manufacturer's recommended procedure.
2. Locate the deepest score.
3. Turn the brake rotor micrometer knobs until the tool bit bottoms out at the deepest point of the score.
4. Zero the scale.
5. Back out the tool bits.
6. Advance the cutter hand-wheel until the bits have cleared the inner edge of the brake rotor face.
7. Perform rough and finish cuts. For refinishing information, refer to the *Brake Lathe Specifications (AMMCO)*
8. Perform swirl refinishing to the brake rotor. Refer to Non-Directional Refinishing below.
9. Remove the brake rotor from the brake lathe.
10. Clean the brake rotor using Brake Parts Cleaner P/N 12345754 or the equivalent.

Non-directional Refinishing

It is very important that you make the brake rotor surface non-directional. Dress the brake surfaces with a sanding disc tool such as the Ammco 8750 Safe Swirl Disc Rotor Grinder, Accu-turn 433179 Non-directional Swirl Finisher, or the equivalent. Use 120 grit aluminum oxide sandpaper.

Standard Method

Important: The finished brake rotor surface should be as close to that of a new brake rotor as possible. Failure to obtain the best possible brake rotor finish can affect braking performance.

Sand each brake rotor surface using moderate pressure for a minimum of 60 seconds.

Alternate Method

If the brake lathe is not equipped with an adequate non-directional finishing tool, use a sanding block with 150 grit aluminum oxide sandpaper.

1. Run the brake rotor at the equipment manufacturer's highest recommended cutting speed.

Important: The finished brake rotor surface should be as close to that of a new brake rotor as possible. Failure to obtain the best possible brake rotor finish can affect braking performance.

2. Sand each brake rotor surface using moderate pressure for a minimum of 60 seconds.

Description and Operation

Disc Brakes System Description (Front)

The disc brake assembly consists of a caliper assembly, rotor, linings, and anchor plate. Applying the brake pedal causes hydraulic pressure to move the caliper piston. The piston then forces the inboard brake lining against the inboard braking surface of the rotor. Increasing the force against the rotor causes the caliper assembly to move inboard. The outer brake lining then contacts the outboard braking surface of the rotor. The force of the two brake linings provides the desired clamping action on the rotor.

Releasing the brake pedal relieves the pressure applied to the piston. The square cut seal on the piston returns to normal position, allowing a running clearance between the brake linings and the rotor.

Servicing Information

Important:

- Before moving the vehicle, pump the brake pedal in order to make sure the pedal is firm. Do not move the vehicle until you obtain a firm brake pedal. Check the brake fluid level in the master cylinder reservoir after pumping the brakes.
- Replace all of the components included in the repair kits used to service the front brake caliper.
- Lubricate the rubber parts in order to ease assembly with Brake Fluid P/N 1052535 or the equivalent.
- Do not use lubricated compressed air on brake parts because rubber component damage may result.
- Flush the hydraulic brake system when installing new brake parts with Brake Fluid P/N 1052535 or the equivalent.
- After a hydraulic component has been removed or disconnected, if needed, bleed all or part of the brake system. Refer to *Hydraulic Brake System Bleeding*
- Replace front brake pads in axle sets only.
- The torques specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench, free from mineral oil and any other contaminants.

Front Brake Rotor (JB7/JB8)

When equipped with RPO JB7 or JB8, the rotor is integral with the hub assembly. During operation, the front brake rotor turns between the front brake linings and basically free-wheels until hydraulic pressure, created by applying the brake pedal, is converted by the front brake caliper to a stopping force. This force acts equally against the pistons and the bottom of the front brake caliper bore to move the pistons outward and move (slide) the front brake caliper inward, resulting in a clamping action on the front brake rotor. This clamping action forces the front brake pad linings against the front brake rotor, creating friction to stop the vehicle. The vented area between the rotor braking surfaces allows for efficient heat dissipation.

Front Brake Rotor (JF9)

When equipped with RPO JF9, the rotor and hub are separate components that are bolted together. During operation, the front brake rotor turns between the front brake linings and basically free-wheels until hydraulic pressure, created by applying the brake pedal, is converted by the front brake caliper to a stopping force. This force acts equally against the pistons and the bottom of the front brake caliper bore in order to move the pistons outward and move (slide) the front brake caliper inward, resulting in a clamping action on the front brake rotor. This clamping action forces the front brake pad linings against the front brake rotor, creating friction in order to stop the vehicle. The vented area between the rotor braking surfaces allows for efficient heat dissipation.

Front Brake Caliper (JB7/JB8)

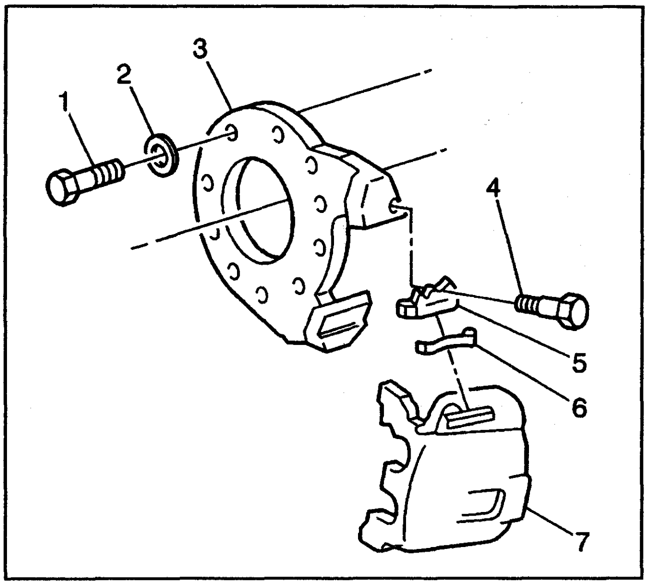
The front brake caliper used on vehicles equipped with RPO JB7 or JB8 is a single piston unit. The caliper is held in place by a support key, a spring, and a bolt assembly.

The caliper mounts to the anchor plate or steering knuckle in a way that allows the caliper to move laterally against the rotor. The caliper is a one-piece casting with the inboard side containing a piston bore. A square-cut rubber seal fits a groove in the piston bore in order to provide a hydraulic seal between the piston and caliper bore.

Front Brake Caliper (JF9)

The front brake caliper used on vehicles equipped with RPO JF9 is a rail slider type with dual-pistons. A piston seal in a groove of the wall in each machined bore provides a hydraulic seal and retracts the piston when hydraulic fluid pressure is relieved. A dust boot keeps the caliper bore clean. A metal heat shield protects the dust boot from the heat caused by braking friction. The front brake caliper mounts using a front brake caliper retainer, a front brake caliper spring, and a front brake caliper retainer bolt to the front brake caliper mounting plate.

Disc Brakes System Description (Rear)



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Rear axles equipped with disc brakes will utilize a rail slider type disc brake caliper (7).

The rear disc brake assembly consists of a brake caliper, brake rotor assembly, disc brake pad assembly, brake caliper mounting plate (3), and brake shield. The brake rotor assembly is bolted to the wheel hub and turns with the wheel. The brake caliper housing has machined bores and pistons. A seal in a groove of the wall in each bore provides a hydraulic seal and retracts the piston when fluid pressure is relieved. A dust boot; keeps the piston bore clean. A metal heat shield protects the dust boot from the heat caused by braking friction. The brake caliper is mounted by a brake caliper retainer and brake caliper retainer spring to the stationary brake caliper mounting plate. The brake caliper mounting plate and brake shield are bolted to the axle flange.

The brake pad assemblies are held in place on each side of the brake rotor. The outer brake pad moves with the brake caliper housing. The inner brake pad is held in place by the brake caliper mounting plate. All of the original equipment brake pad linings are free of asbestos.

Applying the brake pedal causes hydraulic pressure to move the brake caliper pistons. This causes the brake pads to clamp the brake rotor. The brake caliper adjusts the clamping position by sliding laterally in the support rails on the brake caliper mounting plate.

Releasing the brake pedal relieves the pressure applied to the brake caliper pistons. The pistons are pulled back in the bore by the action of the square cut piston seals running to the original shape. This allows for a running clearance between the brake pad linings and brake rotor.

Servicing Information

- Replace all components included in the repair kits used to service the brake caliper.
- Lubricate rubber parts with clean brake fluid in order to ease assembly.
- Do not use lubricated compressed air on brake parts because rubber component damage may result.
- Flush the hydraulic brake system with clean brake fluid when you install new parts.
- After a hydraulic component has been removed or disconnected, if necessary, bleed all or part of the brake system. Refer to *Hydraulic Brake System Bleeding*
- Replace disc brake pads in axle sets only.
- The torques specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench, free from mineral oil and any other contaminants.

Important: Before moving the vehicle, pump the brake pedal several times to make sure the pedal is firm. Do not move the vehicle until a firm brake pedal has been obtained. Check the brake fluid level in the master cylinder after pumping the brakes.

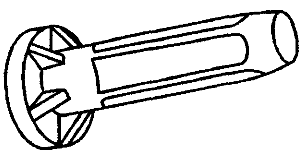
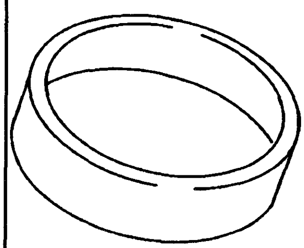
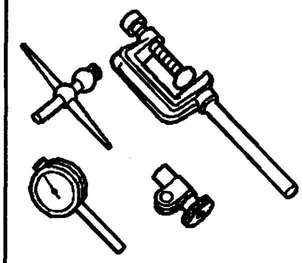
Rear Brake Rotor

The rear disc brakes use a brake rotor that is bolted to the hub assembly. During operation, the brake rotor turns between the linings and basically free-wheels until hydraulic pressure, created by applying the brake pedal, is converted by the brake caliper to a stopping force. This force acts equally against the pistons and the bottom of the brake caliper bore to move the pistons outward and move (slide) the brake caliper inward, resulting in a clamping action on the brake rotor. This clamping action forces the brake pad linings against the brake rotor, creating friction in order to stop the vehicle.

Rear Brake Caliper

The rear brake caliper is a rail slider type with dual-pistons. A seal in a groove of the wall in each machined bore provides a hydraulic seal and retracts the piston when fluid pressure is relieved. A dust boot keeps the piston bore clean. A metal heat shield protects the boot from the heat caused by braking friction. The brake caliper mounts using a brake caliper retainer, brake caliper retainer spring, and a brake caliper retainer screw to the brake caliper mounting plate.

Special Tools and Equipment

Illustration	Tool Number/Description
 156420	J 28735–A Piston Seal Installer
 156422	J 24548 Piston Seal Compressor
 25473	J 8001 Dial Indicator

Drum Brakes

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Backing Plate Mounting Bolts	140 N·m	103 lb ft
Shoe Anchor Pin Nut	295 N·m	218 lb ft
Wheel Cylinder Mounting Bolts	20 N·m	15 lb ft

Component Specifications

Drum Diameter

Original	Maximum Refinish	Replacement (Discard)
279.40 mm (11.0 in)	280.92 mm (11.06 in)	281.69 mm (11.09 in)
330.92 mm (13.0 in)	331.72 mm (13.06 in)	332.48 mm (13.09 in)

Repair Instructions

Brake Drum Inspection

Any time the brake drums are removed, clean and inspect the brake drums for the following faults:

- Cracks
- Scores
- Deep grooves
- Out of round

Surface Finish

Slight scoring can be cleaned up with fine emery cloth. Heavy or extensive scoring causes excessive brake lining wear. The drum braking surface will need machining to remove these scores.

If the drum is grooved and the brake linings are slightly worn, do not machine the drum. Instead, polish the drum braking surface with fine emery cloth. Eliminating all of the drum grooves and the ridges on the lining would require removing too much metal and lining material. The grooves and ridges match and satisfactory service can be obtained by leaving them alone.

Inside Diameter Check

Measure the inside diameter of the brake drum at two or more places around the circumference of the braking surface. The measurements must be made at the same distance in from the edge of the drum. Compare the results with the drum diameter specifications. Refer to *Component Specifications* and *Brake Drum Refinishing.*

Taper Check

Measuring a drum for taper involves taking measurements at the inner and outer edges of the machined surface at two or more places around the drum. These measurements should be equal.

Brake Drum Replacement

Removal Procedure

Construction of this drum and hub assembly does not allow replacement with the hub assembly installed on the vehicle.

1. Raise the vehicle on a hoist and support with suitable safety stands. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the hub and drum assembly. Refer to *Hub and Drum Assembly Replacement (All Models)* in Rear Drive Axle.
3. Remove the retaining bolts, stud nuts, or wheel studs.
4. Separate the drum, hub, and oil deflector.
5. Press the wheel studs out of the drum.
6. Replace parts as necessary.

Installation Procedure

1. Connect the drum to the hub.
2. Align the drain holes.
3. Apply a light coating of sealing compound to the oil deflector contact surface.
4. Connect the oil deflector to the drum.
5. Install the retaining bolts, stud nuts, or wheel studs.
6. Press the wheel studs into the drum.

Brake Drum Refinishing

Important: Do NOT refinish the brake drums in order to correct any of the following complaints:

- Brake noise (growl/squeal)
- Premature brake lining wear
- Cosmetic or superficial corrosion of the drum braking surface
- Drum discoloration

Refinish the brake drums ONLY when one or more of the following conditions exist:

- Severe scoring of the drum braking surface (groove depth in excess of 1.5 mm (0.060 in)
- Brake pulsation caused by the following:
  - Brake drum out of round
  - Corrosion or pitting that is deeper than the drum braking surface

The Accu Turn® or Ammco® brake lathe is approved and achieves satisfactory results.

1. Remove the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
2. Make a mark on the brake drum in order to identify the relationship to the axle flange.
3. Remove the brake drum.
4. Use a micrometer in order to measure the largest diameter of the brake drum. If the largest diameter of the brake drum exceeds the brake drum maximum refinish diameter, do NOT refinish the brake drum. Replace the brake drum. Refer to *Component Specifications*.
5. Use the J 41013 Resurfacing Kit (or equivalent) in order to THOROUGHLY clean the rust from the brake drum flange.
6. Install the brake drum to the brake lathe. Refer to the brake lathe manufacturer's operating instructions.
7. Refinish the brake drum. Refer to the brake lathe manufacturer's operating instructions.

Important: Failure to obtain the best possible braking surface finish may cause the vehicle to stop with difficulty.

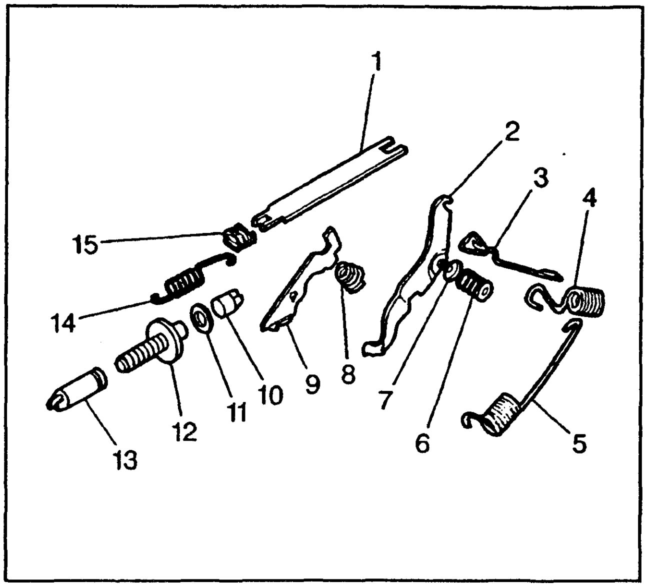
8. After machining the brake drum, use 120 grit aluminum oxide sandpaper in order to create a non-directional braking surface.
9. Clean the braking surfaces with denatured alcohol or with a suitable brake cleaner.
10. Remove the brake drum from the brake lathe.
11. Install the brake drum to the vehicle. Align the brake drum to the hub using the marks made during the removal procedure.

Notice: Improperly tightened wheel nuts can lead to brake pulsation and rotor damage. To avoid expensive brake repairs, evenly tighten the wheel nuts in the proper torque specification.

12. Install the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.

Brake Shoe Inspection

Inspect the brake linings every 6,000 miles (9,654 kilometers) and anytime the wheels are removed (tire rotation, etc.). Replace the brake shoe and the lining assemblies whenever the thickness of any lining is worn to within 0.76 mm (0.030 in) of the shoe. Replace the riveted shoe and the lining assemblies when the lining is worn to within 0.76 mm (0.030 in) of any rivet head. Always replace the brake shoe and the lining assemblies as a complete axle set.



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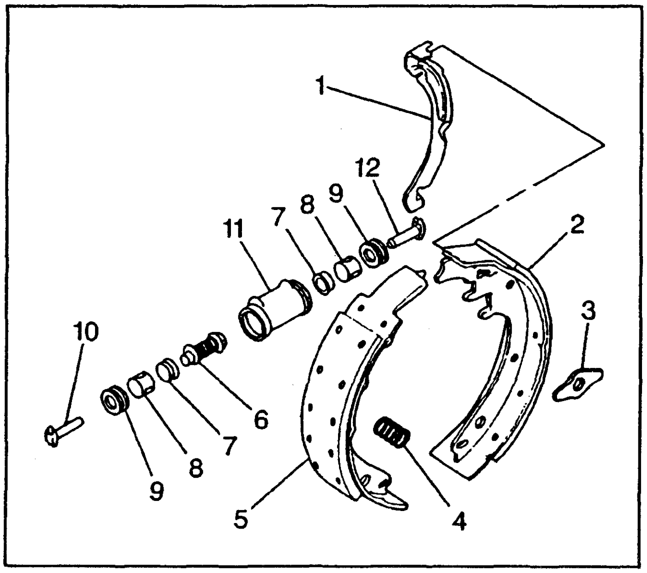

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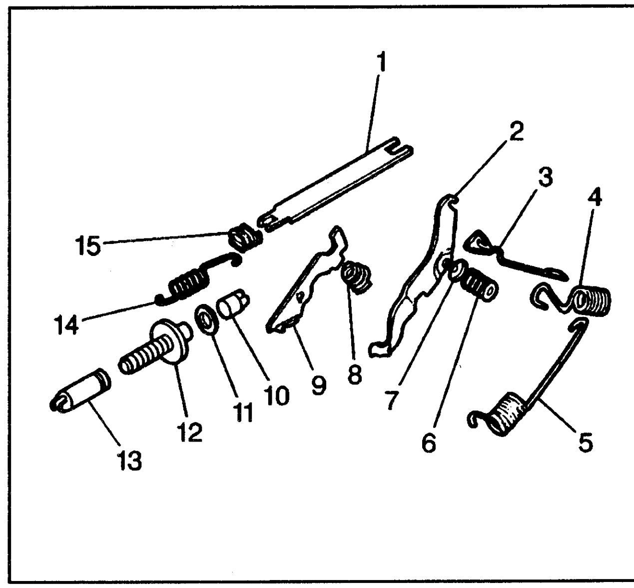
Brake Lining Replacement

Removal Procedure

Workhorse replacement brake lining material is recommended for all vehicles in order to maintain the balance between front and rear brake performance. Workhorse replacement brake parts have been carefully selected to provide the proper brake balance for the purposes of stopping distance and control over the full range of operating conditions. Installation of front or rear lining material with performance different from that of the Workhorse replacement parts recommended for this vehicle can change the intended brake balance of this vehicle.

1. Raise the vehicle and support the vehicle with safety stands.
2. Mark the relationship of the wheel to the hub.
3. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
4. Mark the relationship of the drum to the axle.
5. Remove the drum. Refer to *Hub and Drum Assembly Replacement (All Models)* in Rear Drive Axle.
6. Remove the return springs (4,5).
7. Remove the shoe guide (3).

8. Remove the hold-down spring (6).



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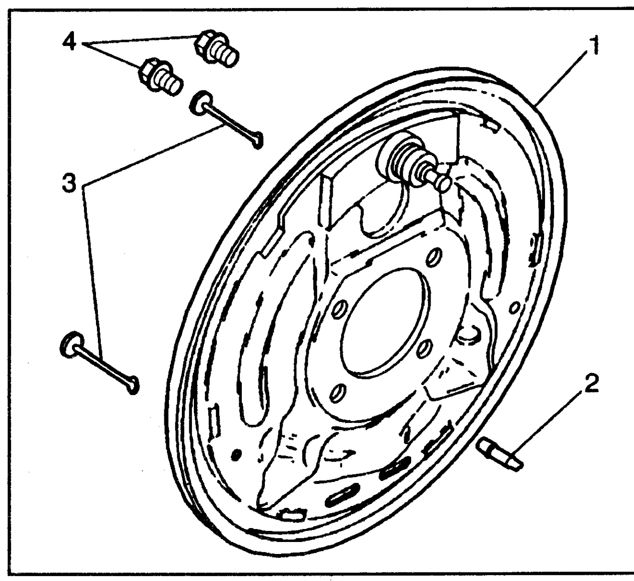
9. Remove the hold-down pins (3).



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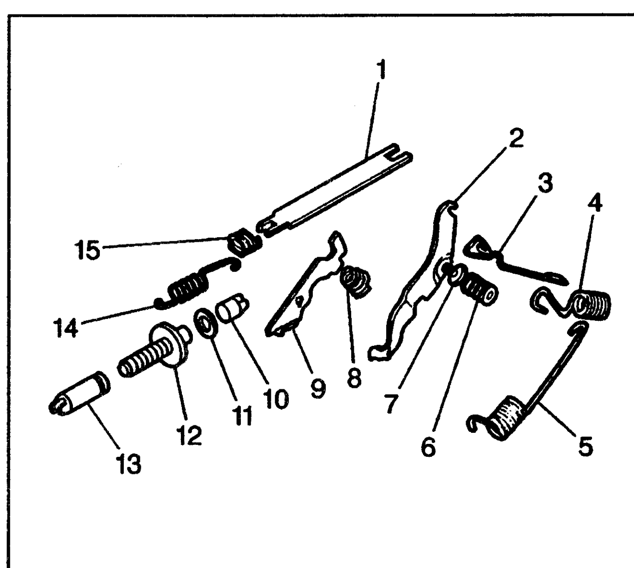
10. Remove the actuator lever (2) and the pivot.
11. Remove the lever return spring (8).
12. Remove the actuator link (3).
13. Remove the parking brake strut (1).
14. Remove the strut spring (15).



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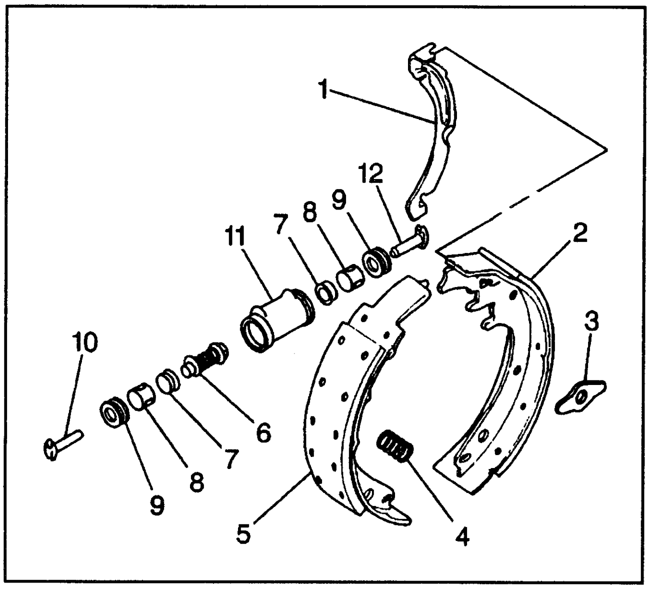

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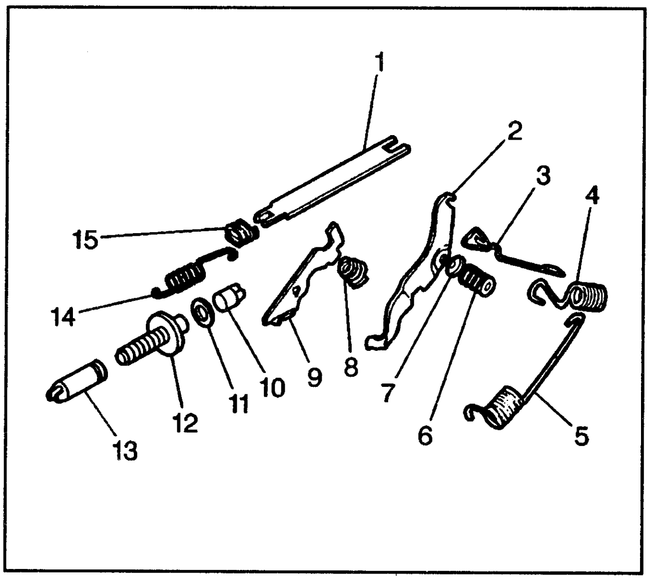
15. Remove the parking brake lever (1).
16. Remove the shoes (2,5).

Important: Do not interchange the right and the left adjusting screws.

17. Remove the adjusting screw assembly.



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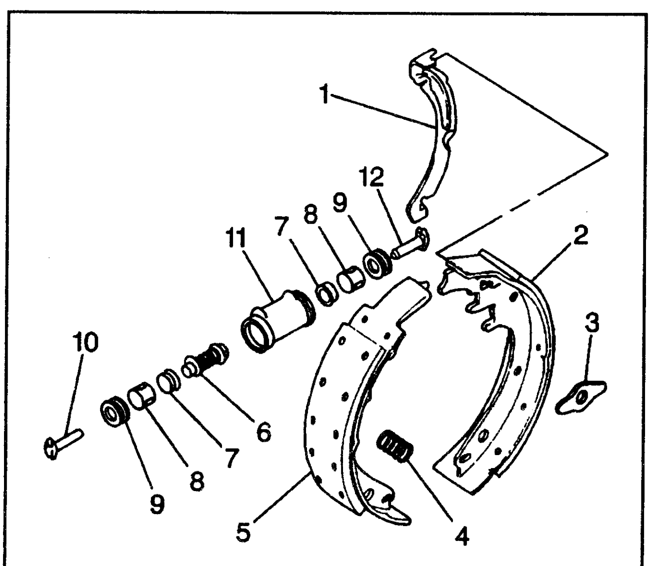
18. Remove the adjusting screw spring (14).
19. Inspect all parts for discoloration due to heat or stress. Replace the parts as needed.
20. Replace all parts with signs of wear.
21. Inspect the wheel cylinder for signs of leakage. Refer to *Wheel Cylinder Replacement.*
22. Inspect the brake drum for scoring and machining tolerance. Refer to *Brake Drum Inspection.*



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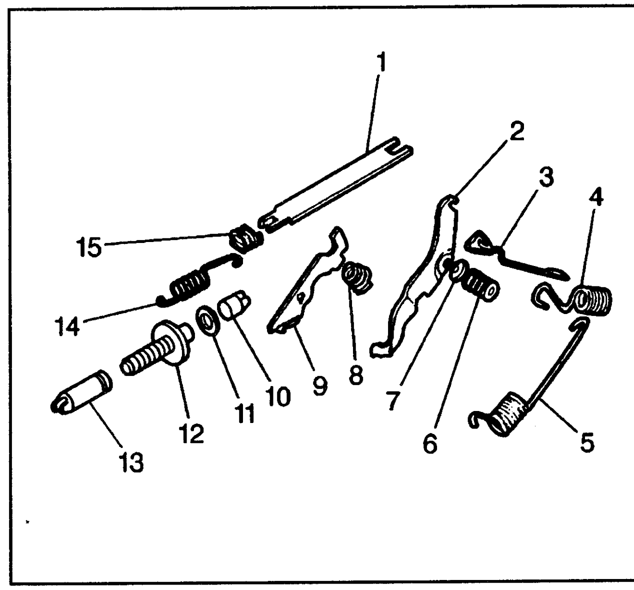
Installation Procedure

1. Lubricate the shoe pads and the adjusting screw threads with a thin coat of white lithium grease.
2. Connect the adjusting screw (12) and the adjusting screw spring to both shoes (2,5). The coils of the spring must not touch the adjusting screw (12).
3. Install the shoe assembly.
4. Install the parking brake lever (1).

5. Install the strut spring (15).
6. Install the parking brake strut (1).
7. Install the actuator lever (2) and pivot.
8. Install the actuator link (3).
9. Install the lever return spring (8).



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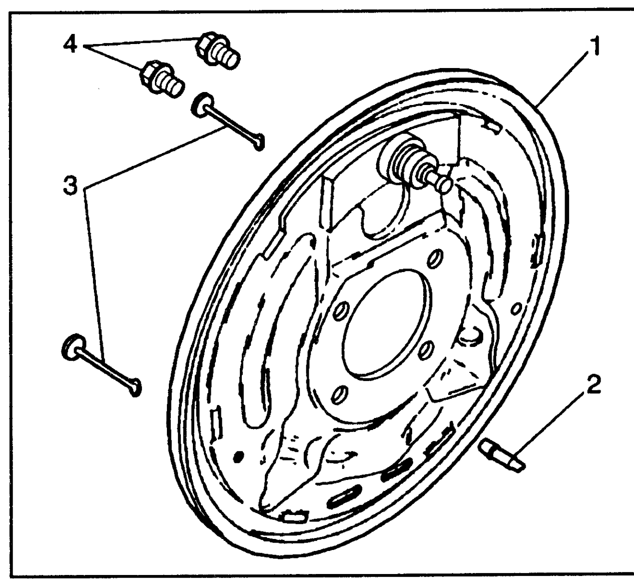
10. Install the hold-down pins (3).



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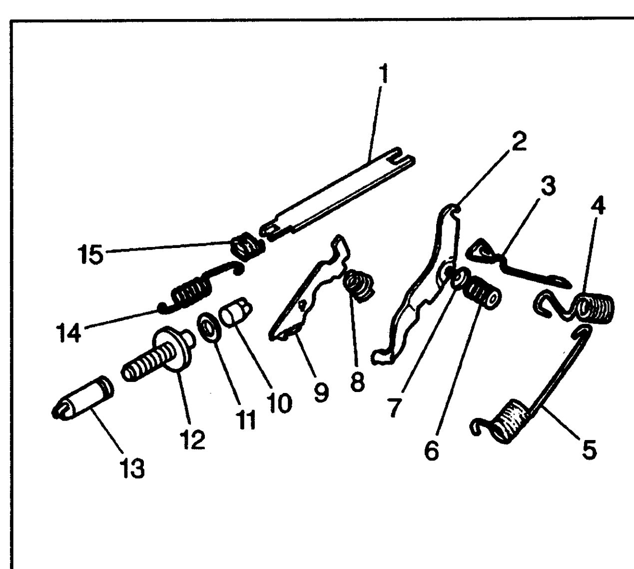
11. Install the hold-down springs (6).
12. Install the return springs (4,5).
13. Install the drum. Align the marks made during disassembly.
14. Install the tire and the wheel. Align the marks made during disassembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
15. Adjust the brakes. Refer to *Drum Brake Adjustment*.



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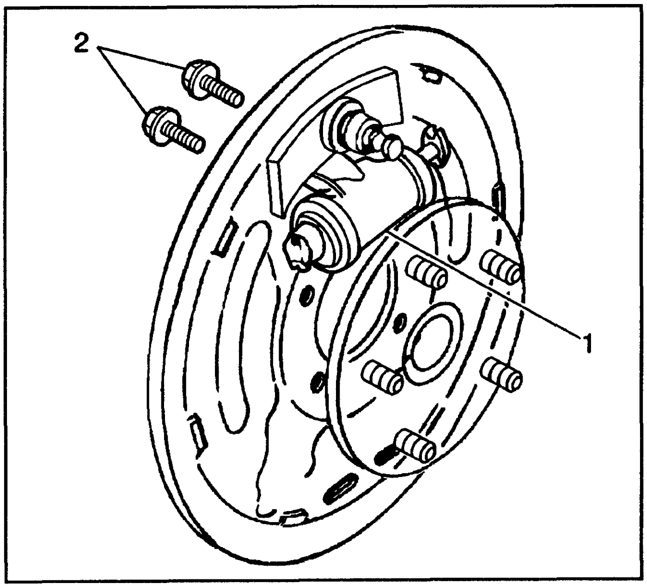

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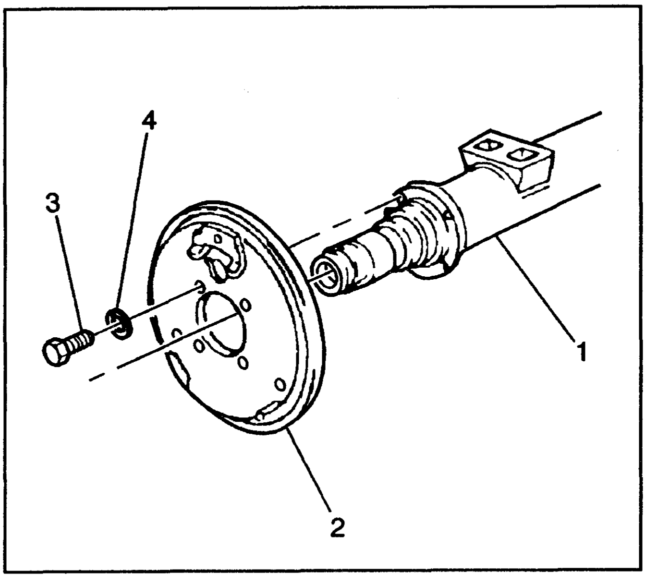
Brake Backing Plate Replacement

Removal Procedure

1. Remove the brake linings. Refer to *Brake Lining Replacement*.
2. Remove the wheel cylinder (1). Refer to *Wheel Cylinder Replacement*.
3. Remove the axle shaft. Refer to *Axle Shaft Replacement (All Models)* in Rear Drive Axle.



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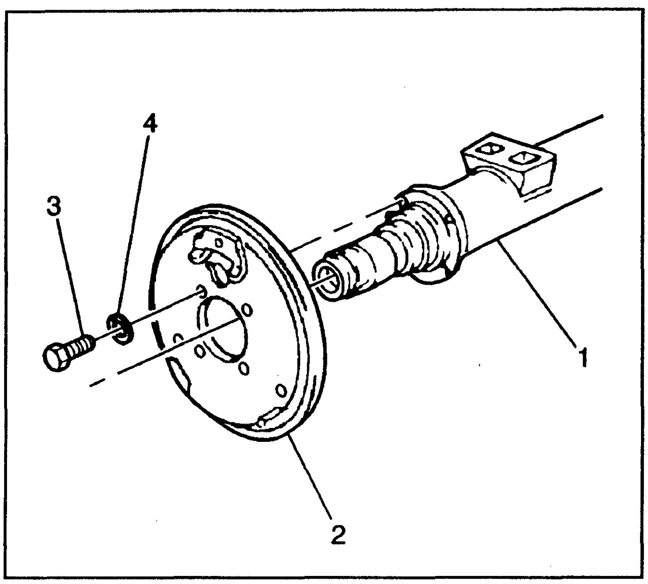
4. Remove the backing plate mounting bolts (3) and the washers (4).
5. Remove the backing plate (2).



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Installation Procedure

1. Install the backing plate (2).

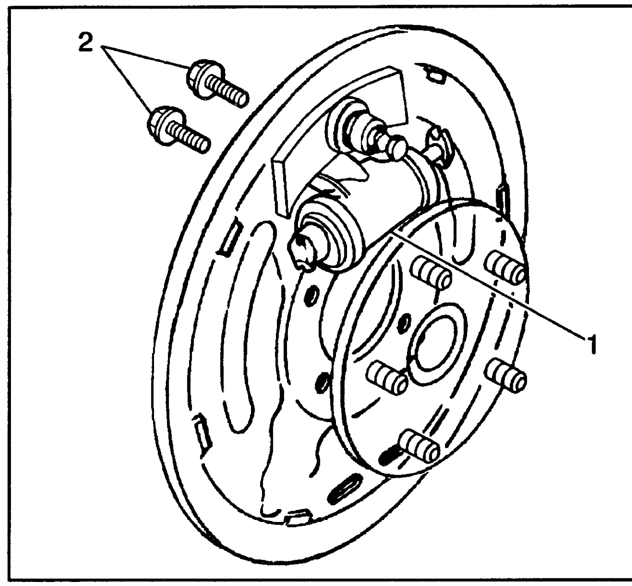
Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the backing plate mounting bolts (3) and the washers (4).

   Tighten

   Tighten the backing plate mounting bolts to 140 N·m (103 lb ft).

3. Install the wheel cylinder (1).
4. Install the axle shaft. Refer to *Axle Shaft Replacement (All Models)* in Rear Drive Axle.
5. Install the linings.
6. Adjust the brakes. Refer to *Drum Brake Adjustment.*
7. Bleed the brakes. Refer to *Hydraulic Brake System Bleeding* in Hydraulic Brakes.



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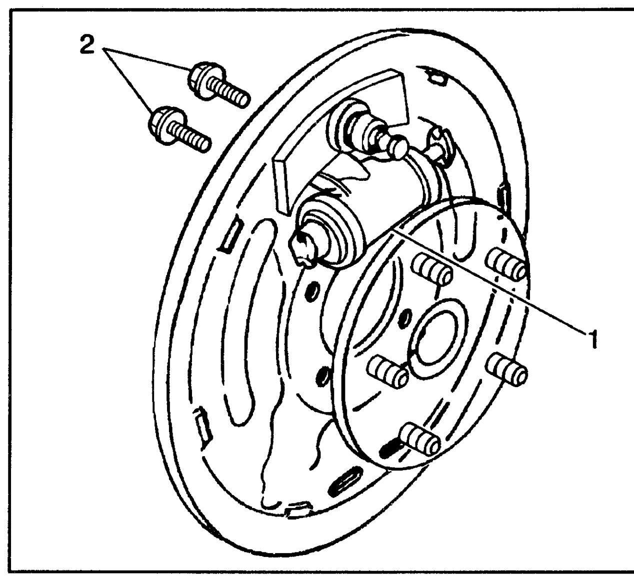
Wheel Cylinder Replacement

Removal Procedure

1. Remove the brake linings. Refer to *Brake Lining Replacement.*
2. Remove the brake pipe.
3. Remove the wheel cylinder mounting bolts (2).
4. Remove the wheel cylinder (1).



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Installation Procedure

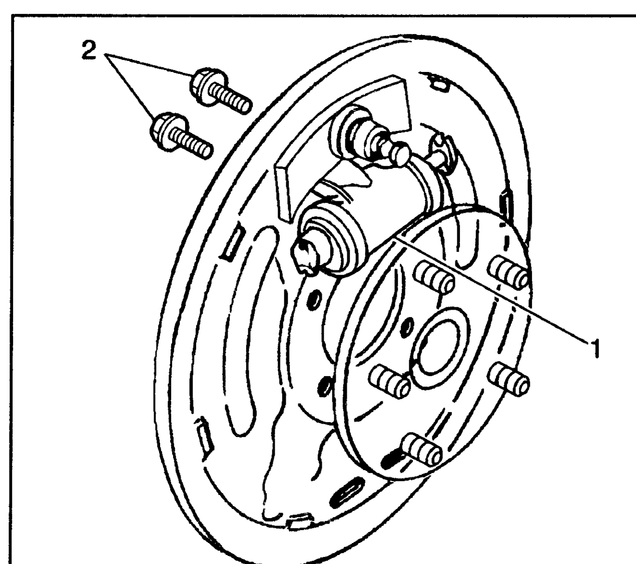
1. Install the wheel cylinder (1).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

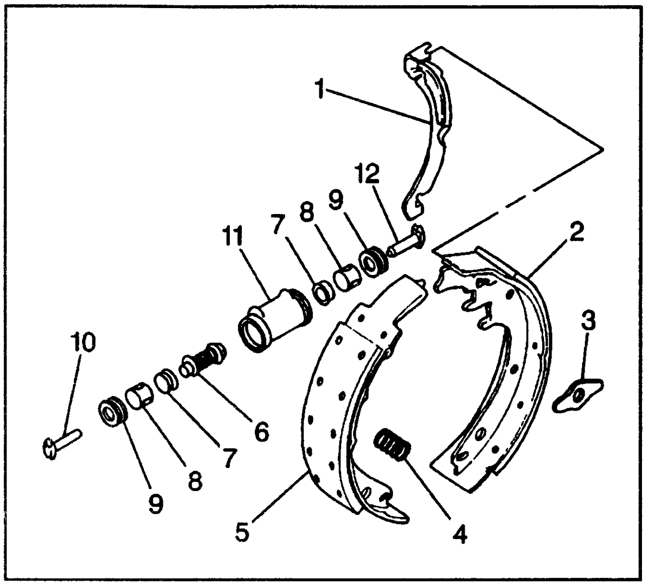
2. Install the wheel cylinder mounting bolts (2).

   Tighten

   Tighten the wheel cylinder mounting bolts to 20 N·m (15 lb ft).
3. Install the brake pipe.
4. Install the brake linings.
5. Bleed the brakes. Refer to *Hydraulic Brake System Bleeding* in Hydraulic Brakes.



176237

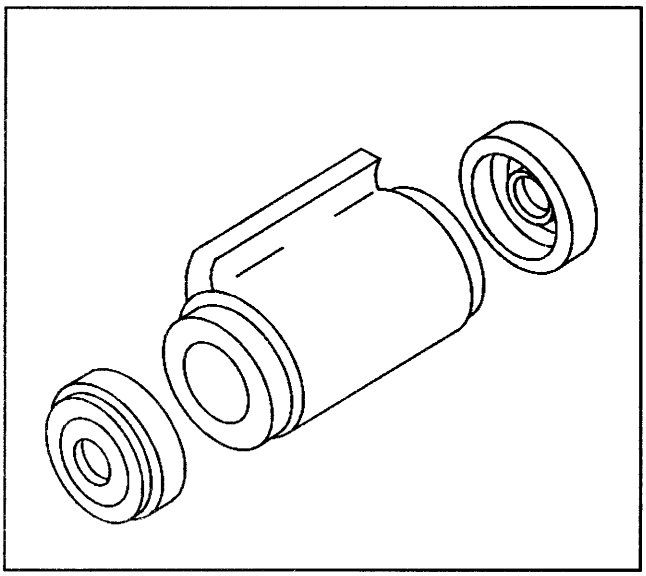


176340

Wheel Cylinder Overhaul

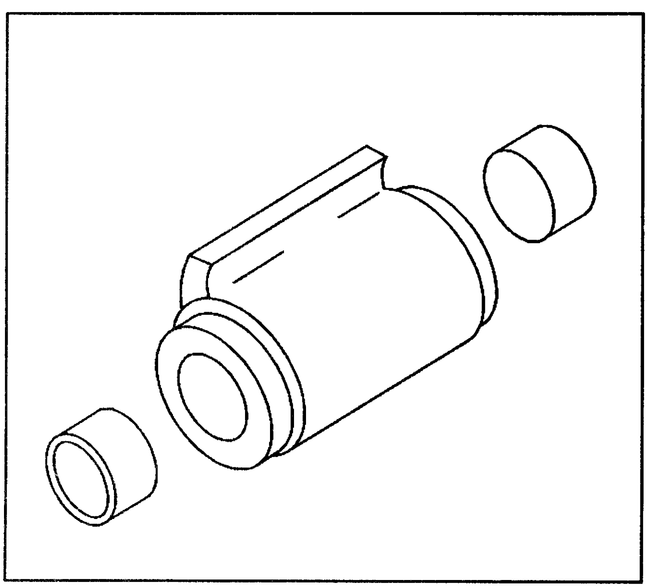
Removal Procedure

1. Remove the links (10,12).



223

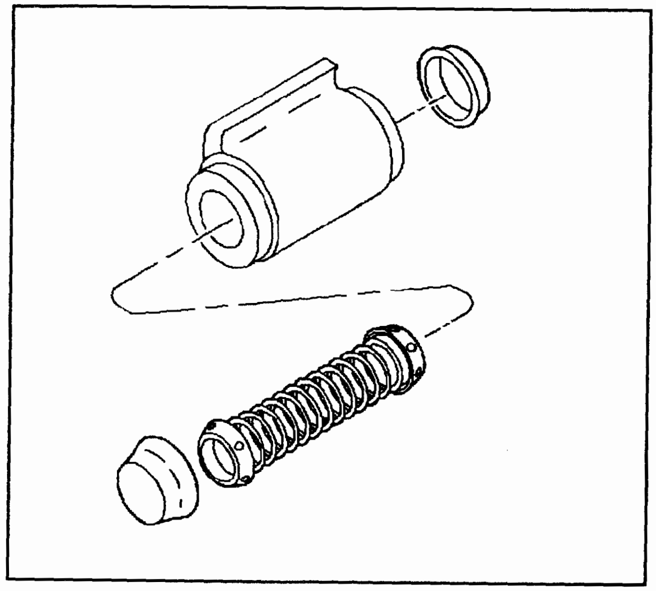
2. Remove the boots.



225

3. Remove the pistons.

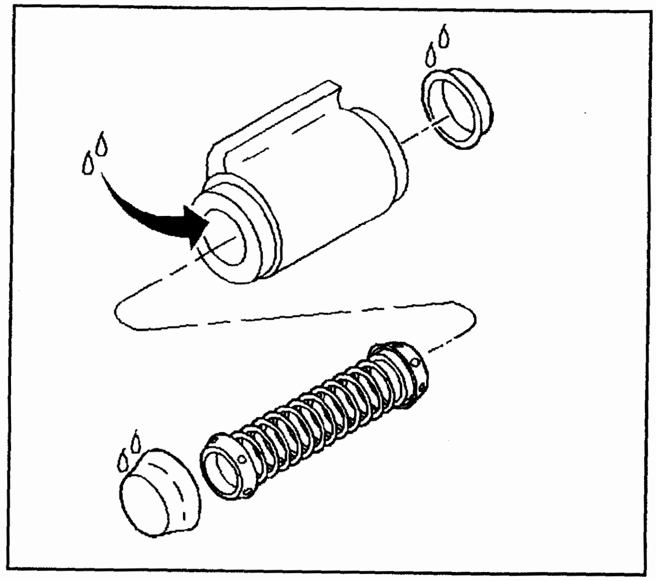
4. Remove the seal.
5. Remove the spring assembly.
6. Inspect the cylinder bore for scoring and corrosion.
7. Inspect the spring assembly for signs of discoloration due to heat. Replace the spring assembly if necessary.
8. Clean inside of the cylinder bore with a crocus cloth. If the bore is still scored, replace the cylinder.



227

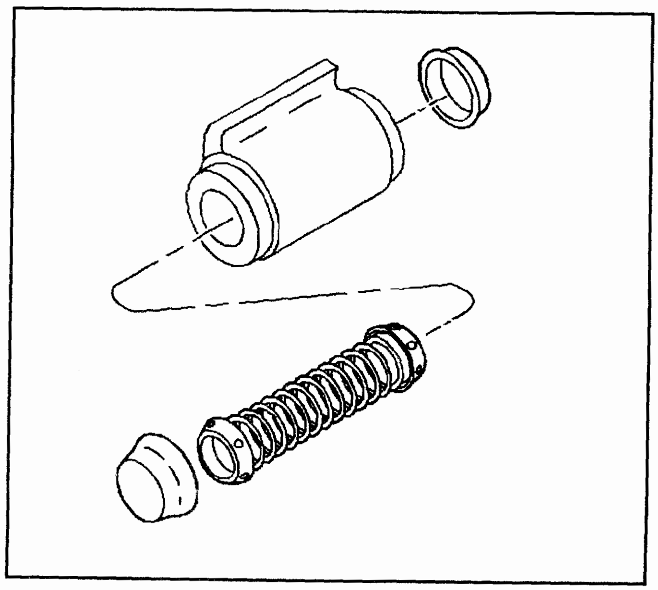
Installation Procedure

1. Lubricate the seals and the cylinder bore with clean brake fluid.



228

2. Install the spring assembly.
3. Install the seals.



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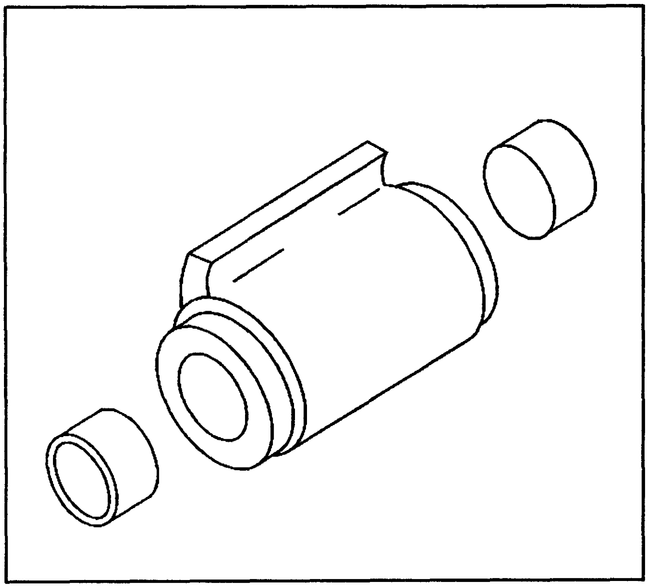
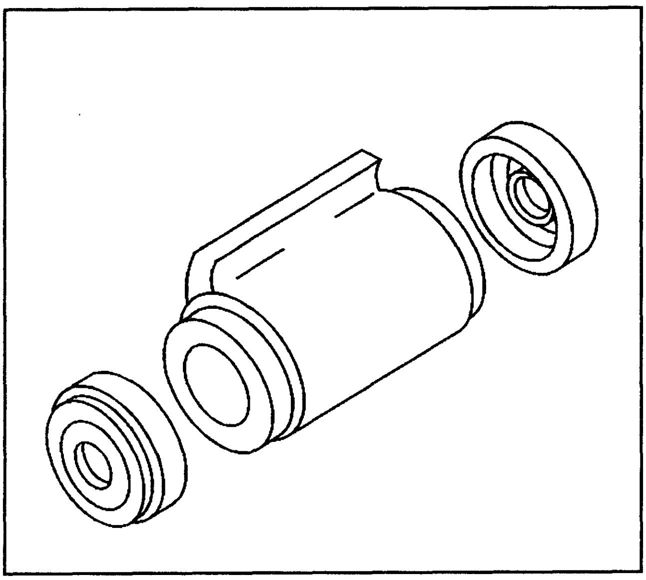


225

4. Install the pistons.



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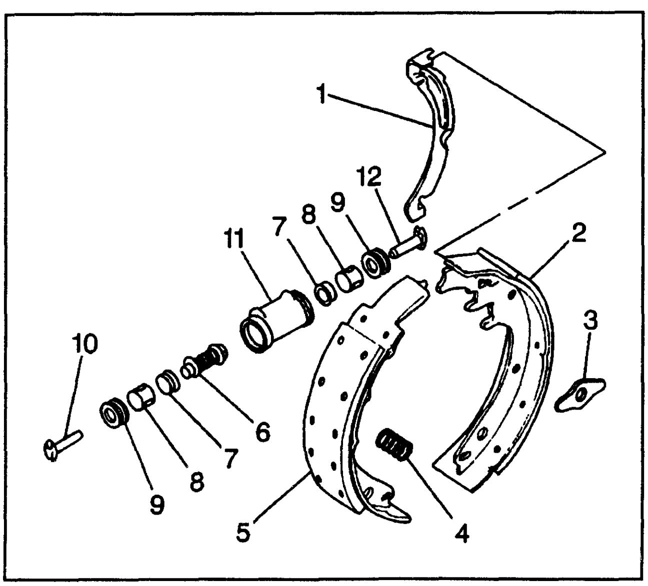
5. Install the boots.



176340

6. Install the links (10,12).

Drum Brake Adjustment

1. Remove the adjusting hole cover in the backing plate.
2. Adjust the adjusting screw until the wheel can just be turned by hand. The brake drag should be equal at both wheels.

Important: The brakes should have no drag after the screw has been backed off about 15 notches. If a heavy drag is present, refer to *Park Brake Cable Service/Adjustment (Mechanical Park Brake)* in Parking Brake.

3. Back off the adjusting screw 3 notches.
4. Install an adjusting hole cover in the backing plate.
5. Check the parking brake adjustment. Refer to *Park Brake Cable Service/Adjustment (Mechanical Park Brake)* in Parking Brake.

Description and Operation

System Description

The drum brake assembly is a duo-servo design. The force applied by the wheel cylinder to the primary shoe forces the leading edge of the shoe to contact the rotating drum.

The shoe tries to rotate with the drum and transfers force to the secondary shoe through the star-wheel adjuster. The secondary shoe's leading edge bites into the drum and tries to rotate, just like the primary shoe. Since the shoes cannot rotate, they wedge themselves into the drum. The rotating torque increases the braking force applied by the wheel cylinder. Because of this wedging action, the design is a duo-servo as opposed to a single-servo design where the wheel cylinder pressure alone is the source of the braking force.

The torque from the brake shoes is transferred through the backing plate to the axle flange. Brake adjustments are automatic and occur during reverse brake applications.

Park Brake

Specifications

Fastener Tightening Specifications

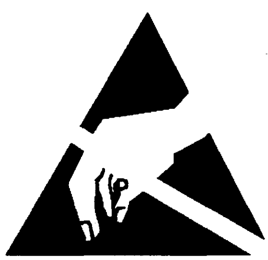
Application	Specification	
	Metric	English
Access Panel Fasteners	12 N·m	106 lb in
Actuator Bolts	40 N·m	30 lb ft
Actuator Mounting Bolts	108 N·m	80 lb ft
Anchor Pin Mounting Nut	200 N·m	148 lb ft
Backing Plate Bolts	41 N·m	30 lb ft
Cable Adjuster Jamb Nut	45 N·m	33 lb ft
Cable Bracket Mounting Bolt	10 N·m	89 lb in
Cable Retainer Clip Bolts	17 N·m	13 lb ft
Cable Clip Nuts	12 N·m	106 lb in
Hydraulic Pipe Fittings	16 N·m	12 lb ft
Parking Brake Cable-to-Frame Clip Bolt	8 N·m	71 lb in
Parking Brake Drum and Yoke Assembly Mounting Bolt	110 N·m	81 lb ft
Parking Brake Lever Mounting Nuts	25 N·m	18 lb ft
Parking Brake Pedal-to-Cowl Mounting Nuts	22 N·m	16 lb ft
Parking Brake Pressure Indicator Switch	12 N·m	106 lb in
Parking Brake Pull Switch Mounting Nut	3 N·m	27 lb in
Parking Brake Pump Assembly Mounting Bolts	37 N·m	27 lb ft
Parking Brake Pressure (Pump Motor) Switch	12 N·m	106 lb in
Parking Brake Rear Axle Bracket Bolt	31 N·m	23 lb ft
Parking Brake Solenoid Valve Mounting Nuts	13 N·m	115 lb in
Propeller Shaft Parking Brake Adjusting Nut	40 N·m	30 lb ft
Propeller Shaft Parking Brake Drum-to-Yoke Bolt	40 N·m	30 lb ft
Propeller Shaft Parking Brake Cable Clip to Frame	17 N·m	13 lb ft
Propeller Shaft Parking Brake Cable to Clip to Dash	12 N·m	107 lb in
Propeller Shaft Parking Brake Cable Clip to Transmission	27 N·m	20 lb ft
Right Rear Parking Brake Cable Clip Bolt to Rear Axle Bracket	31 N·m	23 lb ft

Schematic and Routing Diagrams

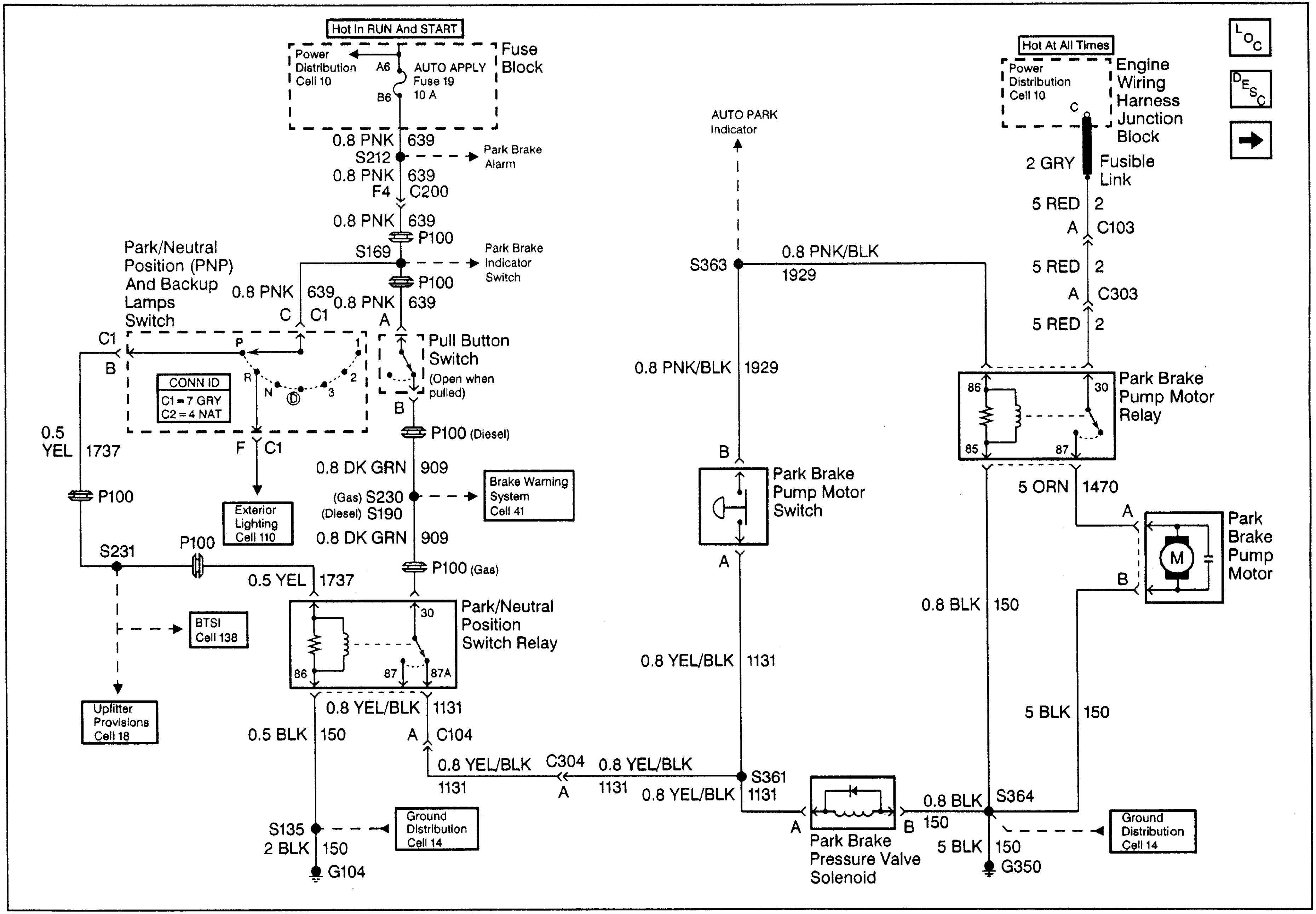
Park Brake System Schematic References

Reference on Schematic	Section Number - Subsection Name
Brake Warning System Schematics Cell 41	5 — Hydraulic Brakes
BTSI Schematics Cell 138	2 — Steering Wheel and Column - Tilt
Ground Distribution Cell 14	8 — Wiring Systems
Instrument Cluster: Analog Schematics Cell 81	8 — Instrument Panel, Gauges and Console
Power Distribution Cell 10	8 — Wiring Systems
Upfitter Provision Schematics Cell 18	8 — Wiring Systems

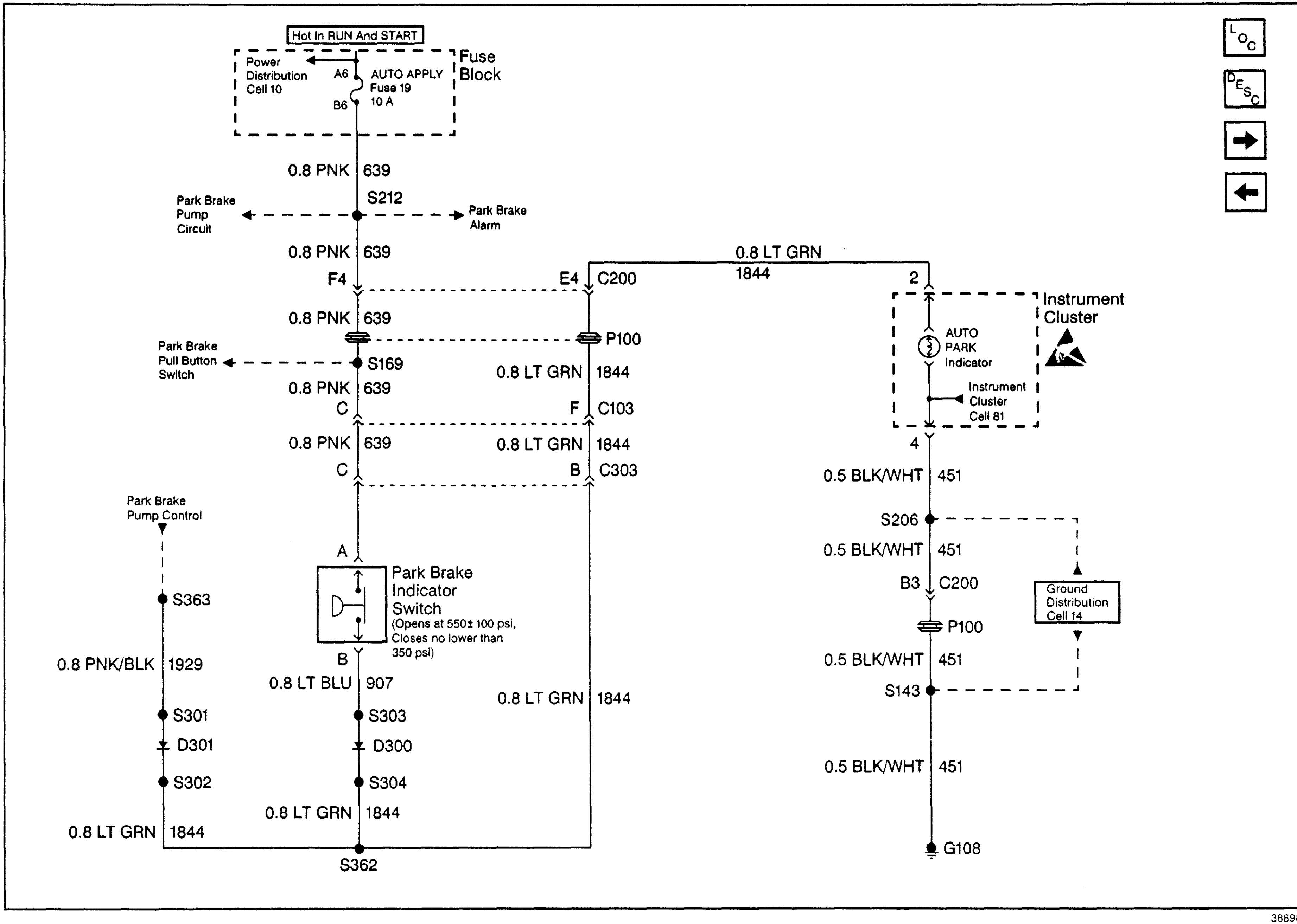
Park Brake System Schematic Icons

Icon	Icon Definition
 19384	Refer to *ESD Notice* in Cautions and Notices.

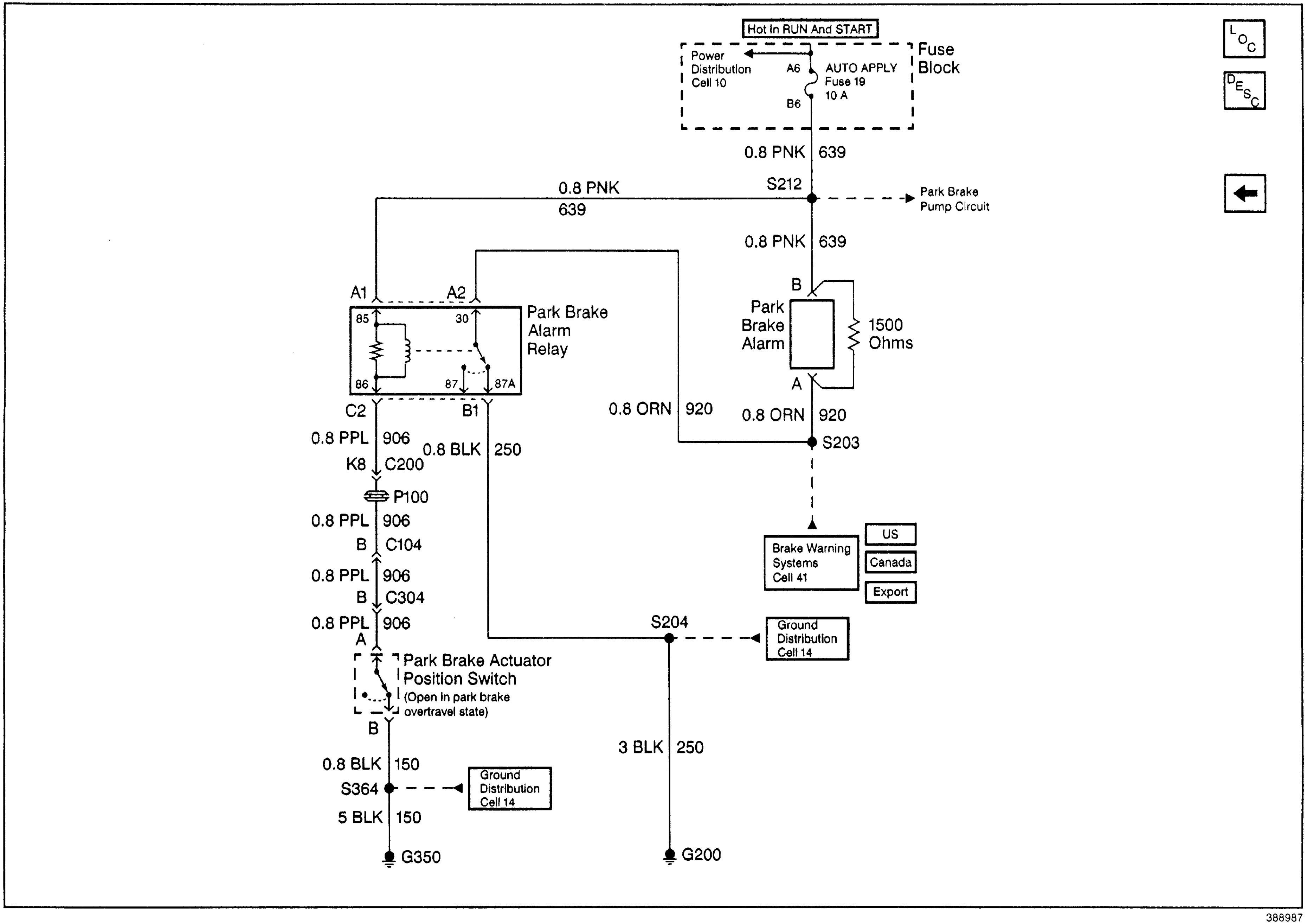
Park Brake System Schematics (Motorhome) (Cell 41: Park Brake Pump Control)



Park Brake System Schematics (Motorhome) (Cell 41: AUTO PARK Warning Circuit)



Park Brake System Schematics (Motorhome) (Cell 41: Park Brake Alarm)



Component Locator

Park Brake System Components

Name	Location	Locator View	Connector End View
Battery Junction Block	On the forward LH side of the bulkhead above P100	*Power and Grounding Component Views* in Wiring Systems	—
Instrument Cluster	Body builder installed	—	*Instrument Cluster Connector End Views* in Instrument Panel, Gauges and Console
IP Fuse Block	Located by the body builder	*Electrical Center Identification (Motorhome)* in Wiring Systems	*Power and Grounding Connector End Views* in Wiring Systems
Park Brake Actuator Position Switch	In the auto apply park brake component box at the RH frame rail behind the transmission	*Park Brake System Component Views*	*Park Brake System Connector End Views*
Park Brake Alarm	On the IP harness located by the body builder	—	*Park Brake System Connector End Views*
Park Brake Alarm Relay	On the IP harness located by the body builder	—	*Park Brake System Connector End Views*
Park Brake Pressure Indicator Switch	In the auto apply park brake component box at the RH frame rail behind the transmission	*Park Brake System Component Views*	*Park Brake System Connector End Views*
Park Brake Pressure Valve Solenoid	In the auto apply park brake component box at the RH frame rail behind the transmission	*Park Brake System Component Views*	*Park Brake System Connector End Views*
Park Brake Pull Button Switch	Mounted to the IP	—	*Park Brake System Connector End Views*
Park Brake Pump Motor	In the auto apply park brake component box at the RH frame rail behind the transmission	*Park Brake System Component Views*	*Park Brake System Connector End Views*
Park Brake Pump Motor Relay	In the auto apply park brake component box at the RH frame rail behind the transmission	*Park Brake System Component Views*	*Park Brake System Connector End Views*
Park Brake Pump Motor Switch	In the auto apply park brake component box at the RH frame rail behind the transmission	*Park Brake System Component Views*	*Park Brake System Connector End Views*
Park/Neutral Position (PNP) and Backup Lamps Switch	On the LH side of the transmission near the middle	*Lighting Systems Component Views (Motorhome)* in Lighting Systems	*Lighting Systems Connector End Views (Motorhome)* in Lighting Systems
Park/Neutral Position (PNP) Switch Relay	Above the engine mounted to the RH side of the driver's island	*Engine Controls Component Views* in Engine Controls	*Engine Controls Connector End Views (6.5L, L65)* in Engine Controls
C103	On top of the transmission	*Harness Routing Views (Motorhome)* in Wiring Systems	*Inline Harness Connector End Views (Motorhome)* in Wiring Systems
C104	On top of the transmission	*Harness Routing Views (Motorhome)* in Wiring Systems	*Inline Harness Connector End Views (Motorhome)* in Wiring Systems
C200	At the top front of the steering column support near the park brake pull button switch	*Harness Routing Views (Motorhome)* in Wiring Systems	*Inline Harness Connector End Views (Motorhome)* in Wiring Systems
C303	Above the auto apply park brake component box at the RH frame rail behind the transmission	*Harness Routing Views (Motorhome)* in Wiring Systems	*Inline Harness Connector End Views (Motorhome)* in Wiring Systems

Park Brake System Components (cont'd)

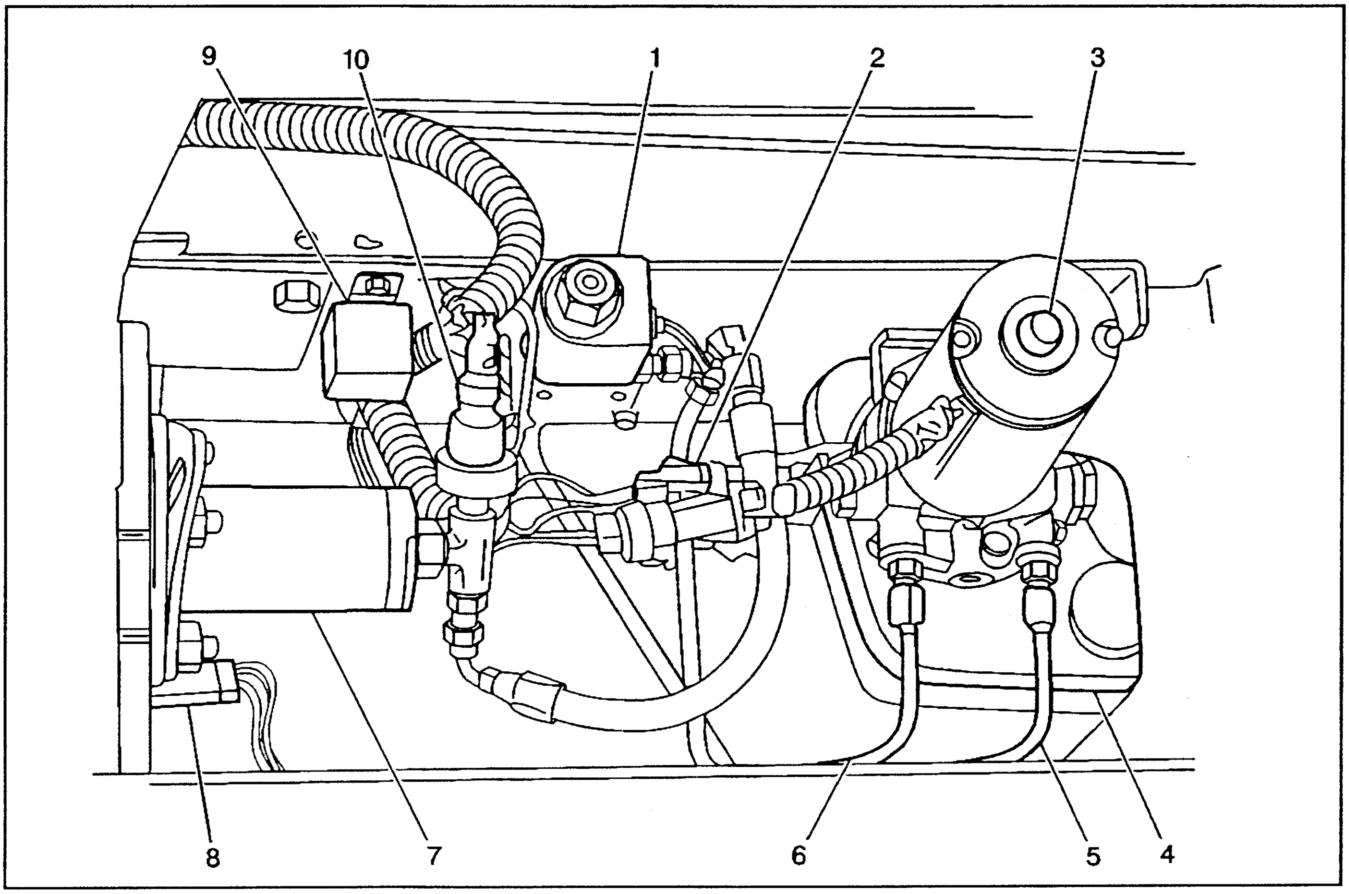
Name	Location	Locator View	Connector End View
C304	Above the auto apply park brake component box at the RH frame rail behind the transmission	*Harness Routing Views (Motorhome)* in Wiring Systems	*Inline Harness Connector End Views (Motorhome)* in Wiring Systems
D300	In the auto apply park brake harness, 23 cm (9 in) from connectors C303 and C304	—	—
D301	In the auto apply park brake harness, 18 cm (8 in) from connectors C303 and C304	—	—
G108	On top of the thermostat housing	*Power and Grounding Component Views* in Wiring Systems	—
G200	Mounted to the top front of the steering column support plate	—	—
G350	In the auto apply park brake component box at the RH frame rail behind the transmission	—	—
P100	Main wiring pass through at the bulkhead	*Harness Routing Views (Motorhome)* in Wiring Systems	—
S135 (Gas)	In the engine harness breakout for the ignition coil, 7 cm (3 in) from the main harness	—	—
S135 (Diesel)	In the engine harness, 7 cm (3 in) from the breakout for ground G104 toward P100	—	—
S143 (Gas)	In the engine harness, 5 cm (2 in) from the breakout for the ABS connectors C110 and C111, toward P100	—	—
S143 (Diesel)	In the engine harness, 2 cm (1 in) from the breakout for C100 and C207, toward the cooling fan connector	—	—
S169 (Gas)	In the engine harness, 58 cm (23 in) from passthrough P100	—	—
S169 (Diesel)	In the engine harness, 8 cm (4 in) from the breakout for the engine coolant level switch toward the starter relay breakout	—	—
S203	Part of the diode splice for D201 In the IP harness, 14 cm (5 in) from the breakouts for connector C200 and the horn relay toward the IP fuse block	—	—
S204	In the IP harness, 16 cm (6 in) from connector C200 toward the IP fuse block	—	—
S206	In the IP harness breakout for the instrument cluster connector, 25 cm (10 in) from the main harness	—	—
S212	In the IP harness, 10 cm (4 in) from the breakouts for the IP cluster connector and the IP dimmer switch toward the IP fuse block	—	—
S230 (Gas)	In the IP side of the engine harness, 7 cm (2 in) from the breakout for the hazard lamp flasher and the windshield wiper switch, toward P100	—	—
S231 (Gas)	In the IP side of the engine harness, 7 cm (2 in) from the breakout for the turn signal switch connector toward P100	—	—

Park Brake System Components (cont'd)

Name	Location	Locator View	Connector End View
S231 (Diesel)	In the IP side of the engine harness, 18 cm (7 in) from the breakout for the turn signal switch connector toward P100	—	—
S301/S302 (D301 Diode Splice)	In the auto apply park brake harness, 18 cm (8 in) from connectors C303 and C304	—	—
S303/S304 (D300 Diode Splice)	In the auto apply park brake harness, 23 cm (9 in) from connectors C303 and C304	—	—
S361	In the auto apply park brake harness, 8 cm (3 in) from the breakout for the park brake pump motor and the park brake pump relay connectors	—	—
S362	In the auto apply park brake harness, 14 cm (5 in) from connectors C303 and C304	—	—
S363	In the auto apply park brake harness, 12 cm (5 in) from the breakout for the park brake pump motor and the park brake pump relay connectors	—	—
S364	In the auto apply park brake harness, 4 cm (1 in) from the breakouts for the park brake pump motor and the park brake pump relay connectors	—	—

Park Brake System Component Views

Auto Apply Park Brake Components (Motorhome)

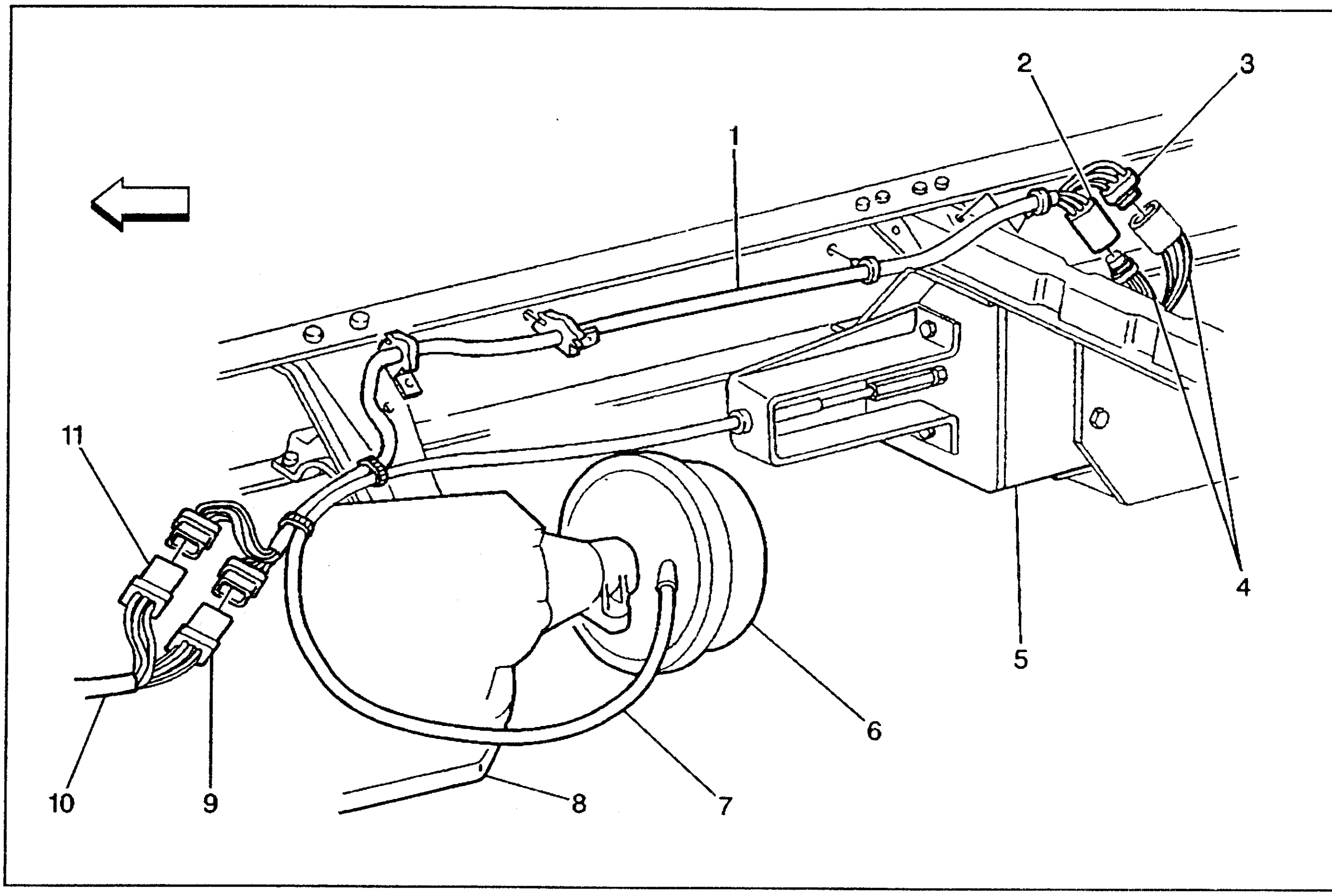


397845

Legend

(1) Park Brake Pressure Valve Solenoid
(2) Park Brake Pump Motor Switch
(3) Park Brake Pump Motor
(4) Pump Motor Reservior
(5) Hydraulic Lines
(6) Hydraulic Lines
(7) Park Brake Actuator Assembly
(8) Park Brake Actuator Position Switch
(9) Park Brake Pump Motor Relay
(10) Park Brake Pressure Indicator Switch

Auto Apply Park Brake Components (Motorhome)

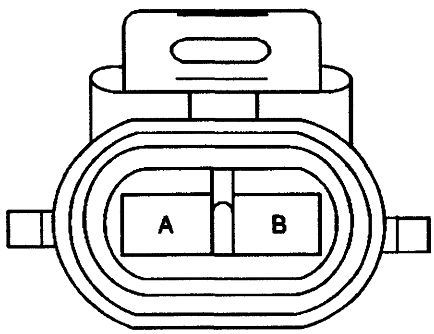


Legend

(1) Park Brake Extension Harness
(2) C303
(3) C304
(4) Park Brake Harness
(5) Park Brake Actuator Assembly Cover
(6) Park Brake Assembly
(7) Park Brake Actuator Cable
(8) Transmission
(9) C104
(10) Engine Harness
(11) C103

Park Brake System Connector End Views

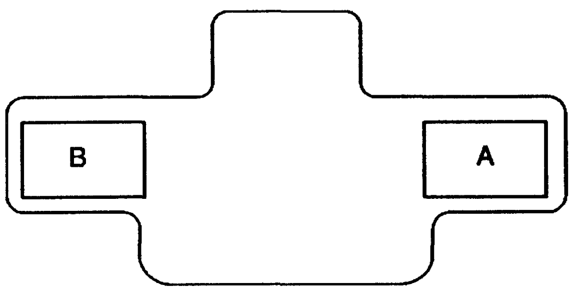
Park Brake Actuator Position Switch



35437

Connector Part Information	• 12052644 • 2 Way F Metri-Pack 150 Series (GRY)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PPL	906	Park Brake Proximity Switch
B	BLK	150	Ground

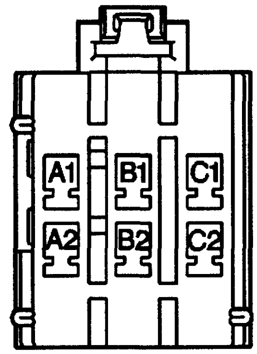
Park Brake Alarm



288713

Connector Part Information	• 08905825 • 2 Way F 56 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	ORN	920	Park Brake Alarm
B	PNK	639	Fuse Output-Ignition 1-Type III Fuse

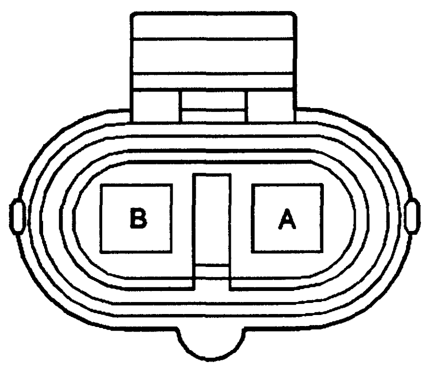
Park Brake Alarm Relay



281201

Connector Part Information	• 12110541 • 6 Way F Metri-Pack 280 Series, Flexlock (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A1	PNK	639	Fuse Output-Ignition 1-Type III Fuse
A2	ORN	920	Park Brake Alarm
B1	BLK	250	Ground
B2-C1	—	—	Not Used
C2	PPL	906	Park Brake Proximity Switch

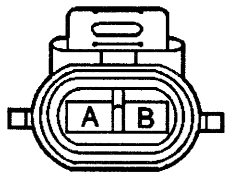
Park Brake Pressure Indicator Switch



35430

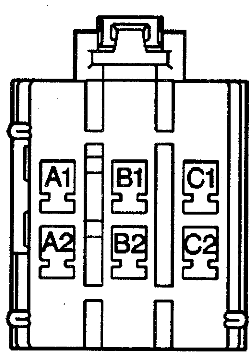
Connector Part Information	• 12020599 • 2 Way F Metri-Pack 280 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PNK	639	Fuse Output-Ignition 1-Type III Fuse
B	LT BLU	907	Diode to AUTO PARK Indicator Lamp

Park Brake Pressure Valve Solenoid



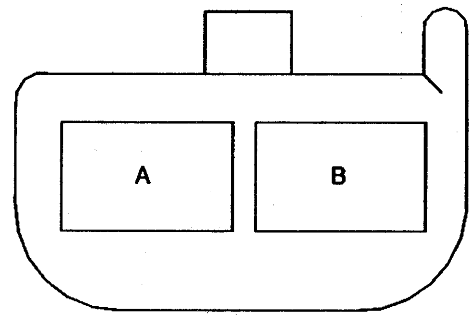
Connector Part Information	• 12052641 • 2 Way F Metri-Pack 150 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	YEL/BLK	1131	Auto Apply Park Brake Switch Signal
B	BLK	150	Ground

Park Brake Pull Button Relay



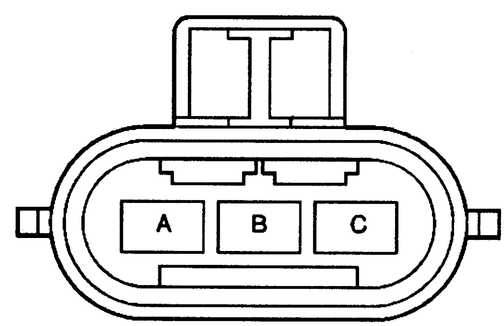
Connector Part Information	• 12110541 • 6 Way F Metri-Pack 280 Series, Flexlock (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A1	DK GRN	909	Output to PNP Relay and Park Brake Pull Button Switch
A2	TAN/WHT	33	Brake Warning Indicator Lamp Output
A2 (Z49)	LT BLU	1134	Park Brake Switch Signal
B1	BLK	250	Ground
B2-C1	—	—	Not Used
C2	BLK	250	Ground

Park Brake Pull Button Switch



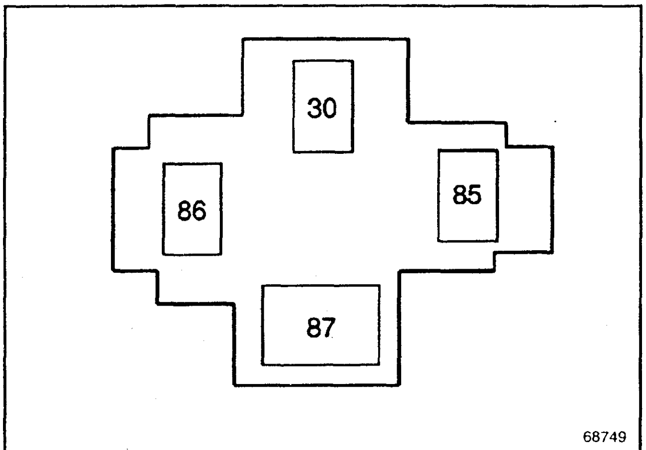
Connector Part Information	• 12047662 • 2 Way F Metri-Pack 150 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PNK	639	Fuse Output-Ignition 1-Type III Fuse
B	DK GRN	909	Output to PNP Relay and Park Brake Pull Button Switch

Park Brake Pump Motor



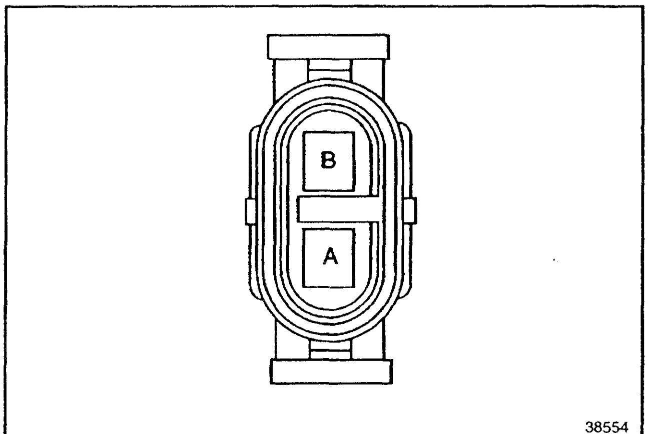
Connector Part Information	• 12124685 • 3 Way F Metri-Pack 630 Series Sealed (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	ORN	1470	Power Brake Booster Pump Motor Feed
B	BLK	150	Ground
C	—	—	Not Used

Park Brake Pump Motor Relay



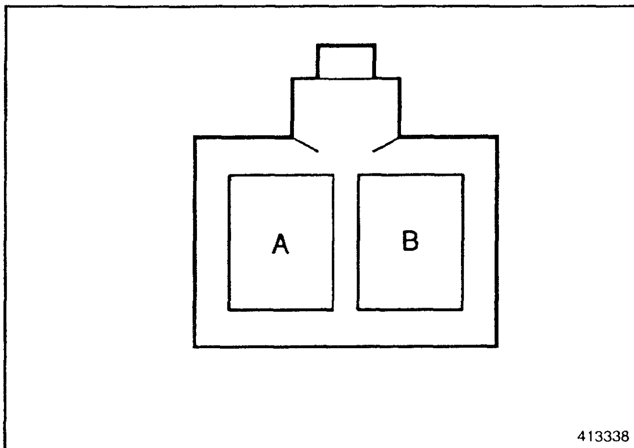
Connector Part Information	• 12124169 • 4 Way F Metri-Pack Mixed Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
30	RED	2	Fuse Output-Battery-Type I Fuse
85	BLK	150	Ground
86	PNK/BLK	1929	Park Brake Pump Motor Relay Output-Coil
87	ORN	1470	Power Brake Booster Pump Motor Feed

Park Brake Pump Motor Switch



Connector Part Information	• 12124819 • 2 Way F Metri-Pack 280 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	YEL/BLK	1131	Auto Apply Park Brake Switch Signal
B	PNK/BLK	1929	Park Brake Pump Motor Relay Output-Coil

Park Brake Switch (Commercial Hand-Operated)



Connector Part Information	• 08911149 • 2 Way F 56 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	250	Ground
B	TAN/WHT	33	Brake Warning Indicator Lamp Output
B (DRL)	LT BLU	1134	Park Brake Switch Signal

Diagnostic Information and Procedures

Park Brake System Check (Process)

Notice: Use care when probing terminals to measure voltage and resistance values. The Digital Multimeter (DMM) probe can damage the connector terminal and cause a poor connection. A damaged terminal condition is very hard to diagnose.

Important: The amount of time it takes for the parking brake to release will vary based on the temperature and battery voltage. In extreme cold weather, it can take up to 15 seconds to release the parking brake. This is normal system operation.

Before beginning diagnosis on the Electric/Auto park brake system, you need a detailed description of when the condition occurred from the owner. This information can be useful in duplicating the condition.Always begin diagnosis with a visual inspection of all connectors, wiring, wire routing and retention, and system components. Many times a disconnected or loose connector, blown fuse, open circuit breaker, corroded terminal, or miss-routed wire is the cause of a malfunction. If you need additional information on wiring conditions, repair procedures or electrical component location, refer to *Park Brake Will Not Release* or *Park Brake Pump Motor Runs All of the Time.*

Refer to *Electric/Auto Park System Description* or *Electric/Auto Park System Operation* for description and operation of the Electric/Auto Parking Brake.

Park Brake Indicator Always On

Checks	Action
DEFINITION: The AUTO PARK light stays on all the time or comes on frequently while driving.	
Confirm that the parking brake is fully released if the AUTO PARK indicator stays on.	Turn the rear wheels and check for drag. If the park brake is not fully releasing, refer to *Park Brake Will Not Release.*
Check for a short in the light circuit.	Repair and/or replace the light circuit.
The AUTO PARK light comes on at intervals less than 15 minutes while driving, and the duration becomes shorter, leading to constant pump operation.	• Refer to *Park Brake Pump Motor Runs All of the Time.* Inspect for a system leak, the solenoid valve failed open, or the motor pressure switch failed closed. • Replace the faulty solenoid valve, the pressure switch, or repair the leak.
The pump is constantly running.	Refer to *Park Brake Pump Motor Runs All of the Time.*

PARK BRAKE Indicator Lamp Does Not Light

Check circuits for the following conditions:

- A wire may be broken (or partially broken) inside the insulation. This could cause a system malfunction but appear good in a continuity test or a voltage check with a system disconnected. If possible, test the circuit for a voltage drop when the system is under load.
- Examine any aftermarket electronic equipment for proper installation. Refer to Troubleshooting.

AUTO PARK Indicator Lamp Does Not Light

Step	Action	Value(s)	Yes	No
1	Turn the ignition to ON Does the AUTO PARK lamp illuminate?	—	*Go to Step 2*	*Go to Step 3*
2	Refer to the instructions above for dealing with an intermittent problem. Is the repair complete?	—	System OK	—
3	Move the shift lever to NEUTRAL. Does the AUTO PARK lamp illuminate?	—	*Go to Step 4*	*Go to Step 9*
4	1. Disconnect the park brake pressure indicator switch. 2. Use a DMM *J 39200* to measure voltage between the connector terminal A and ground. Does the DMM indicate the specified voltage?	11–14 v	*Go to Step 6*	*Go to Step 5*
5	Repair the open in CKT 639 (PNK) between terminal A of the park brake pressure indicator switch and splice S169. Is the repair complete?	—	System OK	—
6	Use a DMM *J 39200* to measure resistance between terminal A and terminal B of the park brake pressure indicator switch. Does the DMM indicate the specified resistance?	Less than 2 Ω	*Go to Step 8*	*Go to Step 7*
7	Replace the park brake pressure indicator switch. Is the repair complete?	—	System OK	—
8	Repair the open between terminal B of the park brake pressure indicator switch and splice S362. This includes the following components: • CKT 907 (LT BLU) between terminal B of the park brake pressure indicator switch and diode D300 • Diode D300 • CKT 1844 (LT GRN) between diode D300 and splice S362 Is the repair complete?	—	System OK	—
9	Use a DMM *J 39200* to backprobe between terminal 2 of the of the I/P cluster connector and ground. Does the DMM indicate the specified voltage?	11–14 v	*Go to Step 10*	*Go to Step 11*
10	Replace the AUTO PARK lamp. Is the repair complete?	—	System OK	—
11	Repair the open in CKT 1844 (LT GRN) between splice S362 and terminal 2 of the I/P cluster connector. Is the repair complete?	—	System OK	—

Park Brake Pump Motor Runs All of the Time

Step	Action	Value(s)	Yes	No
1	1. Set the ignition to LOCK. 2. Have an assistant check the pump. Is the park brake pump motor running?	—	Go to *Step 2*	Go to *Step 7*
2	Look at the instrument cluster. Is the AUTO PARK lamp illuminated?	—	Go to *Step 3*	Go to *Step 4*
3	Repair the short to voltage in one of the following areas: • Between the park brake pump motor switch and splice S363 • Between S363 and the diode splice S301 • Between S363 and the pump motor relay Is the repair complete?	—	System OK	—
4	Disconnect the pump motor relay. Is the pump still running?	—	Go to *Step 5*	Go to *Step 6*
5	Repair the short to B+ in CKT 1470 (ORN) wire between the park brake pump motor relay and the park brake pump motor. Is the repair complete?	—	System OK	—
6	Replace the park brake pump motor relay. Refer to *Park Brake Pressure Relay Replacement.* Is the repair complete?	—	System OK	—
7	1. Make sure that the pull button switch is pushed in. 2. Make sure that the transmission range (TR) selector is in Park. 3. Turn the ignition to RUN. Is the pump running?	—	Go to *Step 3*	Go to *Step 8*
8	Check the hydraulic fluid reservoir of the park brake pump. Is the reservoir empty?	—	Go to *Step 9*	Go to *Step 13*
9	1. Fill the pump reservoir with Dextron III. Refer to *Checking and Adding Park Brake Fluid.* 2. With the ignition in RUN, move the TR selector out of Park. Is there a visible leak when the pump is running?	—	Go to *Step 10*	Go to *Step 11*
10	Repair the leak found as required. Is the repair complete?	—	System OK	—
11	Check the reservoir. Is it empty again?	—	Go to *Step 12*	Go to *Step 13*
12	Replace the actuator assembly. Refer to *Park Brake Actuator Replacement.* Is the repair complete?	—	System OK	—
13	Disconnect the pump motor switch. Is the pump still running?	—	Go to *Step 3*	Go to *Step 14*
14	Locate and replace the failed hydraulic component: • The pump motor switch may not be opening at 1560 +/- 142 psi • The pressure valve solenoid may be leaking through too much to allow a high enough pressure to open the pump motor switch • The pump may not be generating enough pressure to open the switch Is the repair complete?	—	System OK	—

Park Brake Will Not Hold

Step	Action	Value(s)	Yes	No
1	Set the ignition to LOCK. Is the park brake released?	—	Go to *Step 2*	Go to *Step 7*
2	Look at the instrument cluster. Is the BRAKE lamp illuminated?	—	Go to *Step 3*	Go to *Step 4*
3	1. Check for a mechanical problem in one of the following areas: • The park brake cable *Park Brake Cable Inspection* • The park brake shoes *Park Brake Shoe Inspection* 2. Adjust, repair, or replace components as required. Is the repair complete?	—	System OK	—
4	Disconnect the pump motor switch. Does the park brake apply?	—	Go to *Step 5*	Go to *Step 6*
5	Repair the short to B+ in CKT 1131 (YEL/BLK). Is the repair complete?	—	System OK	—
6	Find and repair the mechanical problem in the brake, cable, or linkage. Is the repair complete?	—	System OK	—
7	1. Turn the ignition to RUN. 2. Make sure that the transmission range (TR) selector is in Park. 3. Pull the pull button switch. Does the brake apply?	—	Go to *Step 8*	Go to *Step 9*
8	1. Find the problem in one of the following areas: • Failed PNP relay • Failed PNP switch • Open in one of the following circuits: – CKT 639 (PNK) between splice S169 and the PNP switch – CKT 1737 (YEL) between the PNP switch and the PNP relay – CKT 150 (BLK) between the PNP relay and splice S135 2. Repair or replace as required. Is the repair complete	—	System OK	—
9	Find and repair the short to switched ignition in CKT 1131 (YEL/BLK) Is the repair complete?	—	System OK	—

Park Brake Will Not Release

Step	Action	Value(s)	Yes	No
1	***Caution: Chock the wheels to prevent the vehicle from moving. Failure to chock the wheels can cause personal injury when the electrical system is repaired.*** 1. Turn the ignition to RUN. 2. Observe the instrument cluster. Is the AUTO PARK lamp illuminated?	—	Go to *Step 2*	Go to *Step 6*
2	1. Continue to observe the AUTO PARK lamp. 2. Move the transmission range (TR) selector out of the PARK position. Does the AUTO PARK lamp turn off after a few seconds?	—	Go to *Step 3*	Go to *Step 12*

Park Brake Will Not Release (cont'd)

Step	Action	Value(s)	Yes	No
3	1. Position yourself where you can see the park brake mechanism. 2. Have an assistant move the transmission rance selector between Park and Neutral with the ignition in RUN. Does the mechanism move at all as the brake is applied and released?	—	Go to *Step 4*	Go to *Step 5*
4	Examine the parking brake for a mechanical problem that is preventing its release and repair as required. Is the repair complete?	—	System OK	—
5	Replace the park brake actuator.*Park Brake Actuator Replacement* Is the repair complete?	—	System OK	—
6	1. Turn the ignition switch to LOCK. 2. Inspect AUTO APPLY fuse 19. Has the fuse blown?	—	Go to *Step 8*	Go to *Step 7*
7	Locate and repair the open in CKT 639 (PNK) between AUTO APPLY fuse 19 (fuse block terminal B6) and splice S212. Is the repair complete?	—	System OK	—
8	1. Replace AUTO APPLY fuse 19. 2. Turn the ignition to RUN. Does the fuse blow again?	—	Go to *Step 9*	Go to *Step 10*
9	1. Locate the short to ground in one of the following locations: • CKT 639 (PNK) from the AUTO APPLY fuse 19 (fuse block terminal B6) to splice S212 – from S212 to the park brake alarm – from S212 to the park brake alarm relay – from S212 to terminal F4 of C200 • From terminal F4 of C200 to splice S169 – from S169 to the pull button switch – from S169 to the park/neutral position and backup lamps switch – from S169 to the park brake pressure indicator switch • CKT 909 (DK GRN) from the pull button switch to splice S230 – from S230 to the park/neutral position switch relay – from S230 to the park brake pull button relay • CKT 1737 (YEL) from terminal B, Connector C1 of the park/neutral position and backup lamps switch to splice S231 – from S231 to the park/neutral position switch relay – from S231 to the BTSI relay – from S231 to the 2. Repair as required. Is the repair complete?	—	System OK	—
10	Move the TR selector out of Park. Does the park brake release normally?	—	System OK	Go to *Step 11*
11	Check AUTO APPLY fuse 19. Did the fuse blow again?	—	Go to *Step 12*	Go to *Step 13*

Park Brake Will Not Release (cont'd)

Step	Action	Value(s)	Yes	No
12	1. Locate the short to ground in one of the following locations: • CKT 1131 (YEL/BLK) from the park/neutral position switch relay to splice S361 – S361 to the pressure valve solenoid – S361 to the pump motor switch • The pressure valve solenoid • The pump motor switch • CKT 1929 (PNK/BLK) from the pump motor switch to splice S363 – S363 to splice S301 at diode D301 – S363 to the pump motor relay • The pump motor relay 2. Repair as required Is the repair complete?	—	System OK	—
13	1. Return the TR selector to Park. 2. Examine the park brake pump hydraulic fluid reservoir. Is the fluid level low?	—	*Go to Step 14*	Go to *Step 16*
14	1. Fill the reservoir to the proper level with Dextron III transmission fluid. Refer to *Checking and Adding Park Brake Fluid* 2. Examine the hydraulic components for signs of a leak. Is there any indication of a hydraulic leak?	—	Go to *Step 15*	Go to *Step 16*
15	Repair the park brake hydraulic system as required. Is the repair complete?	—	System OK	—
16	1. Position yourself near the hydraulic pump. 2. Have an assistant move the TR selector out of Park with the ignition in RUN. Does the pump motor operate?	—	Go to *Step 17*	Go to *Step 20*
17	Examine the system for any indication of a leak under pressure. Is there a leak?	—	Go to *Step 15*	Go to *Step 18*
18	Check the functioning of the system. Does the park brake release properly?	—	System OK	Go to *Step 19*
19	1. Examine the following components for a problem: • An open in CKT 1131 (YEL/BLK) from S361 to terminal A of the pressure valve solenoid • An open in CKT 150 (BLK) form S364 to terminal B of the pressure valve solenoid • A malfunction of the pressure valve solenoid 2. Repair/replace as required. Is the repair complete?	Less than 1 Ω	System OK	—
20	1. Move the TR to Park. 2. Disconnect the park brake pump motor. 3. Use a *J 39200* to check for continuity to ground from connector terminal B, CKT 150 (BLK). Is the resistance as specified?	—	Go to *Step 22*	Go to *Step 21*
21	Repair CKT 150 (BLK) between pump motor connector terminal B to ground G350. Is the repair complete?	—	System OK	—

Park Brake Will Not Release (cont'd)

Step	Action	Value(s)	Yes	No
22	1. Connect the *J 39200* between the terminals of the pump motor connector. 2. Set the meter for DC volts. 3. Move the TR selector out of Park with the ignition in RUN. Does the DVM indicate the specified voltage?	11–14 v	Go to *Step 23*	Go to *Step 24*
23	Replace the park brake pump. Is the repair complete?	—	System OK	—
24	1. Move the TR to park. 2. Turn the ignition to LOCK. 3. Remove the pump motor relay connector from the relay. 4. Use a *J 39200* to check for continuity in CKT 1470 (ORN) between the relay socket terminal 87 and the pump motor connector terminal A. Is the resistance within the specified limit?	Less than 1 Ω	Go to *Step 26*	Go to *Step 25*
25	Repair the open in CKT 1470 (ORN). Is the repair complete?	—	System OK	—
26	Replace the park brake pump motor relay. Is the repair complete?	11–14 v	Go to *Step 28*	Go to *Step 27*
27	Repair the open in CKT 2 (RED). Is the repair complete?	—	System OK	—
28	1. Turn the ignition to RUN. 2. Move the TR out of Park. 3. Use a *J 39200* to measure voltage in CKT 1929 (PNK/BLK) between pump motor relay socked terminal 86 and ground. Is the voltage within specified limits?	11–14 v	Go to *Step 29*	Go to *Step 32*
29	Use a *J 39200* to check continuity in CKT 150 (BLK)) between the pump motor relay terminal 85 and ground G350. Is the resistance as specified?	Less than 1 Ω	Go to *Step 30*	Go to *Step 31*
30	Replace the pump motor relay. Is the repair complete?	—	System OK	—
31	Repair the open in CKT 150 (BLK). Is the repair complete?	—	System OK	—
32	1. Disconnect the pump motor switch (CKT 1929 (PNK/BLK) and CKT 1131 (YEL/BLK)). 2. Use a *J 39200* to measure voltage between the pump motor switch connector terminal A (YEL/BLK) and ground with the ignition in RUN and the TR out of Park. Is the voltage as specified?	11–14 v	Go to *Step 33*	Go to *Step 36*
33	Use a *J 39200* to measure resistance between the pump motor switch terminals. Is the resistance as specified?	Less than 1 Ω	Go to *Step 34*	Go to *Step 35*
34	1. Locate the open in CKT 1929 (PNK/BLK) between the pump motor switch and the pump motor relay. 2. Repair the open as required. Is the repair complete?	—	System OK	—
35	Replace the pump motor switch. Is the repair complete?	—	System OK	—

Park Brake Will Not Release (cont'd)

Step	Action	Value(s)	Yes	No
36	With the ignition in RUN and the TR out of Park, measure voltage between terminal A of connector C104 and ground. Is the voltage as specified?	11–14 v	Go to *Step 37*	Go to *Step 38*
37	Locate the open in CKT 1131 (YEL/BLK) between terminal A of connector C104 and the pump motor switch terminal A. Is the repair complete?	—	System OK	—
38	1. Remove the park/neutral position switch relay from its socket. 2. With the ignition in RUN, use a *J 39200* to measure voltage between terminal 30 of the relay socket and ground. Does the voltage within the specified range?	11–14 v	Go to *Step 40*	Go to *Step 39*
39	1. Locate the open in one of the following areas: • CKT 909 (DK GRN) between the park/neutral position switch relay terminal 30 and park brake pull button switch • CKT 639 (PNK) between the pull button switch and splice S169 • Check the pull button switch for proper functioning 2. Repair the open or replace the switch as required. Is the repair complete?	—	System OK	—
40	Use a *J 39200* to measure resistance between terminal 30 and terminal 87A of the park/neutral position switch relay. Is the resistance as specified?	Less than 1 Ω	Go to *Step 42*	Go to *Step 41*
41	Replace the park/neutral position switch relay. Is the repair complete?	—	System OK	—
42	With the ignition in RUN and the TR out of Park, use a *J 39200* to measure voltage between the park/neutral position switch relay terminal 85 and ground. Is the voltage as specified?	11–14 v	Go to *Step 44*	Go to *Step 43*
43	Locate and repair the open in CKT 1131 (YEL/BLK) between the park/neutral position switch relay terminal 87A and terminal A of C104. Is the repair complete?	—	System OK	—
44	1. Disconnect connector C1 (7 GRY) from the park/neutral position and backup lamps switch. 2. With the ignition in RUN and the TR selector out of Park, use a *J 39200* to measure voltage between terminal B of connector C1 and ground. Is the voltage as specified?	11–14 v	Go to *Step 46*	Go to *Step 45*
45	Replace the park/neutral position and backup lamps switch. Is the repair complete?	—	System OK	—
46	1. Locate the short to B+ in CKT 1737 (YEL) in one of the following areas: • Terminal B of the park/neutral position and backup lamps switch and park/neutral position switch relay terminal 85 • Splice S231 and the BTSI relay terminal 85 • S231 and the upfitter connector 2. Repair as required. Is the repair complete?	—	System OK	—

Repair Instructions

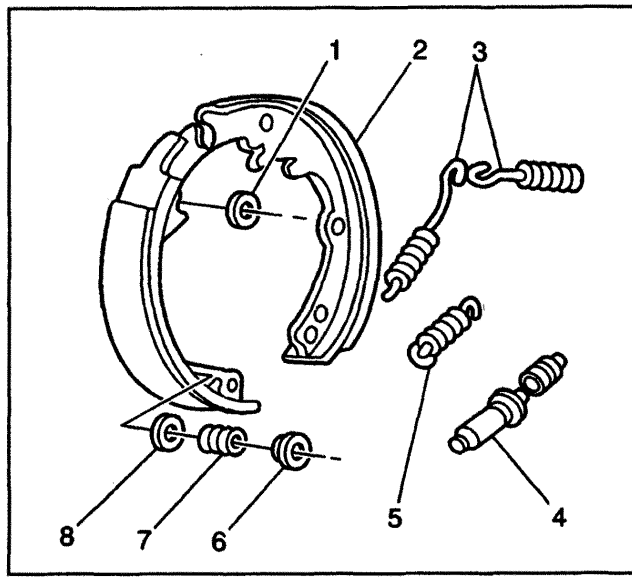
Park Brake Shoe Inspection

Replace the brake shoe and lining assemblies whenever the thickness of any lining is worn to within 0.76 mm (0.030 in) of the shoe. For riveted shoe and lining assemblies, replace when the lining is worn to within 0.76 mm (0.030 in) of any rivet head.

Park Brake Shoe Replacement

Removal Procedure

1. Remove the drum. Refer to *Brake Drum Replacement.*
2. Remove the pull springs (3).



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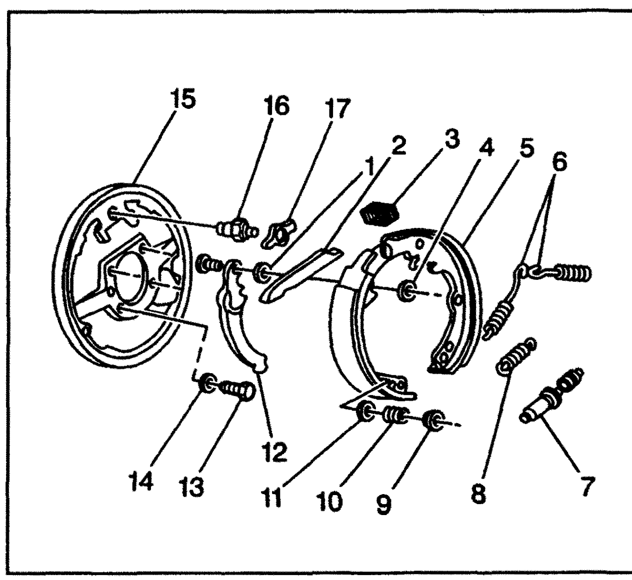
3. Remove the guide plate (17).
4. Remove the holder pin spring cups (10), the springs, and the washers (11).
5. Remove the shoe lever strut (2) and the spring.
6. Remove the shoe lever ring (4).
7. Remove the shoe lever and the washer.



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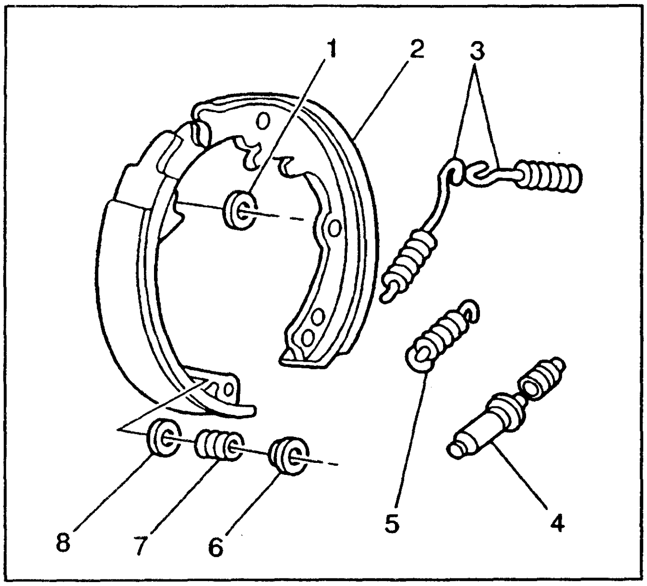

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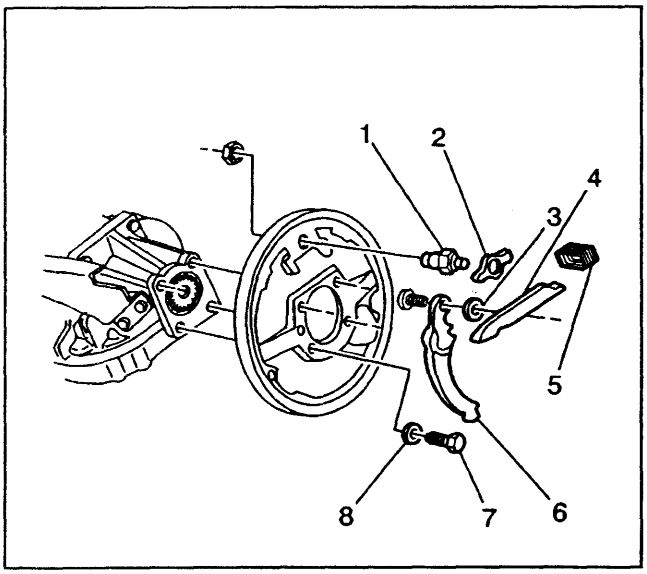
8. Remove the parking brake shoes (2).
9. Remove the brake shoe adjuster (4).
10. Remove the brake shoe adjuster spring (5).
11. Inspect all parts for discoloration due to heat or stress. Replace the parts if necessary.
12. Inspect the brake drum for scoring and heat spots. Machine the drum if needed.



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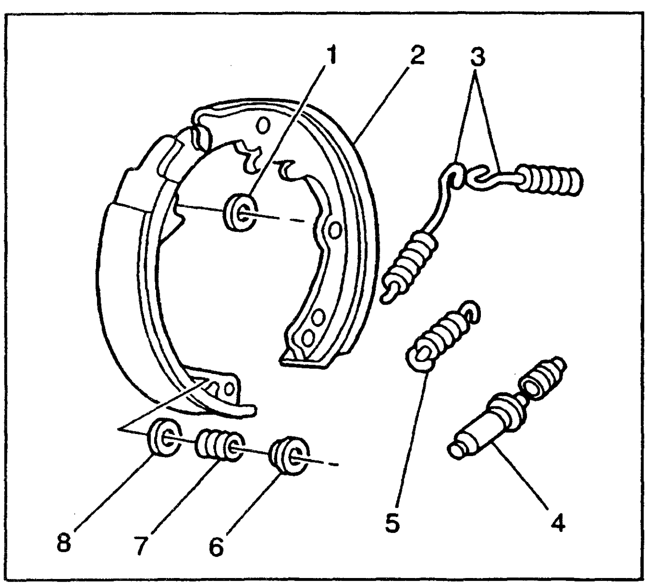
13. Inspect the anchor pin (1) for signs of wear. Replace the anchor pin as needed.



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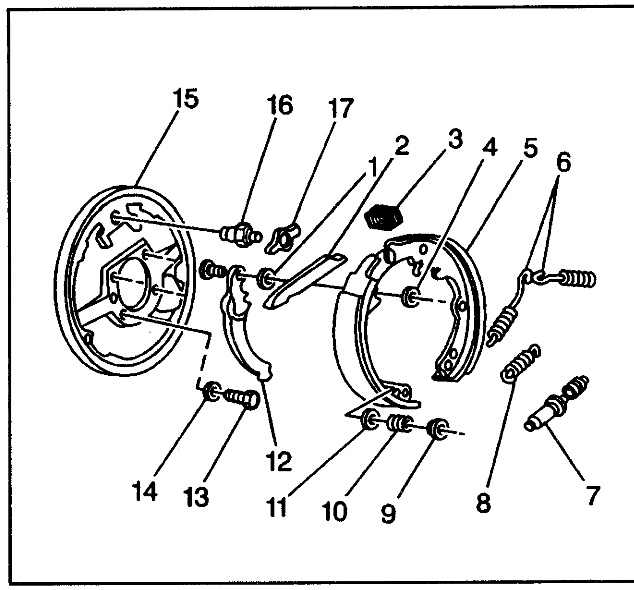
Installation Procedure

Notice: Lubricate the shoe pads and adjusting screw threads with a thin coat of Lubriplate® P/N 1050109 or equivalent. DO NOT ALLOW LUBRICANT TO CONTACT BRAKE LININGS.

1. Install the brake shoe adjuster (4) and the spring to both sides.

2. Install the parking brake shoes (5).
3. Install the shoe lever and the ring.
4. Install the shoe lever strut (2) and the spring.
5. Install the holder pin spring washers (11), the springs, and the cups (10).
6. Install the guide plates (17).



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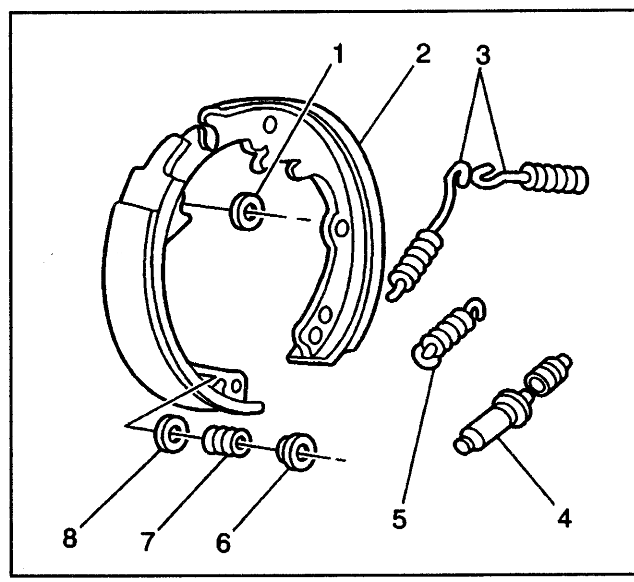
7. Install the pull springs (3).
8. Install the drum.
9. Adjust the parking brake. Refer to *Park Brake Cable Service/Adjustment (Mechanical Park Brake).*



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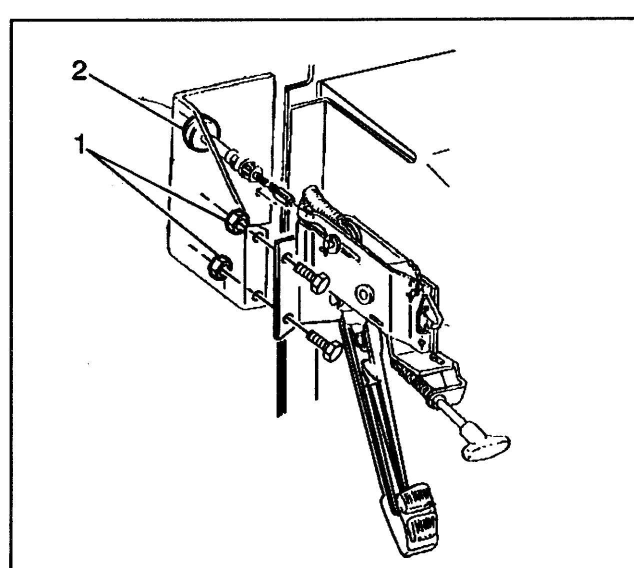
Park Brake Pedal Replacement

Removal Procedure

1. Release the parking brake.
2. Remove the parking brake pedal to cowl mounting nuts (1).
3. Remove the cable (2) from the pedal assembly.
4. Remove the pedal assembly.



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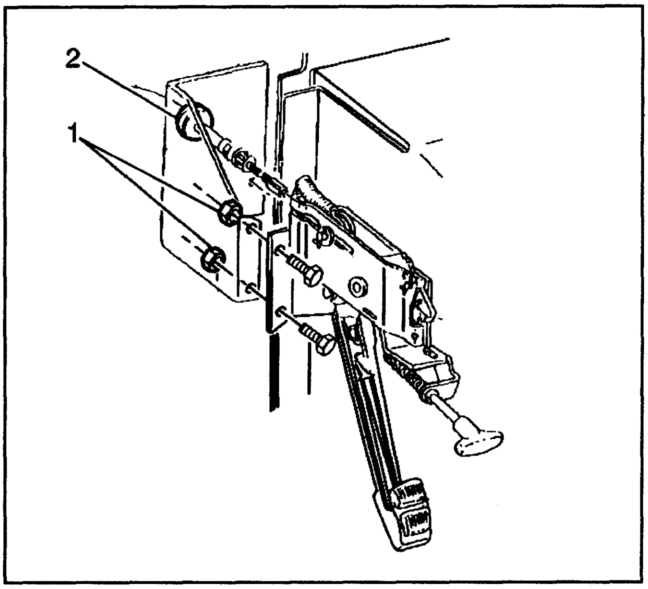

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Installation Procedure

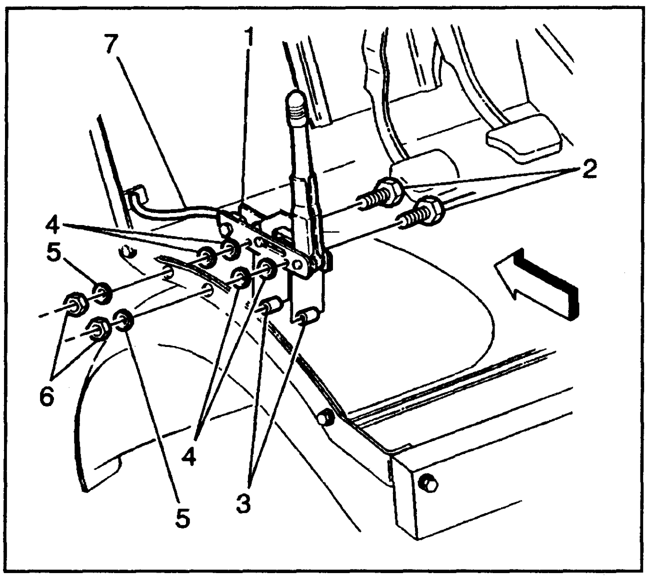
1. Connect the cable (2) to the pedal assembly.
2. Position the pedal assembly and install the bolts.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the parking brake pedal to cowl mounting nuts (1).

   Tighten

   Tighten the pedal to cowl mounting nuts to 22 N·m (16 lb ft).
4. Adjust the parking brake. Refer to *Park Brake Cable Service/Adjustment (Mechanical Park Brake).*



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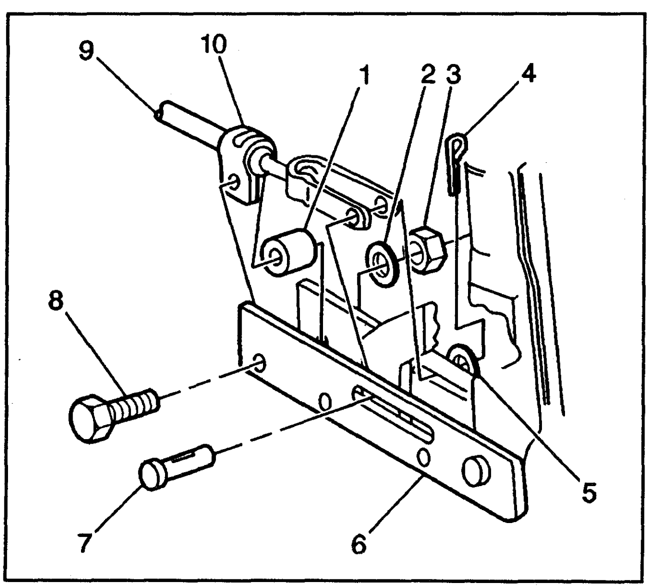
Park Brake Lever Replacement

Removal Procedure

1. Release the parking brake.
2. Remove the parking brake pedal to floor nuts (6) and washers (5).
3. Remove the parking brake pedal to floor bolts (2) and washers (4).
4. Remove the spacers (3).



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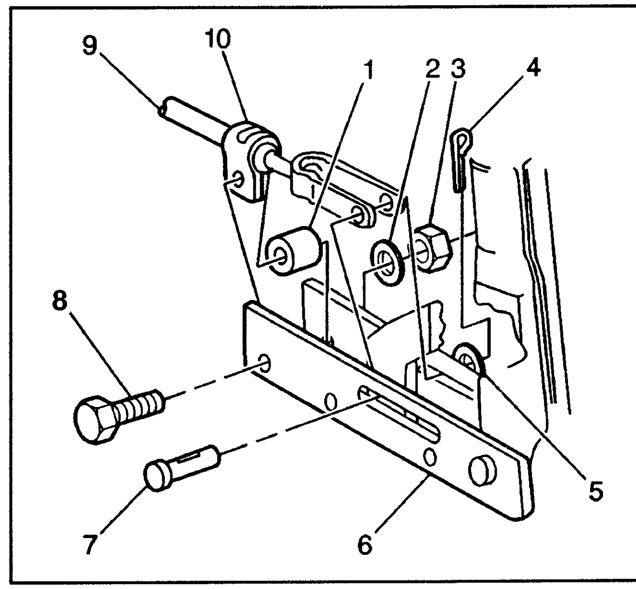
5. Remove the cotter pin (4) and the washer (5).
6. Remove the clevis pin (7).
7. Remove the cable to parking brake lever nut and washer.
8. Remove the cable to parking brake lever bolts.
9. Remove the spacer (1).
10. Remove the cable (9).
11. Remove the lever assembly (6).

Installation Procedure

1. Install the lever assembly (6).
2. Install the cable (9).
3. Install the clevis pin (7).
4. Install the washer (5) and the cotter pin (4).
5. Install the spacer (1).
6. Install the cable to parking brake lever bolt.
7. Install the washer and cable to the parking brake lever nut.



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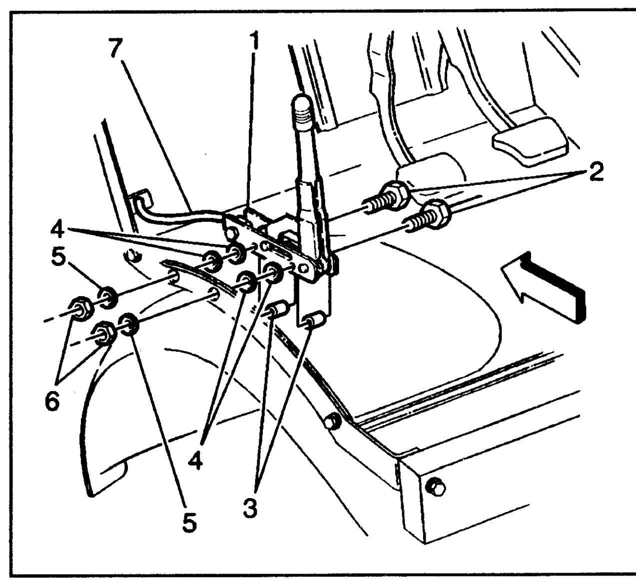
8. Install the spacers (3).
9. Install the washer (4) and the parking brake pedal to floor bolts (2).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

10. Install the washers (5) and the parking brake pedal to floor nuts (6).

    Tighten

    - Tighten the parking brake to floor nuts to 25 N·m (18 lb ft).
    - Tighten the parking brake lever to cowl nuts to 25 N·m (18 lb ft).



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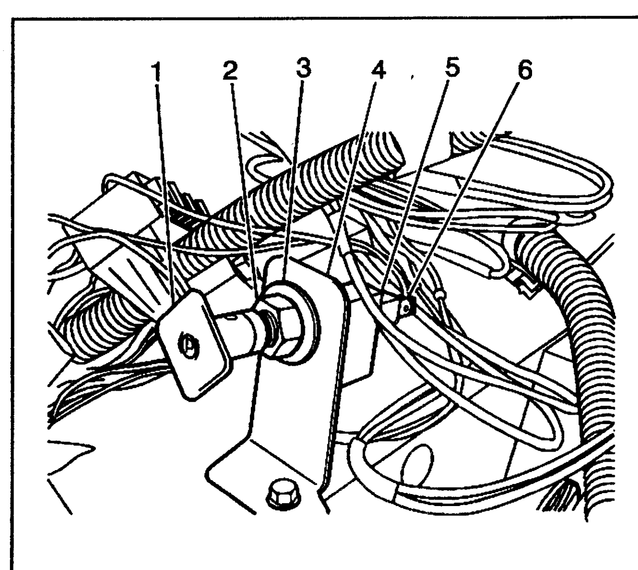
Park Brake Pull Switch Replacement

Removal Procedure

1. Disconnect the electrical connector (6) from the back of the pull switch (5).
2. Remove the pull switch knob retaining pin by using a small hammer and a small drift punch. Gently drive the pin out.
3. Slide the pull switch knob (1) off of the shaft.
4. Remove the pull switch mounting nut (2) and washer (3).
5. Remove the pull switch (5) by sliding it out the back of the mounting bracket (4).



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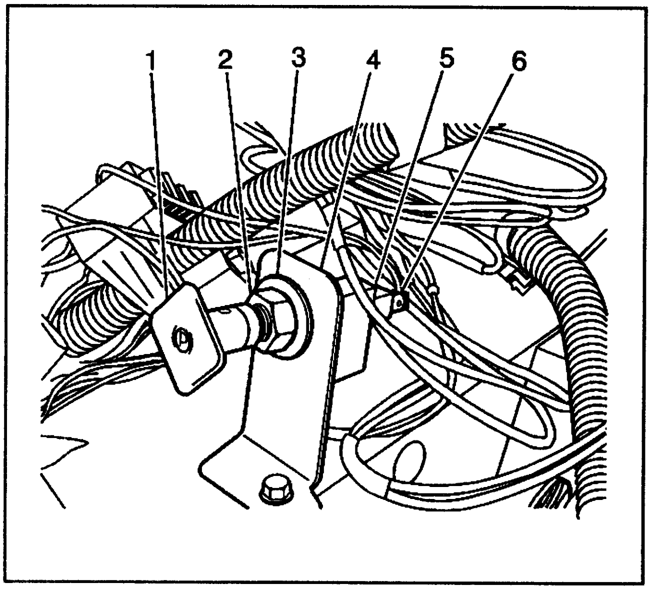

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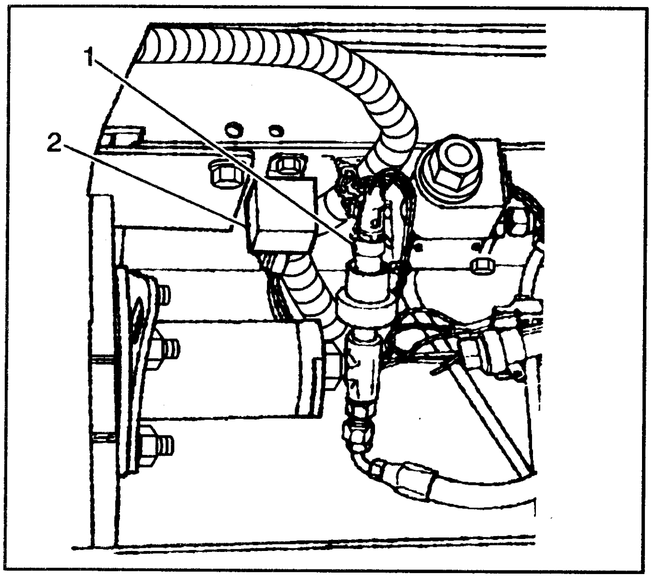
Installation Procedure

1. Install the pull switch (5) into the mounting bracket (4).
2. Install the pull switch washer (3) and mounting nut (2).

   Tighten

   Tighten the pull switch mounting nut (2) to 3 N·m (27 lb in).
3. Install pull switch knob (1) by sliding it onto the pull switch shaft.
4. Install the pull switch knob retaining pin by using a small hammer and a small drift punch. Gently drive the pin in.



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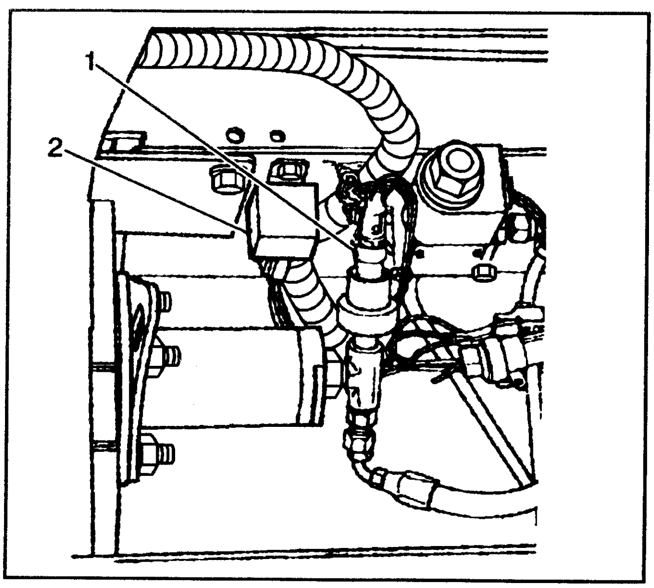
Park Brake Warning Lamp Switch Replacement

Removal Procedure

1. Move the column shift lever to the PARK position and apply the manual parking brake.
2. Position a drain pan to catch the fluid that leaks out. Do not reuse the old fluid.
3. Remove the access panel on the inboard side of the component box.
4. Remove the pressure indicator electrical connector.
5. Remove the switch (1).



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Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the pressure indicator switch (1).

   Tighten

   Tighten the switch to 12 N·m (106 lb in).
2. Install the switch electrical connector.
3. Install the access panel on the inboard side of the component box.

   Tighten

   Tighten the access panel fasteners to 12 N·m (106 lb in).
4. Release the manual parking brake.
5. Check the operation of the AUTO PARK lamp.

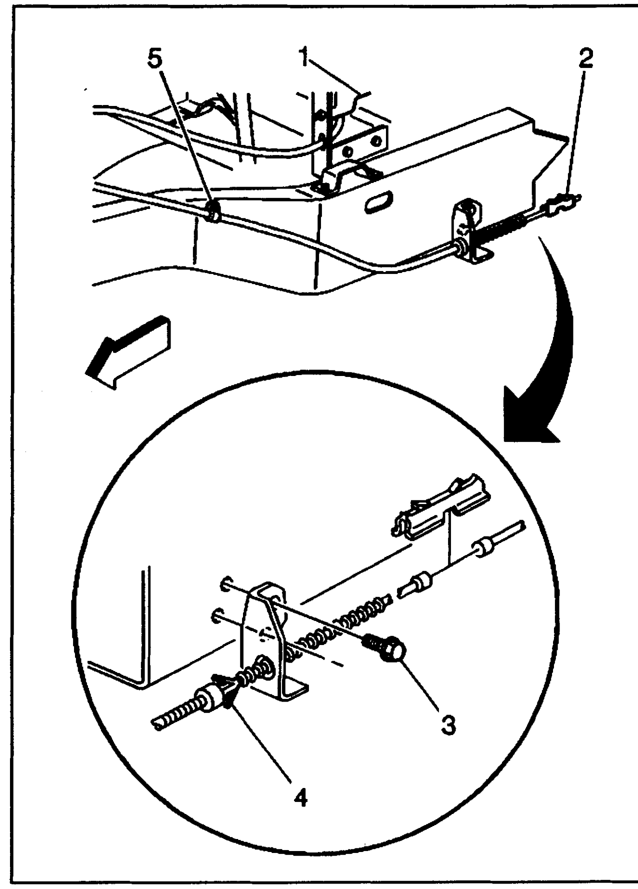
Park Brake Cable Inspection

Check the parking brake system for free operation. The brake lever or pedal must return to the released position without sticking or binding. If a problem is present, check the cable routings for kinks or binding.

Park Brake Cable Replacement (Front Pedal Type)

Removal Procedure

1. Raise the vehicle and support the vehicle with safety stands. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Disconnect the nut from the equalizer.
3. Remove the connector (2).
4. Disconnect the cable from the frame bracket. Bend the retaining fingers (4).
5. Disconnect the cable from the pedal assembly (1).
6. Remove the retainer clip bolts and the retainer clips (5).



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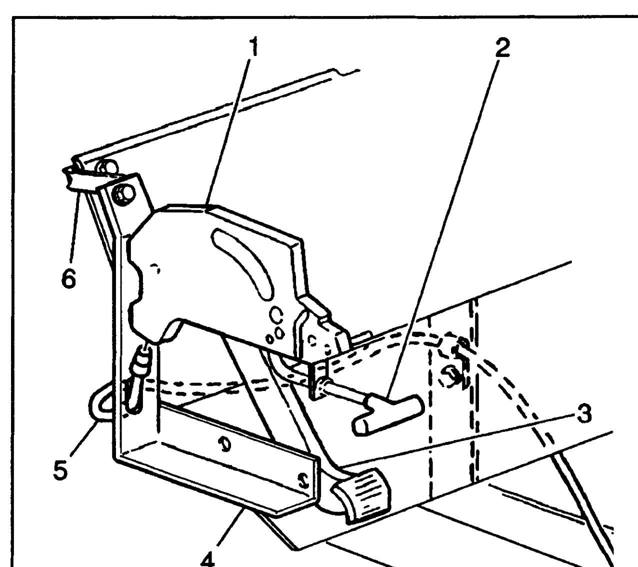
7. Remove the cable assembly (5). Attach a piece of wire to the cable to help in the installation.



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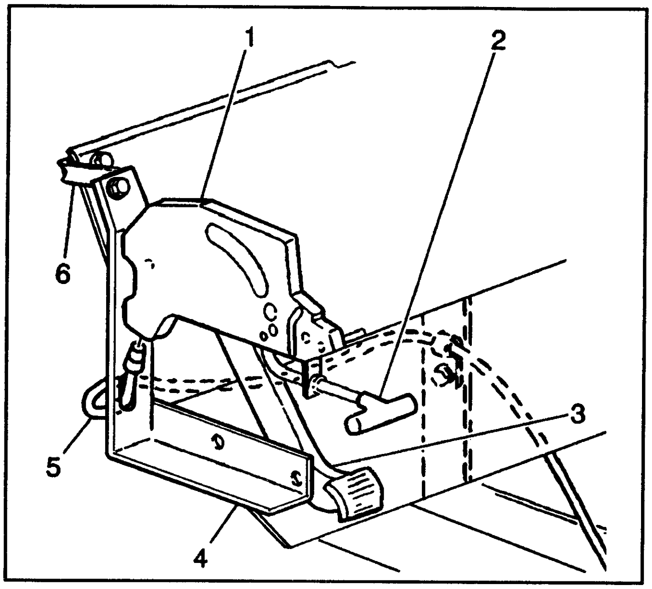
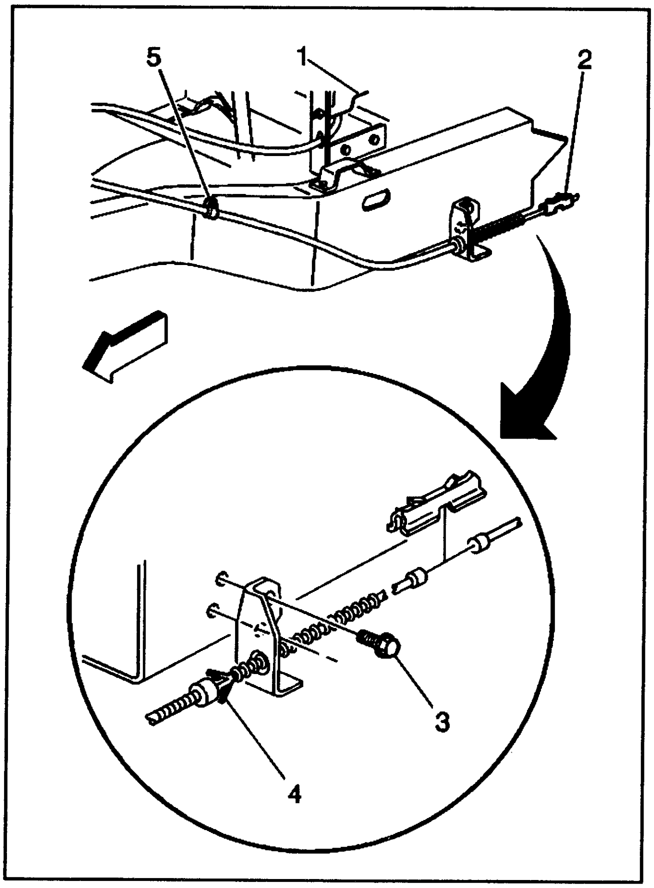


176193

Installation Procedure

1. Install the cable assembly (5). Ensure the retaining fingers are completely through the holes. Bend the retainers back into place.



491760

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the retainer clips (5) and the retainer clip bolts.

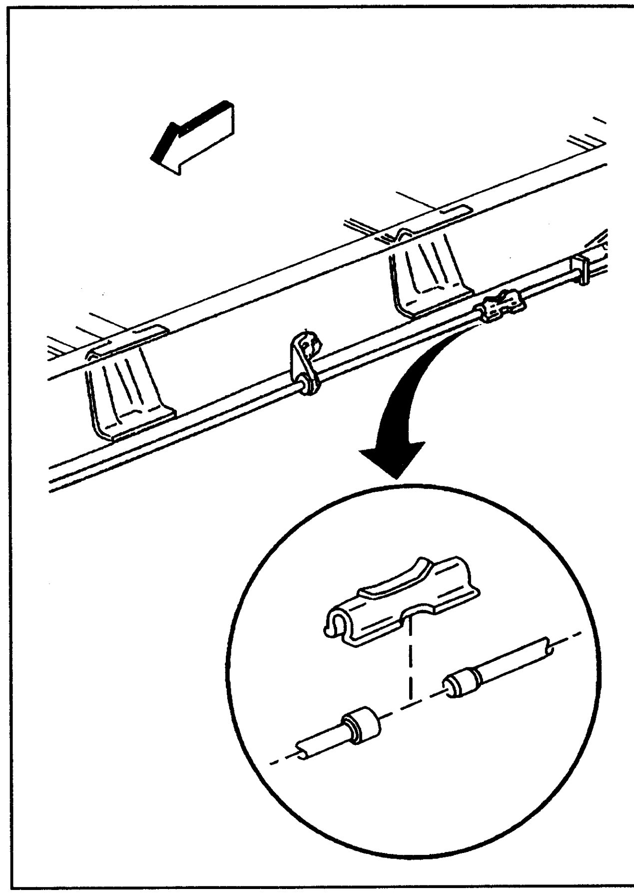
   Tighten

   Tighten the retainer clip bolts to 17 N·m (13 lb ft).
3. Connect the cable (5) to the pedal assembly.
4. Connect the cable to the frame bracket.
5. Install the connector (2).
6. Connect the nut to the equalizer.
7. Adjust the parking brake. Refer to *Park Brake Cable Service/Adjustment (Mechanical Park Brake).*
8. Lower the vehicle.

Park Brake Cable Replacement (Front Lever Type)

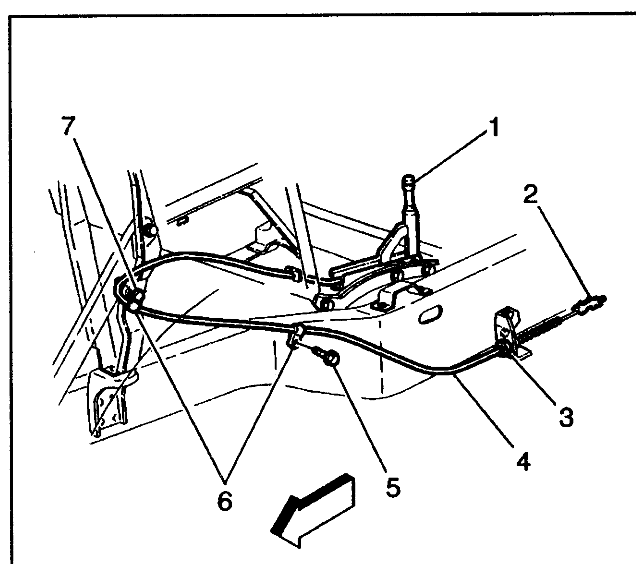
Removal Procedure

1. Raise the vehicle and support the vehicle with safety stands. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the nut from the equalizer.
3. Remove the connector.
4. Remove the retainer clip bolts and retainer clips.



176301

5. Disconnect the cable from the lever assembly (1).
6. Remove the retaining fingers (3).
7. Remove the cable assembly (4). Attach a piece of wire to the cable to help in the installation.



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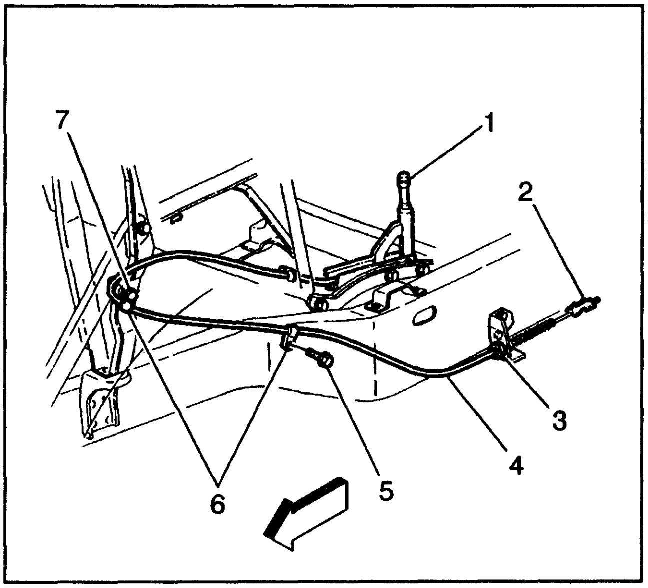


176162

Installation Procedure

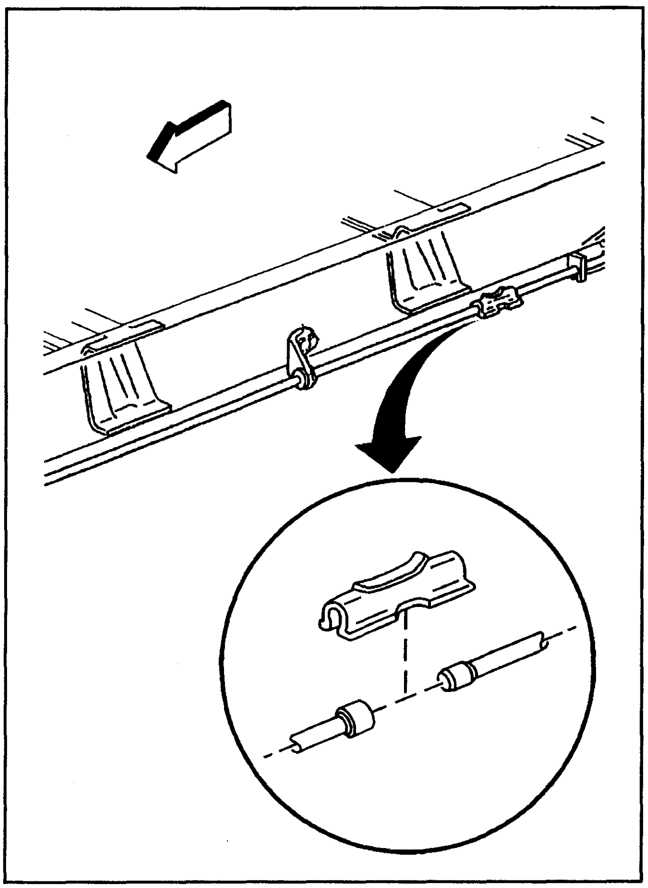
1. Install the cable assembly (4).
2. Install the retaining fingers (3).
3. Connect the cable to the lever assembly (1).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the retainer clips and the retainer clip bolts.

   Tighten

   Tighten the retainer clip bolts to 17 N·m (13 lb ft).



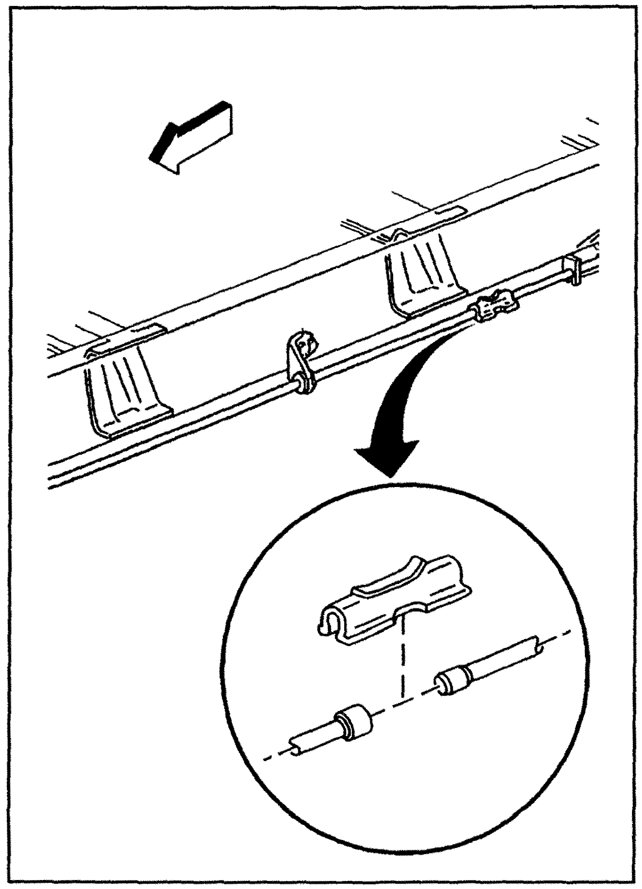
176301

5. Install the connector.
6. Install the nut to the equalizer.
7. Adjust the parking brake. Refer to *Park Brake Cable Service/Adjustment (Mechanical Park Brake).*
8. Lower the vehicle.

Park Brake Cable Replacement (Center)

Removal Procedure

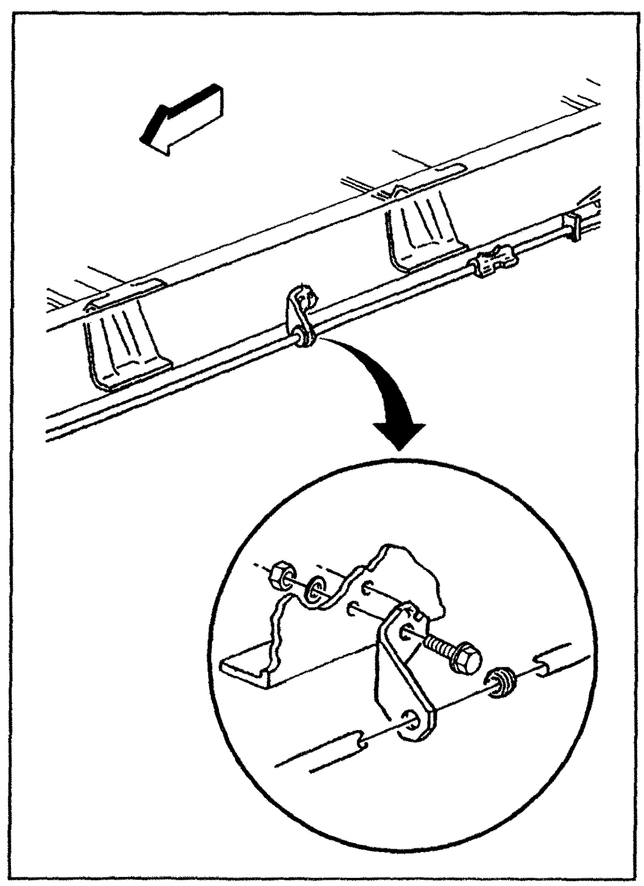
1. Raise the vehicle and support the vehicle with safety stands. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the nut from the equalizer.
3. Remove the front and rear connectors.
4. Remove the cable through the guide grommets.



176301

Installation Procedure

1. Install the cable through the guide grommets.



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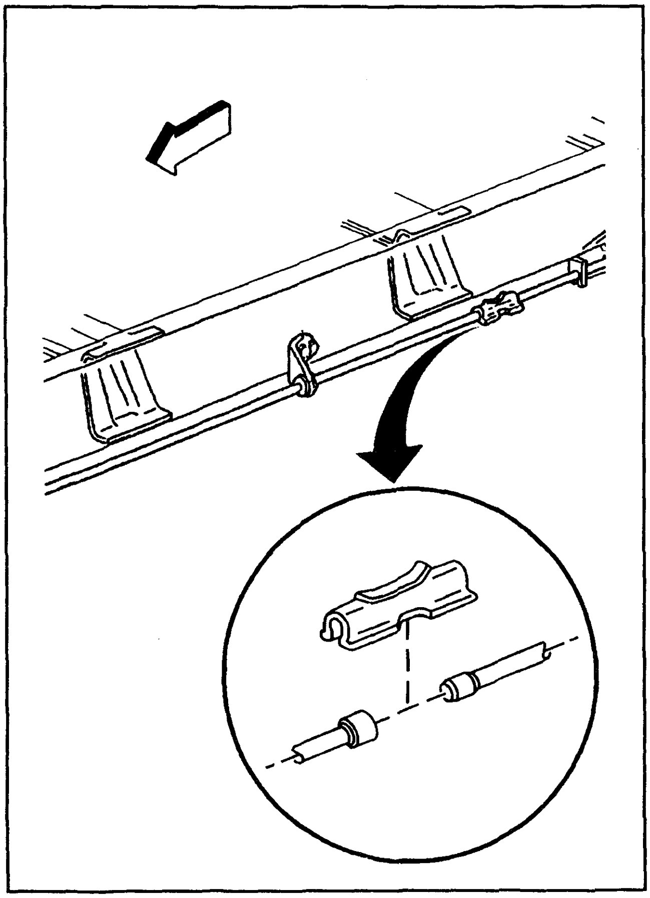

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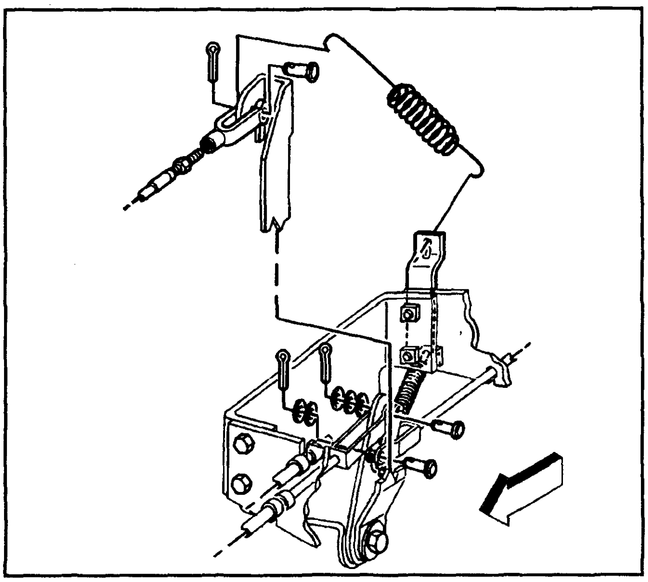


176187

2. Install the connectors (2,3,4,5).
3. Install the nut to the equalizer.
4. Adjust the parking brake. Refer to *Park Brake Cable Service/Adjustment (Mechanical Park Brake).*
5. Lower the vehicle.

Park Brake Cable Replacement (Actuator)

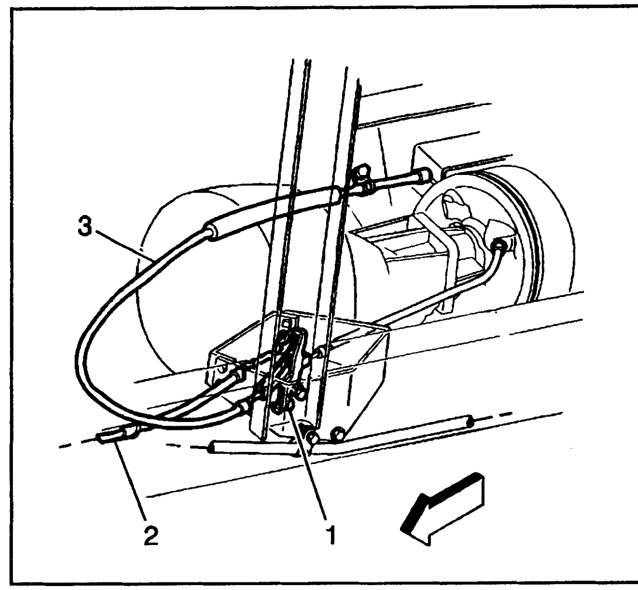
Removal Procedure

Important: If the actuator will hold pressure, place the vehicle in neutral and turn the ignition to the ON position. This will release the load on the cable. Disconnect the cable at the relay lever. Shift the vehicle into park and turn the ignition to the OFF position. Proceed with the procedures below.

Caution: If the actuator will not hold pressure, do not unthread the parking brake cable from the actuator piston. The cable is under tension and unthreading the cable will cause the cable to spring and can result in personal injury.

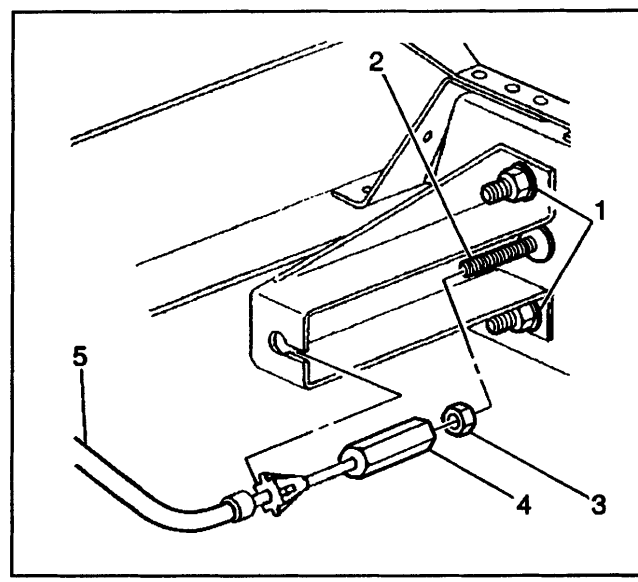
1. If the actuator will not hold pressure, move the column shift lever to the park position. If the actuator will hold pressure, move the column shift lever to the neutral position and turn the ignition switch ON.
2. Raise the vehicle and support the vehicle with safety stands. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Remove the cotter pin and the washers.
4. Remove the clevis pin and remove cable from relay lever.

5. Remove the cable from the relay lever (1) and bracket if the actuator holds pressure. Otherwise, cut the parking brake cable with a bolt cutter.
6. Remove the bolt which secures a cable clip to the frame.



176191

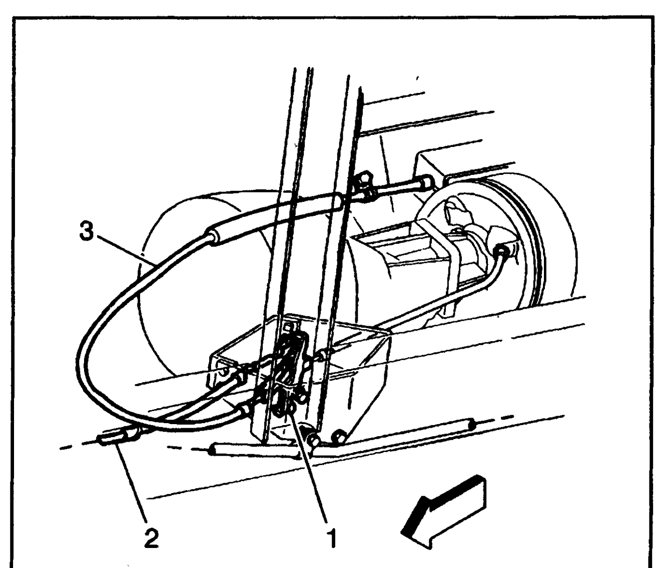
7. Disconnect the parking brake cable (5) by removing the cable fitting (4) and the jamb nut (3) from the actuator rod (2).



410088

Installation Procedure

1. Connect the actuator cable (3) to the relay lever.



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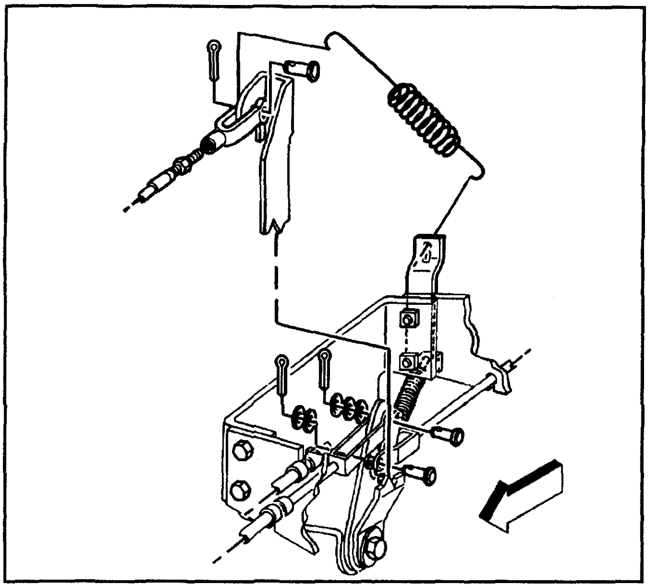


176187

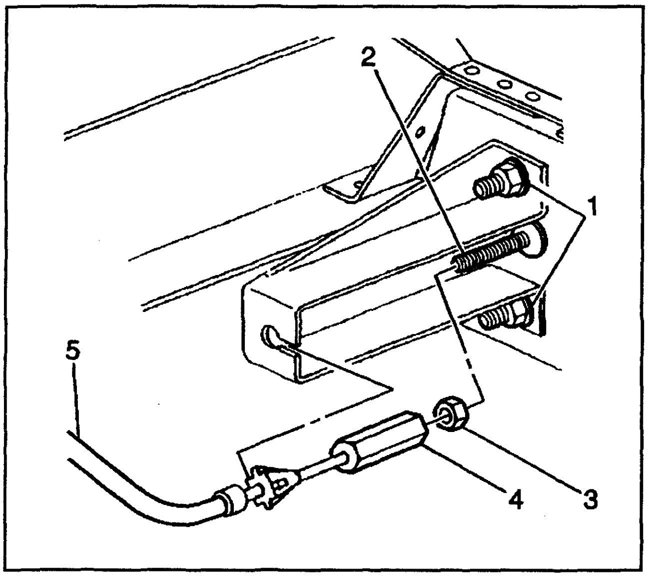
2. Install the clevis pin, the washers and the cotter pin.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the frame clip bolt to secure the cable and install the straps to secure the cable.

   Tighten

   Tighten the frame clip bolt to 8 N·m (71 lb in).

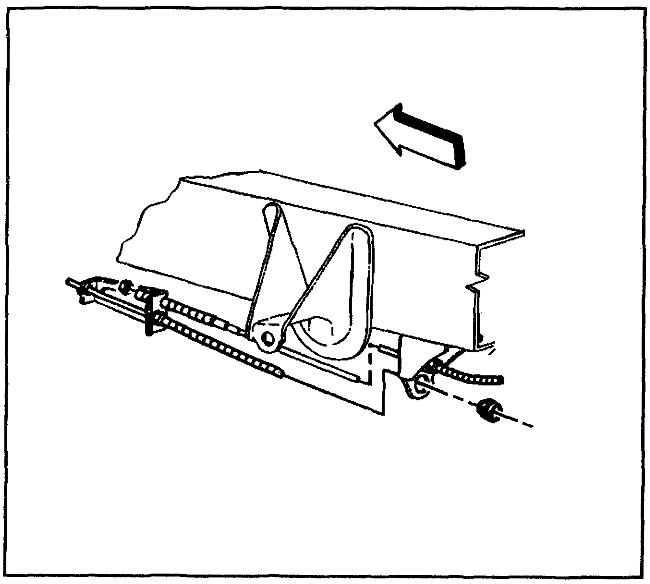


410088

4. Connect the cable (5) to the actuator bracket.
5. Connect the cable fitting (4) and the jamb nut (3) to the actuator piston rod (2).
6. Install the jamb nut against the cable fitting to obtain between 30–37 mm (1.20–1.44 in) travel.

   Tighten

   Tighten the jamb nut to 45 N·m (33 lb ft).
7. Adjust the parking brake. Refer to *Park Brake Cable Service/Adjustment (Electric Auto Park Brake).*
8. Lower the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.



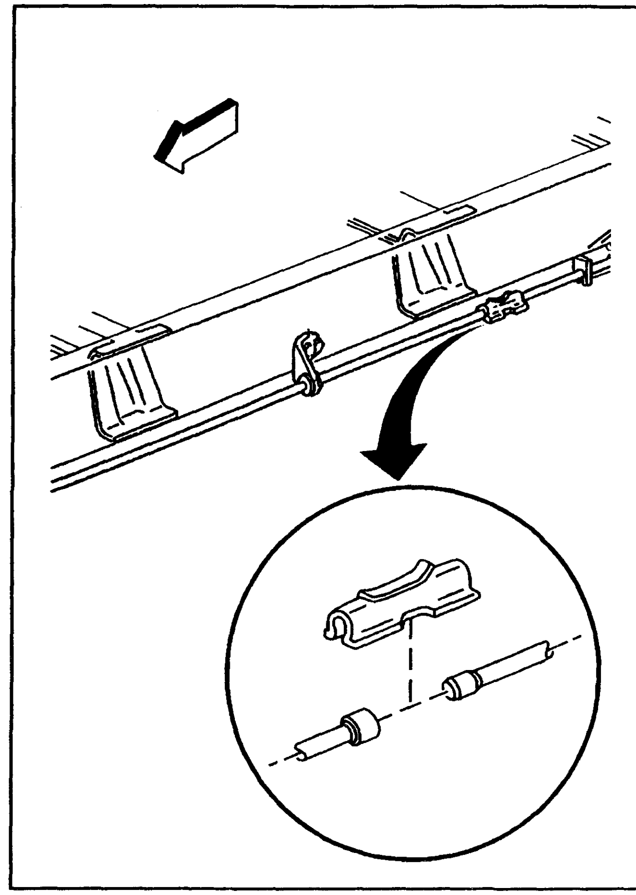
411342

Park Brake Cable Replacement (Rear)

Removal Procedure

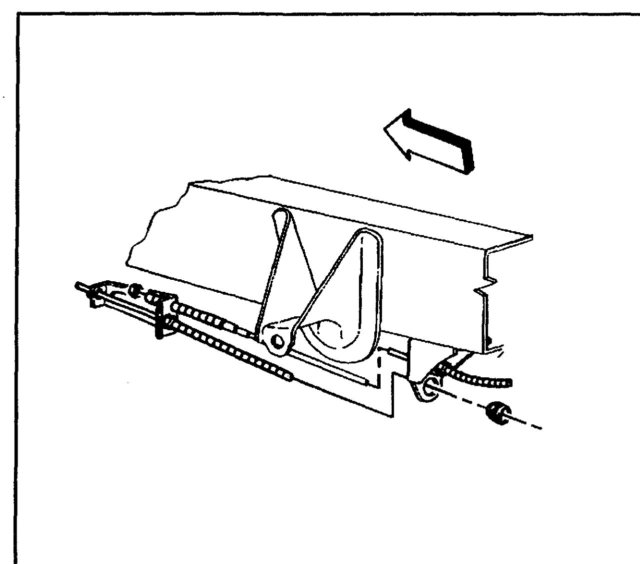
1. Raise the vehicle and support the vehicle with safety stands. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Mark the position of RH rear cable nut at the equalizer and remove the nut.

3. Remove the connector.



176301

4. Disconnect the LH cable from the equalizer and frame bracket, and the RH cable from the frame bracket.



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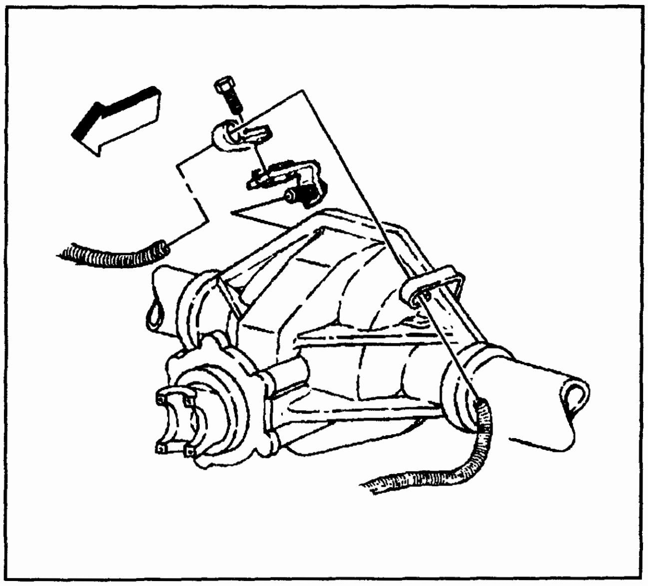
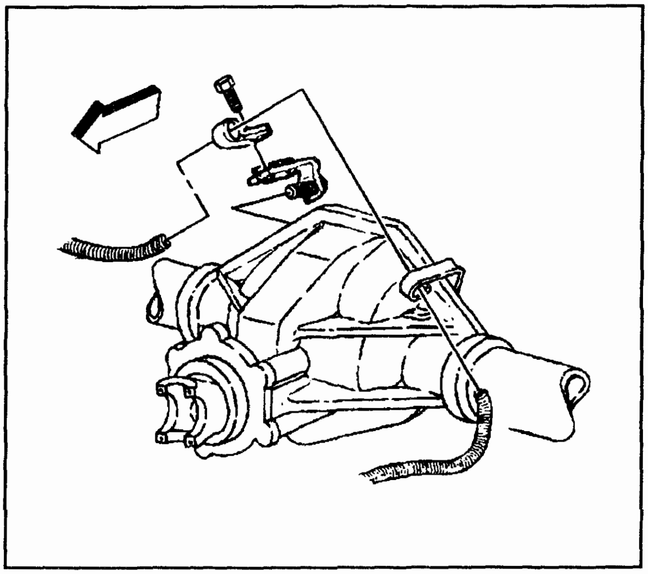


411346

5. Disconnect the RH cable from the axle brackets.
6. Remove the RH and LH rear brake hub and drum assemblies and disconnect the parking brake cable from each brake side. Refer to *Brake Drum Replacement* in Drum Brakes.
7. Remove the retaining clips.
8. Remove the cable assemblies.



411346

Installation Procedure

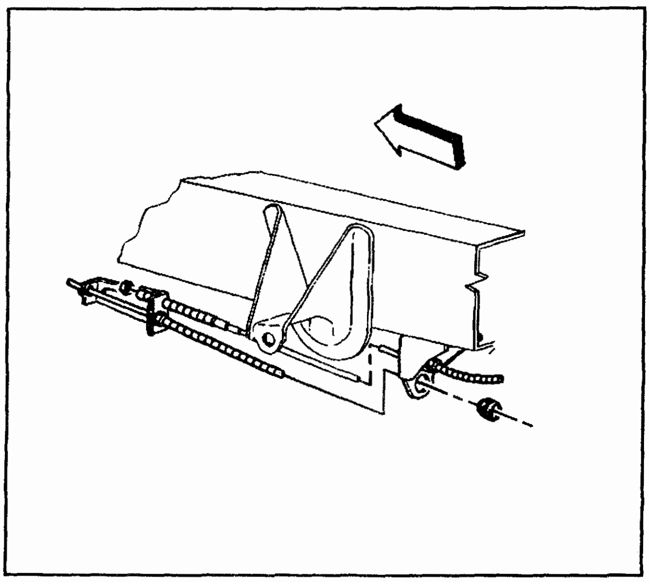
1. Install the cable assemblies to each brake side. Make sure all of the retaining fingers are completely through the backing plate.
2. Install the retaining clips.
3. Install the hub and drum assembly on each side. Refer to *Brake Drum Replacement* in Drum Brakes.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Rout the RH rear cable through the clip on the rear axle bracket and tighten the bolt to secure the clip to the bracket.

   Tighten

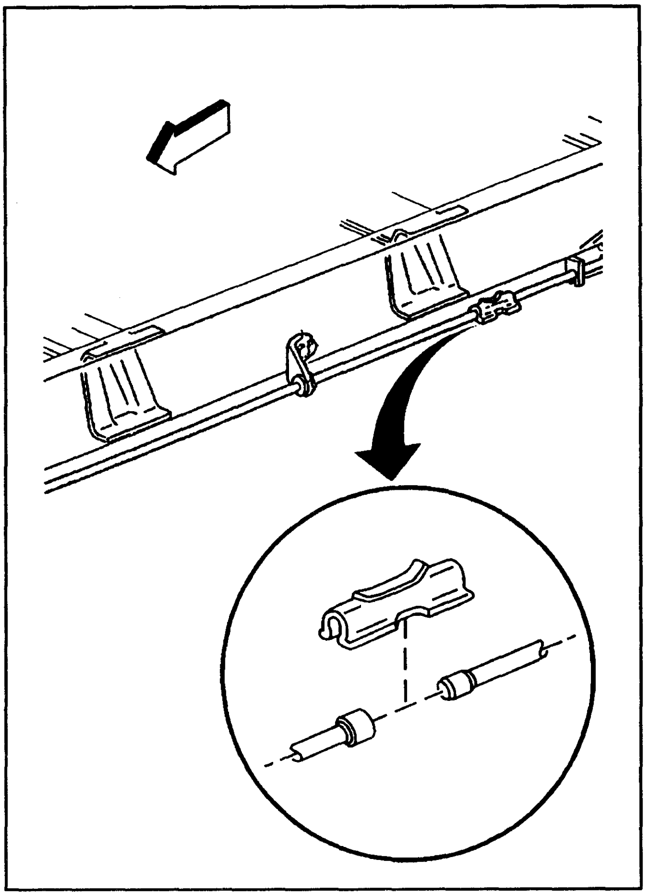
   Tighten the bolt to 31 N·m (23 lb ft).



411342

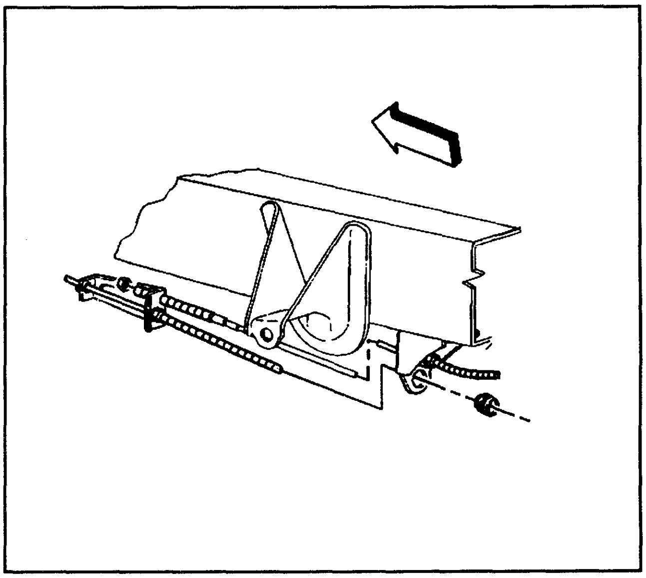
5. Rout and secure the RH and LH cables through the side member bracket and the equalizer.

6. Install the connector.



176301

7. Install the RH cable nut at the equalizer to the previously marked position.
8. Check the parking brake adjustment. Refer to *Park Brake Cable Service/Adjustment (Mechanical Park Brake).*
9. Lower the vehicle.



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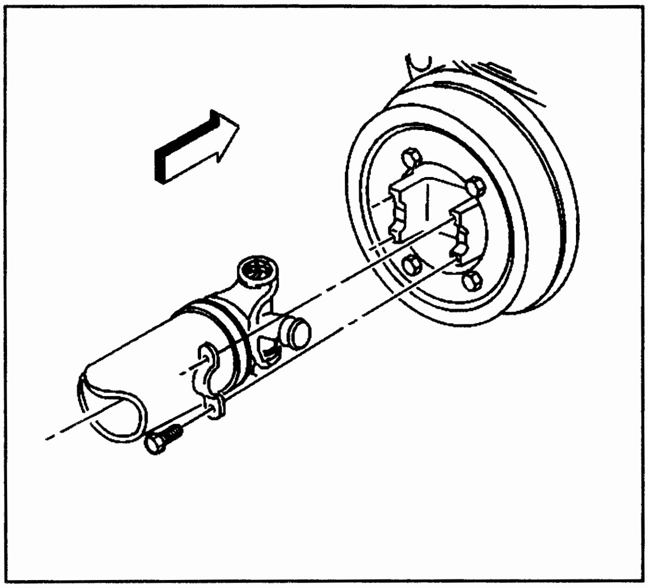


258710

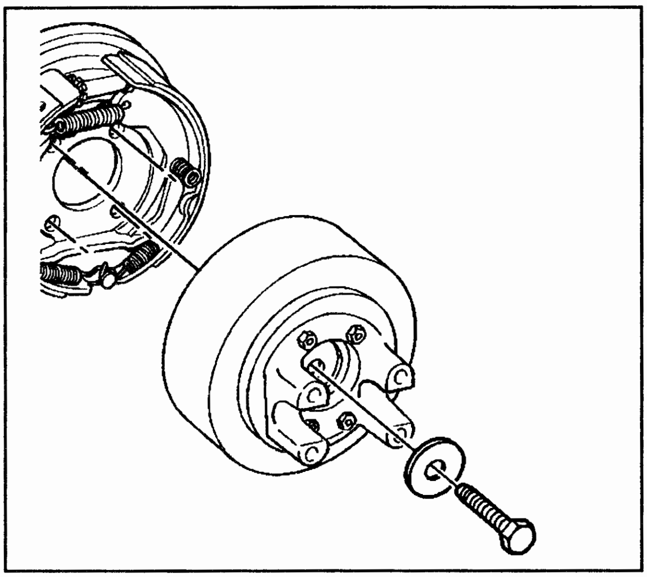
Brake Drum Replacement

Removal Procedure

1. Raise the vehicle and support the vehicle with safety stands. Refer to *Lifting and Jacking the Vehicle* in General Information.

Important: Ensure the park brake is released.

2. Remove the propeller shaft. Refer to *Two-Piece Propeller Shaft Replacement* or *Three-Piece Propeller Shaft Replacement.*



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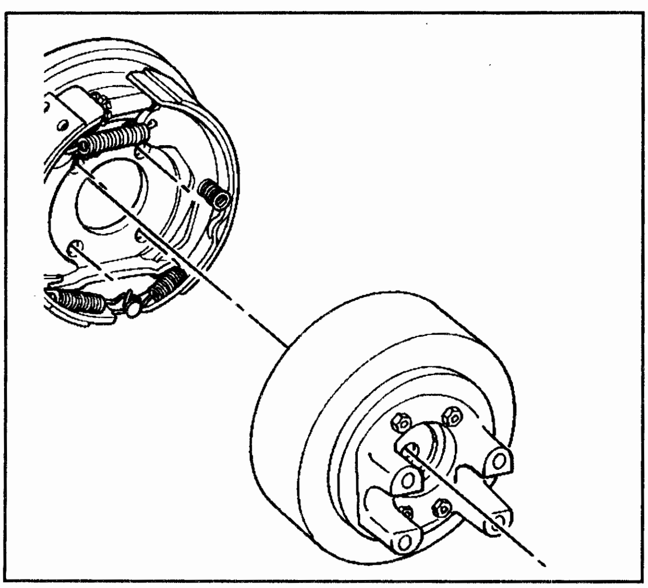
Important: Cap the end of the transmission in order to minimize fluid loss.

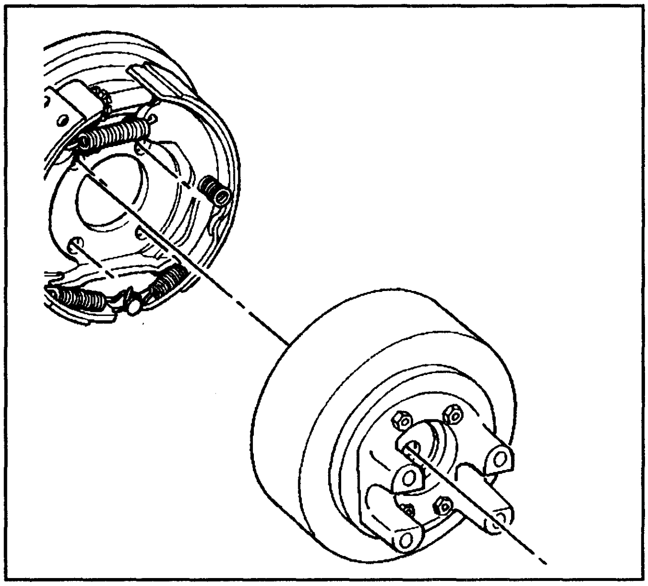
3. Remove the parking brake drum and yoke assembly mounting bolt and washer.



258760

4. Remove the brake drum and yoke assembly.
5. Remove the yoke from the drum assembly.
6. Inspect the yoke ears for damage and the splines for the following damage:
   - Wear
   - Burrs
   - Twisting

Installation Procedure



258760

Notice: Refer to *Fastener Notice* in Cautions and Notices.

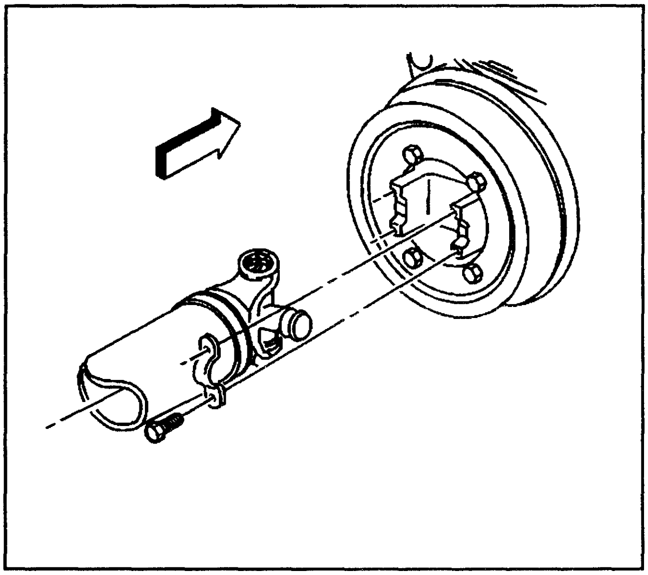
1. Install the bolts and washers holding the drum assembly to the yoke.

   Tighten

   Tighten the bolts and washers to 58 N·m (43 lb ft).
2. Install the parking brake drum and yoke assembly.

   Tighten

   Tighten the bolt to 110 N·m (81 lb ft).



258710

3. Install the propeller shaft. Refer to *Two-Piece Propeller Shaft Replacement* or *Three-Piece Propeller Shaft Replacement.*
4. Adjust the parking brake. Refer to *Park Brake Cable Service/Adjustment (Mechanical Park Brake).*
5. Lower the vehicle.

Brake Drum Inspection

When you remove the drum brake, thoroughly clean and inspect the drum for the following problems:

- Cracks
- Deep grooves
- Scores
- Out-of-round

Surface Finish

Slight scoring can be cleaned up with a fine emery cloth. Heavy or extensive scoring causes excessive brake lining wear. The drum braking surface will need machining to remove these scores.

If the drum is grooved and the brake linings are slightly worn, do not machine the drum. Instead, polish the drum braking surface with a fine emery cloth. Eliminating all of the drum grooves and the ridges on the lining would require removing too much metal and lining material. The grooves and the ridges match and satisfactory service can be obtained by leaving them alone.

Inside Diameter Check

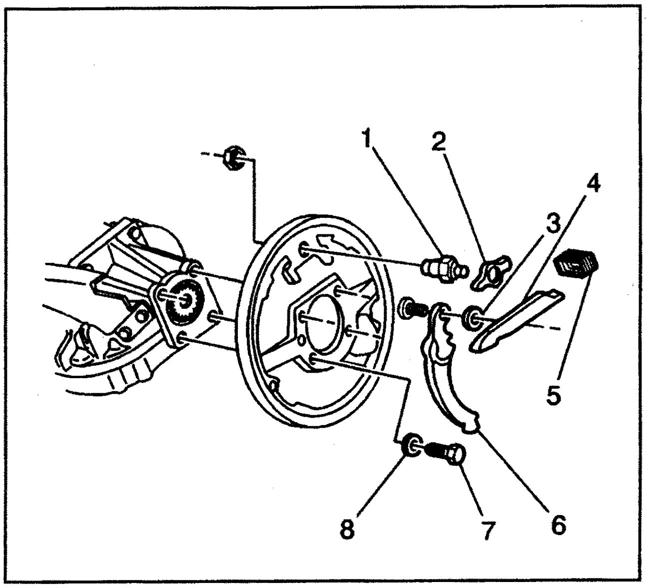
Measure the inside diameter of the brake drum at two or more places around the circumference of the braking surface. The measurements must be made at the same distance in from the edge of the drum.

Taper Check

Measuring a drum for taper involves taking measurements at the inner and the outer edges of the machined surface at two or more places around the drum. These measurements should be equal.

Backing Plate Replacement

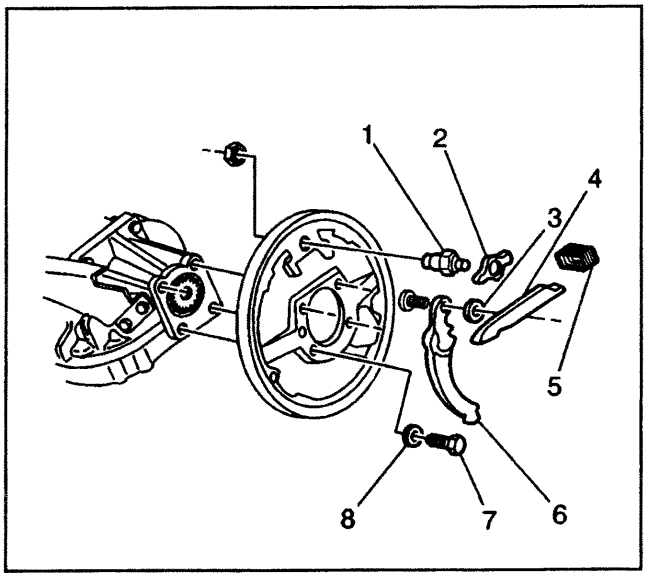
Removal Procedure



176294

1. Remove the drum. Refer to *Brake Drum Replacement.*
2. Remove the linings. Refer to *Park Brake Shoe Replacement.*
3. Remove the backing plate mounting bolts (7) and washers (8).
4. Remove the backing plate.
5. Remove the anchor pin mounting nut and the anchor pin (1).

Installation Procedure



176294

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the anchor pin (1) and the anchor pin mounting nut.

   Tighten

   Tighten the anchor pin mounting nut to 200 N·m (148 lb ft).
2. Install the backing plate).
3. Install the backing plate mounting bolts (7) and washers (8).

   Tighten

   Tighten the backing plate mounting bolts to 41 N·m (30 lb ft).
4. Install the linings. Refer to *Park Brake Shoe Replacement.*
5. Install the drum. Refer to *Brake Drum Replacement.*
6. Adjust the parking brake. Refer to *Park Brake Cable Service/Adjustment (Mechanical Park Brake).*

Service Precautions

Caution: This system operates using fluid pressure up to 12 400 kPa (1800 psi). Some malfunctions can cause this pressure to be trapped in the system. Use caution when loosening pipe fittings on a system that does not work or personal injury can result.

Caution: Do not disassemble the actuator. Always service the actuator as a unit. The actuator contains a large spring under tension. Disassembling the actuator allows the spring to expand with great force, which can result in personal injury.

Caution: If the parking brake applies due to an electrical system failure, activate the parking brake by pulling out the parking brake switch before exiting the vehicle. Failure to do so can result in the parking brake releasing when the electrical system is repaired. This can allow the vehicle to move and cause personal injury.

The electric/auto parking brake system is basically maintenance free. When doing work on this system, the following must be observed:

- Before doing welding work on the vehicle with an electric welding unit, turn the ignition switch OFF and disconnect the PCM connector.
- Do not use a fast charger for starting the engine.
- Disconnect the negative battery cable when fast charging. Refer to *Battery Charging* in Engine Electrical.
- Never disconnect the battery from the vehicle electrical system with the engine running.
- Make sure all the wiring harness connectors are securely connected.
- Proper system operation can only be achieved if the system is restored to its original equipment condition. Always note the routing, position, mounting, and location of the following parts when servicing the system:
  - Components
  - Wiring
  - Connectors
  - Clips
  - Brackets
  - Brake pipes
- The above mentioned items do not cover every possibility, but must be followed when working on the electric/auto parking brake system. When doing service work, become familiar with the system, and how the system interrelates with other components on the vehicle.

Checking and Adding Park Brake Fluid

Check the fluid with the engine off and the transmission in PARK.

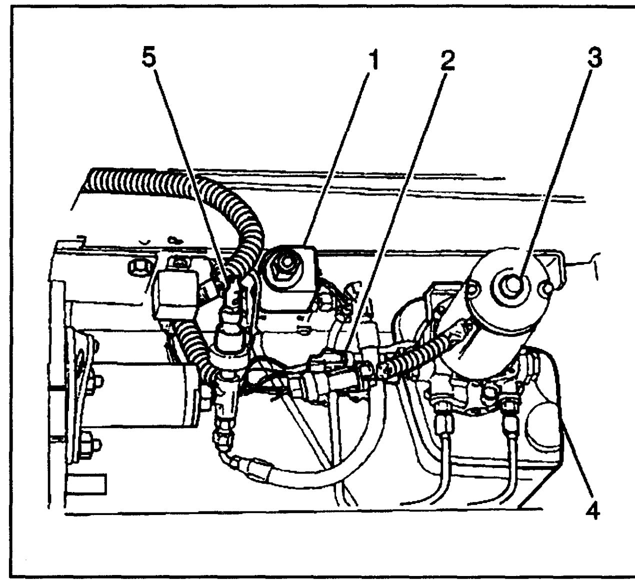
1. Clean away any dirt around the opaque plastic reservoir.
2. Inspect the fluid level. The fluid level should be even with the fill marks on the side of the reservoir.
3. If the fluid level is low, clean around and remove the reservoir cap.
4. Add Dexron® III transmission fluid.
5. Install the cap.

Park Brake Pump Replacement

Removal Procedure

Notice: When replacing any hydraulic components, the hydraulic system should be flushed with Dexron® III transmission fluid. This is to ensure that the hydraulic system is free of contaminants such as metal particles that may have been circulated through the system as a result of a component failure.

1. Move the column shift lever to park and apply the manual parking brake.
2. Position a drain pan to catch the fluid that leaks out. Do not reuse the old fluid.
3. Access the panel on the inboard side of the component box.
4. Remove the parking brake pump motor assembly electrical connector.
5. Remove the pressure indicator switch (5) electrical connector.
6. Remove the hydraulic pipes from the solenoid valve (1).
7. Remove the parking brake pump motor assembly (3) mounting bolts.
8. Remove the parking brake pump motor assembly.
9. Remove the pressure indicator switch (2) from parking brake pump motor assembly (1).



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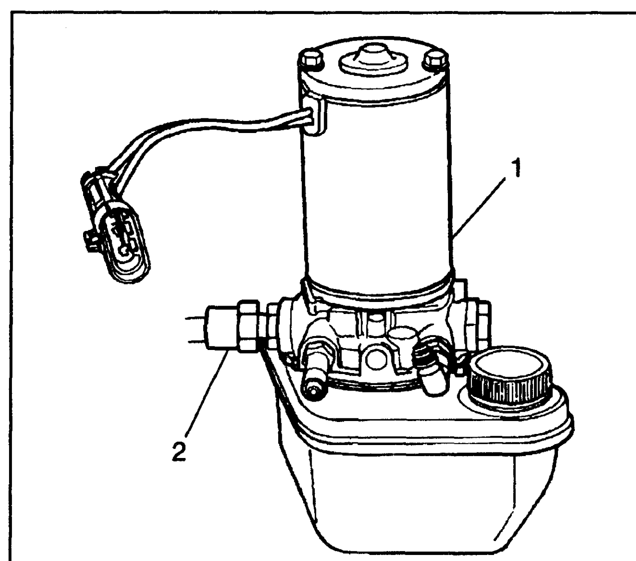

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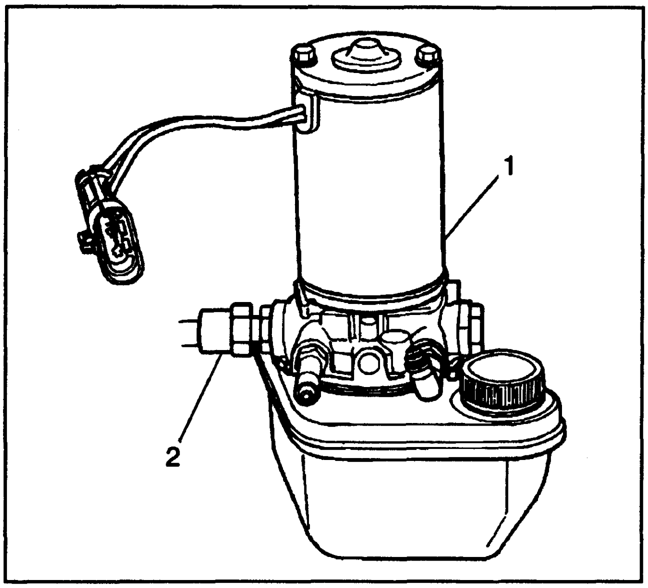


29075

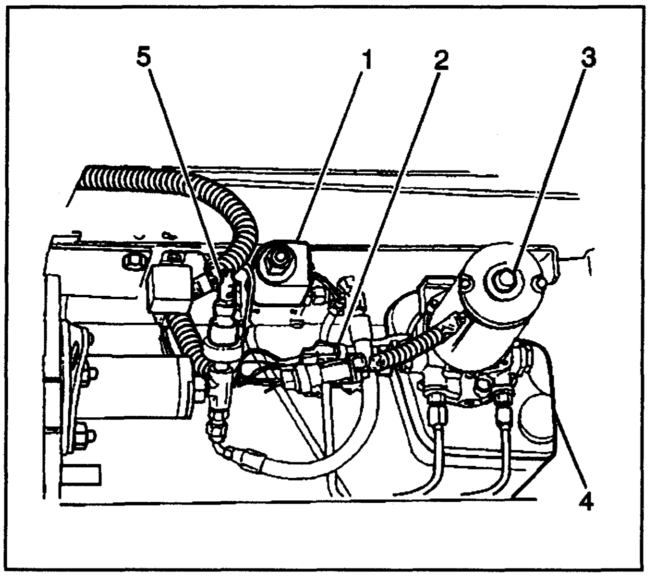
Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Connect the pressure indicator switch (2) to the parking brake pump motor assembly (1).

   Tighten

   Tighten the switch to 12 N·m (106 lb in).



412347

2. Install the parking brake pump motor assembly (3).
3. Install the parking brake pump motor assembly mounting bolts.

   Tighten

   Tighten parking brake pump motor assembly mounting bolts to 37 N·m (27 lb ft).
4. Install the hydraulic pipes.

   Tighten

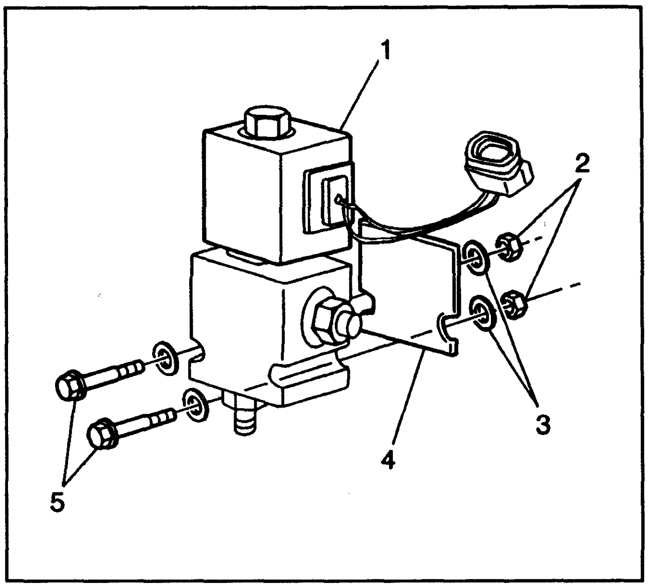
   Tighten the hydraulic pipe fittings to 16 N·m (12 lb ft).
5. Install the pressure indicator switch (5) electrical connector.
6. Install the parking brake pump motor assembly (3) electrical connector.
7. Install the access panel on the inboard side of the component box.

   Tighten

   Tighten the access panel fasteners to 12 N·m (106 lb in).
8. Fill the pump motor reservoir (4) with Dexron® III transmission fluid.
9. Cycle the system at least six times.
10. Turn the ignition switch ON and move the shift lever from Park to Neutral.
11. Check the fluid level. Refer to *Checking and Adding Park Brake Fluid.*
12. Release the manual parking brake.

Park Brake Solenoid Valve Replacement

Removal Procedure

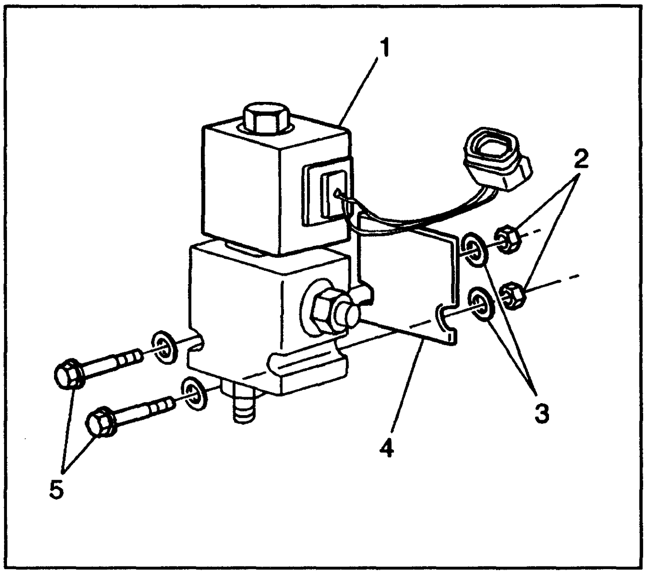


176180

Notice: When replacing any hydraulic components, the hydraulic system should be flushed with Dexron® III transmission fluid. This is to ensure that the hydraulic system is free of contaminants such as metal particles that may have been circulated through the system as a result of a component failure.

1. Move the column shift lever to the park position and apply the manual parking brake.
2. Remove the access panel on the inboard side of the component box.
3. Remove the parking brake solenoid valve electrical connector.
4. Position a drain pan to catch the fluid that leaks out. Do not reuse the old fluid.
5. Remove the hydraulic pipes and hose from the solenoid valve (1) and the pump assembly.
6. Remove the parking brake solenoid valve mounting spacer (4) nuts (2), washers (3), bolts (5), and pipe fittings.
7. Remove the parking brake solenoid valve (1).

Installation Procedure



176180

1. Connect the hydraulic fittings to the solenoid valve (1).
2. Install the parking brake solenoid valve (1).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the parking brake solenoid valve mounting spacer (4) nuts (2), washers (3), and bolts (5).

   Tighten

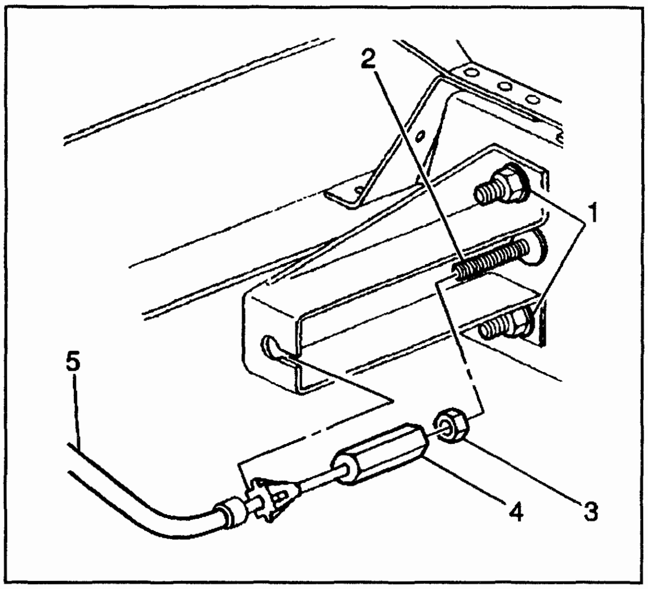
   Tighten the parking brake solenoid valve mounting nuts to 13 N·m (115 lb in).
4. Install the hydraulic pipes and hose.

   Tighten

   Tighten the hydraulic pipe fittings to 16 N·m (12 lb ft).
5. Install the parking brake solenoid valve electrical connector.
6. Install the access panel on the inboard side of the component box.

   Tighten

   Tighten the access panel fasteners to 12 N·m (106 lb in).
7. Cycle the system at least six times. (Turn the ignition switch ON and move the shift lever from PARK to NEUTRAL.) Check the fluid level. Refer to *Checking and Adding Park Brake Fluid.*
8. Release the manual parking brake.



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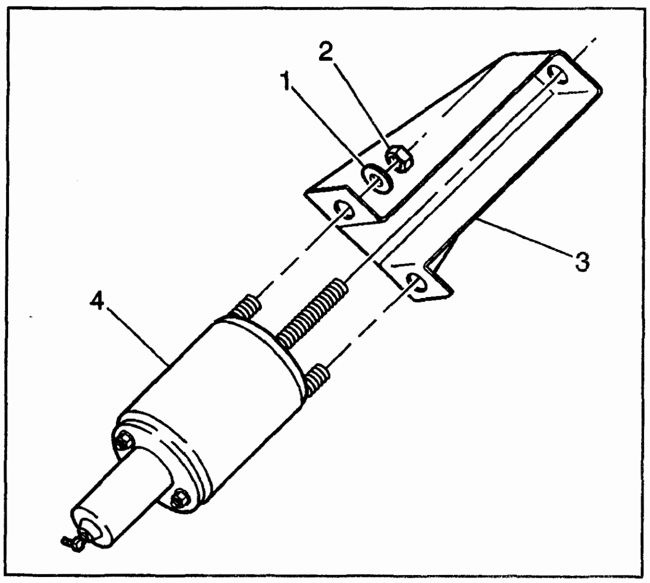

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Park Brake Actuator Replacement

Removal Procedure

Caution: Do not disassemble the actuator. Always service the actuator as a unit. The actuator contains a large spring under tension. Disassembling the actuator allows the spring to expand with great force, which can result in personal injury.

Caution: If the actuator will not hold pressure, do not unthread the parking brake cable from the actuator piston. The cable is under tension and unthreading the cable will cause the cable to spring and can result in personal injury.

Notice: When replacing any hydraulic components, the hydraulic system should be flushed with Dexron® III transmission fluid. This is to ensure that the hydraulic system is free of contaminants such as metal particles that may have been circulated through the system as a result of a component failure.

1. If the actuator will not hold pressure, move the column shift lever to the PARK position and apply the manual parking brake.

   If the actuator will hold pressure, move the column shift lever to the NEUTRAL position with the ignition ON. Apply the manual parking brake.
2. Position a drain pan to catch the fluid that leaks out. Do not reuse the old fluid.
3. Remove the access panel on the inboard side of the component box.
4. Remove the parking brake cable (5).
   - If the actuator will not hold pressure, cut the parking brake cable with a bolt cutter.
   - If the actuator will hold pressure, disconnect the cable at the relay lever and move the shift lever to the park position.
5. Remove the cable fitting (4) and the jam nut (3) from the actuator piston rod (2).
6. Remove the hydraulic hose and the light switch.
7. Remove the actuator mounting nuts (2) and washers (1).
8. Remove the actuator (4).

Installation Procedure

1. Install the actuator (4).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

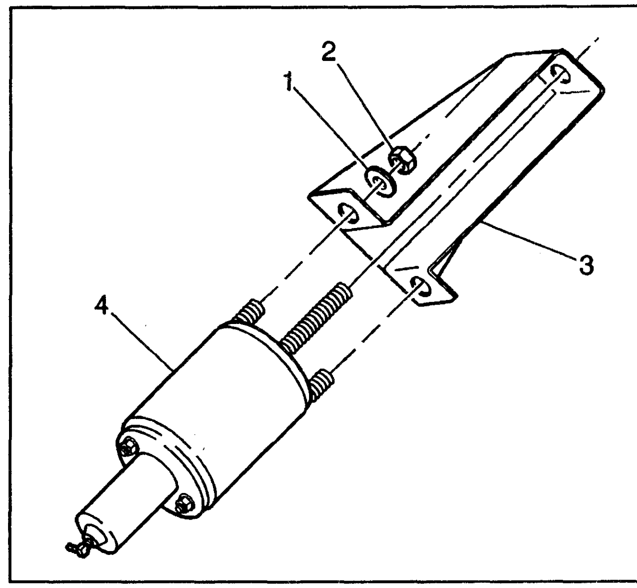
2. Install the actuator mounting nuts (2) and washers (1).

   Tighten

   Tighten the actuator mounting nuts to 108 N·m (80 lb ft).
3. Install the hydraulic hose and the light switch.

   Tighten

   Tighten the hydraulic pipe fitting to 16 N·m (12 lb ft).



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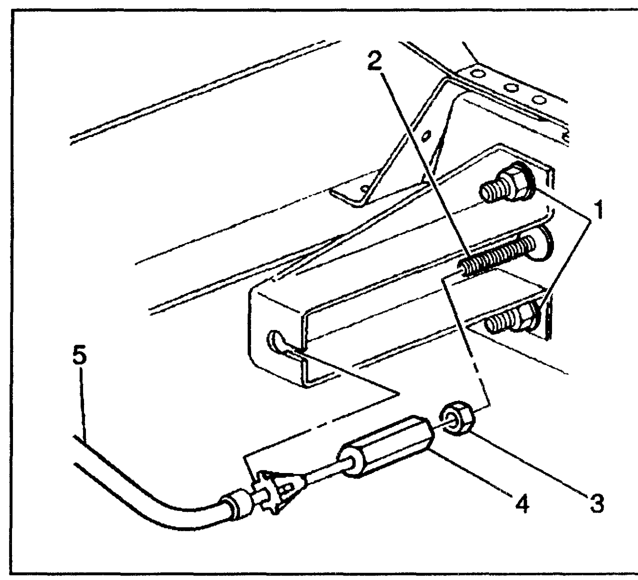
4. Install the parking brake cable (5). Refer to *Park Brake Cable Replacement (Actuator).*
5. Install the access panel on the inboard side of the component box.

   Tighten

   Tighten the access panel fasteners to 12 N·m (106 lb in).
6. Cycle the system at least six times. (Turn the ignition switch ON and move the shift lever from PARK to NEUTRAL.) Check the fluid level. Refer to *Checking and Adding Park Brake Fluid.*
7. Check the hydraulic system for leaks.
8. Release the manual parking brake. Refer to *Park Brake Cable Service/Adjustment (Electric Auto Park Brake).*



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Park Brake Cable Service/Adjustment (Mechanical Park Brake)

The parking brake must be adjusted any time the cables have been disconnected or the brake holding ability is not adequate. Before adjusting the parking brake, check the condition of the service brakes. The service brakes must be adjusted properly before adjusting the parking brake.

Pedal Type

1. Block the front wheels.
2. Raise the rear axle and support the axle with safety stands. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Loosen the equalizer nut.
4. Set the parking brake pedal to four clicks.
5. Adjust the equalizer nut until the wheels are rotated forward with a moderate drag.
6. Release the parking brake and rotate the rear wheels. There should be no brake drag.
7. Lower the vehicle.
8. Unblock the front wheels.

Lever Type

1. Block the front wheels.
2. Raise the rear axle and support the axle with safety stands. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Loosen the equalizer nut.
4. Adjust the equalizer nut until a light drag is felt while rotating the wheels forward.
5. Adjust the knob on the lever until a definite snap over the center is felt.
6. Release the parking brake and rotate the rear wheels. There should be no brake drag.
7. Lower the vehicle.
8. Unblock the front wheels.

Park Brake Cable Service/Adjustment (Electric Auto Park Brake)

Caution: If the actuator will not hold pressure, do not unthread the parking brake cable from the actuator piston. The cable is under tension and unthreading the cable will cause the cable to spring and can result in personal injury.

1. Before beginning this adjustment, the parking brake lining wear adjustment must be made. Refer to *Park Brake Shoe Inspection.*
2. Block the vehicle wheels.
3. Turn the ignition key ON.
4. Place the shift lever in the NEUTRAL position.
5. Loosen the parking brake jam nut on the actuator assembly.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

6. Adjust the cable fitting.

   Tighten

   Tighten the jam nut to 45 N·m (33 lb ft).
7. Place the shift lever into the PARK position and apply the parking brake.
8. Measure the actuator cable/piston rod stroke. If the distance is not between 30–37 mm (1.20–1.44 in) while moving the shift lever from park to neutral, then refer to *Park Brake Cable Service/Adjustment (Mechanical Park Brake).*
9. Remove the wheel blocks.
10. Check the parking brake operating and holding ability.
11. Repeat the procedure if necessary.

Park Brake Cable Service/Adjustment (Propeller Shaft Park Brake)

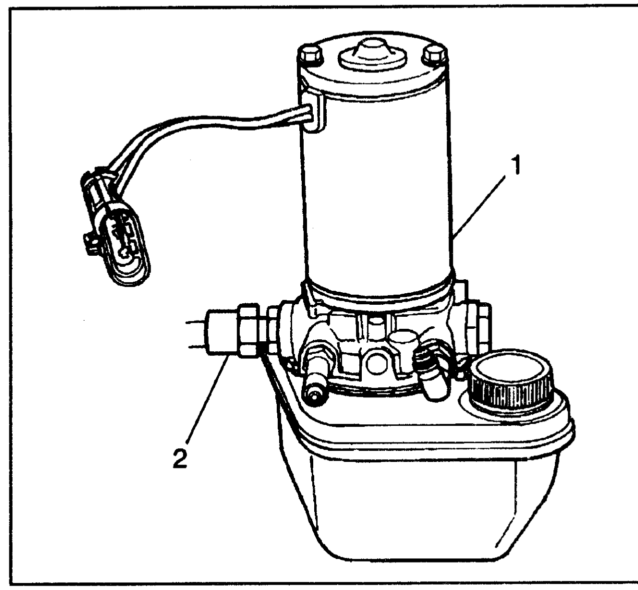
1. Raise the vehicle and support the vehicle with safety stands. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Install the drum over the first rivet section. Leave the adjuster screw accessible.
3. Place 0.254 mm (0.010 in) shims between both the shoes and the drum. The shims should be 140–180 degrees apart.
4. Rotate the adjuster screw until the shims indicate the spacing has been met (no clearance).
5. Remove the shims and complete the drum installation. The drum should spin free with only a light drag.

Optional Method

1. Raise the vehicle and support the vehicle with safety stands. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Adjust the screw through the drum opening until the brake just locks up.
3. Back off the adjuster 2–4 notches. The drum should spin with only a light drag.
4. Lower the vehicle.

Park Brake Pressure Switch Replacement

Removal Procedure



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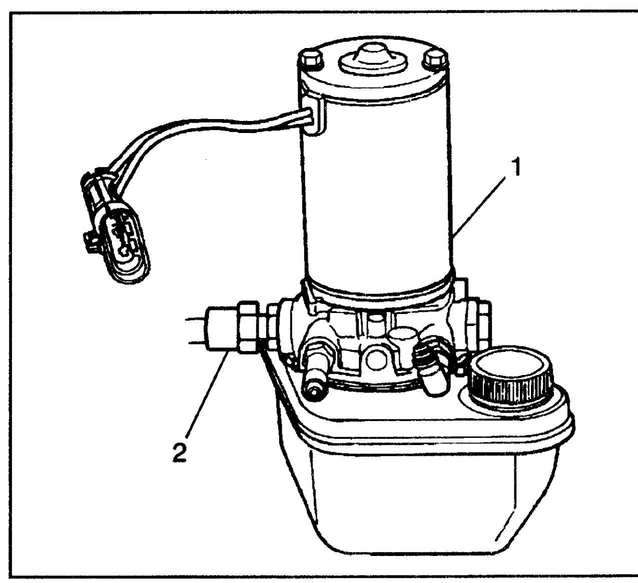
1. Move the column shift lever to the park position and apply the manual parking brake.
2. Position a drain pan to catch the fluid that leaks out. Do not reuse the old fluid.
3. Remove the access panel on the inboard side of the component box.
4. Remove the pressure switch electrical connector.
5. Remove the pressure switch (2).

Installation Procedure



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Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the pressure switch (2).

   Tighten

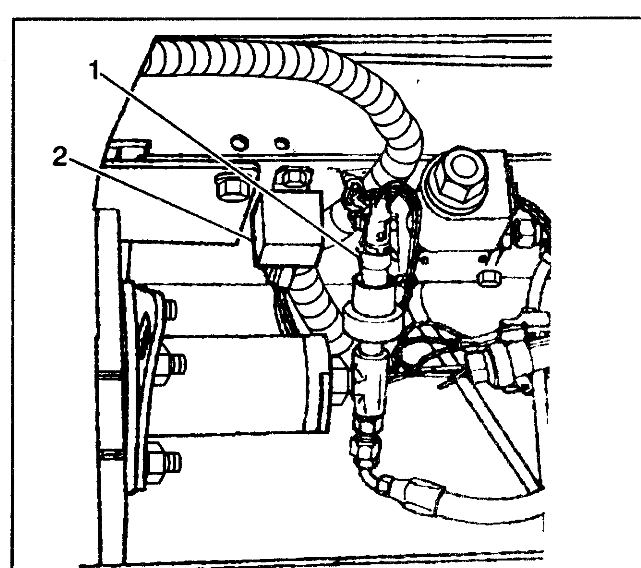
   Tighten the pressure switch to 12 N·m (106 lb in).
2. Install the pressure switch electrical connector.
3. Install the access panel on the inboard side of the component box.

   Tighten

   Tighten the access panel fasteners to 12 N·m (106 lb in).
4. Release the manual parking brake.
5. Check the parking brake operating and holding ability.

Park Brake Pressure Relay Replacement

Removal Procedure



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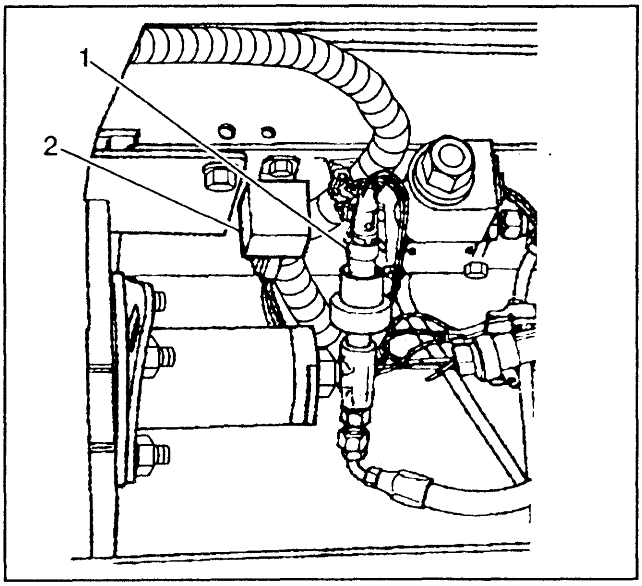
Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable from the battery.
2. Remove the access panel on the inboard side of the component box.
3. Disconnect the electrical connector from the relay (2).
4. Remove the relay mounting bolt.
5. Remove the park brake pump motor relay (2).



189623

Installation Procedure

1. Position the relay (2) in its proper mounting position.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the relay mounting bolt.

   Tighten

   Tighten the relay mounting bolt to 13 N·m (115 lb in).
3. Connect the relay electrical connector
4. Install the access panel on the inboard side of the component box.

   Tighten

   Tighten the access panel fasteners to 12 N·m (106 lb in).
5. Connect the negative battery cable to the battery.

Description and Operation

System Description

Cable Actuated System

The Motorhome/Commercial models use either a cable actuated or electric/automatic apply system. The cable actuated systems can either apply the rear brake shoes on the drum brake applications or a transmission mounted propeller shaft parking brake on rear disc brake applications. All electric/automatic apply systems use a transmission mounted propeller shaft parking brake.

The parking brake is not designed for use in the place of service brakes and should be applied only after the vehicle is brought to a complete stop, except in an emergency.

Pedal and Lever

The parking brake is applied by either a pedal or lever assembly. Motorhome models use a pedal assembly and commercial models use a lever assembly.
The pedal assembly is foot-actuated and the lever assembly is hand-actuated.

Cable System

Coated parking brake cable assemblies are used on this vehicle. The wire strand is coated with a nylon material that slides through the plastic seals inside the conduit end fittings. This is for corrosion protection and reduced parking brake effort.

Notice: Handling of the parking brake cables during service requires extra care. Damage to the nylon coating reduces the corrosion protection. If the damaged area passes through the seal, increased parking brake effort could result. Avoid contacting the coating with sharp-edged tools, or the sharp surfaces of the vehicle underbody.

To prevent damage to the threaded parking brake adjusting rod when servicing the parking brake, the following is recommended:

- Before attempting to turn the adjusting yoke, clean the exposed threads on each side of the yoke.
- Lubricate the threads of the adjusting rod with Lubriplate® P/N 1050109 or equivalent before turning the yoke.

Electric/Auto Park System Description

Auto Apply Actuator System

The parking brake is applied by an actuator which uses a strong spring to pull on the cable and apply the brake. The brake is released by a hydraulic cylinder which pushes a piston against the actuator spring to remove tension from the cable. Hydraulic pressure for this release is supplied by an electric pump which is turned on by having the ignition ON and the transmission range selector moved out of PARK. Shifting the selector into PARK, turning the ignition to OFF, or pulling the pull button switch will shut off power for the release mechanism, allowing the actuator to apply the parking brake.

Pull Button Switch

There is provision for applying the parking brake manually when the transmission is not in PARK. Pulling out the pull button switch will turn off the brake release system and apply the brake.

AUTO PARK and BRAKE Lamp

The AUTO PARK indicator lamp on the instrument cluster turns on when the parking brake is applied or when the pump is running. The BRAKE indicator turns on when the pull button switch is applied or when the actuator is in an overtravel condition. In case of an actuator overtravel, the parking brake alarm will also sound.

Electric/Auto Park System Operation

Release the Parking Brake

To release the electric/auto park brake, turn the ignition switch to ON and move the transmission range (TR) shift lever from the PARK position. This opens a section of the park/neutral position and backup lamps switch. That allows relay contacts to close providing power to the release circuit.

Apply the Parking Brake

Apply the parking brake by one of three methods:

- Put the shift lever back into the PARK position
- Pull the pull button switch
- Turn the ignition to OFF

Any of these actions de-energizes the parking brake release system which allows the actuator to apply the parking brake.

Warning/Indicator Lamp Operation

The AUTO PARK indicator lamp turns on when the system pressure is less than 3 100 kPa (450 psi) or when the electric/hydraulic pump motor is running because the pump motor switch is closed. The pressure pump motor switch and the pressure indicator switch supply B+ to the circuit for lamp operation. The hydraulic pressure involved in releasing the parking brake causes the switches to open the circuit and turns the lamp off. The lamp will light briefly each time the pump runs for pressure maintenance.

Electric/Auto Park Circuit Description

The electric/auto parking brake system controls the propeller shaft-mounted parking brake. It consists of the following components:

- Pump motor switch
- Pump
- Solenoid valve
- Actuator assembly
- Park/Neutral position switch
- Pump motor relay
- Pressure indicator switch
- Actuator position switch

This section covers the diagnostic and service procedures for the system components. For service information on the propeller shaft parking brake, refer to *Park Brake Cable Service/Adjustment (Electric Auto Park Brake).*

Basic Knowledge Required

Before attempting to diagnose the electric/auto park brake system, you must have a good understanding of electrical and hydraulic system basics. Without this basic knowledge, you will find it difficult to diagnose this system.

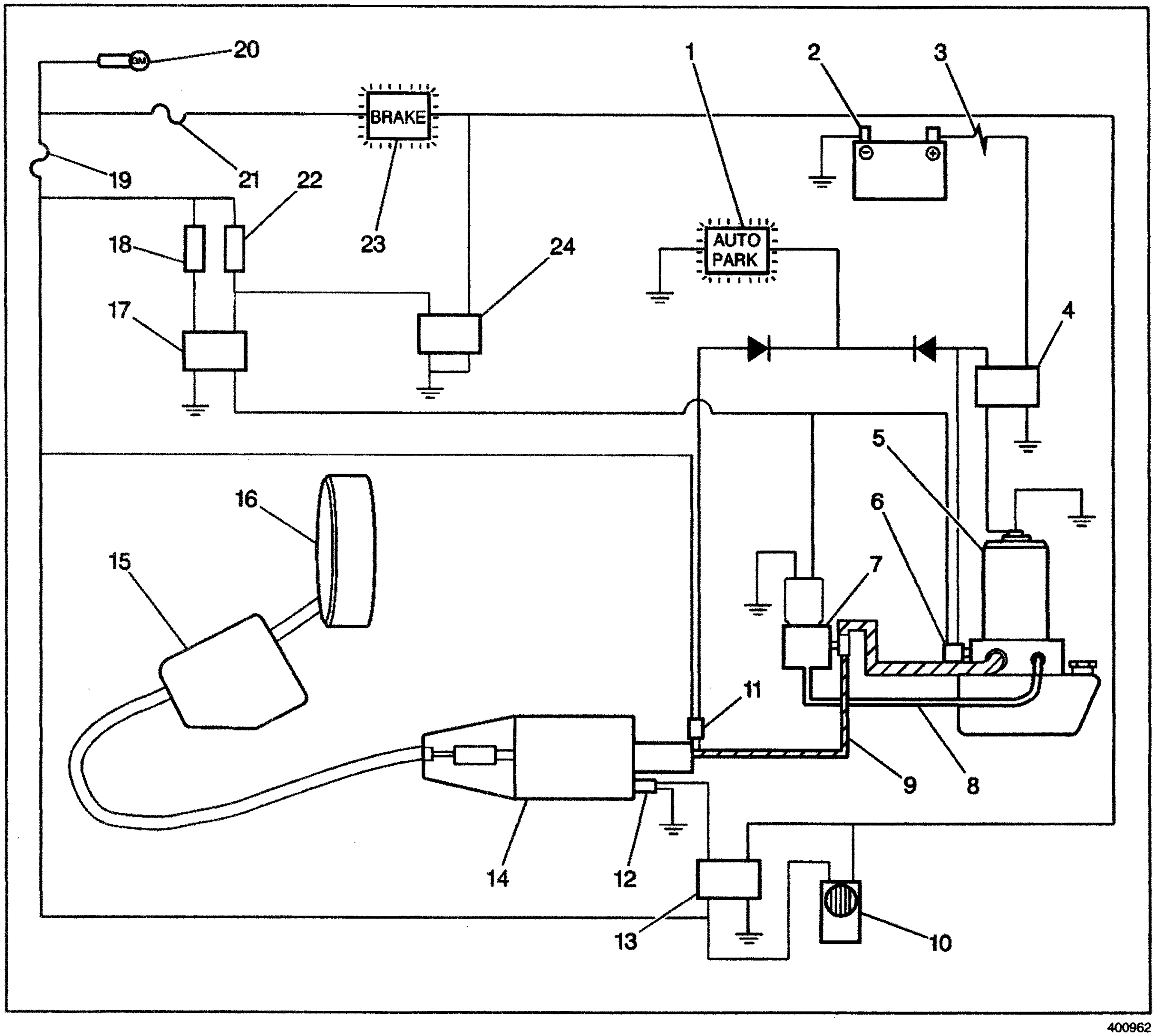
Some electrical basics, basic troubleshooting procedures and hints, and the use of circuit testing tools are discussed in Electrical Diagnosis.

Pump Motor Switch

The pump motor switch mounts to the parking brake pump assembly housing. It is a hydraulic pressure switch that operates within a certain pressure range turning the pump motor on and off. The switch closes when the system pressure is below 8 300 kPa (1,200 psi) and opens when the system pressure reaches approximately 11 000 kPa (1,600 psi). The switch operates the pump motor by applying B+ to the coil (control side) of the relay switch. This also applies B+ to the AUTO PARK indicator lamp which lights whenever the pump relay is energized.

Parking Brake Pump Assembly

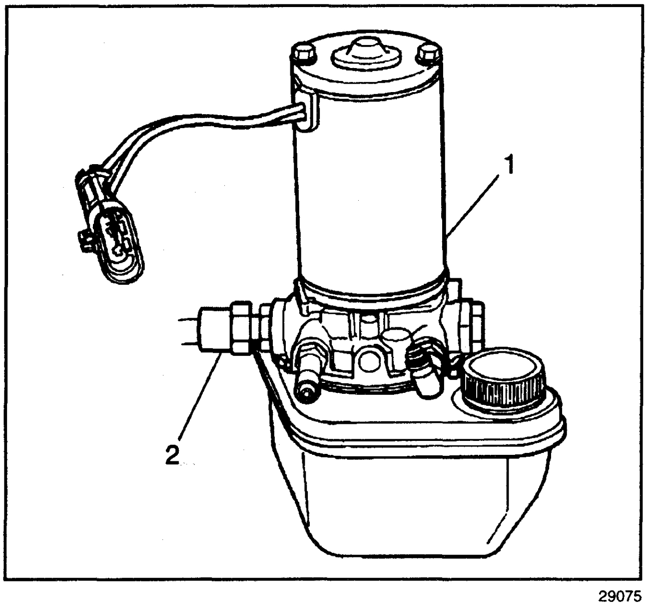
Electric/Auto Parking Brake Components



Legend

(1) AUTO PARK indicator lamp
(2) Battery
(3) Fusible link
(4) Pump motor relay
(5) Pump and reservoir
(6) Pump motor switch
(7) Solenoid valve
(8) Hydraulic return pipe (low pressure)
(9) Hydraulic supply pipe (high pressure)
(10) Parking brake alarm
(11) Pressure indicator switch
(12) Actuator position switch
(13) Alarm relay
(14) Actuator assembly
(15) Differential lever
(16) Parking brake
(17) Park/Neutral position switch relay
(18) Park/Neutral position and backup lamps switch
(19) A/A (Auto Apply) fuse 19
(20) Ignition switch
(21) GAUGES fuse 8
(22) Pull button switch
(23) BRAKE indicator lamp
(24) Pull button relay

Parking Brake Pump Assembly



Legend

(1) Parking Brake Pump Assembly
(2) Pressure Maintenance Switch

The parking brake pump assembly is located in a component box on the passenger's side of the vehicle. The component box is on the inside of the right frame rail behind the transmission. It consists of an electric pump and fluid reservoir. The pump provides fluid pressure to release the brake. A pressure relief valve in the pump limits system pressure to 12 400 kPa (1,800 psi).

Parking Brake Solenoid Valve

The parking brake solenoid valve is located in the component box on the underside of the vehicle. The valve regulates fluid return to the pump reservoir. The parking brake is released by turning on the hydraulic pump and closing the solenoid valve to hold the pressure in the system. The parking brake is applied by turning off the power, which stops pump operation and opens the valve to allow the fluid to return to the pump reservoir.

Actuator Assembly

Caution: Do not disassemble the actuator. Always service the actuator as a unit. The actuator contains a large spring under tension. Disassembling the actuator allows the spring to expand with great force, which can result in personal injury.

The actutor is located underneath the vehicle in front of the component box. The actuator is a spring-loaded device that operates the parking brake cable. A large spring inside the actuator applies the parking brake. The brake is released by applying hydraulic fluid pressure against a piston. When that pressure is great enough, the piston overcomes spring tension and pushes against the actuator to release the parking brake.

Park/Neutral Position Switch

The park/neutral position (PNP) switch is located on the left side of the transmission housing. One portion of this switch is normally open, closed in PARK. This operates a normally closed relay that supplies power to the park brake release mechanism when that relay coil is not energized. By placing the range selector in PARK, the PNP switch applies voltage to the relay coil which opens the contacts and removes voltage from the release system resulting in application of the parking brake. Moving the selector out of PARK de-engerizes the relay which switches power on for the release mechanism to release the park brake.

Pump Motor Relay

The parking brake pump motor relay is located in the component box underneath the vehicle. The relay coil receives B+ from the pump motor switch closing the contacts to complete the feed circuit to the pump motor. When the relay coil is energized, the AUTO PARK indicator is lighted.

Pressure Indicator Switch

The parking brake pressure indicator switch is a hydraulic ON/OFF switch located in the hydraulic fitting at the end of the actuator release cylinder underneath the vehicle. The switch is mounted in the park brake hydraulic system and controls B+ to the AUTO PARK lamp. This switch closes when the system pressure is below 3 100 kPa (450 psi) and turns on the light when the ignition is ON.

Actuator Position Switch (Alarm Circuit)

This is a switch mounted beside the release cylinder on the end of the actuator housing. This switch opens in an actuator overtravel condition, causing the alarm relay to de-energize and complete ground for the park brake alarm and the diode network. That sounds the alarm and lights the BRAKE indicator lamp. Except for an electrical malfunction, this alarm will be active only when the parking brake is applied and indicates the need for adjustment of the cable or service of the park brake linings.

Antilock Brake System

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
EBCM Bracket Mounting Bolts	36 N·m	28 lb ft
Combination Valve to BPMV	16 N·m	12 lb ft
EBCM to BPMV	5 N·m	44 lb in
EHCU to Bracket	9 N·m	7 lb ft
Front Brake Line to Combination Valve	24 N·m	18 lb ft
Front Wheel Speed Sensor Mounting Bolts	26 N·m	19 lb ft
Rear Brake Line to Combination Valve	24 N·m	18 lb ft
Splash Shield Mounting Bolts	11 N·m	9 lb ft
Tube Adapters to BPMV	31 N·m	23 lb ft
Wheel Speed Sensor Harness Clip to Shock Tower	11 N·m	9 lb ft
EHCU Crossmember Bolts	36 N·m	28 lb ft
Hudraulic Lines to Tube Adapters	30 N·m	22 lb ft

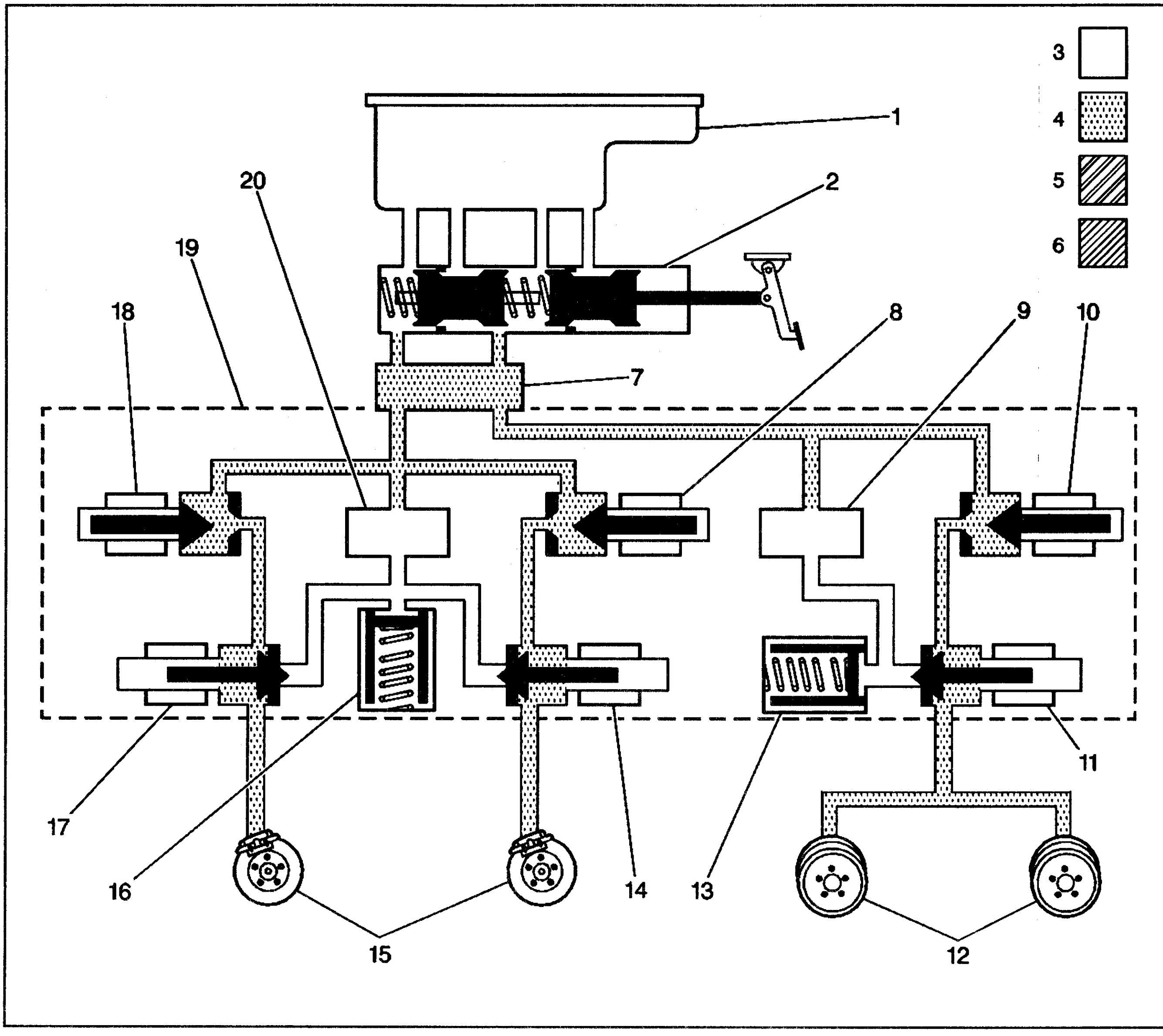
Service Parts Group Numbers

Application	Service Parts Group Number
Brake Pressure Modulator Valve	4.730
Electronic Brake Control Module	4.720
Stoplamp Switch	2.447
Wheel Speed Sensor	4.710

Schematic and Routing Diagrams

BPMV Hydraulic Flow Chart

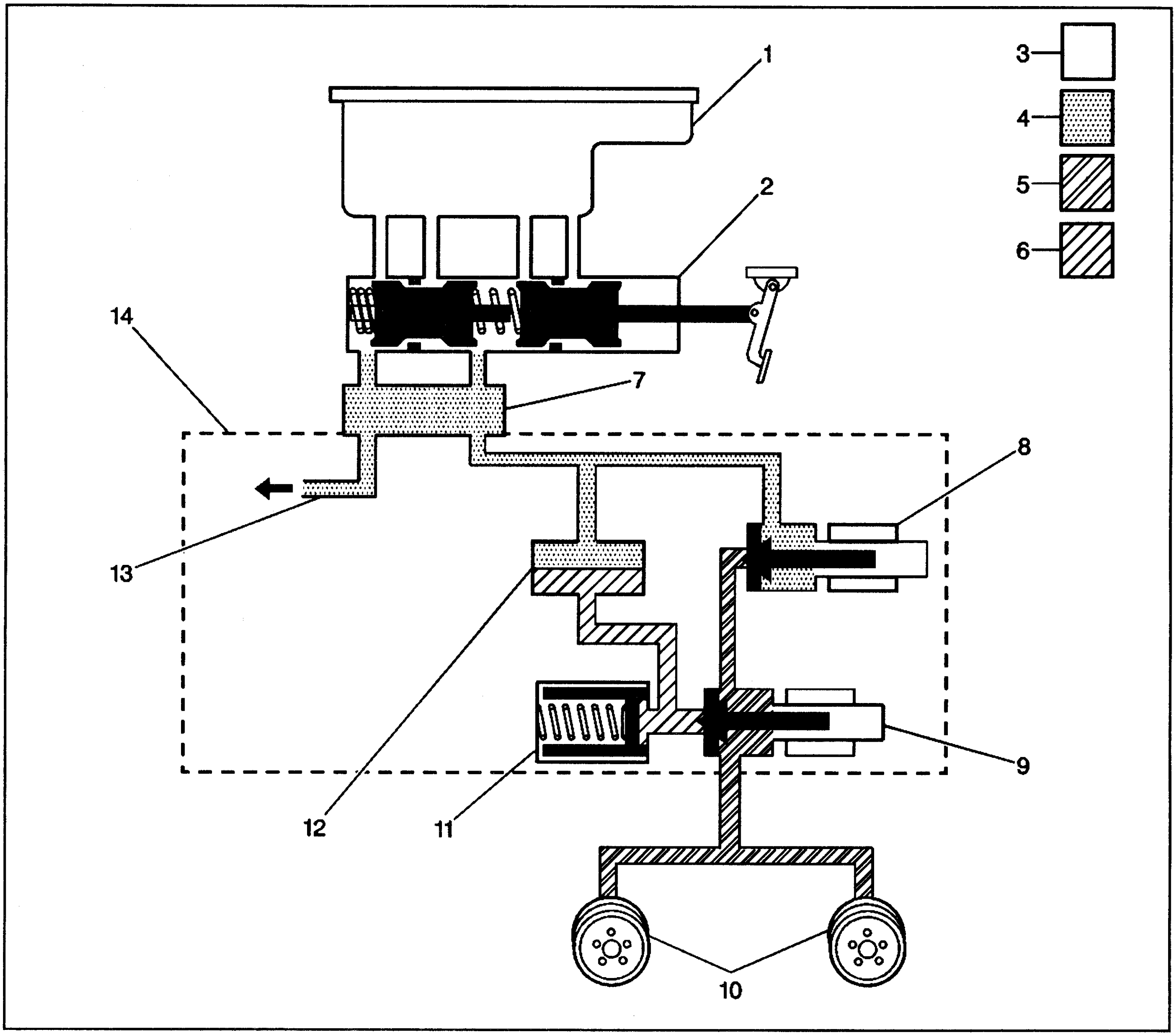
BPMV Hydraulic Flow Chart (Normal Braking Mode)



Legend

(1) Master Cylinder Reservoir
(2) Master Cylinder
(3) Ambient Pressure
(4) Master Cylinder Pressure
(5) Hold Pressure
(6) Accumulator Pressure
(7) Combination Valve
(8) Right Front Isolation Valve
(9) Rear Pump
(10) Rear Isolation Valve
(11) Rear Dump Valve
(12) Rear Brakes
(13) Rear Accumulator
(14) Right Front Dump Valve
(15) Front Brakes
(16) Front Accumulator
(17) Left Front Dump Valve
(18) Left Front Isolation Valve
(19) Brake Pressure Modulator Valve (BPMV)
(20) Front Pump

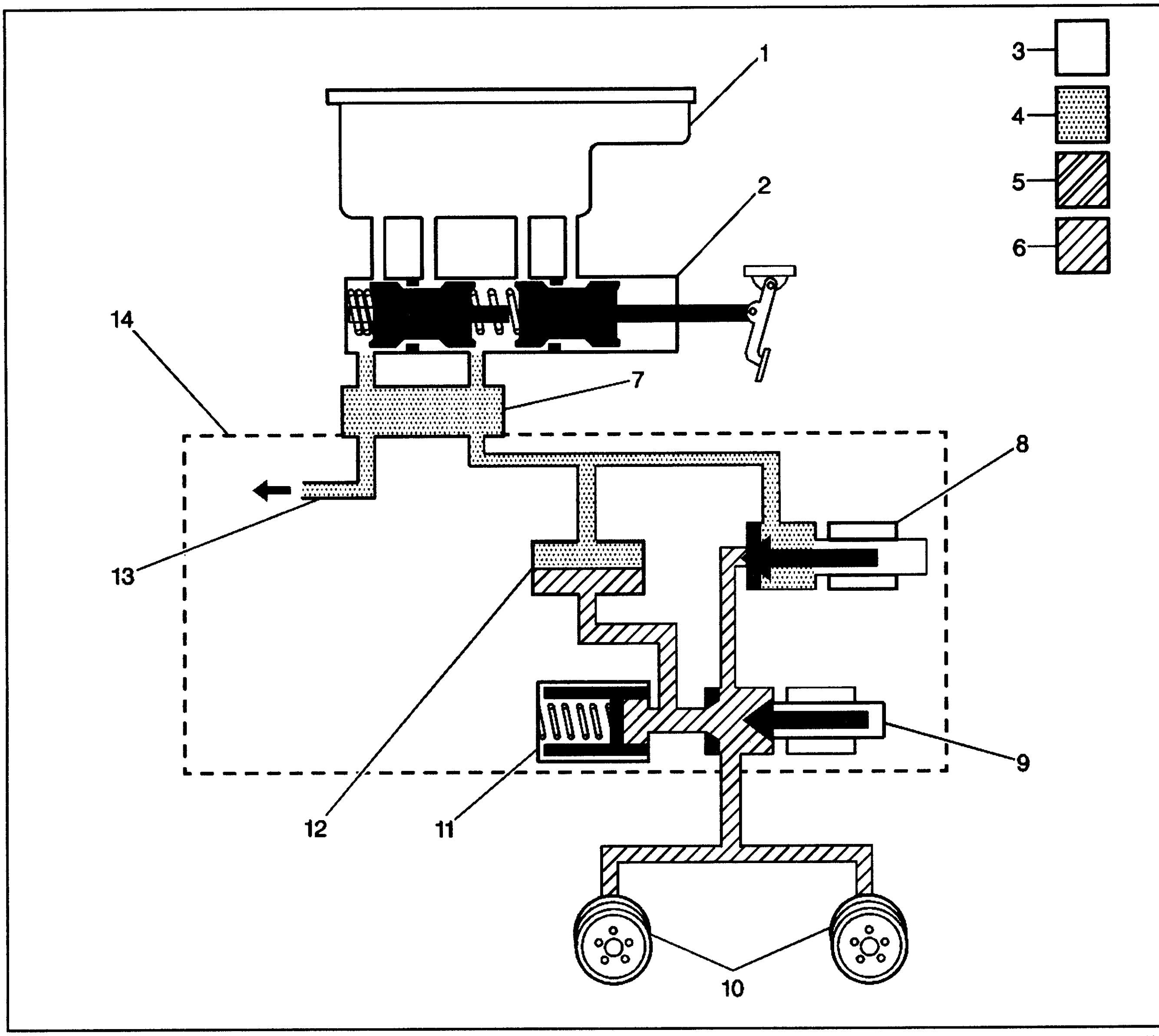
BPMV Hydraulic Flow Chart (Isolation Mode)



Legend

(1) Master Cylinder Reservoir
(2) Master Cylinder
(3) Ambient Pressure
(4) Master Cylinder Pressure
(5) Hold Pressure
(6) Accumulator Pressure
(7) Combination Valve
(8) Rear Isolation Valve
(9) Rear Dump Valve
(10) Rear Wheels
(11) Rear Accumulator
(12) Rear Pump
(13) To Front Channels
(14) Brake Pressure Modulator Valve (BPMV)

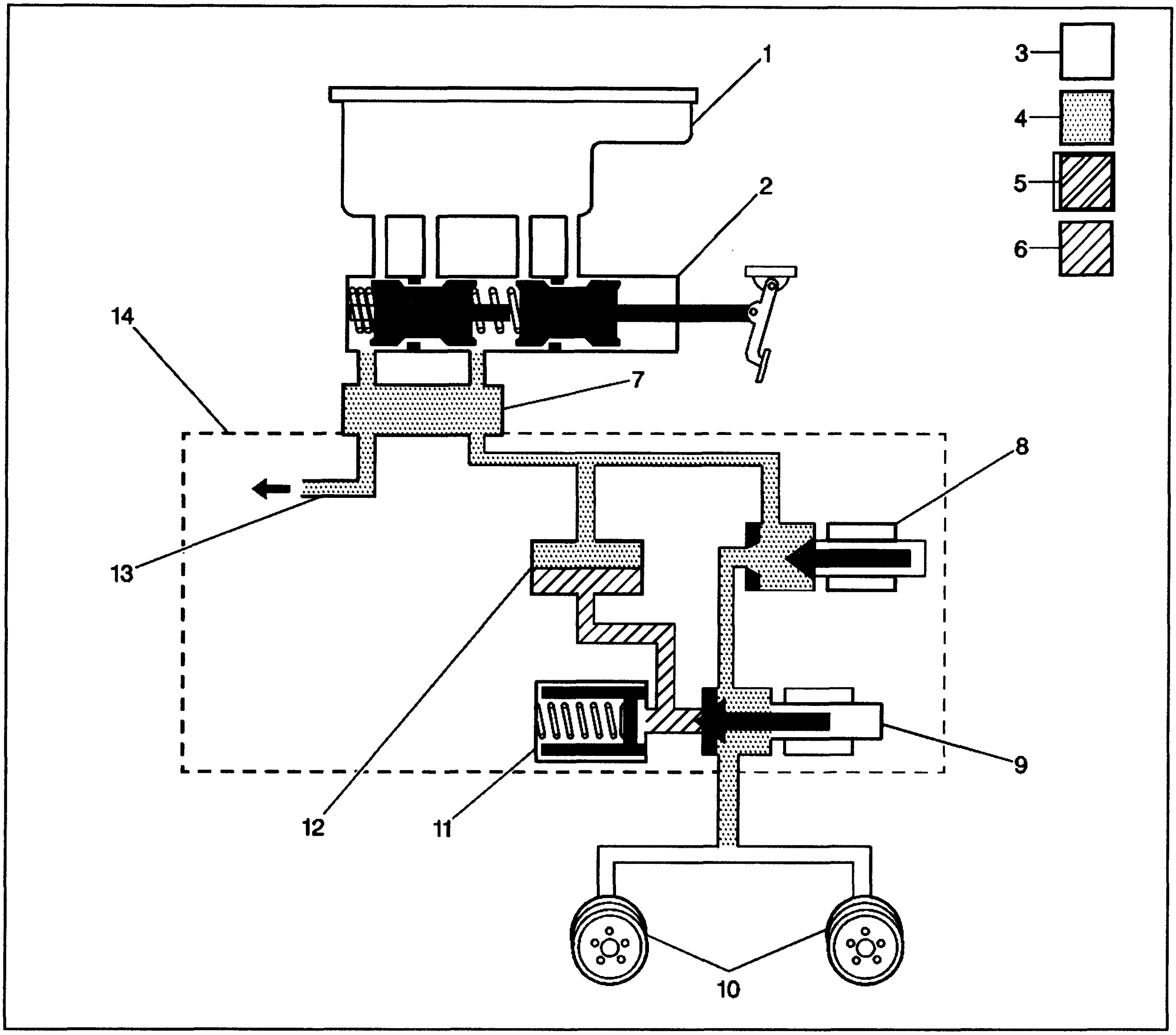
BPMV Hydraulic Flow Chart (Dump Mode)



Legend

(1) Master Cylinder Reservoir
(2) Master Cylinder
(3) Ambient Pressure
(4) Master Cylinder Pressure
(5) Hold Pressure
(6) Accumulator Pressure
(7) Combination Valve
(8) Rear Isolation Valve
(9) Rear Dump Valve
(10) Rear Wheels
(11) Rear Accumulator
(12) Rear Pump
(13) To Front Channels
(14) Brake Pressure Modulator Valve (BPMV)

BPMV Hydraulic Flow Chart (Reapply Mode)



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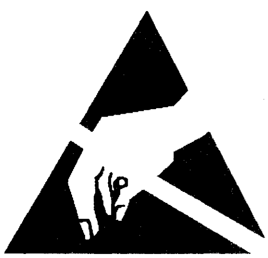
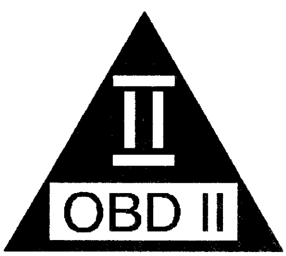
Legend

(1) Master Cylinder Reservoir
(2) Master Cylinder
(3) Ambient Pressure
(4) Master Cylinder Pressure
(5) Hold Pressure
(6) Accumulator Pressure
(7) Combination Valve
(8) Rear Isolation Valve
(9) Rear Dump Valve
(10) Rear Wheels
(11) Rear Accumulator
(12) Rear Pump
(13) To Front Channels
(14) Brake Pressure Modulator Valve (BPMV)

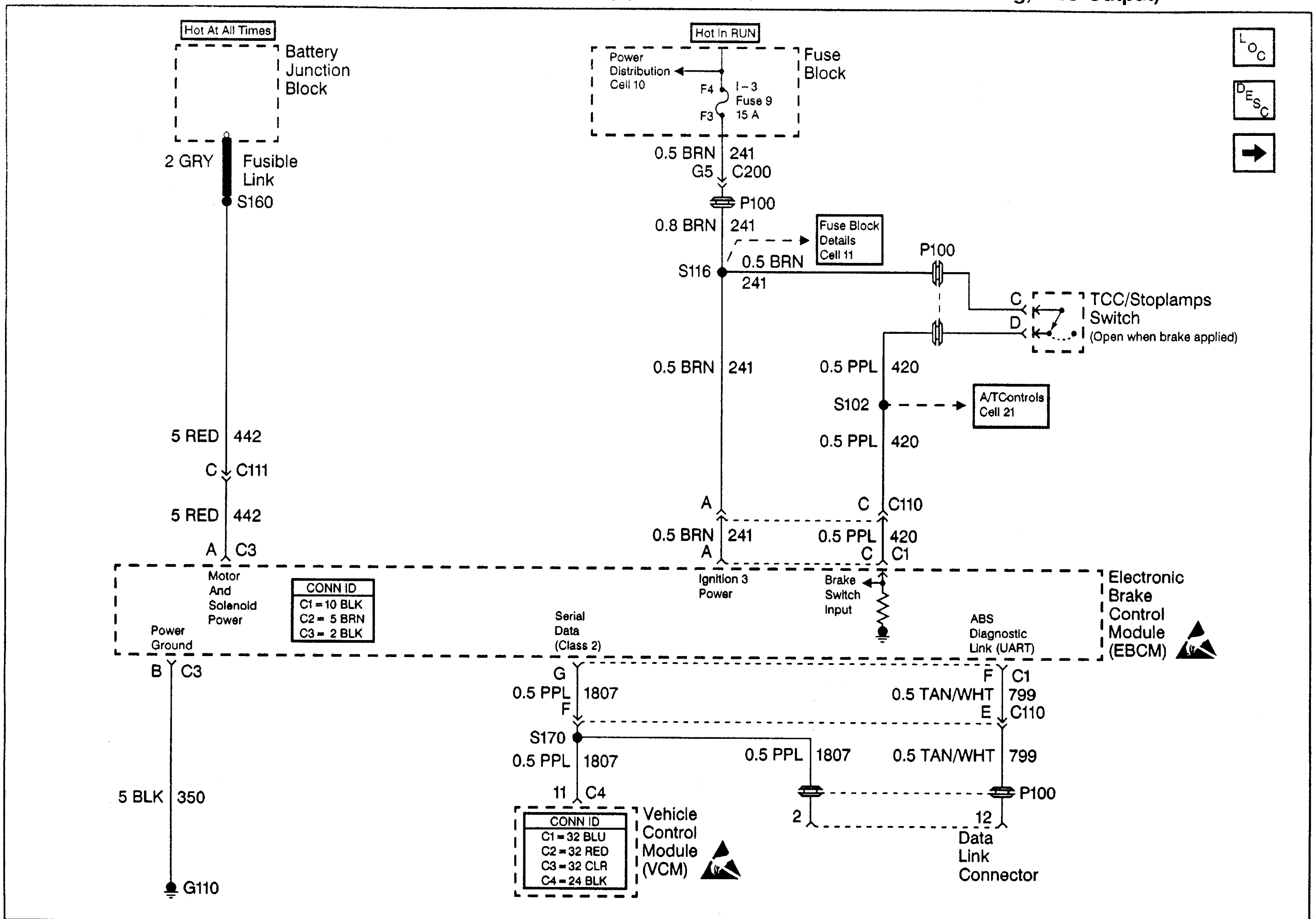
Antilock Brakes System Schematic References

Reference on Schematic	Section Number - Subsection Name
Brake Warning System Cell 41	5 — Hydraulic Brakes
BTSI Schematics Cell 138	2 — Steering Wheel and Column - Tilt
Engine Controls Cell 20	6 — Engine Controls
Engine Controls Cell 21	6 — Engine Controls
Engine Controls Cell 22	6 — Engine Controls
Engine Controls Cell 23	6 — Engine Controls
Fuse Block Details Cell 11	8 — Wiring Systems
Ground Distribution Cell 14	8 — Wiring Systems
Instrument Cluster: Analog Cell 81	8 — Instrument Panel, Gauges and Console
Power Distribution Cell 10	8 — Wiring Systems

Antilock Brakes System Schematic Icons

Icon	Icon Definition
 19384	Refer to *ESD Notice* in Cautions and Notices.
 19385	Refer to *OBD II Symbol Description Notice* in Cautions and Notices.

Antilock Brake System Schematics (Motorhome) (Cell 44: Gas, ABS Power and Grounding, DLC Output)



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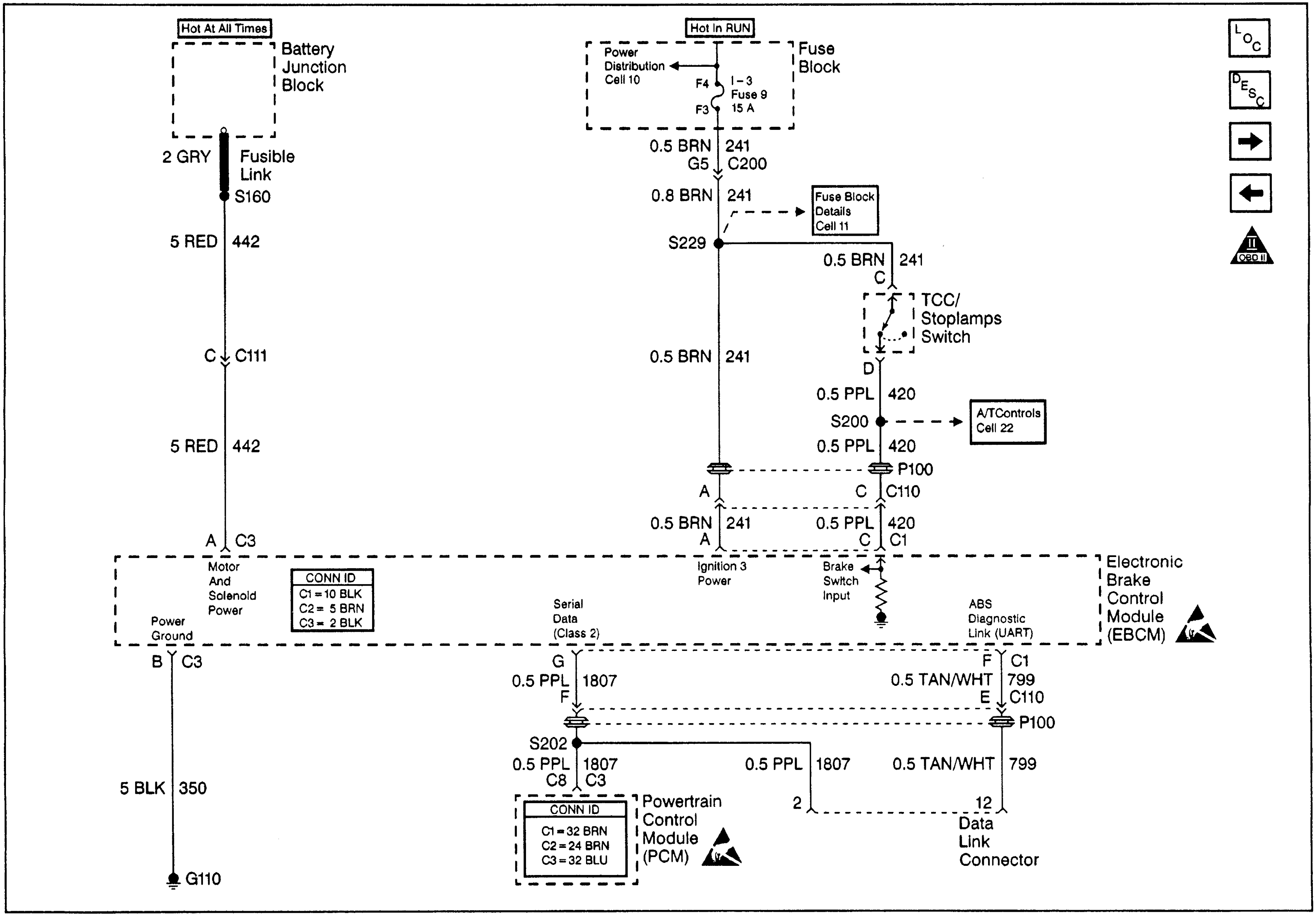
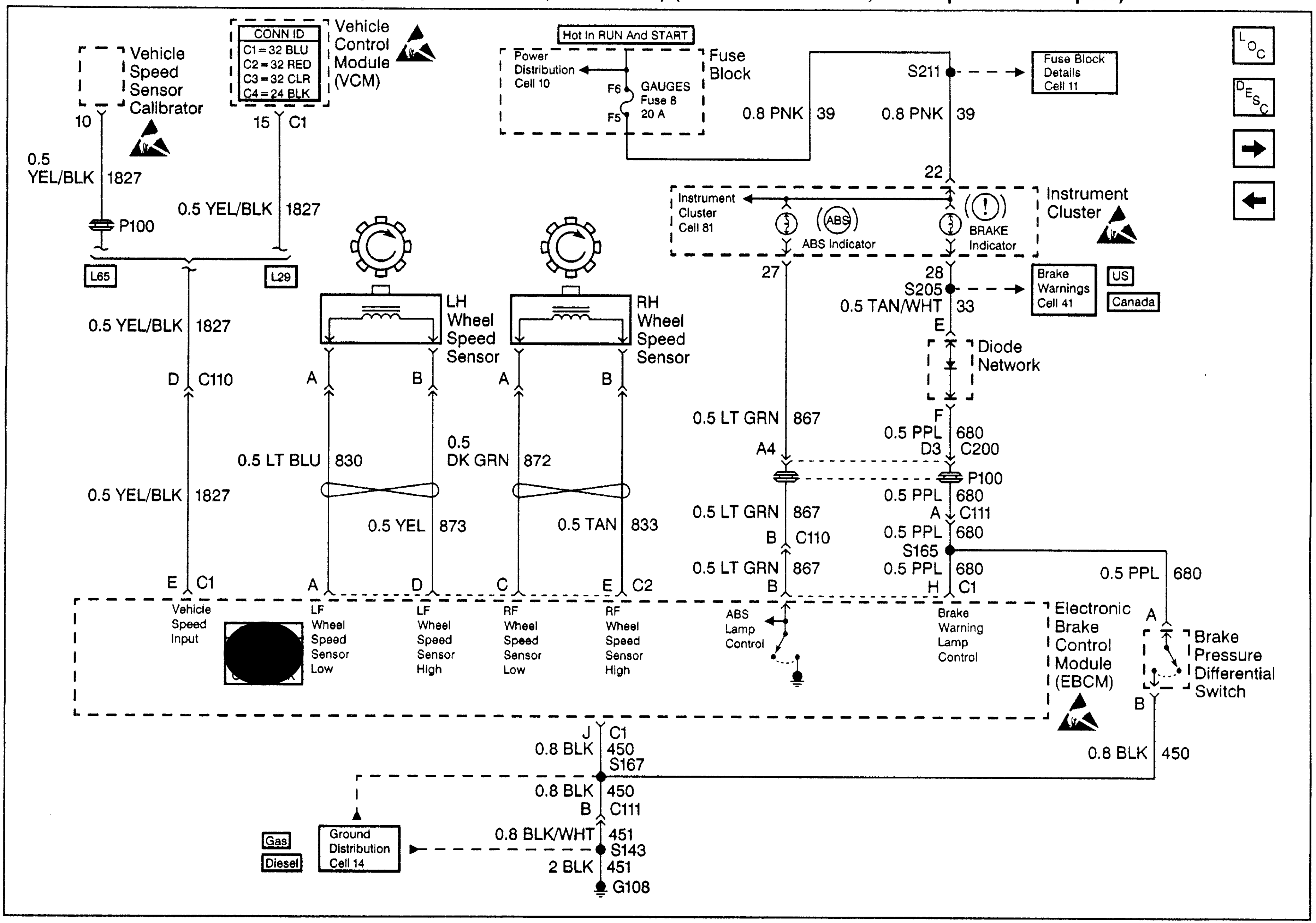
Antilock Brake System Schematics (Motorhome) (Cell 44: Diesel, ABS Power and Grounding, DLC Output)



Antilock Brake System Schematics (Motorhome) (Cell 44: US/Canada, ABS Inputs and Outputs)



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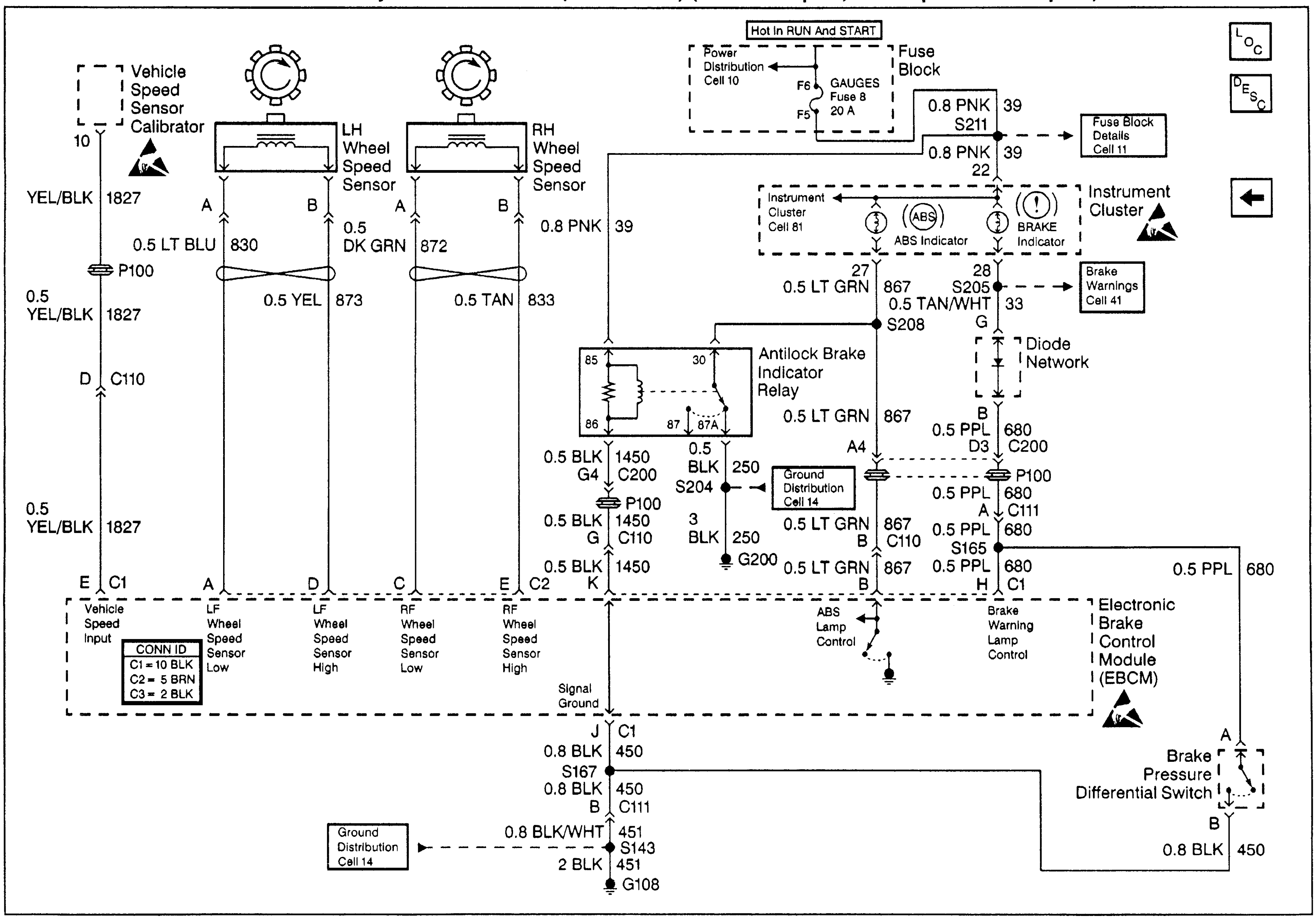
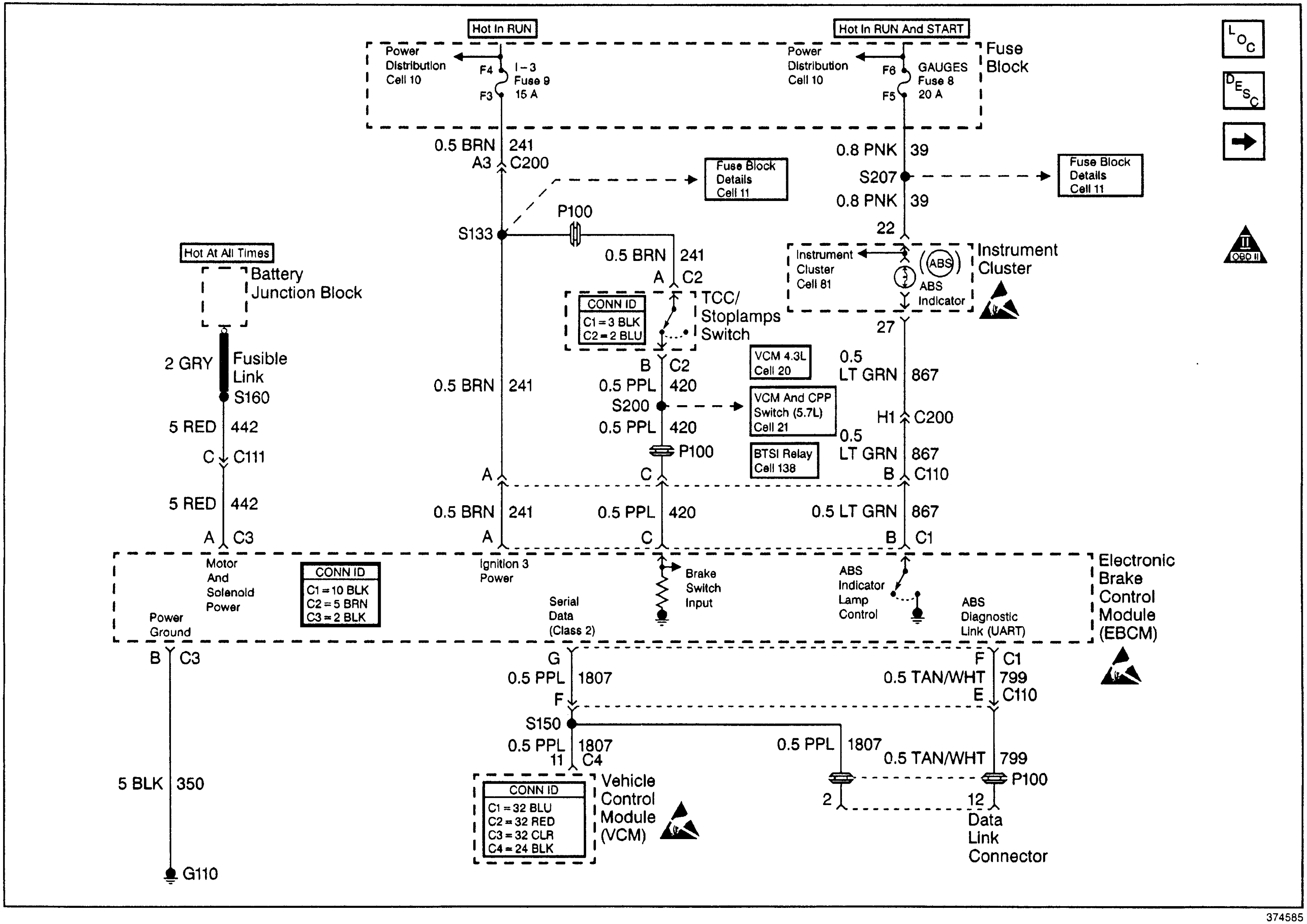
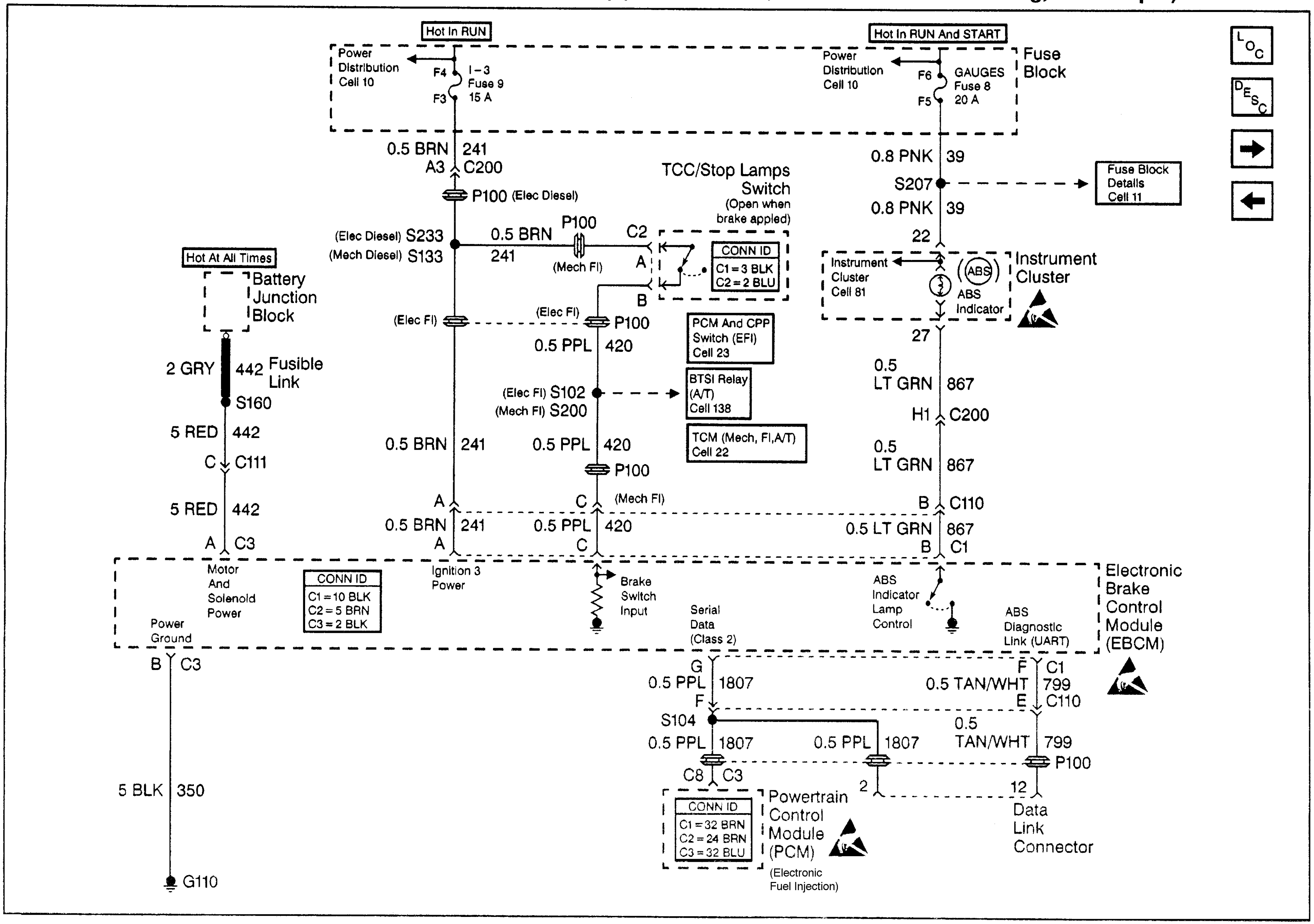
Antilock Brake System Schematics (Motorhome) (Cell 44: Export, ABS Inputs and Outputs)



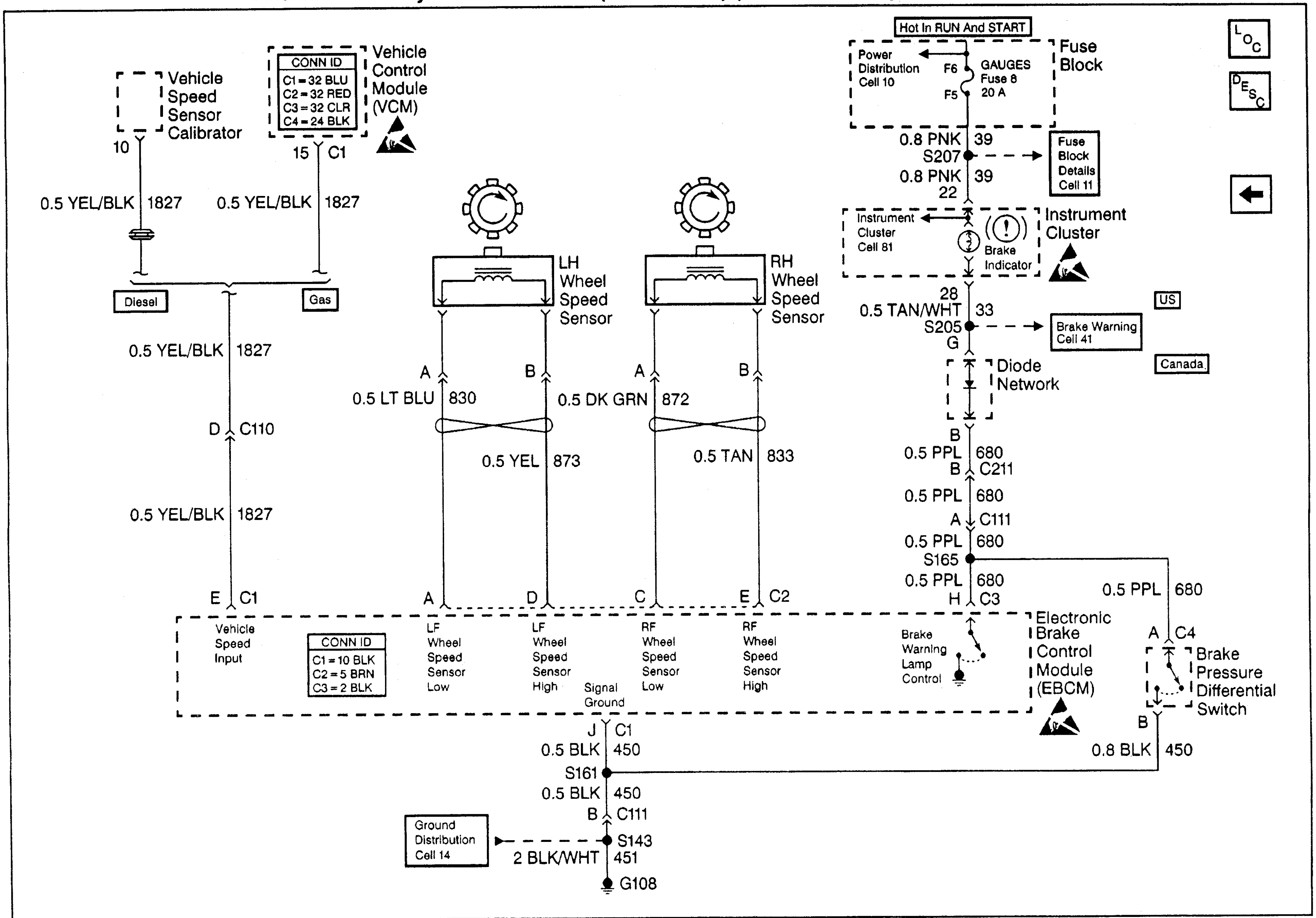
Antilock Brake System Schematics (Commercial) (Cell 44: Gas, ABS Power and Grounding, DLC Output)



Antilock Brake System Schematics (Commercial) (Cell 44: Diesel, ABS Power and Grounding, DLC Output)



Antilock Brake System Schematics (Commercial) (Cell 44: ABS Inputs and Outputs)



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Component Locator

Antilock Brakes System Components (Commercial)

Name	Location	Locator View	Connector End View
Battery Junction Block	On the forward LH side of the bulkhead above P100	*Power and Grounding Component Views* in Wiring Systems	—
Brake Pressure Differential Switch	Bolted to the brake pressure modulator valve below the radiator on the lower crossmember	*Antilock Brakes System Component Views*	*Antilock Brakes System Connector End Views*
Data Link Connector (DLC)	LH side of the passenger compartment lower bulkhead on the side of the relay bracket	*Data Link Communications Component Views (Commercial)* in Data Link Communications	*Data Link Communications Connector End Views* in Data Link Communications
Diode Network	On the IP harness located by the body builder	—	*Hydraulic Brakes Connector End Views* in Hydraulic Brakes
Electronic Brake Control Module (EBCM)	Below the radiator on the lower crossmember	*Antilock Brakes System Component Views*	*Antilock Brakes System Connector End Views*
Instrument Cluster	Body builder installed	—	*Instrument Cluster Connector End Views* in Instrument Panel, Gauges and Console
IP Fuse Block	Located by the body builder	*Electrical Center Identification (Commercial)* in Wiring Systems	*Power and Grounding Connector End Views* in Wiring Systems
Powertrain Control Module (EFI Diesel)	At the LH side of the drivers island on the relay bracket	*Engine Controls Component Views* in Engine Controls	*PCM Connector End Views (EFI)* in Engine Controls
Torque Converter Clutch (TCC) and Stoplamps Switch	Above the brake pedal at the RH side of the steering column	*Lighting Systems Component Views (Commercial)* in Lighting Systems	*Lighting Systems Connector End Views (Commercial)* in Lighting Systems
Vehicle Control Module (Gasoline)	At the LH side of the radiator support	*Engine Controls Component Views* in Engine Controls	*VCM Connector End Views* in Engine Controls
Vehicle Speed Sensor Calibrator (Diesel)	At the LH side of the drivers island under the relay bracket	*Engine Controls Component Views* in Engine Controls	*Engine Controls Connector End Views (L57 MFI)* in Engine Controls
Wheel Speed Sensor, LH Front	Mounted in the LH front wheel hub, connected at the front LH frame rail near the radiator	*Antilock Brakes System Component Views*	*Antilock Brakes System Connector End Views*
Wheel Speed Sensor, RH Front	Mounted in the RH front wheel hub, connected at the front RH frame rail near the radiator	*Antilock Brakes System Component Views*	*Antilock Brakes System Connector End Views*
C110	Engine harness to the ABS harness, at the front of the LH frame rail near the steering gearbox	*Harness Routing Views (Commercial)* in Wiring Systems	*Inline Harness Connector End Views (Commercial)* in Wiring Systems
C111	Engine harness to the ABS harness, at the front of the LH frame rail above the steering gearbox	*Harness Routing Views (Commercial)* in Wiring Systems	*Inline Harness Connector End Views (Commercial)* in Wiring Systems
C200	Engine harness to the IP harness, in the bulkhead near P100	*Harness Routing Views (Commercial)* in Wiring Systems	*Inline Harness Connector End Views (Commercial)* in Wiring Systems
C211	IP harness to the engine harness, on top of the steering column support	*Harness Routing Views (Commercial)* in Wiring Systems	*Inline Harness Connector End Views (Commercial)* in Wiring Systems

Antilock Brakes System Components (Commercial) (cont'd)

Name	Location	Locator View	Connector End View
G108	On top of the thermostat housing	*Power and Grounding Component Views* in Wiring Systems	—
G110	At the front, on the LH frame rail above the steering gearbox	*Power and Grounding Component Views* in Wiring Systems	—
P100	LH bulkhead left of the steering column	*Harness Routing Views (Commercial)* in Wiring Systems	—
S102 (EFI Diesel)	In the engine harness, approximately 32 cm (13 in) from the breakout for the battery junction block	—	—
S104 (EFI Diesel)	In the engine harness, approximately 25 cm (10 in) from the breakout for the battery junction block	—	—
S133 (MFI Diesel)	In the engine harness, approximately 17 cm (7 in) from breakout for C200	—	—
S133 (Gasoline)	In the engine harness breakout for the VCM, approximately 8 cm (3 in) from the main harness	—	—
S143 (MFI Diesel)	In the engine harness, approximately 17 cm (7 in) from P100	—	—
S143 (EFI Diesel)	In the engine harness, approximately 16 cm (6 in) from the A/C compressor clutch breakout towards C200	—	—
S143 (Gasoline)	In the engine harness, approximately 6 cm (2 in) from the C200 breakout towards the MAF sensor	—	—
S150 (Gas)	In the engine harness, approximately 18 cm (7 in) from the C200 breakout towards P100	—	—
S160	Fusible link splice in the engine harness, approximately 16 cm (6 in) from the battery junction block	—	—
S165	In the ABS harness, approximately 10 cm (4 in) from the breakout for C110	—	—
S167	In the ABS harness, approximately 15 cm (6 in) from the RH wheel speed sensor breakout toward C110	—	—
S200 (Gasoline)	In the IP side of engine harness, approximately 19 cm (8 in) from P100 toward the ignition switch	—	—
S205	In the IP harness, approximately 4 cm (2 in) from the fuse block breakout toward C200	—	—
S207	In the IP harness, approximately 40 cm (16 in) before the fuse block breakout toward the instrument cluster connector	—	—
S233 (EFI Diesel)	In the IP side of the engine harness, approximately 31 cm (13 in) from P100 toward the ignition switch	—	—

Antilock Brakes System Components (Motorhome)

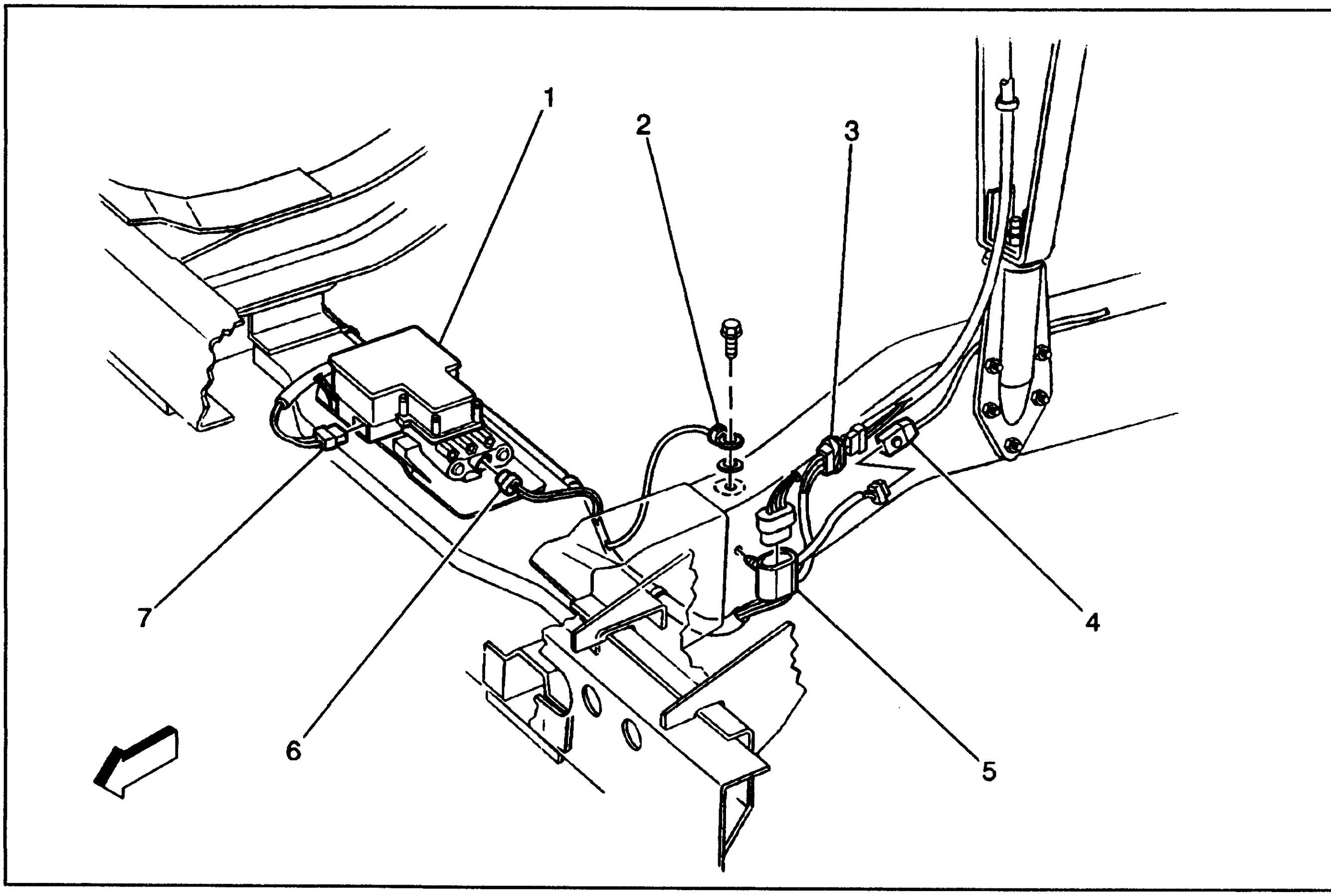
Name	Location	Locator View	Connector End View
Antilock Brake Indicator Relay (Export)	On the IP harness located by the body builder	—	*Antilock Brakes System Connector End Views*
Battery Junction Block	On the forward LH side of the bulkhead above P100	*Power and Grounding Component Views* in Wiring Systems	—
Brake Pressure Differential Switch	Bolted to the brake pressure modulator valve below the radiator on the lower crossmember	*Antilock Brakes System Component Views*	*Antilock Brakes System Connector End Views*
Data Link Connector (DLC)	At the lower LH side of the steering column on the support bracket	*Data Link Communications Component Views (Motorhome)* in Data Link Communications	*Data Link Communications Connector End Views* in Data Link Communications
Diode Network	On the IP harness located by the body builder	—	*Hydraulic Brakes Connector End Views* in Hydraulic Brakes
Electronic Brake Control Module (EBCM)	Below the radiator on the lower crossmember	*Antilock Brakes System Component Views*	*Antilock Brakes System Connector End Views*
Instrument Cluster	Body builder installed	—	*Instrument Cluster Connector End Views* in Instrument Panel, Gauges and Console
IP Fuse Block	Located by the body builder	*Electrical Center Identification (Motorhome)* in Wiring Systems	*Power and Grounding Connector End Views* in Wiring Systems
Powertrain Control Module (Diesel)	On the LH side of the driver's island	*Engine Controls Component Views* in Engine Controls	*PCM Connector End Views* in Engine Controls
Torque Converter Clutch (TCC) and Stoplamps Switch	Above the brake pedal at the RH side of the steering column	*Lighting Systems Component Views (Motorhome)* in Lighting Systems	*Lighting Systems Connector End Views (Motorhome)* in Lighting Systems
Vehicle Control Module (Gas)	Mounted on top of the radiator support	*Engine Controls Component Views* in Engine Controls	*VCM Connector End Views* in Engine Controls
Vehicle Speed Sensor Calibrator (Diesel)	Above the accelerator pedal at the RH side of the brake pedal support	*Engine Controls Component Views* in Engine Controls	*Engine Controls Connector End Views (6.5L, L65)* in Engine Controls
Wheel Speed Sensor, LH Front	Mounted in the LH front wheel hub, connected at the front LH frame rail near the radiator	*Antilock Brakes System Component Views*	*Antilock Brakes System Connector End Views*
Wheel Speed Sensor, RH Front	Mounted in the RH front wheel hub, connected at the front RH frame rail near the radiator	—	*Antilock Brakes System Connector End Views*
C110	Engine harness to the ABS harness, at the front of the LH frame rail near the steering gearbox	*Harness Routing Views (Motorhome)* in Wiring Systems	*Inline Harness Connector End Views (Motorhome)* in Wiring Systems
C111	Engine harness to the ABS harness, at the front of the LH frame rail near the brake master cylinder	*Harness Routing Views (Motorhome)* in Wiring Systems	*Inline Harness Connector End Views (Motorhome)* in Wiring Systems
C200	At the top front of the steering column support near the park brake pull button switch	*Harness Routing Views (Motorhome)* in Wiring Systems	*Inline Harness Connector End Views (Motorhome)* in Wiring Systems
G108	On top of the thermostat housing	*Power and Grounding Component Views* in Wiring Systems	—
G110	At the front, on the LH frame rail above the steering gearbox	*Power and Grounding Component Views* in Wiring Systems	—

Antilock Brakes System Components (Motorhome) (cont'd)

Name	Location	Locator View	Connector End View
G200	Mounted to the top front of the steering column support plate	—	—
P100	Main wiring pass through at the bulkhead	*Harness Routing Views (Motorhome)* in Wiring Systems	—
S102 (Gas)	In the engine harness, 25 cm (10 in) from the breakout for the windshield wiper and the forward lamp harness connectors, going away from passthrough P100	—	—
S116 (Gas)	In the engine harness, 31 cm (12 in) from the breakout for the MAF sensor toward P100	—	—
S143 (Gas)	In the engine harness, 5 cm (2 in) from the breakout for the ABS connectors C110 and C111, toward P100	—	—
S143 (Diesel)	In the engine harness, 2 cm (1 in) from the breakout for C100 and C207, toward the cooling fan connector	—	—
S160	Fusible link splice in the engine harness, 16 cm (6 in) from the battery junction block	—	—
S165	In the ABS harness, 10 cm (4 in) from the breakout for C110	—	—
S167	In the ABS harness, 19 cm (7 in) from the breakout for the brake pressure differential switch	—	—
S170 (Gas)	In the engine harness, 15 cm (6 in) from the breakout for the ABS connectors C110 and C111, toward passthrough P100	—	—
S200 (Diesel)	In the IP side of the engine harness, 8 cm (3 in) from the breakout for the turn signal switch connector, toward P100	—	—
S202 (Diesel)	In the IP side of the engine harness, 7 cm (3 in) from the breakout for the wiper switch and the hazard lamp flasher, toward P100	—	—
S204 (Export)	In the IP side of the engine harness, 22 cm (9 in) from P100	—	—
S205	In the IP harness breakout for the instrument cluster connector, 10 cm (4 in) from the main harness	—	—
S211	In the IP harness, 6 cm (2 in) from the dimmer switch and the IP cluster breakout, toward the IP fuse block	—	—
S229 (Diesel)	In the IP side of the engine harness, 3 cm (1 in) from the breakout for the hazard flasher and the wiper switch connector, toward the breakout for the data link connector	—	—

Antilock Brakes System Component Views

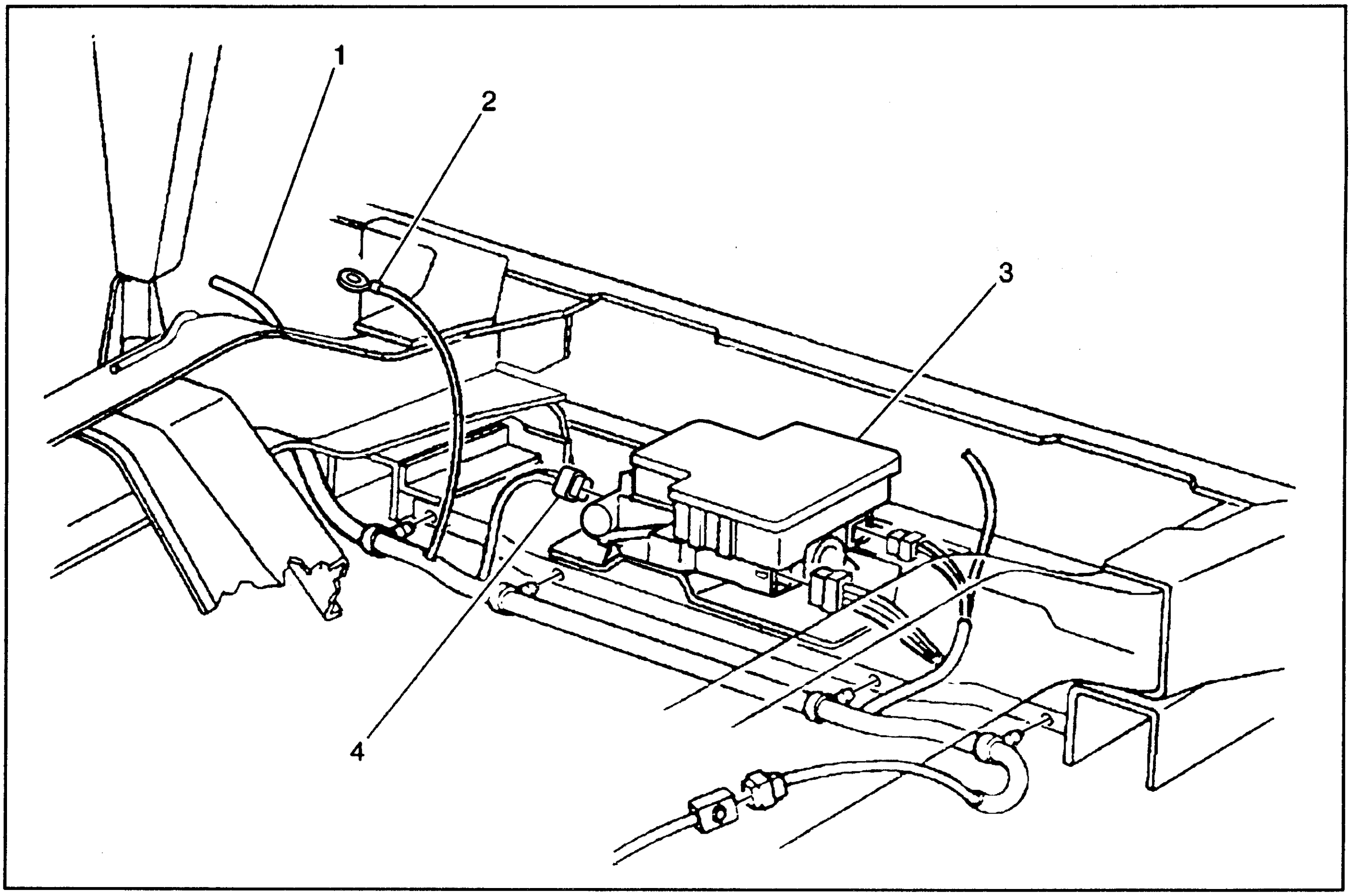
Electronic Brake Control Module (EBCM)



Legend

(1) Electronic Brake Control Module (EBCM)
(2) G110
(3) C111
(4) Wheel Speed Sensor Pigtail
(5) C110
(6) Brake Pressure Differential Switch
(7) C2

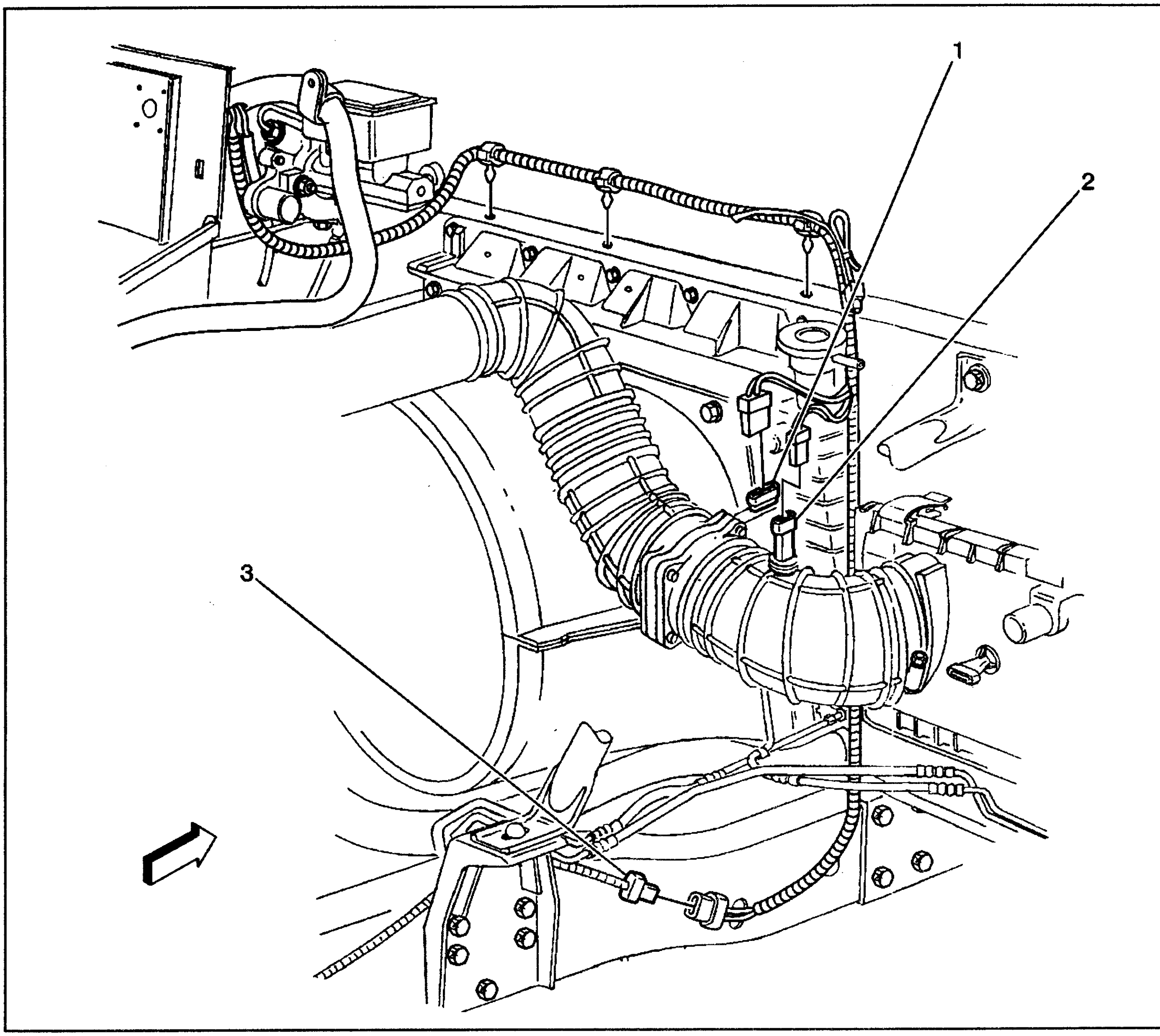
Electronic Brake Control Module, Rear View



Legend

(1) ABS Harness
(2) ABS Ground (G110)
(3) Electronic Brake Control Module (EBCM)
(4) Brake Pressure Differential Switch

Engine Wiring- Gasoline Right Hand Forward of Bulkhead



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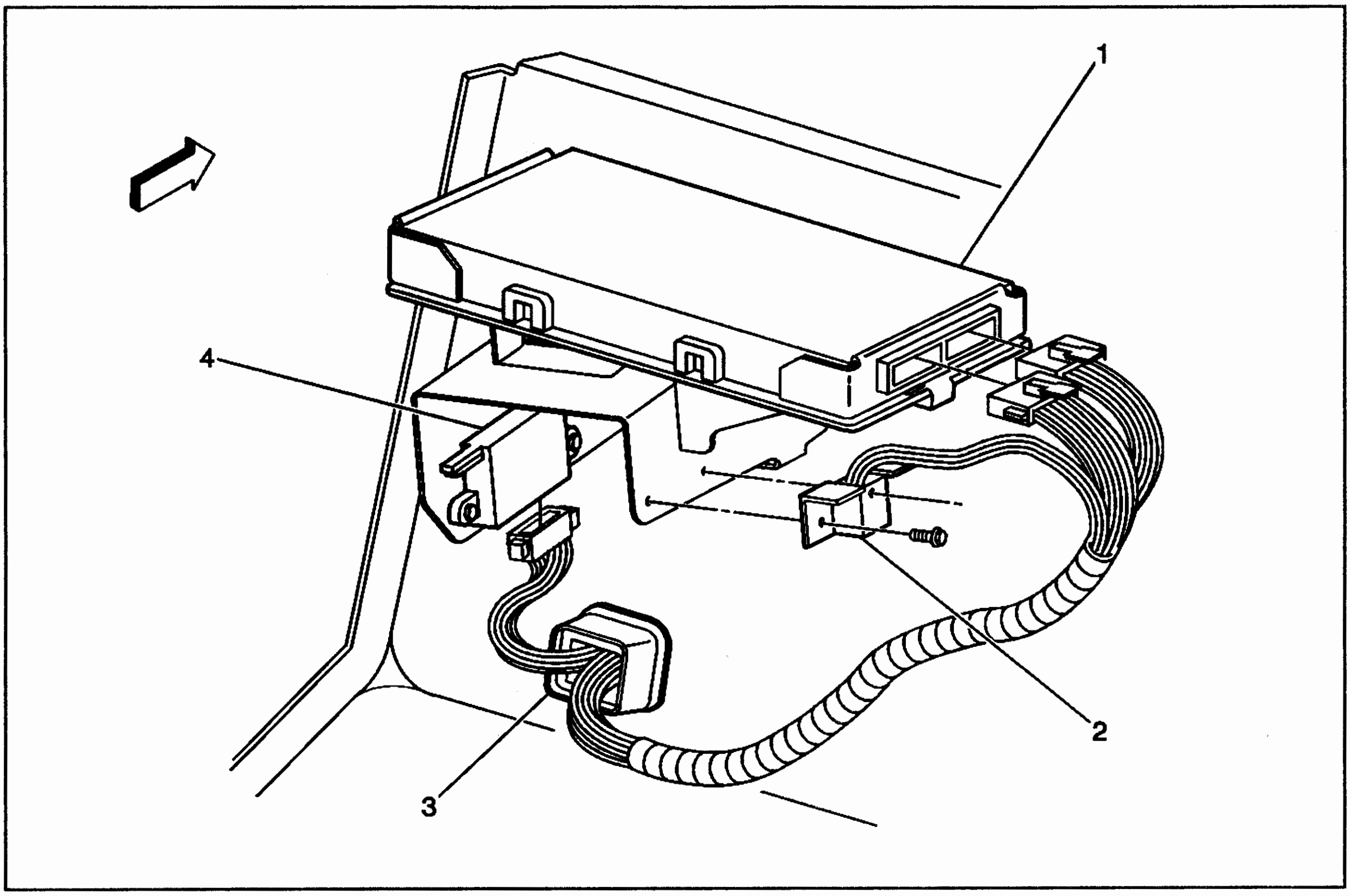
Legend

(1) Mass Air Flow Sensor (MAF)

(2) Intake Air Temperature Sensor (IAT)

(3) Wheel Speed Sensor (WSS) (Right Shown, Left Typical)

IP Side of Engine Wiring—Diesel—Forward View

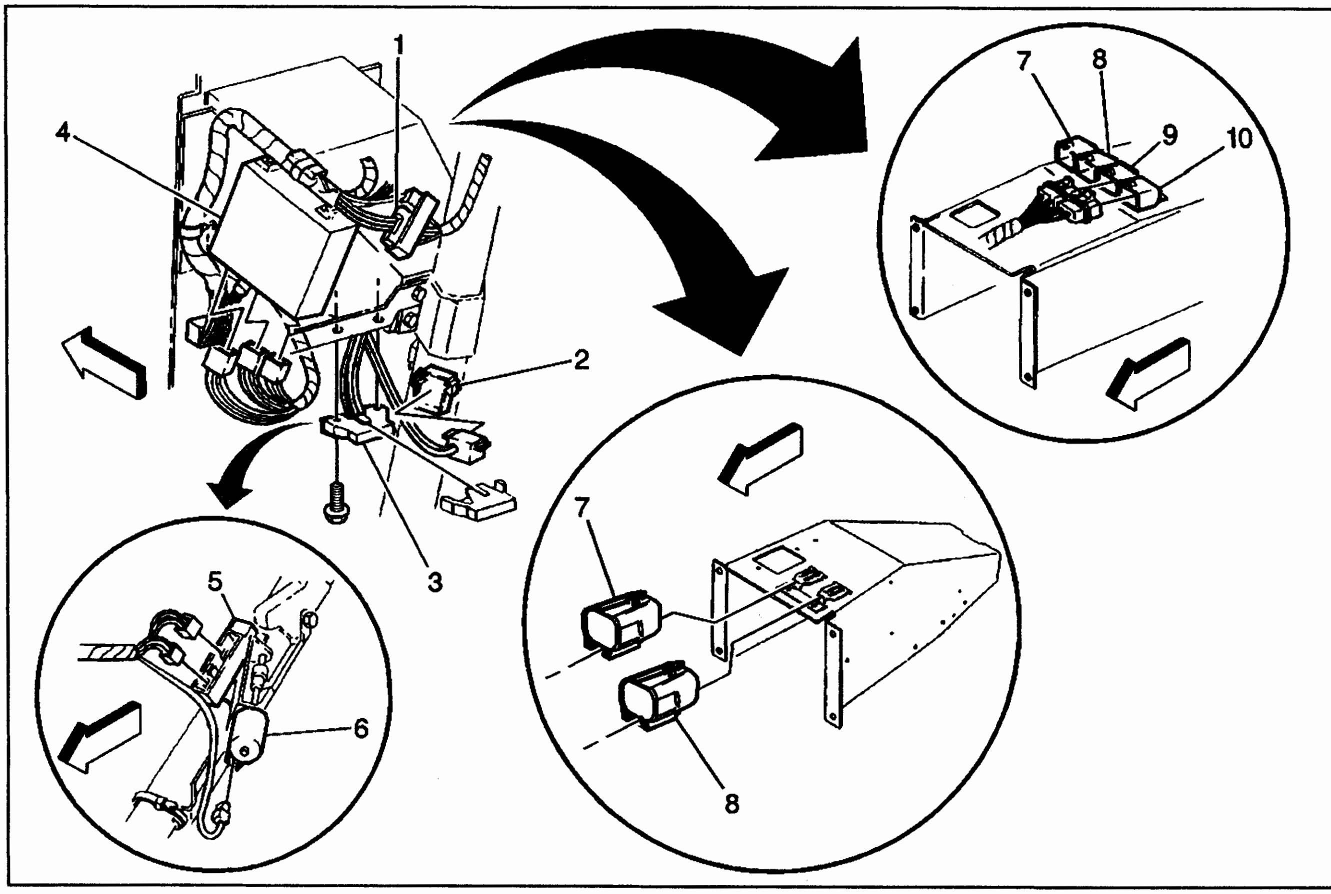


440934

Legend

(1) Powertrain Control Module (EFI Diesel)/Transmission Control Module (MFI Diesel with Auto Trans)
(2) Data Link Connector (DLC)
(3) P100
(4) Vehicle Speed Sensor (VSS) Calibrator

Engine Wiring Harness to Dash and Steering Column

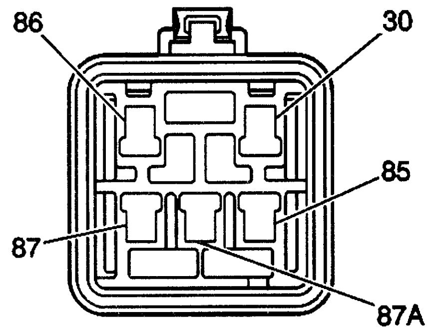


Legend

(1) Turn Signal Switch Connector
(2) Headlamps Dimmer Switch
(3) Data Link Connector (DLC)
(4) Powertrain Control Module (Diesel)
(5) Ignition Switch
(6) Brake Transmission Shift Interlock (BTSI) Solenoid
(7) Daytime Running Lamps (DRL) Relay
(8) Horn Relay
(9) Brake Transmission Shift Interlock (BTSI) Relay
(10) Fan Control Relay

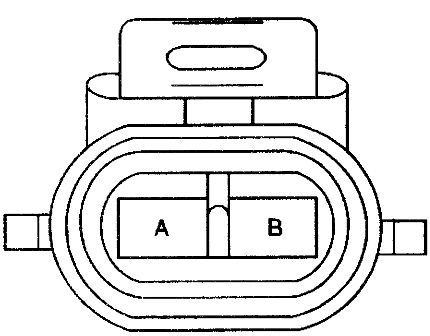
Antilock Brakes System Connector End Views

Antilock Brake Indicator Relay



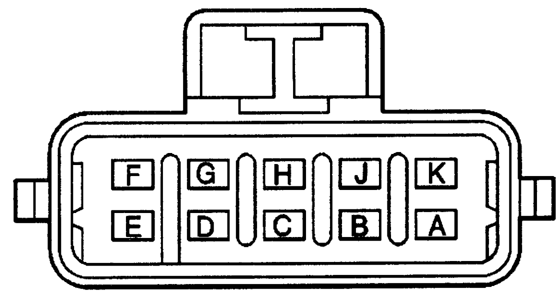
Connector Part Information	• 12110539 • 5 Way F Metri-Pack 280 Series, Flexlock (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
30	LT GRN	867	ABS Failure Indicator Lamp Output
85	PNK	39	Fuse Output-Ignition 1-Type III Fuse
86	BLK	1450	Ground
87	—	—	Not Used
87A	BLK	250	Ground

Brake Pressure Differential Switch



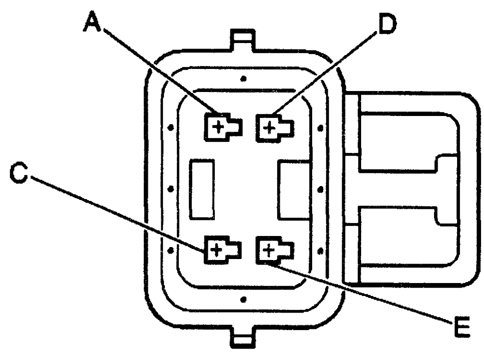
Connector Part Information	• 12052646 • 2 Way F Metri-Pack 150 Series (WHT)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PPL	680	ABS Pressure Differential Sensor Signal
B	BLK	450	Ground

Electronic Brake Control Module (EBCM) Connector C1



Connector Part Information	• 12065425 • 10 Way F Metri-Pack 150 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BRN	241	Fuse Output-Ignition 3-Type III Fuse
B	LT GRN	867	ABS Failure Indicator Lamp Output
C	PPL	420	Brake Pedal Switch Input-Torque Converter Clutch
D	—	—	Not Used
E	YEL/BLK	1827	Vehicle Speed Signal-128000 Pulses Per Mile
F	TAN/WHT	799	Diagnostic Signal-ABS
G	PPL	1807	Serial Data Signal-Class B-10400 BAUD-Primary
H	PPL	680	ABS Brake Pressure Differential Sensor Signal
J	BLK	450	Ground
K	—	—	Not Used
K (P32 WX7)	BLK	1450	Ground

EBCM Connector C2



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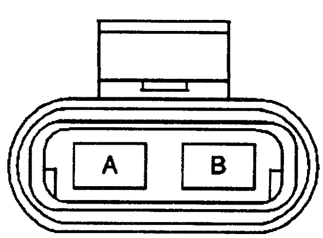
Connector Part Information	• 12124662 • 5 Way F Metri-Pack 150 Series (BRN)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	830	Wheel Speed Signal-Left Front
B	—	—	Not Used
C	DK GRN	872	Wheel Speed Signal-Right Front
D	YEL	873	Wheel Speed Return-Left Front
E	TAN	833	Wheel Speed Return-Right Front

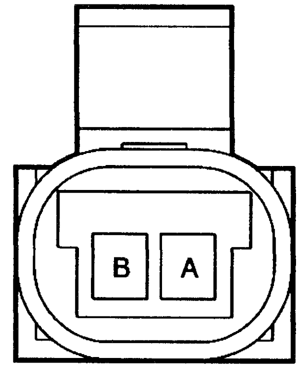
EBCM Connector C3



62489

Connector Part Information	• 12085030 • 2 Way F 630 Series P2S (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	RED	442	Fuse Output-Battery-Type II Fuse
B	BLK	350	Ground

Wheel Speed Sensors



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Connector Part Information	• 12162852 • 2 Way F Metri-Pack 150.2 Series P2S (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
Left Front			
A	LT BLU	830	Wheel Speed Sensor Signal
B	YEL	873	Wheel Speed Sensor Return
Right Front			
A	DK GRN	872	Wheel Speed Sensor Signal
B	TAN	833	Wheel Speed Sensor Return

Diagnostic Information and Procedures

Self-Diagnostics

The EBCM performs self-diagnostics of the ABS, and detects and isolates system malfunctions. When a malfunction is detected, the EBCM sets a corresponding diagnostic trouble code (DTC).

Malfunction Response

ABS response to malfunctions falls into three classes:

Permanent Latched Malfunction Response:: This means that the ABS is disabled and the ANTILOCK indicator lamp is requested on (whenever the ignition is turned on) even if the cause of the malfunction goes away. The only way to restore normal ABS operation is to take the vehicle to an authorized service center to have the cause of the malfunction corrected and the system reset by an electronic command sequence.

Ignition Latched Malfunction Response:: This means that the ABS is disabled and the ANTILOCK indicator lamp is requested on until the ignition is turnes off even if the cause of the malfunction goes away. When the ignition is turned on again, the ABS will not be disabled unless/until a subsequent malfunction is detected.

Condition Latched Malfunction Response:: This means that the ABS is disabled and the ANTILOCK indicator lamp is requested on only as long as the apparent malfunction condition persists. Normal ABS operation resumes automatically and the ANTILOCK indicator is requested off as soon as the problem goes away; no service is necesary. The vehicle operator may choose, without being prompted further by the ANTILOCK indicator lamp, to take the vehicle to an authorized service center.

Displaying DTCs

Read DTCs using a *Scan Tool.* No provisions are made for Flash Code DTCs.

Clearing DTCs

Use a *Scan Tool* in order to erase the DTCs in the EBCM memory. Verify proper system operation and absence of DTCs when the clearing procedure completes. DTCs cannot be cleared by unplugging the EBCM, by disconnecting the battery cables, or by turning the ignition OFF.

Intermittents and Poor Connections

Most intermittent faults are caused by a faulty electrical connection or faulty wiring. Occasionally a damaged EBCM can be the cause of an intermittent fault. For a detailed explanation of how to locate and repair intermittent conditions refer to *Intermittents and Poor Connections Diagnosis* in Wiring Systems.

Scan Tool Diagnosis

Refer to the Scan Tool Manual for complete information on scan tool diagnostics.

F0 - Diagnostic Trouble Codes (DTC)

The Diagnostic Trouble Codes (DTC) function has three modes that are described below:

- DTC Information: In this mode, current or history DTC(s) stored by the EBCM can be displayed.
- History Data: In this mode, DTC data is stored for the last 12 DTC events. This data includes the following information at the time when the DTC(s) was set:
  - The DTC number
  - Number of occurrences of the DTC
  - Number of ignition cycles since last occurrence
  - Was EBCM in an ABS mode when the DTC occurred
  - Composite vehicle speed (3 speed sensor inputs, averaged) when the DTC occurred
  - Was vehicle in an 4WD when the DTC occurred
  - Brake switch status
  - Differential Pressure switch status
- Clear DTC Information: In this mode, current and history DTCs are cleared. History data is not cleared from the EBCM.

F1 - Data Display

The Data Diplay function contains two special function "hot keys," and a data list which details ABS parameters. The hot keys perform the following functions:

- DTCs — used to instantly read stored DTCs
- Quick Snap — used to record instant events

The following ABS parameters are viewable on the data list:

Brake Switch Status: scan tool displays: On / Off

4WD Status: scan tool displays: Two Wheel Drive or Four Wheel Drive

Left Front Wheel Speed: scan tool displays: km/h / mph—Display shows actual wheel speed. The default wheel speed is 3 mph.

Right Front Wheel Speed: scan tool displays: km/h / mph—Display shows actual wheel speed. The default wheel speed is 3 mph.

Rear Wheel Speed: scan tool displays: km/h / mph—Display shows actual wheel speed. The default wheel speed is 3 mph.

ABS Lamp Command: scan tool displays: On / Off

Brake Warning Lamp Cmd: scan tool displays: On / Off

Diff. Pressure Switch: scan tool displays: Ok / Low

DRP Active: scan tool displays: Yes/No

ABS Stop State: scan tool displays: On/Off

ABS Pump Motor: scan tool displays: On/Off— This parameter indicates the state of the ABS Pump Motor.

ABS Relay Command: scan tool displays: On/Off— This parameter indicates the state of the ABS relay.

RF ISO Valve Command: scan tool displays: On/Off—This parameter indicates the state of the RF ISO Valve.

RF ISO Valve Feedback: scan tool displays: On/Off—This parameter indicates the state of the RF ISO Valve feedback.

LF ISO Valve Command: scan tool displays: On/Off—This parameter indicates the state of the LF ISO Valve feedback.

LF ISO Valve Feedback: scan tool displays: On/Off—This parameter indicates the state of the LF ISO Valve feedback.

Rear ISO Valve Command: scan tool displays: On/Off—This parameter indicates the state of the Rear ISO Valve.

Rear ISO Valve Feedback: scan tool displays: On/Off—This parameter indicates the state of the Rear ISO Valve feedback.

RF Dump Valve Command: scan tool displays: On/Off—This parameter indicates the state of the RF Dump Valve.

RF Dump Valve Feedback: scan tool displays: On/Off—This parameter indicates the state of the RF Dump Valve feedback.

LF Dump Valve Command: scan tool displays: On/Off—This parameter indicates the state of the LF Dump Valve.

LF Dump Valve Feedback: scan tool displays: On/Off—This parameter indicates the state of the LF Dump Valve feedback.

Rear Dump Valve Command: scan tool displays: On/Off—This parameter indicates the state of the Rear Dump Valve.

Rear Dump Valve Feedback: scan tool displays: On/Off—This parameter indicates the state of the Rear Dump Valve feedback.

F2 - Special Functions

In this test mode, the scan tool can be used to perform functional tests on the ABS which help verify proper operation. Malfunction conditions can be further identified by testing and observing the test results. DTCs must be cleared before any tests in Special Functions can be performed. In a vehicle equipped with ABS, the Special Functions are grouped as following:

ABS

- Function Test
- Automated Bleed
- ABS Motor
- System Identification
- Tire Size Calibration
- ABS Lamp
- Solenoid Tests (for all Dump and Isolation solenoid valves)
- ABS Relay
- Brake Lamp

Function Test

The Function Test cycles each valve solenoid and the pump motor (as well as the necessary relays) to check component operation. If a malfunction is detected, the EBCM will set DTC(s), which will be displayed upon completion of the test. Perform the test as follows:

1. Ignition OFF.
2. Install the scan tool.
3. Turn ignition to RUN.
4. Select the scan tool's Special Functions.
5. Select the Function Test.
6. Run the Function Test.
7. Note any DTCs set.

Automated Bleed

Automated Bleed cycles each valve solenoid and the pump motor in a special sequence (as well as the necessary relays) in order to bleed air out of the BPMV after removal or installation of brake lines, or BPMV replacement. Perform the test as follows:

1. Ignition OFF.
2. Install the scan tool.
3. Turn ignition to RUN.
4. Select the scan tool's Special Functions.
5. Select the Automated Bleed function.
6. Run the Automated Bleed function.

ABS Motor

This function tests the ABS pump motor to check component operation. If a malfunction is detected, the EBCM will set DTC(s), and the ABS indicator lamp will turn on. Perform the test as follows:

1. Ignition OFF.
2. Install the scan tool.
3. Turn ignition to RUN.
4. Select the scan tool's Special Functions.
5. Select the ABS Motor Test.
6. Run the ABS Motor Test.

System Identification

This function is used to identify the hardware and software revision of the EHCU

1. Ignition OFF.
2. Install the scan tool.
3. Turn ignition to RUN.
4. Select the scan tool's Special Functions.
5. Select System Identification.
6. Make note of the relevant information.

Tire Size Calibration

This function allows the EBCM tire size to be set or changed when a new EBCM is installed, or different tires/wheels are installed on the vehicle.

1. Turn ignition OFF.
2. Install the scan tool.
3. Turn ignition to RUN.
4. Select the scan tool's Special Functions.
5. Select the Tire Size Calibration.
6. Make the necessary changes to existing tire size setting.

ABS Lamp

This test allows activation of the ABS indicator. The ABS Lamp test aids in diagnosing indicator malfunctions. The test allows the operator to turn the indicator on and off manually.

BRAKE Lamp

This test allows activation of the BRAKE indicator. The BRAKE Lamp test aids in diagnosing indicator malfunctions. The test allows the operator to flash the indicator on and off manually.

Solenoid Tests (Isolation Valves)

The Solenoid Test for isolation valves activates the selected wheel circuit Isolation valve, placing it in the pressure hold position. When in the pressure hold position, the valve will not allow master cylinder pressure to be delivered to the hydraulic wheel circuit. This is done under ABS operating conditions because the EBCM has determined that the wheel is moving too slowly, so it holds additional master cylinder pressure from it in an attempt to allow it to rotate at an appropriate speed. The scan tool commands the valve to close, which should allow the technician to spin the wheel even though an assistant is applying pressure to the brake pedal. Perform the test as follows:

1. Ignition OFF.
2. Install the scan tool.
3. Turn ignition to RUN.
4. Raise vehicle such that wheels are about 6 inches off the floor with the transmission in neutral.
5. Select the scan tool's Special Functions.
6. Select the desired Isolation Solenoid test. Have an assistant command the Isolation valve ON with the scan tool.
7. Have the assistant press and hold the brake pedal.
8. Attempt to move the wheel being tested by hand; it should move even though the assistant is applying pressure to the brake pedal. The wheels may be difficult to turn by hand, but can be moved if the system is working properly.

Solenoid Tests (Dump Valves)

The Solenoid Test for Dump valves activates the selected hydraulic wheel circuit Dump valve, placing it in the pressure release position. When in the pressure release position, the valve will allow wheel caliper pressure to be returned to the master cylinder circuit. This is done under ABS operating conditions because the EBCM has determined that the wheel is moving too slowly, and holding additional master cylinder pressure from it has not allowed it to rotate at an appropriate speed. The scan tool commands the valve to release hydraulic pressure to the affected brake caliper, which should allow the technician to spin the wheel even though an assistant is applying pressure to the brake pedal. Perform the test as follows:

1. Ignition OFF.
2. Install the scan tool.
3. Turn ignition to RUN.
4. Raise vehicle such that wheels are about 6 inches off the floor with the transmission in neutral.
5. Have an assistant press and hold the brake pedal.
6. Select the scan tools Special Functions.
7. Select the desired Dump Solenoid Test. Have the assistant command the Dump valve ON with the scan tool.
8. Attempt to move the wheel being tested by hand; it should move even though the assistant is applying pressure to the brake pedal. The wheels may be difficult to turn by hand, but can be moved if the system is working properly.

ABS Relay

This function allows.

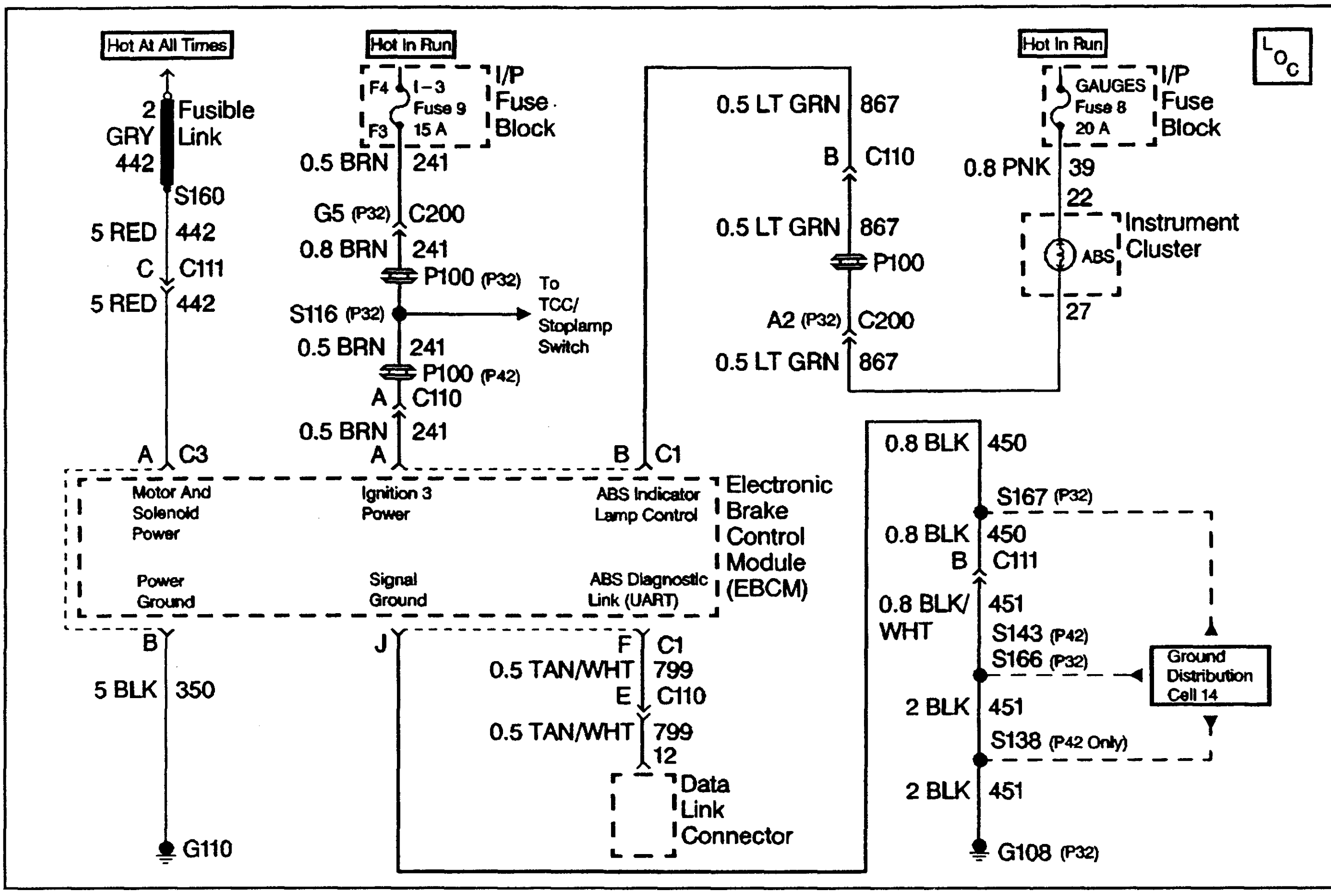
1. Ignition OFF.
2. Install the scan tool.
3. Turn ignition to RUN.
4. Select the scan tool's Special Functions.
5. Select the ABS Relay.
6. Take note of the relay status as the relay is cycled.

F3 - Snapshot

In this test mode, the scan tool captures the data listed in the data displays before and after a snapshot. The following triggering conditions are available:

- DTC — In this mode, the snapshot will be triggered on a specific (operator selected) DTC.
- Any DTC — in this mode, the snapshot will trigger on any DTC
- Auto Trigger — will trigger a snapshot under two conditions:
  1. Wheel speed out of range — Snapshot will trigger when a WSS/VSS input is +/- 7 mph out of range in relation to other WSS/VSS inputs.
  2. ABS Stop — Snapshot will trigger when an ABS event occurs.

ABS Diagnostic System Check (Motorhome)



191458

System Description

The diagnostic system check is an organized approach to identifying an Antilock Brake System (ABS) malfunction. The diagnostic system check must be the starting point for any ABS complaint diagnosis. The diagnostic system check directs the service technician to the next logical step in diagnosing the complaint.

Diagnostic serial data is transmitted/received by the EBCM 10-way terminal F. The EBCM is supplied switched ignition voltage through the EBCM 10-way terminal A, and signal ground is provided through the EBCM 10–way terminal J.

Diagnostic Aids

Excessive resistance in the signal ground or ignition power circuit will not allow communication with the EBCM. If communication with the EBCM is not possible, ensure that the ABS signal ground connection is good and that there is no excessive resistance in the ignition power circuit.

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step checks for normal ABS indicator lamp operation.
4. This step checks for ignition voltage at the EBCM.
5. This step checks for high resistance in the ground circuit.
9. This step checks for high resistance in the ignition voltage circuit.
10. This step checks for a short to ground in the ignition voltage circuit.

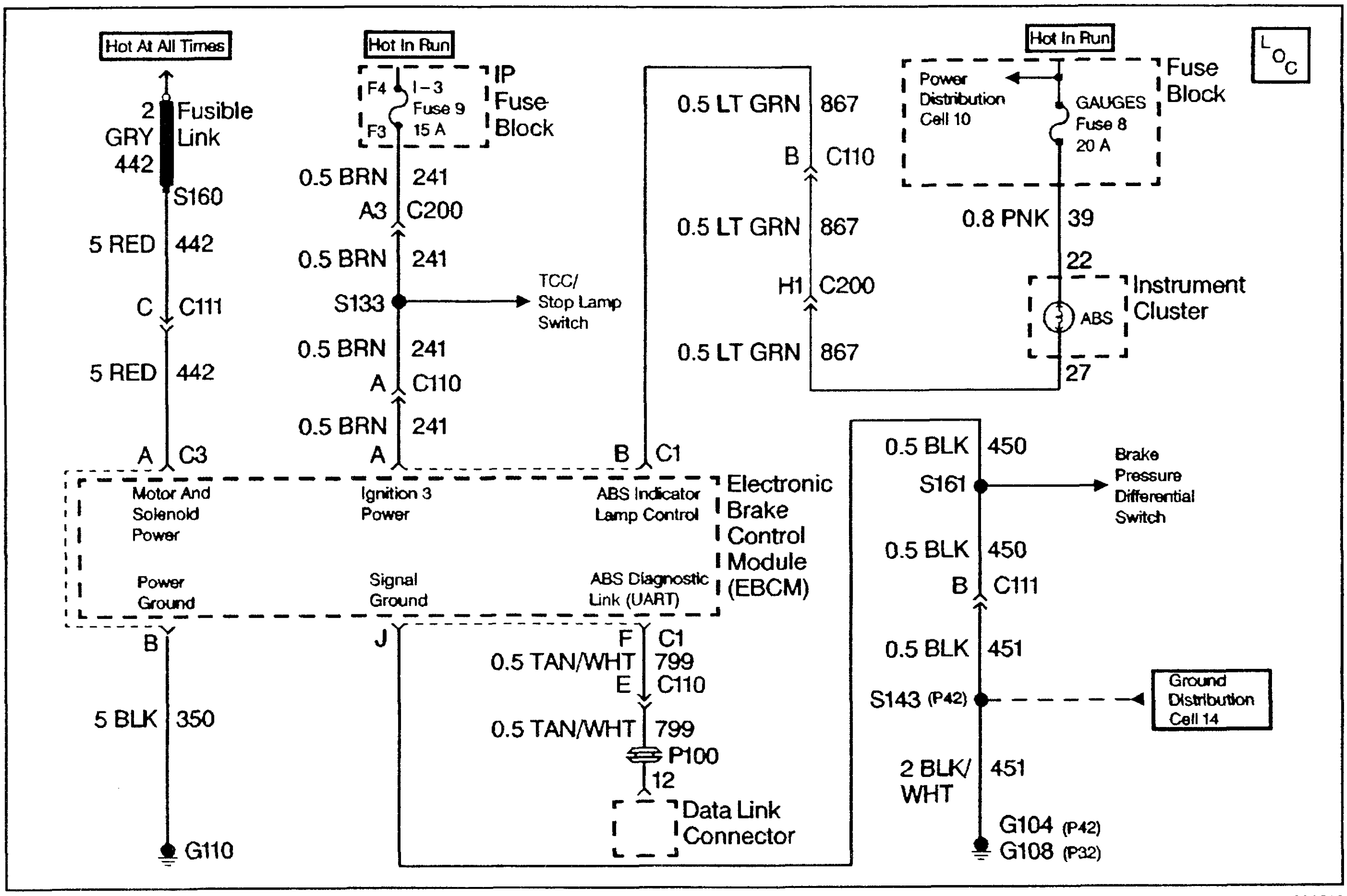
ABS Diagnostic System Check (Motorhome)

Step	Action	Value(s)	Yes	No
1	1. Verify that all of the EBCM connectors are connected properly. 2. Install the *Scan Tool*. 3. Turn the ignition to RUN. 4. Attempt to communicate with the EBCM using the *Scan Tool*. Is data being received from the EBCM?	—	Go to *Step 2*	Go to *Step 4*
2	Using the *Scan Tool*, check for any DTCs. Are any current or history DTCs displayed?	—	Go to Appropriate DTC Table	Go to *Step 3*
3	1. Turn the ignition to OFF for 10 seconds. 2. Turn the ignition to RUN and observe the ABS indicator lamp. Did the ABS indicator lamp turn on for two seconds and then turn off?	—	Go to Diagnostic Aids	Go to *Step 11*
4	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM harness connector. 3. Turn the ignition to RUN. 4. Measure the voltage between the 10-way EBCM harness connector terminal A and ground using the *J 39200*. Is the voltage measured within the specified range?	10-15 V	Go to *Step 5*	Go to *Step 9*
5	1. Turn the ignition to OFF. 2. Disconnect the negative battery cable. Refer to *Battery Disconnect Caution* in Cautions and Notices. 3. Using the *J 39200*, measure the resistance between the 10-way EBCM harness connector terminal J and the negative battery terminal. Is the resistance measured within the specified range?	0-2 Ω	Go to *Step 6*	Go to *Step 12*
6	1. Inspect the EBCM terminals and the EBCM harness connector terminals for poor terminal contact. 2. Inspect the battery terminals and the battery cable terminals for poor connection. Refer to Checking Terminal Contact in Electrical Diagnosis. Is the terminal contact or the connection poor?	—	Go to *Step 7*	Go to *Step 8*
7	Replace the terminals or repair the poor connection. Is the repair complete?	—	Go to *Step 1*	—
8	Reconnect the EBCM connectors and the battery cables. Are the EBCM connectors and the battery cables reconnected?	—	Go to *Scan Tool Does Not Communicate with EBCM*	—
9	1. Disconnect the positive battery cable. 2. Turn the ignition to RUN. (This is to provide circuit continuity.) 3. Using the *J 39200*, measure the resistance between the 10-way EBCM connector terminal A and the positive battery cable. Is the resistance measured within the specified range.	0-2 Ω	Go to *Step 10*	Go to *Step 13*
10	1. Turn the ignition to OFF. 2. Remove Fuse I-3. 3. Using the *J 39200*, measure the resistance between the 10-way EBCM connector terminal A and ground. Is the resistance measurement equal to the specified value?	OL	Go to *Step 15*	Go to *Step 14*

ABS Diagnostic System Check (Motorhome) (cont'd)

Step	Action	Value(s)	Yes	No
11	Observe the ABS indicator lamp. Does the ABS indicator lamp stay on?	—	Go to *ABS Indicator On No DTC Set (Motorhome)*	Go to *ABS Indicator Off No DTC Set (Motorhome)*
12	Repair open or high resistance in CKT 451. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *Step 1*	—
13	1. Repair open or high resistance in CKT 241. Refer to *Wiring Repairs.* 2. Check for an open in Fuse I-3. Is the repair complete?	—	Go to *Step 1*	—
14	1. Repair short to ground in CKT 241. Refer to *Wiring Repairs.* 2. Check for an open in Fuse I-3. Is the repair complete?	—	Go to *Step 1*	—
15	Inspect CKT 241 and the 10-way EBCM harness connector for physical damage which may result in a short to ground with the 10-way EBCM harness connector connected to the EBCM. Is there evidence of damage?	—	Go to *Step 16*	Go to *Step 17*
16	Repair the terminals which are damaged. Is the repair complete?	—	Go to *Step 1*	—
17	1. Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* 2. Check for an open in Fuse I-3. Is the repair complete?	—	Go to *Step 1*	—

ABS Diagnostic System Check (Commercial)



396516

System Description

The diagnostic system check is an organized approach to identifying an Antilock Brake System (ABS) malfunction. The diagnostic system check must be the starting point for any ABS complaint diagnosis. The diagnostic system check directs the service technician to the next logical step in diagnosing the complaint.

Diagnostic serial data is transmitted/received by the EBCM 10-way terminal F. The EBCM is supplied switched ignition voltage through the EBCM 10-way terminal A, and signal ground is provided through the EBCM 10–way terminal J.

Diagnostic Aids

Excessive resistance in the signal ground or ignition power circuit will not allow communication with the EBCM. If communication with the EBCM is not possible, ensure that the ABS signal ground connection is good and that there is no excessive resistance in the ignition power circuit.

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step checks for normal ABS indicator lamp operation.
4. This step checks for ignition voltage at the EBCM.
5. This step checks for high resistance in the ground circuit.
9. This step checks for high resistance in the ignition voltage circuit.
10. This step checks for a short to ground in the ignition voltage circuit.

ABS Diagnostic System Check (Commercial)

Step	Action	Value(s)	Yes	No
1	1. Verify that all of the EBCM connectors are connected properly. 2. Install the *Scan Tool.* 3. Turn the ignition to RUN. 4. Attempt to communicate with the EBCM using the *Scan Tool.* Is data being received from the EBCM?	—	Go to *Step 2*	Go to *Step 4*
2	Using the *Scan Tool*, check for any DTCs. Are any current or history DTCs displayed?	—	Go to Appropriate DTC Table	Go to *Step 3*
3	1. Turn the ignition to OFF for 10 seconds. 2. Turn the ignition to RUN and observe the ABS indicator lamp. Did the ABS indicator lamp turn on for two seconds and then turn off?	—	Go to Diagnostic Aids	Go to *Step 11*
4	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM harness connector. 3. Turn the ignition to RUN. 4. Using the *J 39200*, measure the voltage between the 10-way EBCM harness connector terminal A and ground. Is the voltage measured within the specified range?	10-15 V	Go to *Step 5*	Go to *Step 9*
5	1. Turn the ignition to OFF. 2. Disconnect the negative battery cable. Refer to *Battery Disconnect Caution* in Cautions and Notices. 3. Using the *J 39200*, measure the resistance between the 10-way EBCM harness connector terminal J and the negative battery terminal. Is the resistance measured within the specified range?	0-2 Ω	Go to *Step 6*	Go to *Step 12*
6	1. Inspect the EBCM terminals and the EBCM harness connector terminals for poor terminal contact. 2. Inspect the battery terminals and the battery cable terminals for poor connection. Refer to Checking Terminal Contact in Electrical Diagnosis. Is the terminal contact or the connection poor?	—	Go to *Step 7*	Go to *Step 8*
7	Replace the terminals or repair the poor connection. Is the repair complete?	—	Go to *Step 1*	—
8	Reconnect the EBCM connectors and the battery cables. Are the EBCM connectors and the battery cables reconnected?	—	Go to *Scan Tool Does Not Communicate with EBCM*	—
9	1. Disconnect the positive battery cable. 2. Turn the ignition to RUN. (This is to provide circuit continuity.) 3. Using the *J 39200*, measure the resistance between the 10-way EBCM connector terminal A and the positive battery cable. Is the resistance measured within the specified range.	0-2 Ω	Go to *Step 10*	Go to *Step 13*
10	1. Turn the ignition to OFF. 2. Remove Fuse I-3. 3. Using the *J 39200*, measure the resistance between the 10-way EBCM connector terminal A and ground. Is the resistance measurement equal to the specified value?	OL	Go to *Step 15*	Go to *Step 14*

ABS Diagnostic System Check (Commercial) (cont'd)

Step	Action	Value(s)	Yes	No
11	Observe the ABS indicator lamp. Does the ABS indicator lamp stay on?	—	Go to *ABS Indicator On No DTC Set (Commercial)*	Go to *ABS Indicator Off No DTC Set (Commercial)*
12	Repair open or high resistance in CKT 451. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *Step 1*	—
13	1. Repair open or high resistance in CKT 241. Refer to *Wiring Repairs.* 2. Check for an open in Fuse I-3. Is the repair complete?	—	Go to *Step 1*	—
14	1. Repair short to ground in CKT 241. Refer to *Wiring Repairs.* 2. Check for an open in Fuse I-3. Is the repair complete?	—	Go to *Step 1*	—
15	Inspect CKT 241 and the 10-way EBCM harness connector for physical damage which may result in a short to ground with the 10-way EBCM harness connector connected to the EBCM. Is there evidence of damage?	—	Go to *Step 16*	Go to *Step 17*
16	Repair the terminals which are damaged. Is the repair complete?	—	Go to *Step 1*	—
17	1. Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* 2. Check for an open in Fuse I-3. Is the repair complete?	—	Go to *Step 1*	—

DTC List

DTC	Definition
DTC C0221	*DTC C0221 RF Wheel Speed Sensor Circuit Open (Motorhome)* or *DTC C0221 RF Wheel Speed Sensor Circuit Open (Commercial)*
DTC C0222	*DTC C0222 RF Wheel Speed Signal Missing (Motorhome)* or *DTC C0222 RF Wheel Speed Signal Missing (Commercial)*
DTC C0223	*DTC C0223 RF Wheel Speed Signal Erratic (Motorhome)* or *DTC C0223 RF Wheel Speed Signal Erratic (Commercial)*
DTC C0225	*DTC C0225 LF Wheel Speed Sensor Circuit Open (Motorhome)* or *DTC C0225 LF Wheel Speed Sensor Circuit Open (Commercial)*
DTC C0226	*DTC C0226 LF Wheel Speed Signal Missing (Motorhome)* or *DTC C0226 LF Wheel Speed Signal Missing (Commercial)*
DTC C0227	*DTC C0227 LF Wheel Speed Signal Erratic (Motorhome)* or *DTC C0227 LF Wheel Speed Signal Erratic (Commercial)*

DTC List (cont'd)

DTC	Definition
DTC C0229	DTC C0229 Drop Out of Front Wheel Speed Signals (Motorhome) or *DTC C0229 Drop Out of Front Wheel Speed Signals (Commercial)*
DTC C0235	*DTC C0235 Rear Wheel Speed Signal Circuit Open (Motorhome)* or *DTC C0235 Rear Wheel Speed Signal Circuit Open (Commercial)*
DTC C0236	*DTC C0236 Rear Wheel Speed Signal Circuit Missing (Motorhome)* or *DTC C0236 Rear Wheel Speed Signal Circuit Missing (Commercial)*
DTC C0237	*DTC C0237 Rear Wheel Speed Signal Erratic (Motorhome)* or DTC C0237 Rear Wheel Speed Signal Erratic (Commercial)
DTC C0238	*DTC C0238 Wheel Speed Mismatch (Motorhome)* or DTC C0238 Wheel Speed Mismatch (Commercial)
DTC C0241	*DTC C0241-C0254 EBCM Control Valve Circuit (Motorhome)* or DTC C0241-C0254 EBCM Control Valve Circuit (Commercial)

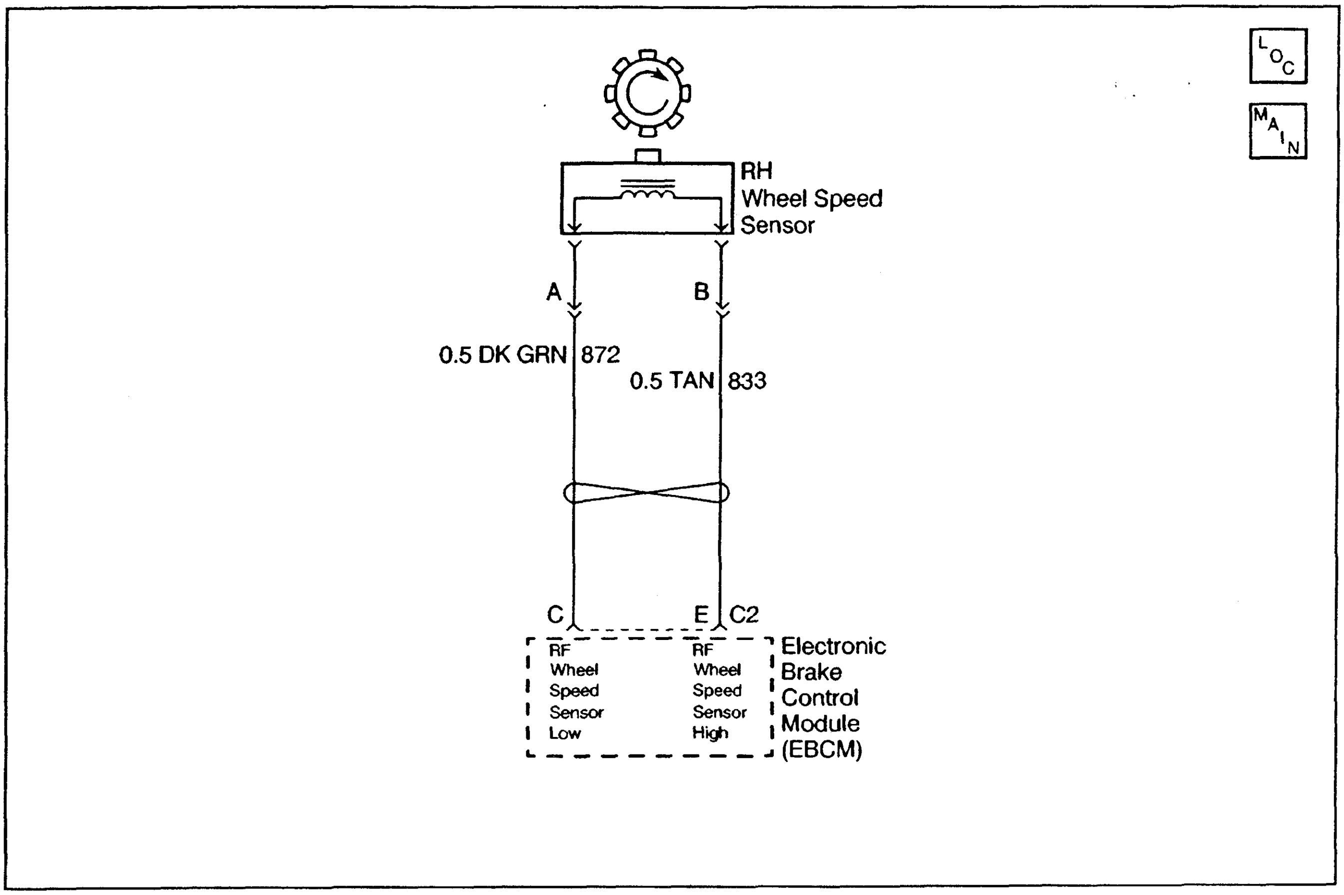
DTC List (cont'd)

DTC	Definition
DTC C0242	*DTC C0241-C0254 EBCM Control Valve Circuit (Motorhome)* or *DTC C0241-C0254 EBCM Control Valve Circuit (Commercial)*
DTC C0243	*DTC C0241-C0254 EBCM Control Valve Circuit (Motorhome)* or *DTC C0241-C0254 EBCM Control Valve Circuit (Commercial)*
DTC C0244	*DTC C0241-C0254 EBCM Control Valve Circuit (Motorhome)* or *DTC C0241-C0254 EBCM Control Valve Circuit (Commercial)*
DTC C0245	*DTC C0241-C0254 EBCM Control Valve Circuit (Motorhome)* or *DTC C0241-C0254 EBCM Control Valve Circuit (Commercial)*
DTC C0246	*DTC C0241-C0254 EBCM Control Valve Circuit (Motorhome)* or *DTC C0241-C0254 EBCM Control Valve Circuit (Commercial)*
DTC C0247	*DTC C0241-C0254 EBCM Control Valve Circuit (Motorhome)* or *DTC C0241-C0254 EBCM Control Valve Circuit (Commercial)*
DTC C0248	*DTC C0241-C0254 EBCM Control Valve Circuit (Motorhome)* or *DTC C0241-C0254 EBCM Control Valve Circuit (Commercial)*
DTC C0251	*DTC C0241-C0254 EBCM Control Valve Circuit (Motorhome)* or *DTC C0241-C0254 EBCM Control Valve Circuit (Commercial)*
DTC C0252	*DTC C0241-C0254 EBCM Control Valve Circuit (Motorhome)* or *DTC C0241-C0254 EBCM Control Valve Circuit (Commercial)*
DTC C0253	*DTC C0241-C0254 EBCM Control Valve Circuit (Motorhome)* or *DTC C0241-C0254 EBCM Control Valve Circuit (Commercial)*
DTC C0254	*DTC C0241-C0254 EBCM Control Valve Circuit (Motorhome)* or *DTC C0241-C0254 EBCM Control Valve Circuit (Commercial)*
DTC C0265	*DTC C0265 or C0266 EBCM Relay Circuit (Motorhome) or DTC C0265* or *C0266 EBCM Relay Circuit (Commercial)*

DTC List (cont'd)

DTC	Definition
DTC C0266	*DTC C0265 or C0266 EBCM Relay Circuit (Motorhome) or DTC C0265* or *C0266 EBCM Relay Circuit (Commercial)*
DTC C0267	*DTC C0267 or C0268 Pump Motor Circuit Open/Shorted (Motorhome)* or *DTC C0267 or C0268 Pump Motor Circuit Open/Shorted (Commercial)*
DTC C0268	*DTC C0267 or C0268 Pump Motor Circuit Open/Shorted (Motorhome)* or *DTC C0267 or C0268 Pump Motor Circuit Open/Shorted (Commercial)*
DTC C0269	*DTC C0269 or C0274 Excessive Dump/Isolation Time (Motorhome)* or *DTC C0269 or C0274 Excessive Dump/ Isolation Time (Commercial)*
DTC C0271	*DTC C0271-C0273 EBCM Malfunction (Motorhome)* or *DTC C0271-C0273 EBCM Malfunction (Commercial)*
DTC C0272	*DTC C0271-C0273 EBCM Malfunction (Motorhome)* or *DTC C0271-C0273 EBCM Malfunction (Commercial)*
DTC C0273	*DTC C0271-C0273 EBCM Malfunction (Motorhome)* or *DTC C0271-C0273 EBCM Malfunction (Commercial)*
DTC C0274	*DTC C0269 or C0274 Excessive Dump/Isolation Time (Motorhome)* or *DTC C0269 or C0274 Excessive Dump/ Isolation Time (Commercial)*
DTC C0281	*DTC C0281 Brake Switch Circuit (Motorhome)* or *DTC C0281 Brake Switch Circuit (Commercial)*
DTC C0286	*DTC C0286 ABS Indicator Lamp Circuit Shorted to B+ (Motorhome)* or *DTC C0286 ABS Indicator Lamp Circuit Shorted to B+ (Commercial)*
DTC C0288	*DTC C0288 Brake Warning Lamp Circuit Shorted to B+ (Motorhome)* or *DTC C0288 Brake Warning Lamp Circuit Shorted to B+ (Commercial)*

DTC C0221 RF Wheel Speed Sensor Circuit Open (Motorhome)



191471

Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed ring. This distance is referred to as the air gap.

Conditions for Setting the DTC

- No output signal from the right front wheel speed sensor for 1.0 second
- Excessive right front wheel speed sensor resistance for 1.0 second

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0221 is a Condition Latched DTC, which indicates that the above actions remain true only as long as the condition persists.

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, then replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)*.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature. Refer to the following tables for temperature/resistance values.

WSS Temperature vs. Sensor Resistance

°C	°F	Ohms
Temperature vs Resistance Values (Approximate)		
-40 to 4	-40 to 40	1575 to 2420
5 to 43	41 to 110	1980 to 2800
44 to 93	111 to 200	2250 to 3280
94 to 150	201 to 302	2750 to 3850

Test Description

The numbers below refer to the steps in the diagnostic table:

2. This step checks the resistance of the right front wheel speed sensor circuit.
3. This step checks for continuity in the right front wheel speed sensor harness.
4. This step checks the resistance of the right front wheel speed sensor.

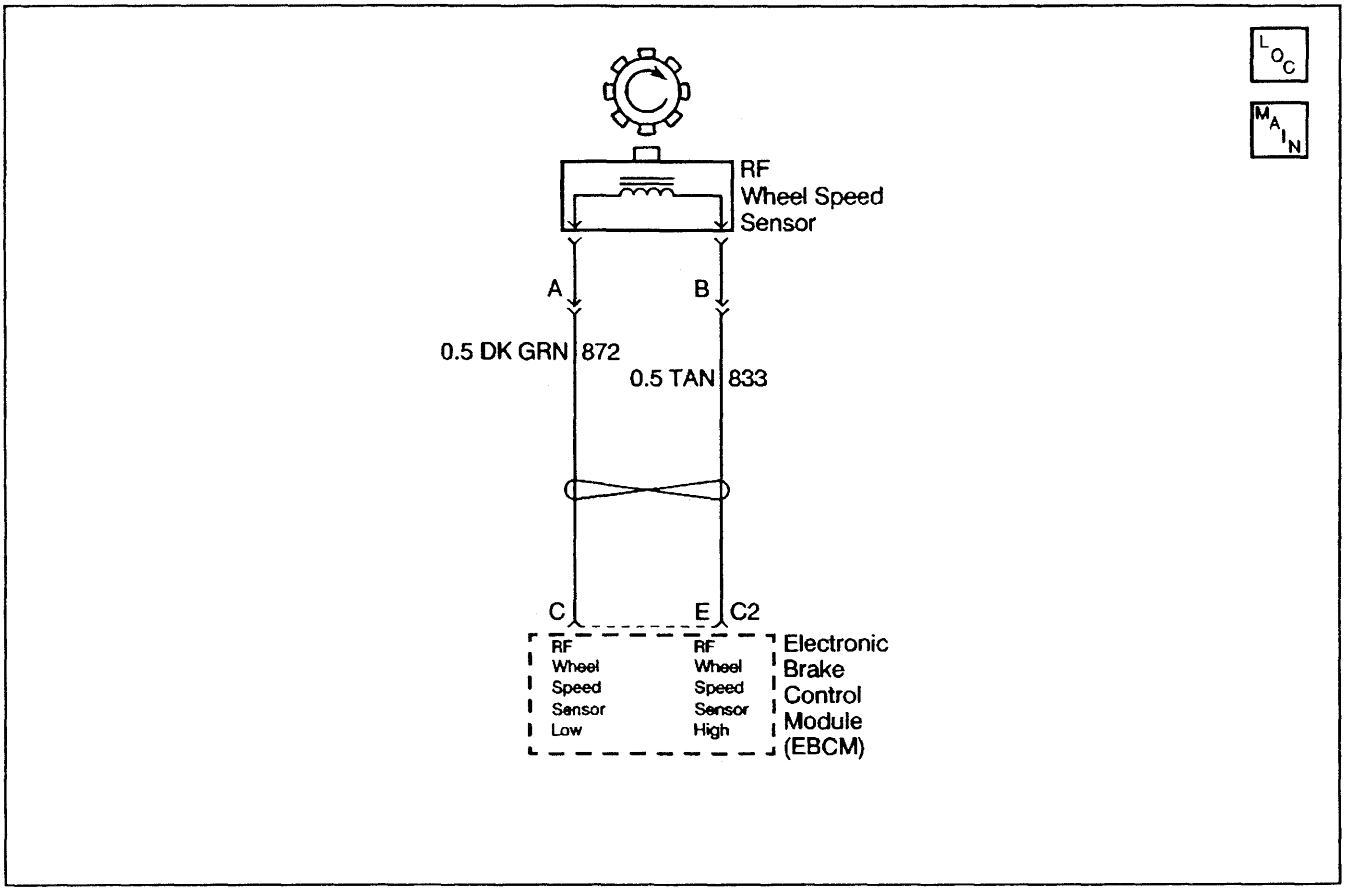
DTC C0221 RF Wheel Speed Sensor Circuit Open (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Turn the ignition OFF. 2. Disconnect the 4-way EBCM harness connector. 3. Using a *J 39200*, measure the resistance between terminal C and terminal E of the 4-way EBCM harness connector. Is the resistance measurement within the specified range? (Refer to the WSS temperature VS resistance table for the applicable resistance values. The values in this table is for sensor temperature not air temperature.)	—	Go to *Step 5*	Go to *Step 3*
3	1. Disconnect the right front wheel speed sensor harness connector from the wheel speed sensor. 2. Using a *J 36169-A* connect terminal A and terminal B of the 2-way wheel speed sensor harness connector (chassis harness side). 3. Using a *J 39200*, measure the resistance between terminal C and terminal E of the 4-way EBCM harness connector. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 4*	Go to *Step 10*
4	Using a *J 39200*, measure the resistance between terminal A and terminal B of the right front wheel speed sensor connector. Is the resistance measurement within the specified range? (Refer to the WSS temperature Vs resistance table for the applicable resistance values. The values in this table is for sensor temperature not air temperature.)	—	Go to *Step 7*	Go to *Step 11*
5	Inspect the 4-way EBCM harness connector for poor terminal contact or corrosion. Does damage or corrosion exist?	—	Go to *Step 8*	Go to *Step 6*
6	1. Reconnect all connectors. 2. Test drive the vehicle above 24 km/h (15 mph). Does the DTC set as a current DTC?	—	Go to *Step 9*	Go to *Step 7*

DTC C0221 RF Wheel Speed Sensor Circuit Open (Motorhome) (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Malfunction is intermittent. 2. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic Aids for more information. 3. Perform all necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
8	Make necessary repairs to the 4-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
9	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
10	Repair the open or high resistance in CKT 833 or CKT 872. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
11	Replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)* or *Wheel Speed Sensor Replacement (I-Beam front Suspension).* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0221 RF Wheel Speed Sensor Circuit Open (Commercial)



396501

Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed ring. This distance is referred to as the air gap.

Conditions for Setting the DTC

- No output signal from the right front wheel speed sensor for 1.0 second
- Excessive right front wheel speed sensor resistance for 1.0 second

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0221 is a Condition Latched DTC, which indicates that the above actions remain true only as long as the condition persists.

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, then replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension).*

Resistance of the wheel speed sensor will increase with an increase in sensor temperature. Refer to the following tables for temperature/resistance values.

WSS Temperature vs. Sensor Resistance

°C	°F	Ohms
Temperature vs Resistance Values (Approximate)		
-40 to 4	-40 to 40	1575 to 2420
5 to 43	41 to 110	1980 to 2800
44 to 93	111 to 200	2250 to 3280
94 to 150	201 to 302	2750 to 3850

Test Description

The numbers below refer to the steps in the diagnostic table:

2. This step checks the resistance of the right front wheel speed sensor circuit.
3. This step checks for continuity in the right front wheel speed sensor harness.
4. This step checks the resistance of the right front wheel speed sensor.

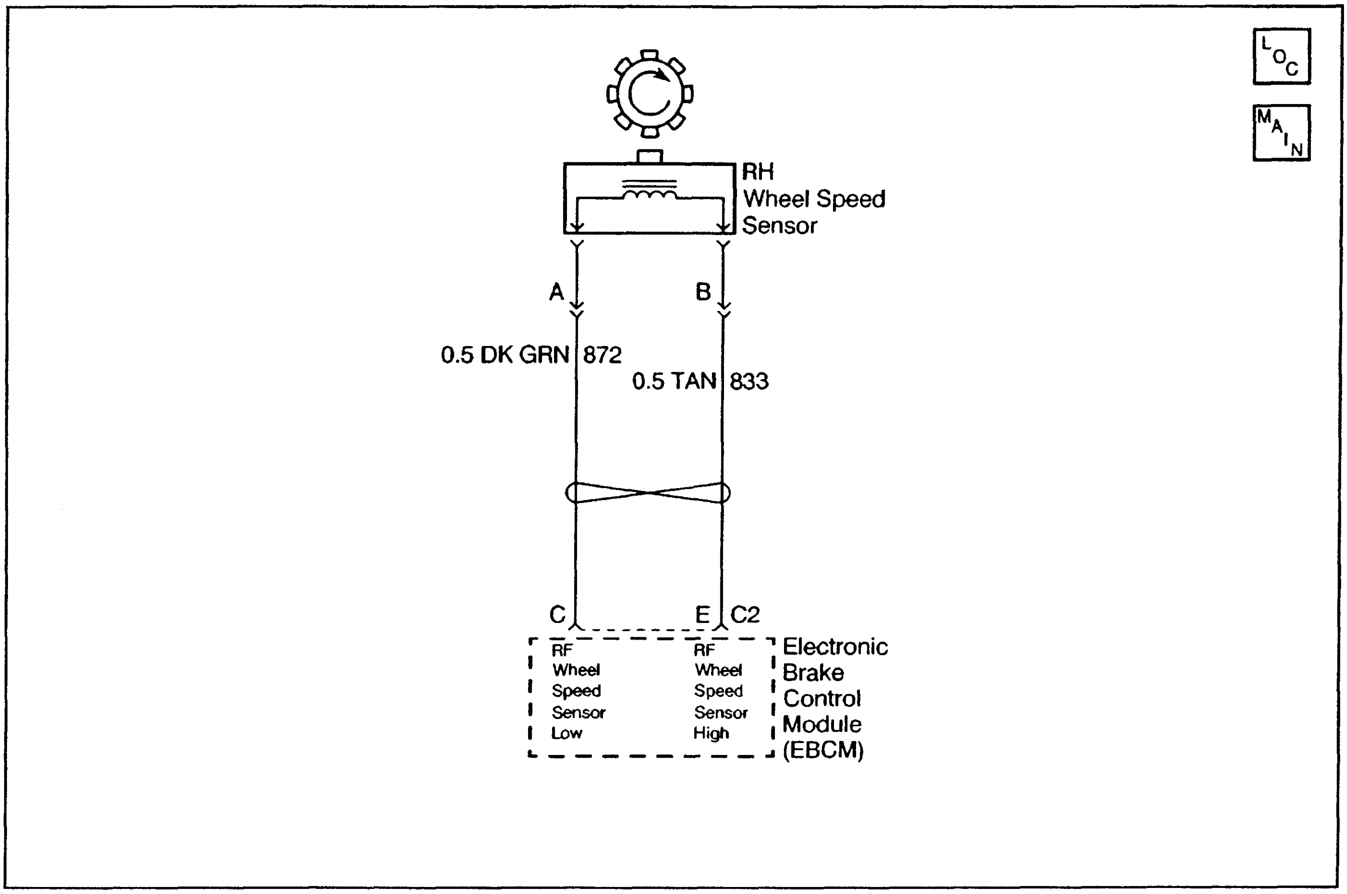
DTC C0221 RF Wheel Speed Sensor Circuit Open (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Turn the ignition OFF. 2. Disconnect the 4-way EBCM harness connector. 3. Using a *J 39200*, measure the resistance between terminal C and terminal E of the 4-way EBCM harness connector. Refer to the WSS temperature Vs resistance table for the applicable resistance values. The values in this table are for the sensor temperature not air temperature. Is the resistance measurement within the specified range?	—	Go to *Step 5*	Go to *Step 3*
3	1. Disconnect the right front wheel speed sensor harness connector from the wheel speed sensor. 2. Using a *J 36169-A* connect terminal A and terminal B of the 2-way wheel speed sensor harness connector (chassis harness side). 3. Using a *J 39200*, measure the resistance between terminals C and E of the 4-way EBCM harness connector. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 4*	Go to *Step 10*
4	Using a *J 39200*, measure the resistance between terminal A and terminal B of the right front wheel speed sensor connector. Refer to the WSS temperature Vs resistance table for the applicable resistance values. The values in this table are for the sensor temperature not air temperature. Is the resistance measurement within the specified range?	—	Go to *Step 7*	Go to *Step 11*
5	Inspect the 4-way EBCM harness connector for poor terminal contact or corrosion. Does damage or corrosion exist?	—	Go to *Step 8*	Go to *Step 6*
6	1. Reconnect all connectors. 2. Test drive the vehicle above 24 km/h (15 mph). Does the DTC set as a current DTC?	—	Go to *Step 9*	Go to *Step 7*

DTC C0221 RF Wheel Speed Sensor Circuit Open (Commercial) (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Malfunction is intermittent. 2. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic Aids for more information. 3. Perform all necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
8	Make necessary repairs to the 4-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
9	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
10	Repair the open or high resistance in CKT 833 or CKT 872. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
11	Replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)* or *Wheel Speed Sensor Replacement (I-Beam front Suspension).* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

DTC C0222 RF Wheel Speed Signal Missing (Motorhome)



191471

Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed ring. This distance is referred to as the air gap.

Conditions for Setting the DTC

- The right front wheel speed is less than 6 km/h (4 mph)
- All other wheel speeds are greater than 13 km/h (8 mph)
- No unexpected wheel acceleration/deceleration. Anything that keeps the right front wheel speed sensor low while the vehicle is moving above 13 km/h (8 mph).

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0222 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water)
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, then replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension).*

Resistance of the wheel speed sensor will increase with an increase in sensor temperature. Refer to the following tables for temperature/resistance values.

WSS Temperature vs. Sensor Resistance

°C	°F	Ohms
Temperature vs Resistance Values (Approximate)		
-40 to 4	-40 to 40	1575 to 2420
5 to 43	41 to 110	980 to 2800
44 to 93	111 to 200	2250 to 3280
94 to 150	201 to 302	2750 to 3850

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step checks the resistance of the right front wheel speed sensor.
4. This step checks the voltage output of the right front wheel speed sensor.
5. This step checks for a short in the wiring between the wheel speed sensor circuits.
6. This step checks for a short to ground in the right front wheel speed sensor circuits.

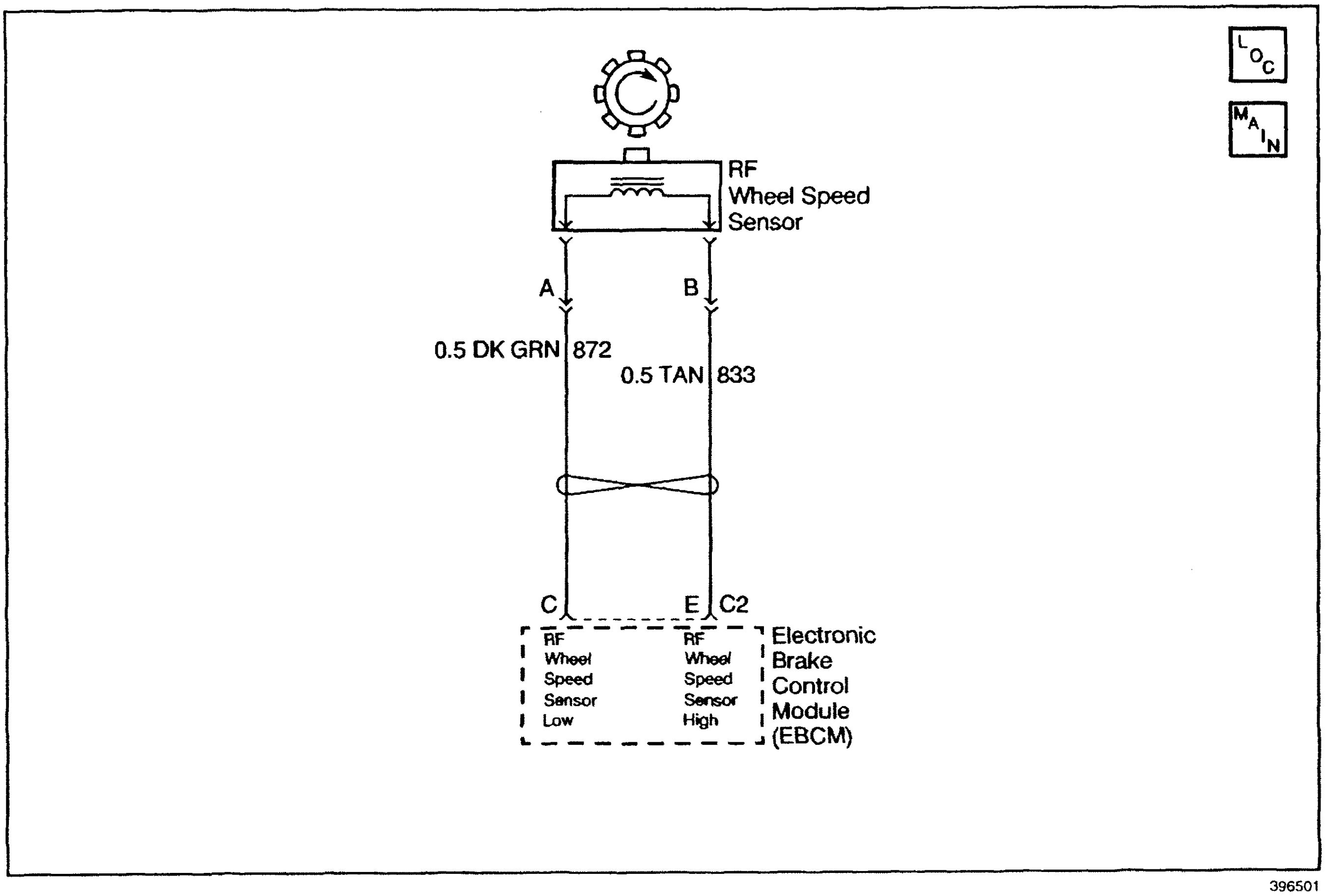
DTC C0222 RF Wheel Speed Signal Missing (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Turn the ignition to OFF. 2. Inspect the right front wheel speed sensor, sensor wire and the connectors for signs of damage or corrosion. 3. Inspect the wheel speed sensor and the toothed ring for looseness. Any deviation will affect the wheel speed sensor output signal. 4. Inspect the 4-way EBCM harness connector and harness for signs of damage or corrosion. Can you observe physical damage?	—	Go to *Step 8*	Go to *Step 3*
3	1. Disconnect the right front wheel speed sensor harness connector from the wheel speed sensor. 2. Using a *J 39200*, measure the resistance between terminal A and terminal B of the right front wheel speed sensor connector. Is the resistance measurement within the specified range?	—	Go to *Step 4*	Go to *Step 9*
4	1. With the *J 39200* still connected, select the A/C voltage scale. 2. Spin the wheel by hand while observing the voltage reading. Is the voltage measured equal to or greater than the specified value?	100 mV	Go to *Step 5*	Go to *Step 9*

DTC C0222 RF Wheel Speed Signal Missing (Motorhome) (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Disconnect the 4-way EBCM harness connector from the EBCM. 2. Using a *J 39200*, measure the resistance between terminal C and terminal E of the 4-way EBCM harness connector. Is the resistance measurement equal to the specified value?	OL	Go to *Step 6*	Go to *Step 11*
6	1. Reconnect the right front wheel speed sensor. 2. Using a *J 39200*, measure the resistance between terminal C of the 4-way EBCM harness connector and ground. Is the resistance measurement equal to the specified value?	OL	Go to *Step 7*	Go to *Step 12*
7	1. Inspect the 4-way EBCM harness connector terminal C and terminal E for poor terminal contact or corrosion. 2. Inspect CKT 833 and CKT 872 for damage that could result in a shorted circuit. Repair any evident damage. 3. Replace the terminals if poor contact or corrosion exists. 4. Reconnect all the connectors. 5. Using the *Scan Tool*, clear all DTCs. 6. Test drive the vehicle above 24 km/h (15 mph). Does the DTC set as a current DTC?	—	Go to *Step 10*	Go to *Step 13*
8	Make the necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
9	Replace the right front wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)* or *Wheel Speed Sensor Replacement (I-Beam front Suspension)*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
10	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
11	Repair the short between CKT 833 and CKT 872. Refer to *Wiring Repairs*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	
12	Repair the short to ground in CKT 833 or CKT 872. Refer to *Wiring Repairs*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
13	Malfunction is intermittent. 1. Inspect all connectors for damage which may result in high resistance when all components are connected. Refer to Diagnostic aids for more information. 2. Repair all damage found. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0222 RF Wheel Speed Signal Missing (Commercial)



Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed ring. This distance is referred to as the air gap.

Conditions for Setting the DTC

- The right front wheel speed is less than 6 km/h (4 mph)
- All other wheel speeds are greater than 13 km/h (8 mph)
- No unexpected wheel acceleration/deceleration. Anything that keeps the right front wheel speed sensor low while the vehicle is moving above 13 km/h (8 mph).

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0222 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water)
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, then replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension).*

Resistance of the wheel speed sensor will increase with an increase in sensor temperature. Refer to the following tables for temperature/resistance values.

WSS Temperature vs. Sensor Resistance

°C	°F	Ohms
Temperature vs Resistance Values (Approximate)		
-40 to 4	-40 to 40	1575 to 2420
5 to 43	41 to 110	980 to 2800
44 to 93	111 to 200	2250 to 3280
94 to 150	201 to 302	2750 to 3850

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step checks the resistance of the right front wheel speed sensor.
4. This step checks the voltage output of the right front wheel speed sensor.
5. This step checks for a short in the wiring between the wheel speed sensor circuits.
6. This step checks for a short to ground in the right front wheel speed sensor circuits.

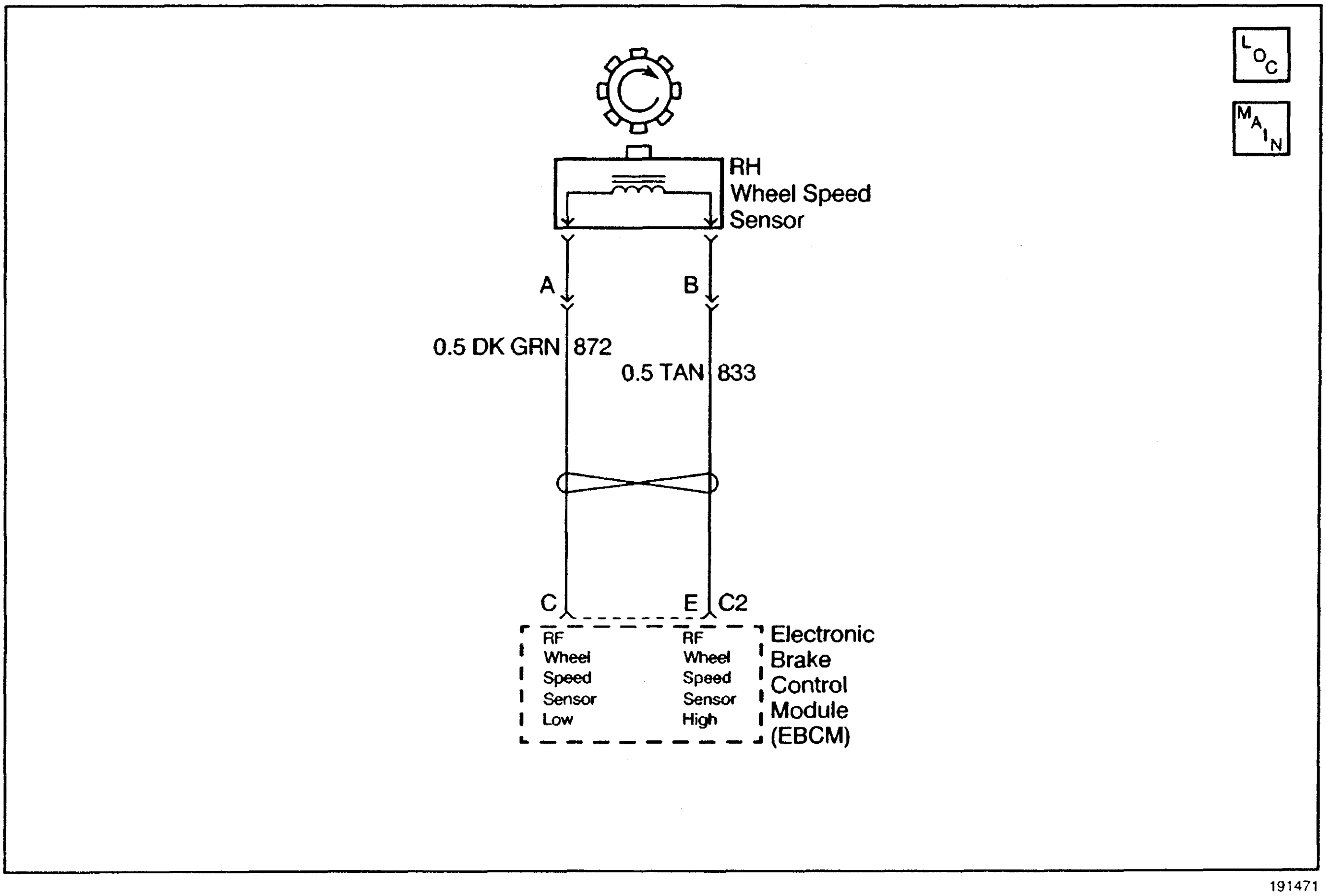
DTC C0222 RF Wheel Speed Signal Missing (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Turn the ignition to OFF. 2. Inspect the right front wheel speed sensor, sensor wire and the connectors for signs of damage or corrosion. 3. Inspect the wheel speed sensor and the toothed ring for looseness. Any deviation will affect the wheel speed sensor output signal. 4. Inspect the 4-way EBCM harness connector and harness for signs of damage or corrosion. Can you observe physical damage?	—	Go to *Step 8*	Go to *Step 3*
3	1. Disconnect the right front wheel speed sensor harness connector from the wheel speed sensor. 2. Using a *J 39200*, measure the resistance between terminal A and terminal B of the right front wheel speed sensor connector. Is the resistance measurement within the specified range? (Refer to the WSS temperature Vs resistance table for the applicable resistance values. The values in this table are for the sensor temperature not air temperature.)	—	Go to *Step 4*	Go to *Step 9*
4	1. With the *J 39200* still connected, select the A/C voltage scale. 2. Spin the wheel by hand while observing the voltage reading. Is the voltage measured equal to or greater than the specified value?	100 mV	Go to *Step 5*	Go to *Step 9*

DTC C0222 RF Wheel Speed Signal Missing (Commercial) (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Disconnect the 4-way EBCM harness connector from the EBCM. 2. Using a *J 39200*, measure the resistance between terminal C and terminal E of the 4-way EBCM harness connector. Is the resistance measurement equal to the specified value?	OL	Go to *Step 6*	Go to *Step 11*
6	1. Reconnect the right front wheel speed sensor. 2. Using a *J 39200*, measure the resistance between terminal C of the 4-way EBCM harness connector and ground. Is the resistance measurement equal to the specified value?	OL	Go to *Step 7*	Go to Step *12*
7	1. Inspect the 4-way EBCM harness connector terminal C and terminal E for poor terminal contact or corrosion. 2. Inspect CKT 833 and CKT 872 for damage that could result in a shorted circuit. Repair any evident damage. 3. Replace the terminals if poor contact or corrosion exists. 4. Reconnect all the connectors. 5. Using the *Scan Tool*, clear all DTCs. 6. Test drive the vehicle above 24 km/h (15 mph). Does the DTC set as a current DTC?	—	Go to *Step 10*	Go to *Step 13*
8	Make the necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
9	Replace the right front wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)* or *Wheel Speed Sensor Replacement (I-Beam front Suspension).* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
10	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
11	Repair the short between CKT 833 and CKT 872. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
12	Repair the short to ground in CKT 833 or CKT 872. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
13	Malfunction is intermittent. 1. Inspect all connectors for damage which may result in high resistance when all components are connected. Refer to Diagnostic aids for more information. 2. Repair all damage found. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

DTC C0223 RF Wheel Speed Signal Erratic (Motorhome)



Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed ring. This distance is referred to as the air gap.

Conditions for Setting the DTC

- The average wheel speed for all wheel signals is greater than 13 km/h (8 mph).
- The right front wheel speed computation is greater than 33 km/h (20 mph) when the brake is applied or greater than 20 km/h (12 mph) when the brake is released.
- No speed signal input to the EBCM from the right front wheel speed sensor for 15 milliseconds. Anything which sudenly prevents (intermittent) the right front wheel speed signal to drop to zero while the vehicle is moving greater than 40 km/h (25 mph).

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0223 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical daage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water)
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, then replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)*.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature. Refer to the following tables for temperature/resistance values.

WSS Temperature vs. Sensor Resistance

°C	°F	Ohms
Temperature vs Resistance Values (Approximate)		
-40 to 4	-40 to 40	1575 to 2420
5 to 43	41 to 110	1980 to 2800
44 to 93	111 to 200	2250 to 3280
94 to 150	201 to 302	2750 to 3850

Test Description

The numbers below refer to the steps in the diagnostic table:

2. This step checks the EBCM 4-way connector for looseness, corrosion, etc.
3. This step uses the wheel speed sensor resistance check to help isolate an intermittent connection.
4. This step checks the right front wheel speed sensor for the proper resistance.
5. This step checks for proper mounting and orientation of the right front wheel speed sensor.

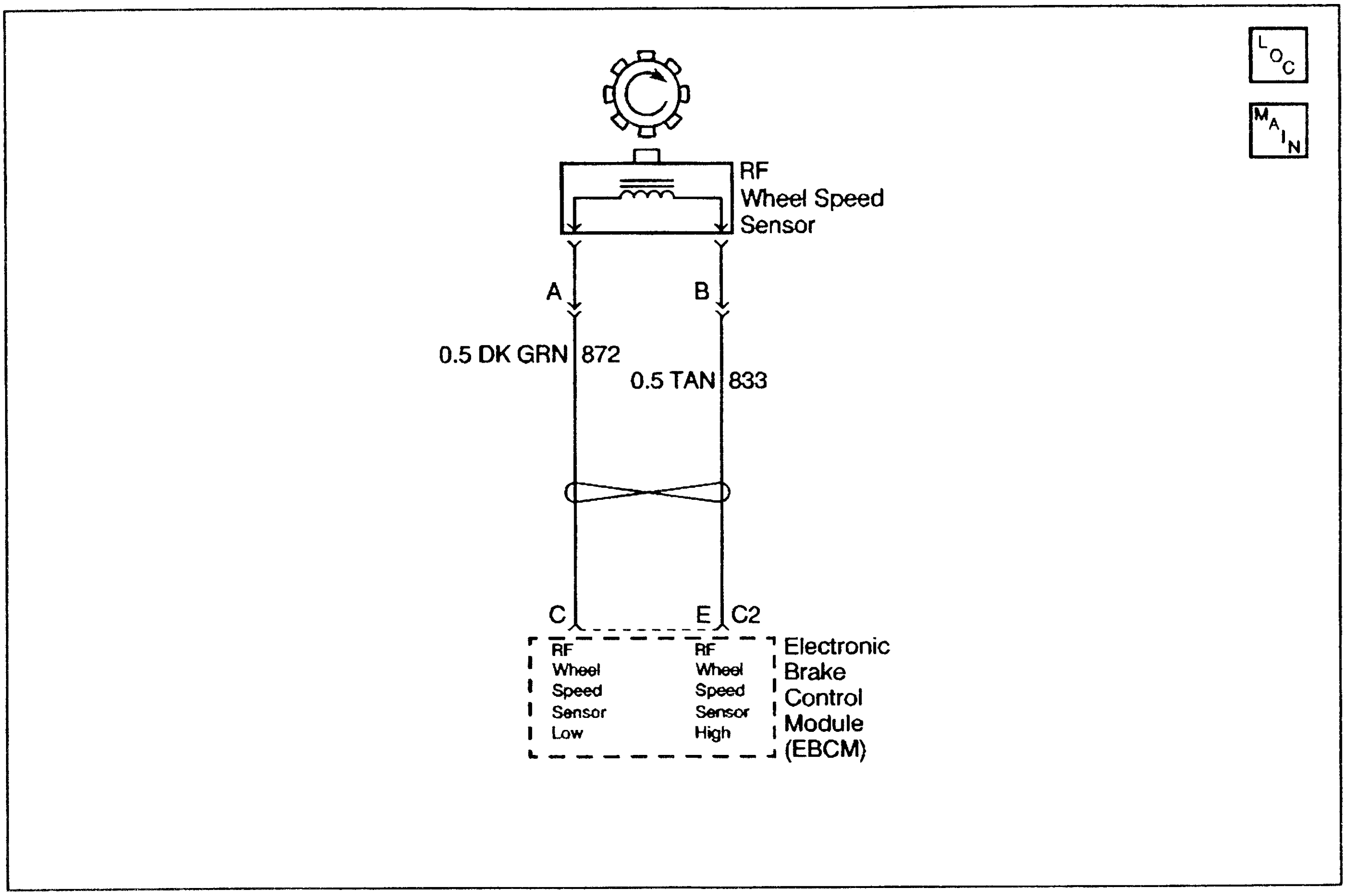
DTC C0223 RF Wheel Speed Signal Erratic (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Turn the ignition to OFF. 2. Disconnect the 4-way EBCM harness connector from the EBCM and inspect for signs of damage or corrosion. 3. Inspect the wheel speed sensor harness and sensor harness connector for signs of damage or corrosion. Are all connections clean and tight?	—	Go to *Step 3*	Go to *Step 6*
3	Using a *J 39200*, measure the resistance between terminal C and terminal E of the 4-way EBCM harness connector. Wiggle the WSS harness in various locations between the sensor and the EBCM while performing this measurement. Refer to the WSS temperature VS resistance table for the applicable resistance values. The values in this table are for sensor temperature not air temperature. Is the resistance measurement within the specified range without fluctuation when the harness is wiggled?	—	Go to *Step 5*	Go to *Step 4*

DTC C0223 RF Wheel Speed Signal Erratic (Motorhome) (cont'd)

Step	Action	Value(s)	Yes	No
4	1. Disconnect the wheel speed sensor from the wheel speed sensor harness connector. 2. Using a *J 39200*, measure the resistance between terminal A and terminal B of the right front wheel speed sensor. Refer to the WSS temperature VS resistance table for the applicable resistance values. The values in this table is for sensor temperature not air temperature. Is the resistance measurement within the specified range?	—	Go to *Step 7*	Go to *Step 8*
5	1. Reconnect all connectors. 2. Verify that the front wheel speed sensor is securely mounted and that the tone wheel is in good condition. Is the wheel speed sensor and tone wheel in good condition?	—	Go to *Step 9*	Go to *Step 10*
6	Make necessary repairs to the 4-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
7	Repair the open, high resistance or short in CKT 833 or CKT 872. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
8	Replace the right front wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)* or *Wheel Speed Sensor Replacement (I-Beam front Suspension).* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
9	Malfunction is intermittent, perform the following: 1. Inspect all connectors for damage which may result in high resistance when all components are connected. Refer to Diagnostic aids for more information. 2. Repair all damage found. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
10	Make necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0223 RF Wheel Speed Signal Erratic (Commercial)



396501

Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed ring. This distance is referred to as the air gap.

Conditions for Setting the DTC

- The average wheel speed for all wheel signals is greater than 13 km/h (8 mph).
- The right front wheel speed computation is greater than 33 km/h (20 mph) when the brake is applied or greater than 20 km/h (12 mph) when the brake is released.
- No speed signal input to the EBCM from the right front wheel speed sensor for 15 milliseconds. Anything which sudenly prevents (intermittent) the right front wheel speed signal to drop to zero while the vehicle is moving greater than 40 km/h (25 mph).

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0223 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water)
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds

If the DTC returns, replace the suspected harness.

When inspecing a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, then replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)*.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature. Refer to the following tables for temperature/resistance values.

WSS Temperature vs. Sensor Resistance

°C	°F	Ohms
Temperature vs Resistance Values (Approximate)		
-40 to 4	-40 to 40	1575 to 2420
5 to 43	41 to 110	1980 to 2800
44 to 93	111 to 200	2250 to 3280
94 to 150	201 to 302	2750 to 3850

Test Description

The numbers below refer to the steps in the diagnostic table:

2. This step checks the EBCM 4-way connector for looseness, corrosion, etc.
3. This step uses the wheel speed sensor resistance check to help isolate an intermittent connection.
4. This step checks the right front wheel speed sensor for the proper resistance.
5. This step checks for proper mounting and orientation of the right front wheel speed sensor.

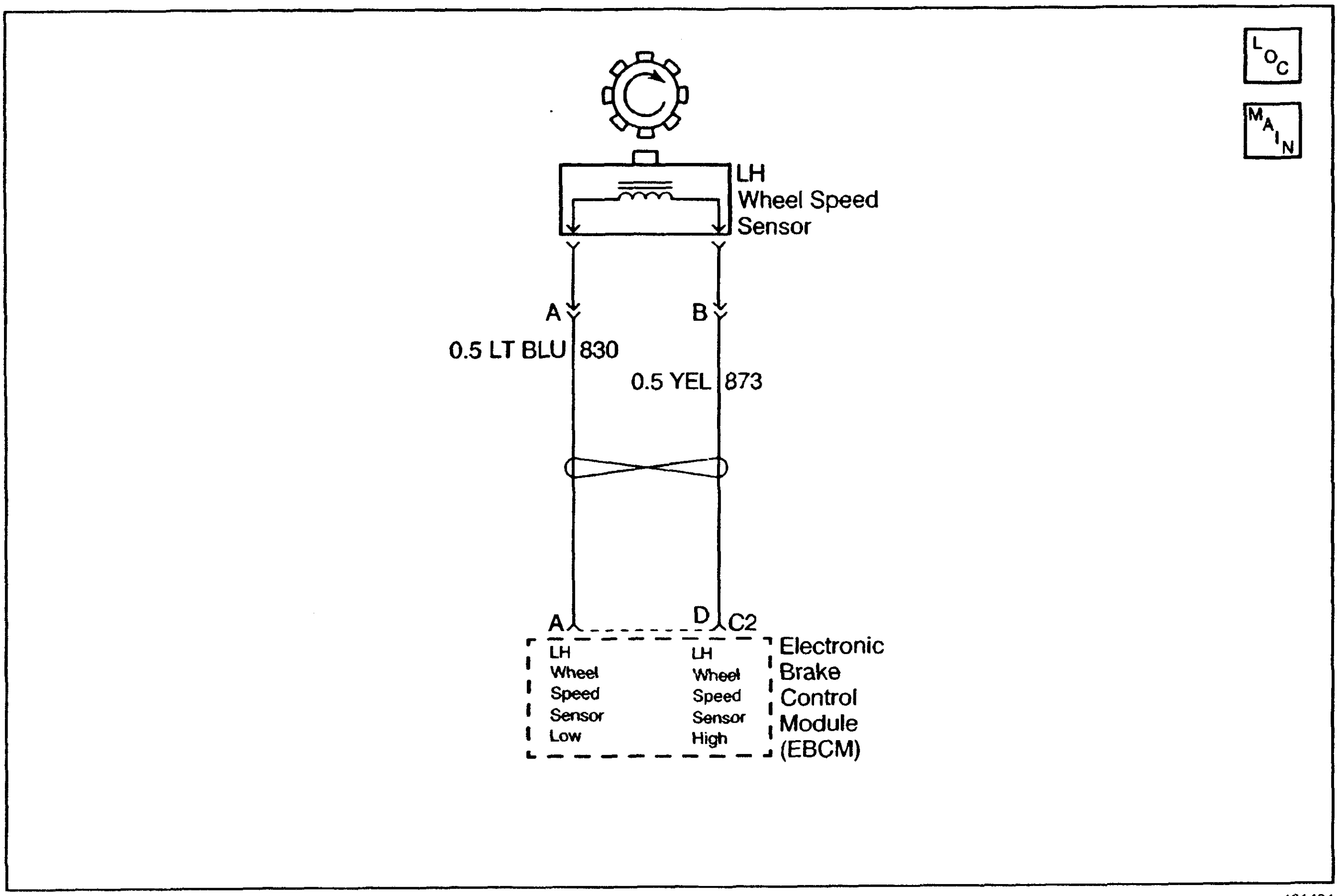
DTC C0223 RF Wheel Speed Signal Erratic (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Turn the ignition to OFF. 2. Disconnect the 4-way EBCM harness connector from the EBCM and inspect for signs of damage or corrosion. 3. Inspect the wheel speed sensor harness and sensor harness connector for signs of damage or corrosion. Are all connections clean and tight?	—	Go to *Step 3*	Go to *Step 6*
3	Using a *J 39200*, measure the resistance between terminal C and terminal E of the 4-way EBCM harness connector. Wiggle the WSS harness in various locations between the sensor and the EBCM while performing this measurement. Refer to the WSS temperature Vs resistance table for the applicable resistance values. The values in this table are for the sensor temperature not air temperature. Is the resistance measurement within the specified range without fluctuation when the harness is wiggled?	—	Go to *Step 5*	Go to *Step 4*
4	1. Disconnect the wheel speed sensor from the wheel speed sensor harness connector. 2. Using a *J 39200*, measure the resistance between terminal A and terminal B of the right front wheel speed sensor. Refer to the WSS temperature Vs resistance table for the applicable resistance values. The values in this table are for the sensor temperature not air temperature. Is the resistance measurement within the specified range?	—	Go to *Step 7*	Go to *Step 8*
5	1. Reconnect all connectors. 2. Verify that the front wheel speed sensor is securely mounted and that the tone wheel is in good condition. Is the wheel speed sensor and tone wheel in good condition?	—	Go to *Step 9*	Go to *Step 10*

DTC C0223 RF Wheel Speed Signal Erratic (Commercial) (cont'd)

Step	Action	Value(s)	Yes	No
6	Make necessary repairs to the 4-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
7	Repair the open, high resistance or short in CKTs 833 or 872. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
8	Replace the right front wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)* or *Wheel Speed Sensor Replacement (I-Beam front Suspension).* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
9	Malfunction is intermittent, perform the following: 1. Inspect all connectors for damage which may result in high resistance when all components are connected. Refer to Diagnostic aids for more information. 2. Repair all damage found. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
10	Make necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

DTC C0225 LF Wheel Speed Sensor Circuit Open (Motorhome)



Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed ring. This distance is referred to as the air gap.

Conditions for Setting the DTC

- No output signal from the left front wheel speed sensor for 1.0 second
- Excessive left front wheel speed sensor resistance for 1.0 second

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0225 is a Condition Latched DTC, which indicates that the above actions remain true only as long as the condition persists.

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool*

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, then replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)* or *Wheel Speed Sensor Replacement (I-Beam front Suspension).*

Resistance of the wheel speed sensor will increase with an increase in sensor temperature. Refer to the following tables for temperature/resistance values.

WSS Temperature vs. Sensor Resistance

°C	°F	Ohms
Temperature vs Resistance Values (Approximate)		
-40 to 4	-40 to 40	1575 to 2420
5 to 43	41 to 110	1980 to 2800
44 to 93	111 to 200	2250 to 3280
94 to 150	201 to 302	2750 to 3850

Test Description

The numbers below refer to the steps in the diagnostic table:

2. This step checks the resistance of the left front wheel speed sensor circuit.
3. This step checks for continuity in the left front wheel speed sensor harness.
4. This step checks the resistance of the left front wheel speed sensor.

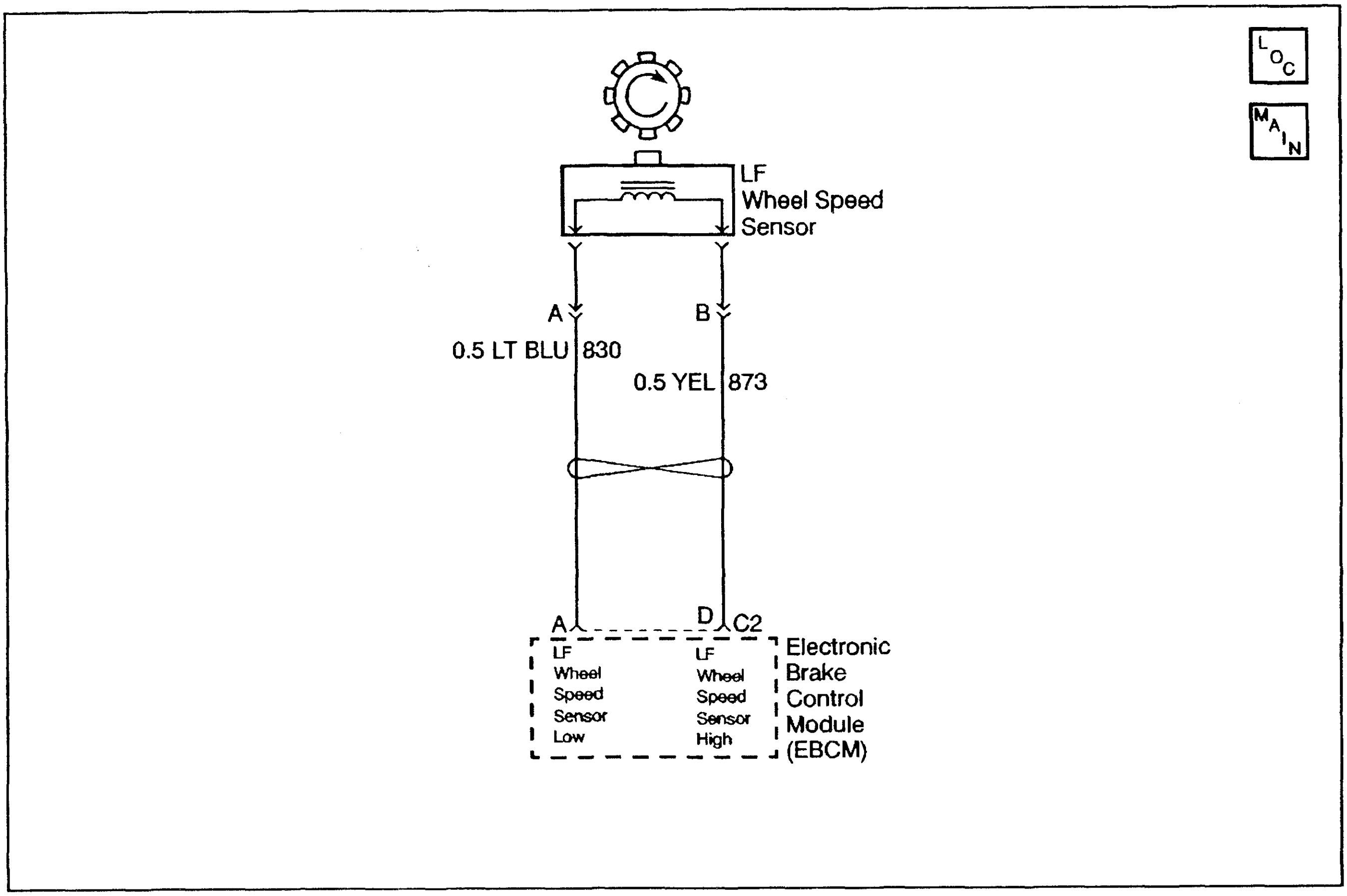
DTC C0225 LF Wheel Speed Sensor Circuit Open (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Turn the ignition OFF. 2. Disconnect the 4-way EBCM harness connector. 3. Using a *J 39200*, measure the resistance between terminal D and terminal A of the 4-way EBCM harness connector. Refer to the WSS temperature VS resistance table for the applicable resistance values. The values in this table are for sensor temperature not air temperature. Is the resistance measurement within the specified range?	—	Go to *Step 5*	Go to *Step 3*
3	1. Disconnect the left front wheel speed sensor harness connector from the wheel speed sensor. 2. Using a *J 36169-A* connect terminal A and terminal B of the 2-way wheel speed sensor harness connector (chassis harness side). 3. Using a *J 39200*, measure the resistance between terminal D and terminal A of the 4-way EBCM harness connector. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 4*	Go to *Step 10*
4	Using a *J 39200*, measure the resistance between terminal A and terminal B of the left front wheel speed sensor connector. Refer to the WSS temperature VS resistance table for the applicable resistance values. The values in this table are for sensor temperature not air temperature. Is the resistance measurement within the specified range?	—	Go to *Step 7*	Go to *Step 11*
5	Inspect the 4-way EBCM harness connector for poor terminal contact or corrosion. Does damage or corrosion exist?	—	Go to *Step 8*	Go to *Step 6*
6	1. Reconnect all connectors. 2. Test drive the vehicle above 24 km/h (15 mph). Does the DTC set as a current DTC?	—	Go to *Step 9*	Go to *Step 7*
7	Malfunction is intermittent. 1. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic Aids for more information. 2. Perform all necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0225 LF Wheel Speed Sensor Circuit Open (Motorhome) (cont'd)

Step	Action	Value(s)	Yes	No
8	Make necessary repairs to the 4-way EBCM harness connector. Refer to *Connector Repairs*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
9	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
10	Repair the open or high resistance in CKT 830 or CKT 873. Refer to *Wiring Repairs*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
11	Replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)* or *Wheel Speed Sensor Replacement (I-Beam front Suspension)*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0225 LF Wheel Speed Sensor Circuit Open (Commercial)



396499

Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed ring. This distance is referred to as the air gap.

Conditions for Setting the DTC

- No output signal from the left front wheel speed sensor for 1.0 second
- Excessive left front wheel speed sensor resistance for 1.0 second

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0225 is a Condition Latched DTC, which indicates that the above actions remain true only as long as the condition persists.

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool*

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, then replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)*

Resistance of the wheel speed sensor will increase with an increase in sensor temperature. Refer to the following tables for temperature/resistance values.

WSS Temperature vs. Sensor Resistance

°C	°F	Ohms
Temperature vs Resistance Values (Approximate)		
-40 to 4	-40 to 40	1575 to 2420
5 to 43	41 to 110	1980 to 2800
44 to 93	111 to 200	2250 to 3280
94 to 150	201 to 302	2750 to 3850

Test Description

The numbers below refer to the steps in the diagnostic table:

2. This step checks the resistance of the left front wheel speed sensor circuit.
3. This step checks for continuity in the left front wheel speed sensor harness.
4. This step checks the resistance of the left front wheel speed sensor.

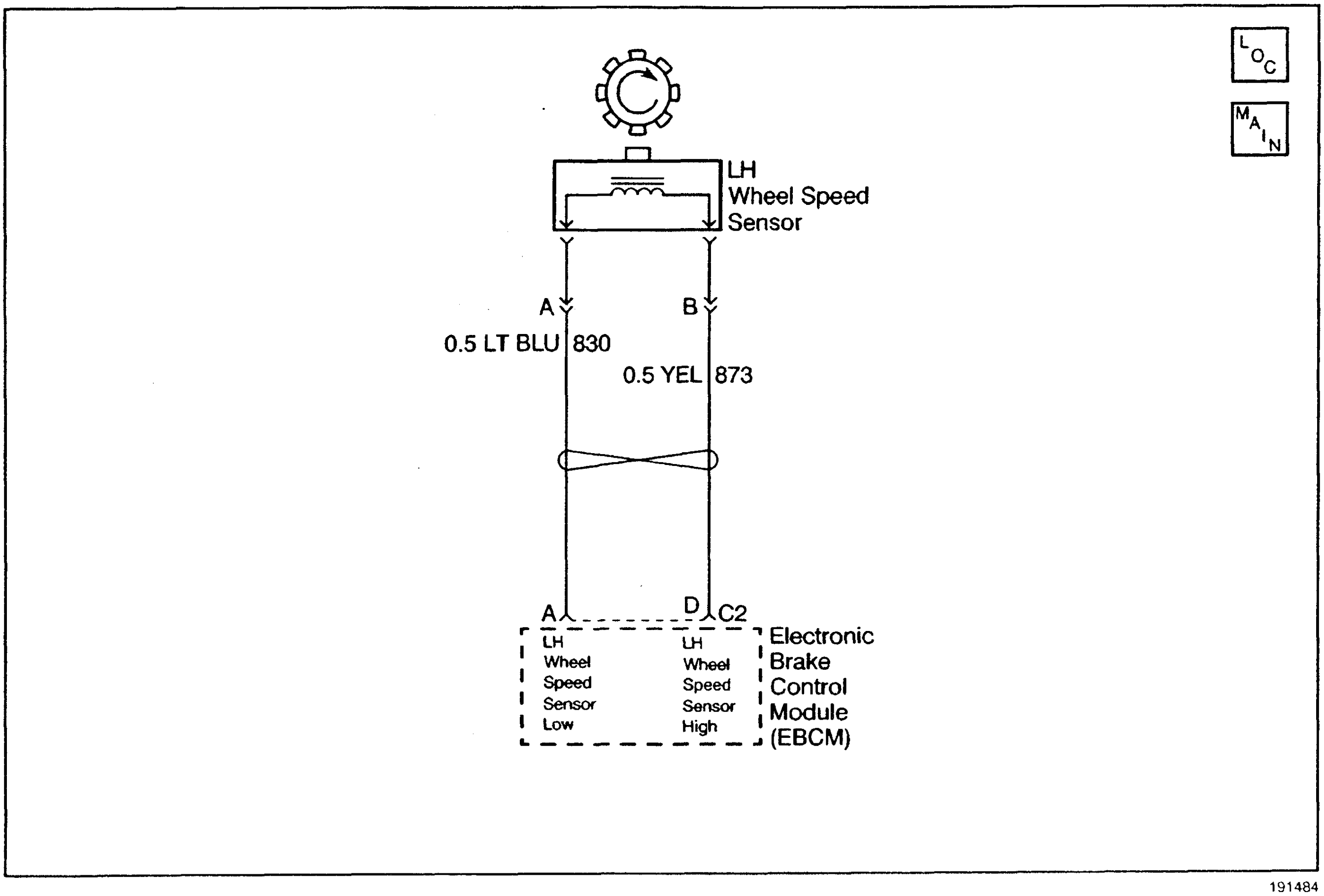
DTC C0225 LF Wheel Speed Sensor Circuit Open (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Turn the ignition OFF. 2. Disconnect the 4-way EBCM harness connector. 3. Using a *J 39200*, measure the resistance between terminal D and terminal A of the 4-way EBCM harness connector. Refer to the WSS temperature Vs resistance table for the applicable resistance values. The values in this table are for the sensor temperature not the air temperature. Is the resistance measurement within the specified range?	—	Go to *Step 5*	Go to *Step 3*
3	1. Disconnect the left front wheel speed sensor harness connector from the wheel speed sensor. 2. Using a *J 36169-A* connect terminal A and terminal B of the 2-way wheel speed sensor harness connector (chassis harness side). 3. Using a *J 39200*, measure the resistance between terminals D and A of the 4-way EBCM harness connector. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 4*	Go to *Step 10*
4	Using a *J 39200*, measure the resistance between terminal A and terminal B of the left front wheel speed sensor connector. Refer to the WSS temperature Vs resistance table for the applicable resistance values. The values in this table are for the sensor temperature not the air temperature. Is the resistance measurement within the specified range?	—	Go to *Step 7*	Go to *Step 11*
5	Inspect the 4-way EBCM harness connector for poor terminal contact or corrosion. Does damage or corrosion exist?	—	Go to *Step 8*	Go to *Step 6*
6	1. Reconnect all connectors. 2. Test drive the vehicle above 24 km/h (15 mph). Does the DTC set as a current DTC?	—	Go to *Step 9*	Go to *Step 7*
7	Malfunction is intermittent. 1. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic Aids for more information. 2. Perform all necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

DTC C0225 LF Wheel Speed Sensor Circuit Open (Commercial) (cont'd)

Step	Action	Value(s)	Yes	No
8	Make necessary repairs to the 4-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
9	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
10	Repair the open or high resistance in CKT 830 or CKT 873. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
11	Replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)* or *Wheel Speed Sensor Replacement (I-Beam front Suspension).* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

DTC C0226 LF Wheel Speed Signal Missing (Motorhome)



Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed ring. This distance is referred to as the air gap.

Conditions for Setting the DTC

- The left front wheel speed is less than 6 km/h (4 mph)
- All other wheel speeds are greater than 13 km/h (8 mph)
- No unexpected wheel acceleration/deceleration. Anything that keeps the left front wheel speed sensor low while the vehicle is moving above 13 km/h (8 mph).

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0226 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool*

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water)
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, then replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)* or *Wheel Speed Sensor Replacement (I-Beam front Suspension)*.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature. Refer to the following tables for temperature/resistance values.

WSS Temperature vs. Sensor Resistance

°C	°F	Ohms
Temperature vs Resistance Values (Approximate)		
-40 to 4	-40 to 40	1575 to 2420
5 to 43	41 to 110	1980 to 2800
44 to 93	111 to 200	2250 to 3280
94 to 150	201 to 302	2750 to 3850

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step checks the resistance of the left front wheel speed sensor.
4. This step checks the voltage output of the left front wheel speed sensor.
5. This step checks for a short in the wiring between the wheel speed sensor circuits.
6. This step checks for a short to ground in the left front wheel speed sensor circuit.

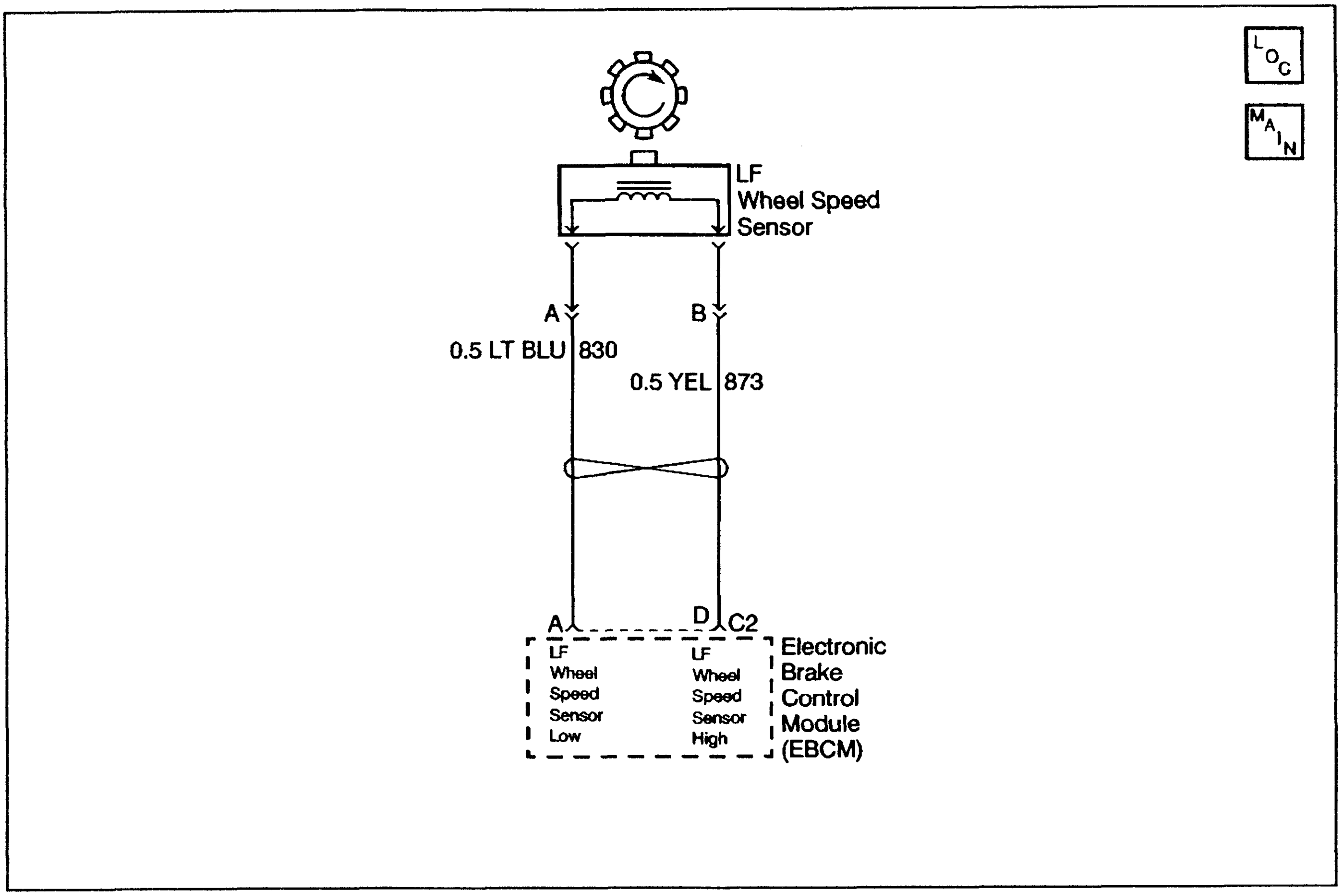
DTC C0226 LF Wheel Speed Signal Missing (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Turn the ignition to OFF. 2. Inspect the left front wheel speed sensor, sensor wire and the connectors for signs of damage or corrosion. 3. Inspect the wheel speed sensor and the toothed ring for looseness. Any deviation will affect the wheel speed sensor output signal. 4. Inspect the 4-way EBCM harness connector and harness for signs of damage or corrosion. Can you observe physical damage?	—	Go to *Step 8*	Go to *Step 3*
3	1. Disconnect the left front wheel speed sensor harness connector from the wheel speed sensor. 2. Using a *J 39200*, measure the resistance between terminal A and terminal B of the left front wheel speed sensor connector. Refer to the WSS temperature VS resistance table for the applicable resistance values. The values in this table are for sensor temperature not air temperature. Is the resistance measurement within the specified range?	—	Go to *Step 4*	Go to *Step 9*
4	1. With the *J 39200* still connected, select the A/C voltage scale. 2. Spin the wheel by hand while observing the voltage reading. Is the voltage measured equal to or greater than the specified value?	100 mV	Go to *Step 5*	Go to *Step 9*

DTC C0226 LF Wheel Speed Signal Missing (Motorhome) (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Disconnect the 4-way EBCM harness connector from the EBCM. 2. Using a *J 39200*, measure the resistance between terminal D and terminal A of the 4-way EBCM harness connector. Is the resistance measurement equal to the specified value?	OL	Go to *Step 6*	Go to *Step 11*
6	1. Reconnect the left front wheel speed sensor. 2. Using a *J 39200*, measure the resistance between terminal D of the 4-way EBCM harness connector and ground. Is the resistance measurement equal to the specified value?	OL	Go to *Step 7*	Go to *Step 12*
7	1. Inspect the 4-way EBCM harness connector terminal D and terminal A for poor terminal contact or corrosion. 2. Inspect CKT 830 and CKT 873 for damage that could result in a shorted circuit. Repair any evident damage. 3. Replace the terminals if poor contact or corrosion exists. 4. Reconnect all the connectors. 5. Clear all DTCs using the *Scan Tool.* 6. Test drive the vehicle above 24 km/h (15 mph). Does the DTC set as a current DTC?	—	Go to *Step 10*	Go to *Step 13*
8	Make the necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
9	Replace the left front wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)* or *Wheel Speed Sensor Replacement (I-Beam front Suspension).* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
10	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
11	Repair the short between CKT 830 and CKT 873. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
12	Repair the short to ground in CKT 873. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
13	Malfunction is intermittent. 1. Inspect all connectors for damage which may result in high resistance when all components are connected. Refer to Diagnostic aids for more information. 2. Repair all damage found. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0226 LF Wheel Speed Signal Missing (Commercial)



396499

Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed ring. This distance is referred to as the air gap.

Conditions for Setting the DTC

- The left front wheel speed is less than 6 km/h (4 mph)
- All other wheel speeds are greater than 13 km/h (8 mph)
- No unexpected wheel acceleration/deceleration. Anything that keeps the left front wheel speed sensor low while the vehicle is moving above 13 km/h (8 mph).

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0226 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool*

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water)
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, then replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension).*

Resistance of the wheel speed sensor will increase with an increase in sensor temperature. Refer to the following tables for temperature/resistance values.

WSS Temperature vs. Sensor Resistance

°C	°F	Ohms
Temperature vs Resistance Values (Approximate)		
-40 to 4	-40 to 40	1575 to 2420
5 to 43	41 to 110	1980 to 2800
44 to 93	111 to 200	2250 to 3280
94 to 150	201 to 302	2750 to 3850

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step checks the resistance of the left front wheel speed sensor.
4. This step checks the voltage output of the left front wheel speed sensor.
5. This step checks for a short in the wiring between the wheel speed sensor circuits.
6. This step checks for a short to ground in the left front wheel speed sensor circuit.

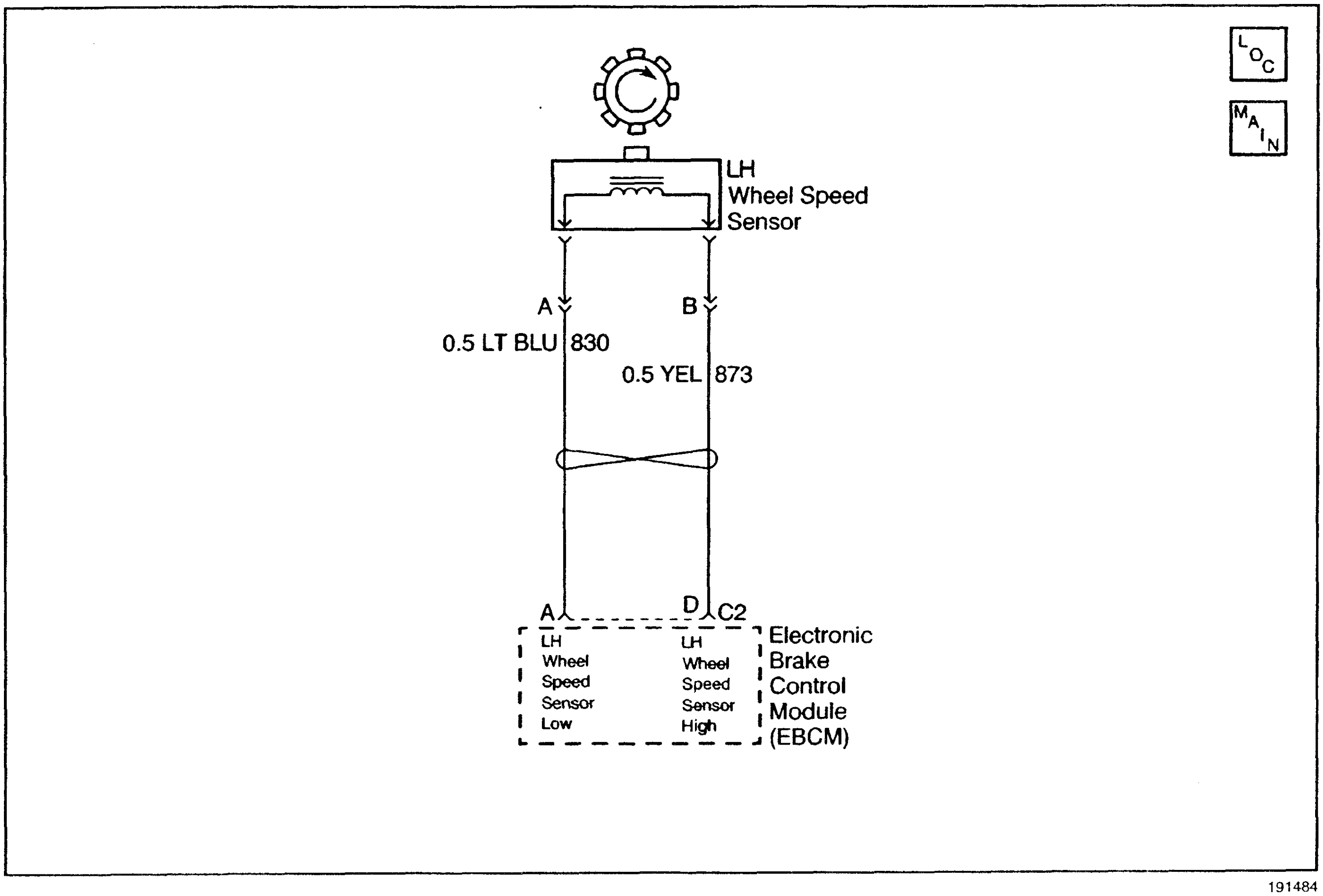
DTC C0226 LF Wheel Speed Signal Missing (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Turn the ignition to OFF. 2. Inspect the left front wheel speed sensor, sensor wire and the connectors for signs of damage or corrosion. 3. Inspect the wheel speed sensor and the toothed ring for looseness. Any deviation will affect the wheel speed sensor output signal. 4. Inspect the 4-way EBCM harness connector and harness for signs of damage or corrosion. Can you observe physical damage?	—	Go to *Step 8*	Go to *Step 3*
3	1. Disconnect the left front wheel speed sensor harness connector from the wheel speed sensor. 2. Using a *J 39200*, measure the resistance between terminal A and terminal B of the left front wheel speed sensor connector. Refer to the WSS temperature Vs resistance table for the applicable resistance values. The values in this table are for the sensor temperature not the air temperature. Is the resistance measurement within the specified range?	—	Go to *Step 4*	Go to *Step 9*
4	1. With the *J 39200* still connected, select the A/C voltage scale. 2. Spin the wheel by hand while observing the voltage reading. Is the voltage measured equal to or greater than the specified value?	100 mV	Go to *Step 5*	Go to *Step 9*

DTC C0226 LF Wheel Speed Signal Missing (Commercial) (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Disconnect the 4-way EBCM harness connector from the EBCM. 2. Using a *J 39200*, measure the resistance between terminal D and terminal A of the 4-way EBCM harness connector. Is the resistance measurement equal to the specified value?	OL	Go to *Step 6*	Go to *Step 11*
6	1. Reconnect the left front wheel speed sensor. 2. Using a *J 39200*, measure the resistance between terminal D of the 4-way EBCM harness connector and ground. Is the resistance measurement equal to the specified value?	OL	Go to *Step 7*	Go to *Step 12*
7	1. Inspect the 4-way EBCM harness connector terminal D and terminal A for poor terminal contact or corrosion. 2. Inspect CKT 830 and CKT 873 for damage that could result in a shorted circuit. Repair any evident damage. 3. Replace the terminals if poor contact or corrosion exists. 4. Reconnect all the connectors. 5. Clear all DTCs using the *Scan Tool*. 6. Test drive the vehicle above 24 km/h (15 mph). Does the DTC set as a current DTC?	—	Go to *Step 10*	Go to *Step 13*
8	Make the necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
9	Replace the left front wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)* or *Wheel Speed Sensor Replacement (I-Beam front Suspension)*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
10	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
11	Repair the short between CKT 830 and CKT 873. Refer to *Wiring Repairs*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
12	Repair the short to ground in CKT 873. Refer to *Wiring Repairs*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
13	Malfunction is intermittent. 1. Inspect all connectors for damage which may result in high resistance when all components are connected. Refer to Diagnostic aids for more information. 2. Repair all damage found. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

DTC C0227 LF Wheel Speed Signal Erratic (Motorhome)



Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed ring. This distance is referred to as the air gap.

Conditions for Setting the DTC

- The average wheel speed for all wheel signals is greater than 13 km/h (8 mph).
- The right front wheel speed computation is greater than 33 km/h (20 mph) when the brake is applied or greater than 20 km/h (12 mph) when the brake is released.
- No speed signal input to the EBCM from the left front wheel speed sensor for 15 milliseconds. Anything which sudenly prevents (intermittent) the left front wheel speed signal to drop to zero while the vehicle is moving greater than 40 km/h (25 mph).

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0227 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water)
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, then replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)* or *Wheel Speed Sensor Replacement (I-Beam front Suspension).*

Resistance of the wheel speed sensor will increase with an increase in sensor temperature. Refer to the following tables for temperature/resistance values.

WSS Temperature vs. Sensor Resistance (2WD and 4WD only)

°C	°F	Ohms
Temperature vs Resistance Values (Approximate)		
-40 to 4	-40 to 40	1575 to 2420
5 to 43	41 to 110	1980 to 2800
44 to 93	111 to 200	2250 to 3280
94 to 150	201 to 302	2750 to 3850

Test Description

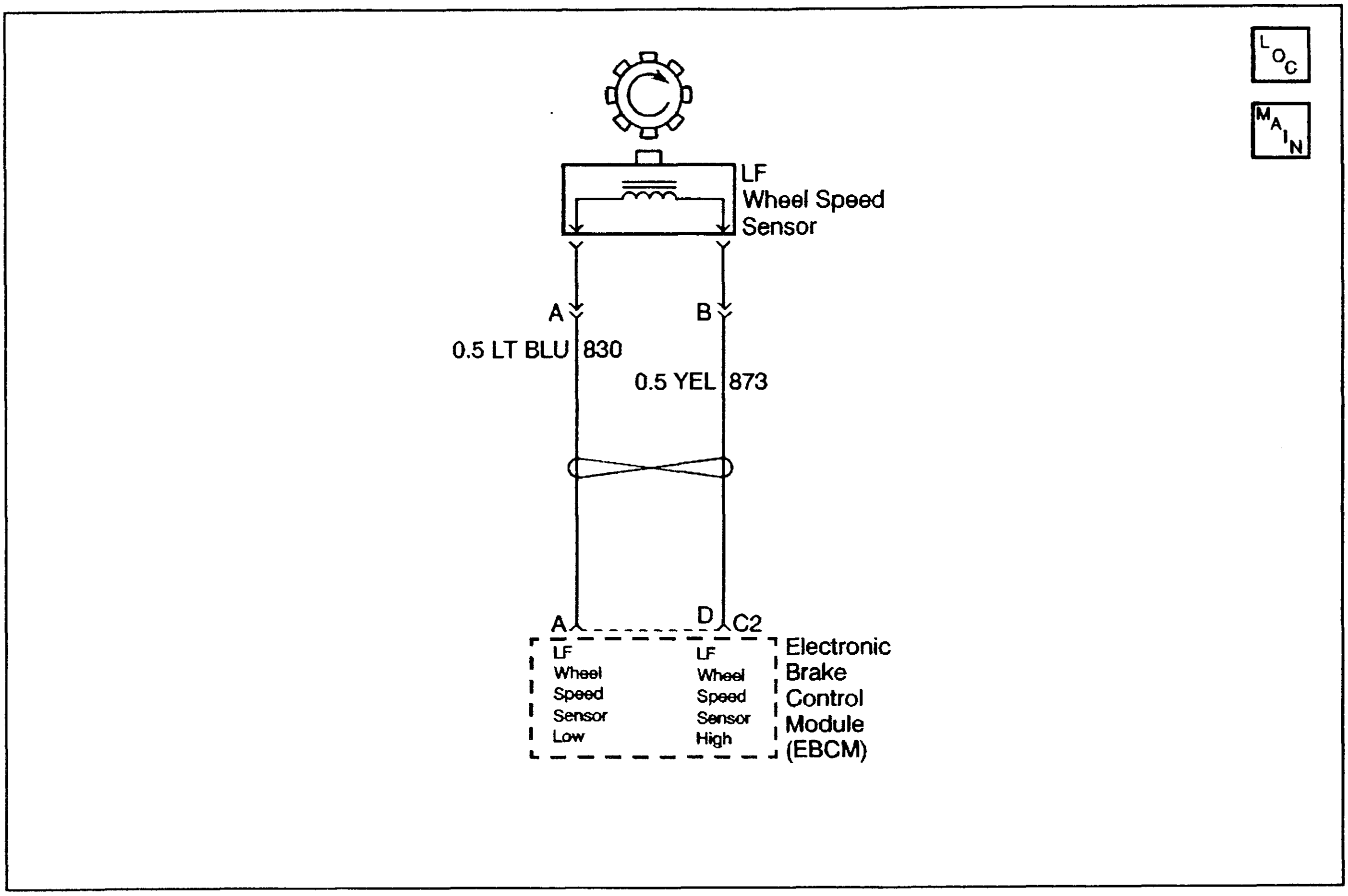
The numbers below refer to the steps in the diagnostic table:

2. This step checks the EBCM 4-way connector for looseness, corrosion, etc.
3. This step uses the wheel speed sensor resistance check to help isolate an intermittent connection.
4. This step checks the left front wheel speed sensor for the proper resistance.
5. This step checks for proper mounting and orientation of the left front wheel speed sensor.

DTC C0227 LF Wheel Speed Signal Erratic (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Turn the ignition to OFF. 2. Disconnect the 4-way EBCM harness connector from the EBCM and inspect for signs of damage or corrosion. 3. Inspect the wheel speed sensor harness and sensor harness connector for signs of damage or corrosion. Are all connections clean and tight?	—	Go to *Step 3*	Go to *Step 6*
3	Using a *J 39200*, measure the resistance between terminal D and terminal A of the 4-way EBCM harness connector. Wiggle the WSS harness in various locations between the sensor and the EBCM while performing this measurement. Refer to the WSS temperature VS resistance table for the applicable resistance values. The values in this table are for sensor temperature not air temperature. Is the resistance measurement within the specified range without fluctuation when the harness is wiggled?	—	Go to *Step 5*	Go to *Step 4*
4	1. Disconnect the wheel speed sensor from the wheel speed sensor harness connector. 2. Using a *J 39200*, measure the resistance between terminal A and terminal B of the left front wheel speed sensor. Refer to the WSS temperature VS resistance table for the applicable resistance values. The values in this table are for sensor temperature not air temperature. Is the resistance measurement within the specified range?	—	Go to *Step 7*	Go to *Step 8*
5	1. Reconnect all connectors. 2. Verify that the front wheel speed sensor is securely mounted and that the tone wheel is in good condition. Is the wheel speed sensor and tone wheel in good condition?	—	Go to *Step 9*	Go to *Step 10*
6	Make necessary repairs to the 4-way EBCM harness connector. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
7	Repair the open, high resistance or short in CKT 830 or CKT 873. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
8	Replace the left front wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)* or *Wheel Speed Sensor Replacement (I-Beam front Suspension).* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
9	Malfunction is intermittent, perform the following: 1. Inspect all connectors for damage which may result in high resistance when all components are connected. Refer to Diagnostic aids for more information. 2. Repair all damage found. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
10	Make necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0227 LF Wheel Speed Signal Erratic (Commercial)



396499

Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed ring. This distance is referred to as the air gap.

Conditions for Setting the DTC

- The average wheel speed for all wheel signals is greater than 13 km/h (8 mph).
- The right front wheel speed computation is greater than 33 km/h (20 mph) when the brake is applied or greater than 20 km/h (12 mph) when the brake is released.
- No speed signal input to the EBCM from the left front wheel speed sensor for 15 milliseconds. Anything which sudenly prevents (intermittent) the left front wheel speed signal to drop to zero while the vehicle is moving greater than 40 km/h (25 mph).

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0227 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water)
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, then replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)*.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature. Refer to the following tables for temperature/resistance values.

WSS Temperature vs. Sensor Resistance (2WD and 4WD only)

°C	°F	Ohms
Temperature vs Resistance Values (Approximate)		
-40 to 4	-40 to 40	1575 to 2420
5 to 43	41 to 110	1980 to 2800
44 to 93	111 to 200	2250 to 3280
94 to 150	201 to 302	2750 to 3850

Test Description

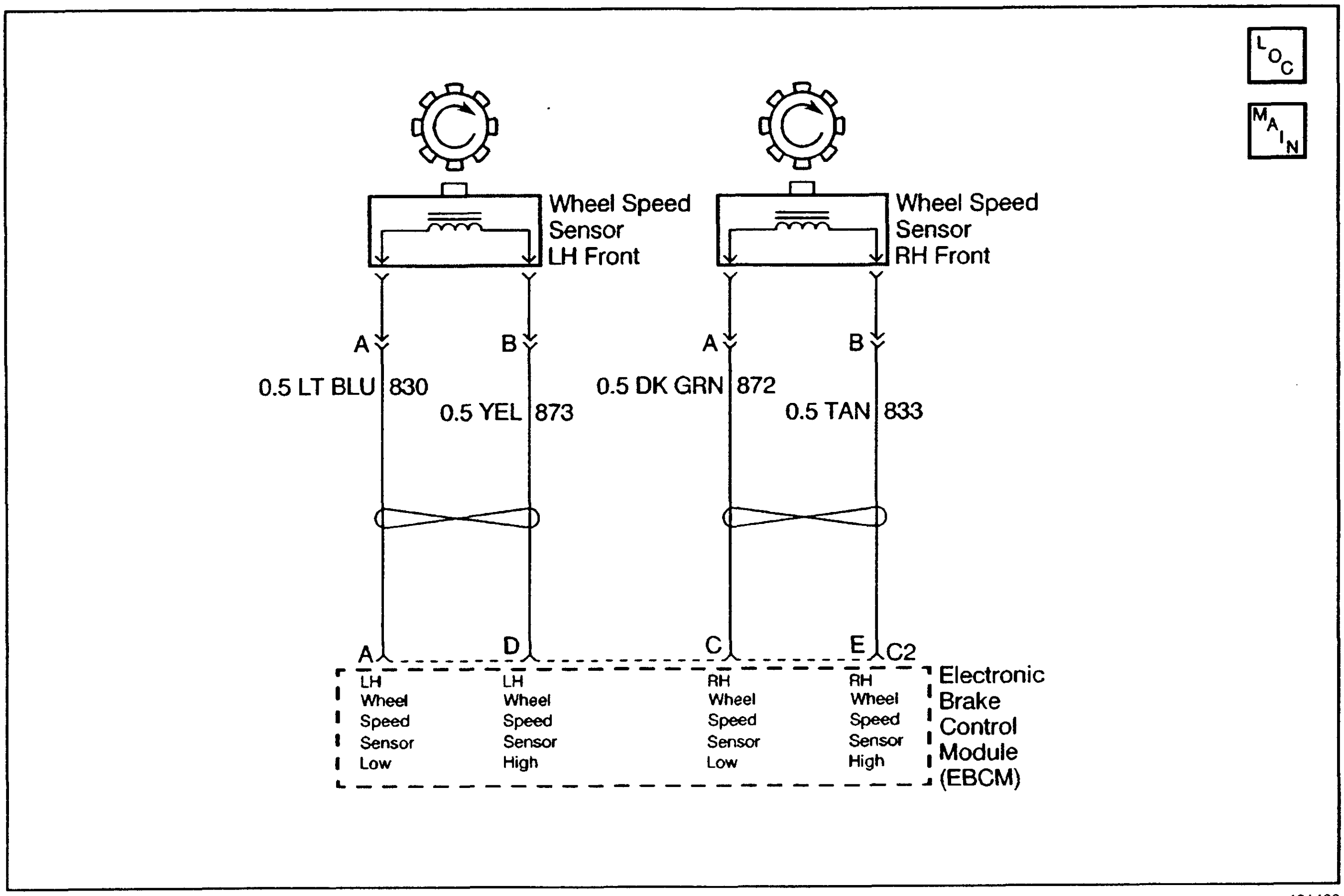
The numbers below refer to the steps in the diagnostic table:

2. This step checks the EBCM 4-way connector for looseness, corrosion, etc.
3. This step uses the wheel speed sensor resistance check to help isolate an intermittent connection.
4. This step checks the left front wheel speed sensor for the proper resistance.
5. This step checks for proper mounting and orientation of the left front wheel speed sensor.

DTC C0227 LF Wheel Speed Signal Erratic (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Turn the ignition to OFF. 2. Disconnect the 4-way EBCM harness connector from the EBCM and inspect for signs of damage or corrosion. 3. Inspect the wheel speed sensor harness and sensor harness connector for signs of damage or corrosion. Are all connections clean and tight?	—	Go to *Step 3*	Go to *Step 6*
3	Using a *J 39200*, measure the resistance between terminal D and terminal A of the 4-way EBCM harness connector. Wiggle the WSS harness in various locations between the sensor and the EBCM while performing this measurement. Refer to the WSS temperature Vs resistance table for the applicable resistance values. The values in this table are for the sensor temperature not the air temperature. Is the resistance measurement within the specified range without fluctuation when the harness is wiggled?	—	Go to *Step 5*	Go to *Step 4*
4	1. Disconnect the wheel speed sensor from the wheel speed sensor harness connector. 2. Using a *J 39200*, measure the resistance between terminal A and terminal B of the left front wheel speed sensor. Refer to the WSS temperature Vs resistance table for the applicable resistance values. The values in this table are for the sensor temperature not the air temperature. Is the resistance measurement within the specified range?	—	Go to *Step 7*	Go to *Step 8*
5	1. Reconnect all connectors. 2. Verify that the front wheel speed sensor is securely mounted and that the tone wheel is in good condition. Is the wheel speed sensor and tone wheel in good condition?	—	Go to *Step 9*	Go to *Step 10*
6	Make necessary repairs to the 4-way EBCM harness connector. Refer to *Wiring Repairs*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
7	Repair the open, high resistance or short in CKT 830 or CKT 873. Refer to *Connector Repairs*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
8	Replace the left front wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)* or *Wheel Speed Sensor Replacement (I-Beam front Suspension)*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
9	Malfunction is intermittent, perform the following: 1. Inspect all connectors for damage which may result in high resistance when all components are connected. Refer to Diagnostic aids for more information. 2. Repair all damage found. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
10	Make necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

DTC C0229 Drop Out of Front Wheel Speed Signals (Motorhome)



191488

Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed ring. This distance is referred to as the air gap.

Conditions for Setting the DTC

EBCM losing both front wheel speed signals when the vehicle is at speeds over 19 km/h (12 mph) (brake released), or 32 km/h (20 mph) (brake applied).

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0229 is an Ignition Latched DTC, which indicates that the above conditions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, then replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)* or *Wheel Speed Sensor Replacement (I-Beam front Suspension).*

Test Description

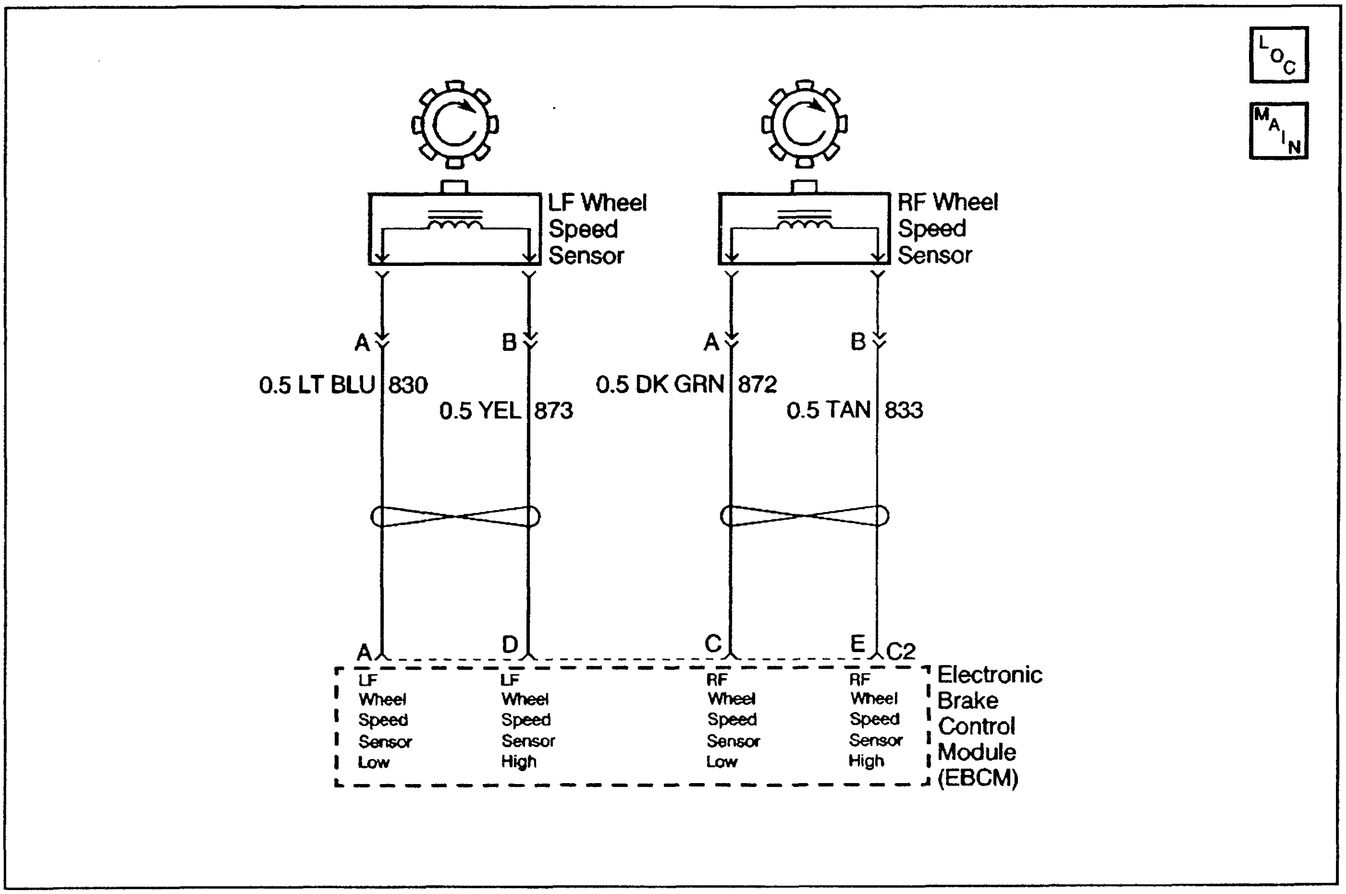
The numbers below refer to the numbers on the diagnostic chart.

2. This step checks the EBCM 4-way connector for looseness, corrosion, etc.

DTC C0229 Drop Out of Front Wheel Speed Signals (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Turn the ignition to OFF. 2. Disconnect the 4-way EBCM harness connector from the EBCM. 3. Inspect the 4-way EBCM harness connector and harness for signs of damage or corrosion. Is the harness OK and are all the connections clean and tight?	—	Go to *Step 3*	Go to *Step 4*
3	1. Reconnect all connectors. 2. Clear DTC. 3. Road test vehicle at speeds above 24 km/h (15 mph). 4. Use the scan tool to read the DTCs. Did the DTC C0229 set?	—	Go to *Step 5*	Go to *Step 6*
4	Make necessary repairs to the 4-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
5	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
6	Malfunction is intermittent. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to diagnostic aids for more information. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0229 Drop Out of Front Wheel Speed Signals (Commercial)



396461

Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed ring. This distance is referred to as the air gap.

Conditions for Setting the DTC

EBCM losing both front wheel speed signals when the vehicle is at speeds over 19 km/h (12 mph) (brake released), or 32 km/h (20 mph) (brake applied).

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0229 is an Ignition Latched DTC, which indicates that the above conditions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, then replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement (Independent Front Suspension)* or *Wheel Speed Sensor Replacement (I-Beam front Suspension).*

Test Description

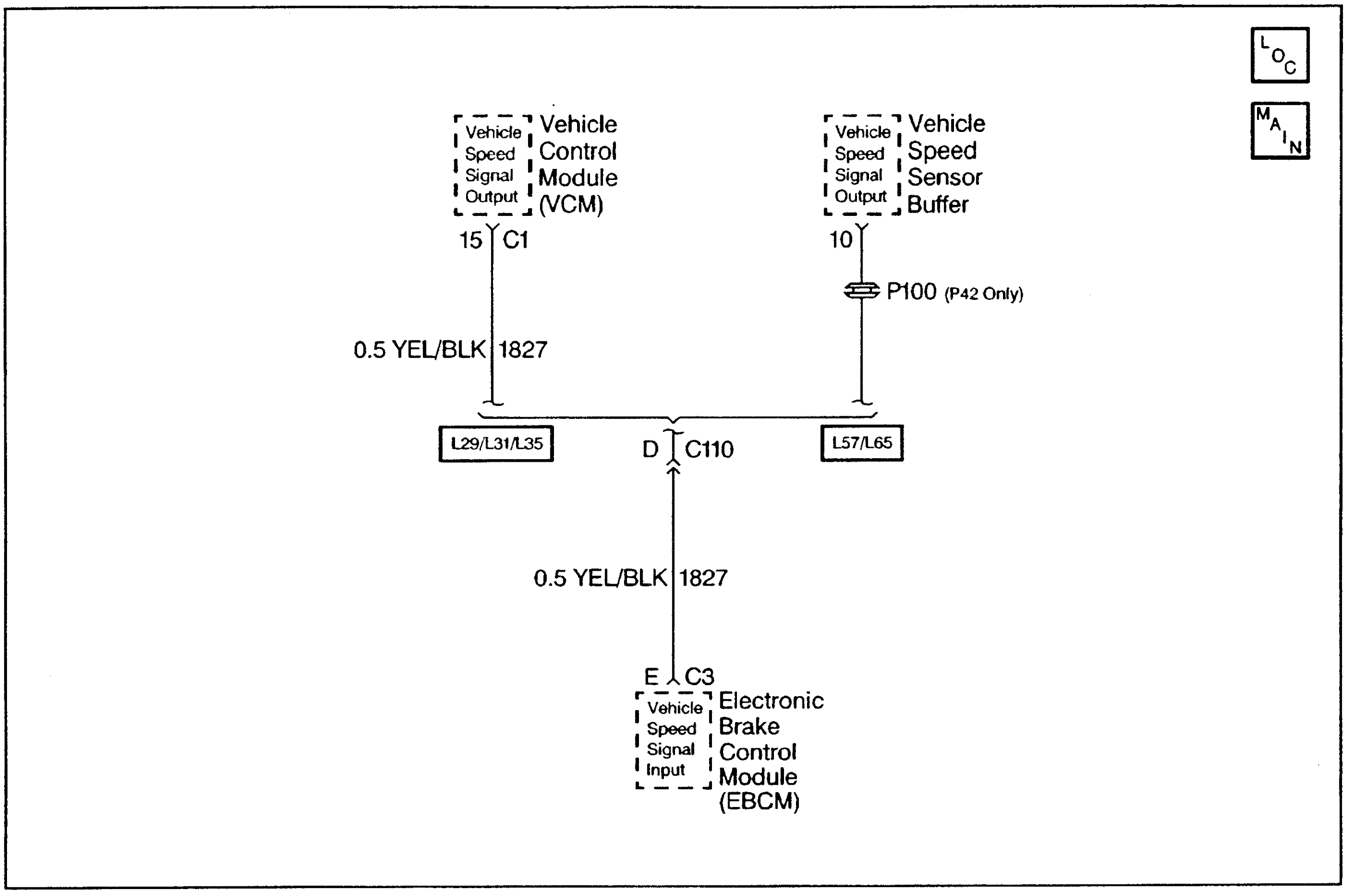
The numbers below refer to the numbers on the diagnostic chart.

2. This step checks the EBCM 4-way connector for looseness, corrosion, etc.

DTC C0229 Drop Out of Front Wheel Speed Signals (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Turn the ignition to OFF. 2. Disconnect the 4-way EBCM harness connector from the EBCM. 3. Inspect the 4-way EBCM harness connector and harness for signs of damage or corrosion. Is the harness OK and are all the connections clean and tight?	—	Go to *Step 3*	Go to *Step 4*
3	1. Reconnect all connectors. 2. Clear DTC. 3. Road test vehicle at speeds above 24 km/h (15 mph). 4. Use the scan tool to read the DTCs. Did the DTC C0229 set?	—	Go to *Step 5*	Go to *Step 6*
4	Make necessary repairs to the 4-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
5	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
6	Malfunction is intermittent. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to diagnostic aids for more information. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

DTC C0235 Rear Wheel Speed Signal Circuit Open (Motorhome)



191492

Circuit Description

The EBCM receives the rear wheel speed signal from the Vehicle Control Module (VCM) for gas engine vehicles or the Vehicle Speed Sensor Buffer for diesel engine vehicles. The rear wheel speed signal originates from the Vehicle Speed Sensor (VSS) which is connected to the VCM (gas) or Vehicle Speed Sensor Buffer (diesel). When the vehicle is not moving, the VCM (gas) or Vehicle Speed Sensor Buffer (diesel) will have 12 VDC present on the circuit. The EBCM checks for this votage when the vehicle is not moving.

Conditions for Setting the DTC

EBCM not seeing the correct voltage level from the VCM (gas) or the Vehicle Speed Sensor Buffer (diesel) at startup.

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0235 is a Conition Latched DTC, which indicates that the above actions are true until the condition is cleared.

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

This DTC can be set by a faulty EBCM or a fault in CKT 696.

If the voltage readings are low or varying, the battery or charging system could be the cause. Check these areas before replacing any components. In addition, any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

Test Description

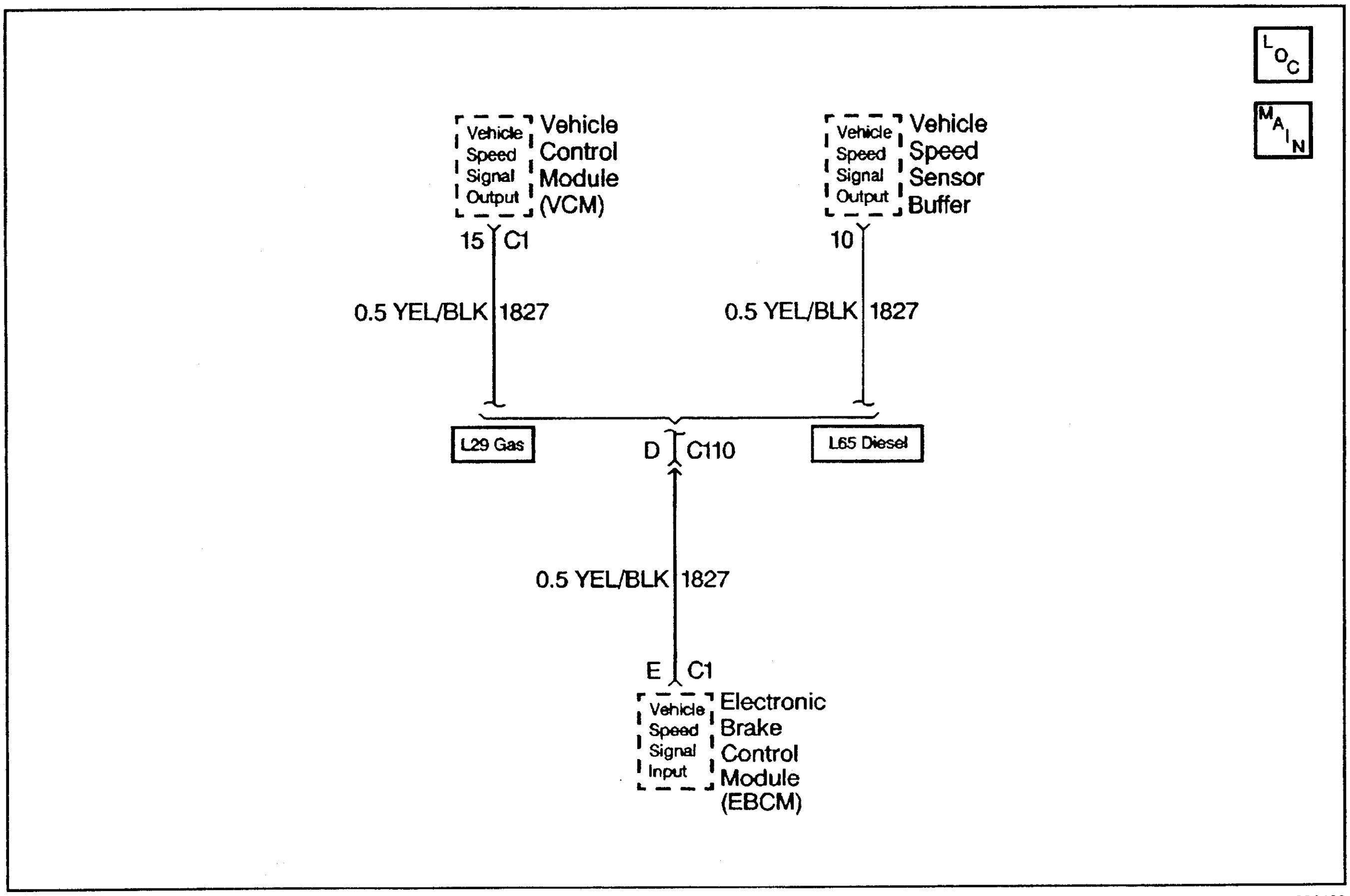
The numbers below refer to the steps in the diagnostic table:

2. This step uses the voltage output from the VCM (gas) or Vehicle Speed Sensor Buffer (diesel) to check CKT 1827.
3. This step checks the CKT 1827 for proper resistance.
5. This step checks for a short in the wiring between the ECBM and the PCM.

DTC C0235 Rear Wheel Speed Signal Circuit Open (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM harness connector from the EBCM. 3. Turn the ignition to RUN. 4. Using a *J 39200*, measure the voltage at terminal E of the 10-way EBCM harness connector. Is the voltage measurement within the specified range?	10-15 V	Go to *Step 4*	Go to *Step 3*
3	1. Turn the ignition to OFF. 2. Disconnect the VCM harness connector C1 for gas vehicles or the Vehicle Speed Sensor Buffer harness connector for diesel vehicles. 3. Using a *J 39200,* measure the resistance between the EBCM 10-way connector terminal E and the VCM harness connector C1 terminal 15 for gas vehicles or the Vehicle Speed Sensor Buffer harness connector terminal 10 for diesel vehicles. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 5*	Go to *Step 8*
4	1. Turn the ignition to OFF. 2. Reconnect all connectors. 3. Turn the ignition to RUN. 4. Using a *Scan Tool*, clear DTCs. 5. Test drive the vehicle above 24 km/h (15 mph). 6. Use a *Scan Tool* to read DTCs. Did a DTC set?	—	Go to *Step 6*	Go to *Step 7*
5	Using the *J 39200*, measure the resistance between the EBCM 10-way connector terminal E and ground. Is the resistance measurement within the specified range?	OL	Go to Engine Controls for Vehicle Speed Sensor Diagnosis	Go to *Step 9*
6	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
7	Malfunction is intermittent, perform the following: 1. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. 2. Refer to Diagnostic Aids for more information. 3. Perform all necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
8	Repair the open in CKT 696. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
9	Repair short to ground in CKT 696. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0235 Rear Wheel Speed Signal Circuit Open (Commercial)



396489

Circuit Description

The EBCM receives the rear wheel speed signal from the Vehicle Control Module (VCM) for gas engine vehicles or the Vehicle Speed Sensor Buffer for diesel engine vehicles. The rear wheel speed signal originates from the Vehicle Speed Sensor (VSS) which is connected to the VCM (gas) or Vehicle Speed Sensor Buffer (diesel). When the vehicle is not moving, the VCM (gas) or Vehicle Speed Sensor Buffer (diesel) will have 12 VDC present on the circuit. The EBCM checks for this votage when the vehicle is not moving.

Conditions for Setting the DTC

EBCM not seeing the correct voltage level from the VCM (gas) or the Vehicle Speed Sensor Buffer (diesel) at startup.

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0235 is a Conition Latched DTC, which indicates that the above actions are true until the condition is cleared.

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

This DTC can be set by a faulty EBCM or a fault in CKT 696.

If the voltage readings are low or varying, the battery or charging system could be the cause. Check these areas before replacing any components. In addition, any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

Test Description

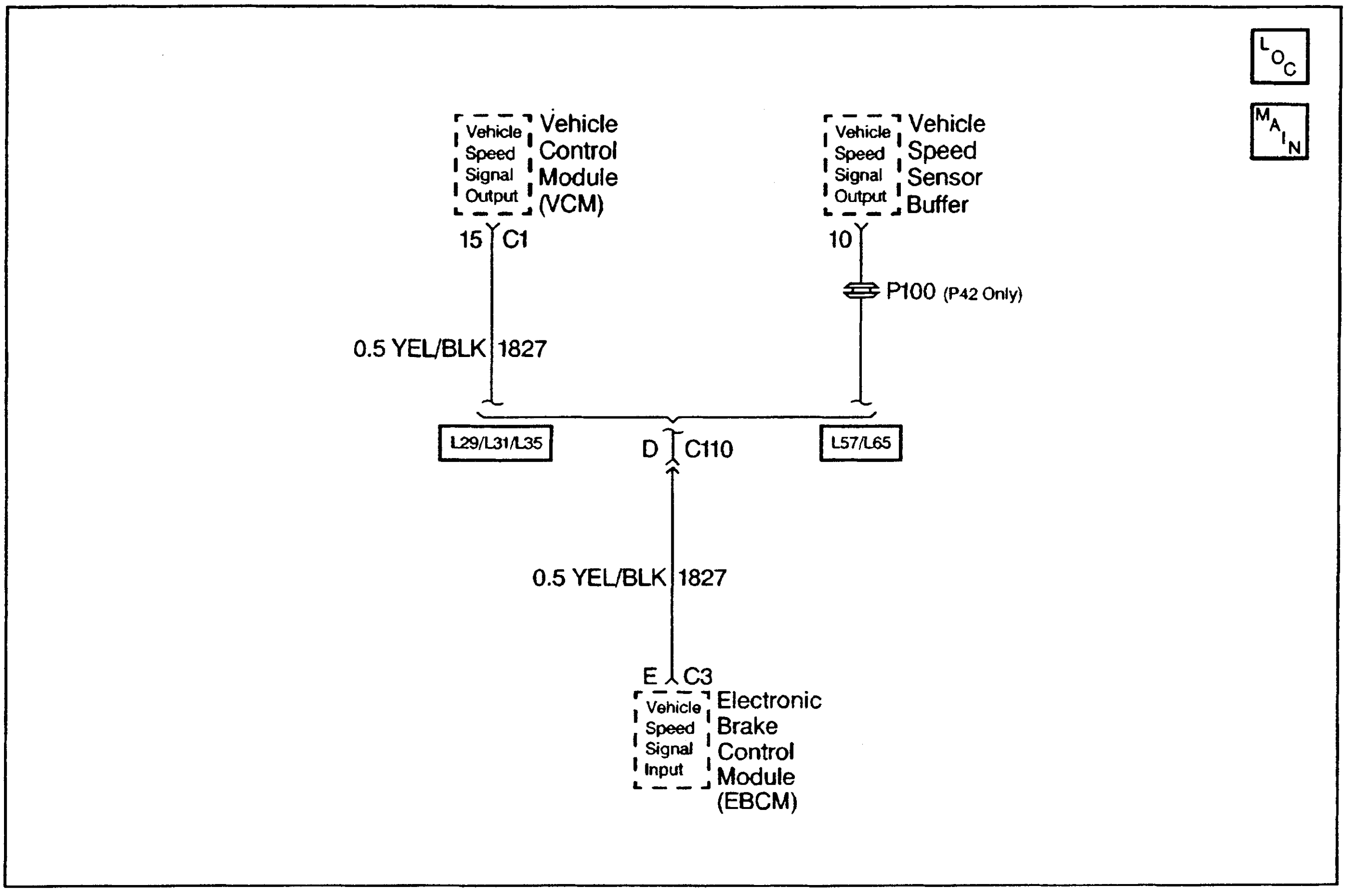
The numbers below refer to the steps in the diagnostic table:

2. This step uses the voltage output from the VCM (gas) or Vehicle Speed Sensor Buffer (diesel) to check CKT 1827.
3. This step checks the CKT 1827 for proper resistance.
5. This step checks for a short in the wiring between the ECBM and the PCM.

DTC C0235 Rear Wheel Speed Signal Circuit Open (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM harness connector from the EBCM. 3. Turn the ignition to RUN. 4. Using a *J 39200*, measure the voltage at terminal E of the 10-way EBCM harness connector. Is the voltage measurement within the specified range?	10-15 V	Go to *Step 4*	Go to *Step 3*
3	1. Turn the ignition to OFF. 2. Disconnect the VCM harness connector C1 for gas vehicles or the Vehicle Speed Sensor Buffer harness connector for diesel vehicles. 3. Using a *J 39200*, measure the resistance between the EBCM 10-way connector terminal E and the VCM harness connector C1 terminal 15 for gas vehicles or the Vehicle Speed Sensor Buffer harness connector terminal 10 for diesel vehicles. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 5*	Go to *Step 8*
4	1. Turn the ignition to OFF. 2. Reconnect all connectors. 3. Turn the ignition to RUN. 4. Using a *Scan Tool*, clear DTCs. 5. Test drive the vehicle above 24 km/h (15 mph). 6. Use a *Scan Tool* to read DTCs. Did a DTC set?	—	Go to *Step 6*	Go to *Step 7*
5	Using the *J 39200*, measure the resistance between the EBCM 10-way connector terminal E and ground. Is the resistance measurement within the specified range?	OL	Go to Engine Controls	Go to *Step 9*
6	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
7	Malfunction is intermittent, perform the following: 1. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. 2. Refer to Diagnostic Aids for more information. 3. Perform all necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
8	Repair the open in CKT 696. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
9	Repair short to ground in CKT 696. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

DTC C0236 Rear Wheel Speed Signal Circuit Missing (Motorhome)



191492

Circuit Description

The EBCM receives the rear wheel speed signal from the Vehicle Control Module (VCM) for gas engine vehicles or the Vehicle Speed Sensor Buffer for diesel engine vehicles. The rear wheel speed signal originates from the Vehicle Speed Sensor (VSS) which is connected to the VCM (gas) or the Vehicle Speed Sensor Buffer (diesel).

Conditions for Setting the DTC

EBCM losing the rear wheel speed signal for at least 5 seconds while the vehicle is moving above 13 km/h (8 mph) with the brake pedal released.

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0236 is an Ignition Latched DTC, which indicates that the above actions are true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

This malfunction can be caused by a malfunction in the EBCM, VCM (gas) Vehicle Speed Sensor Buffer (diesel), VSS or a fault in CKT 821, 822 or 1827.

In addition, any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect the suspected circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water)
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds

If the DTC returns, replace the suspected harness.

Test Description

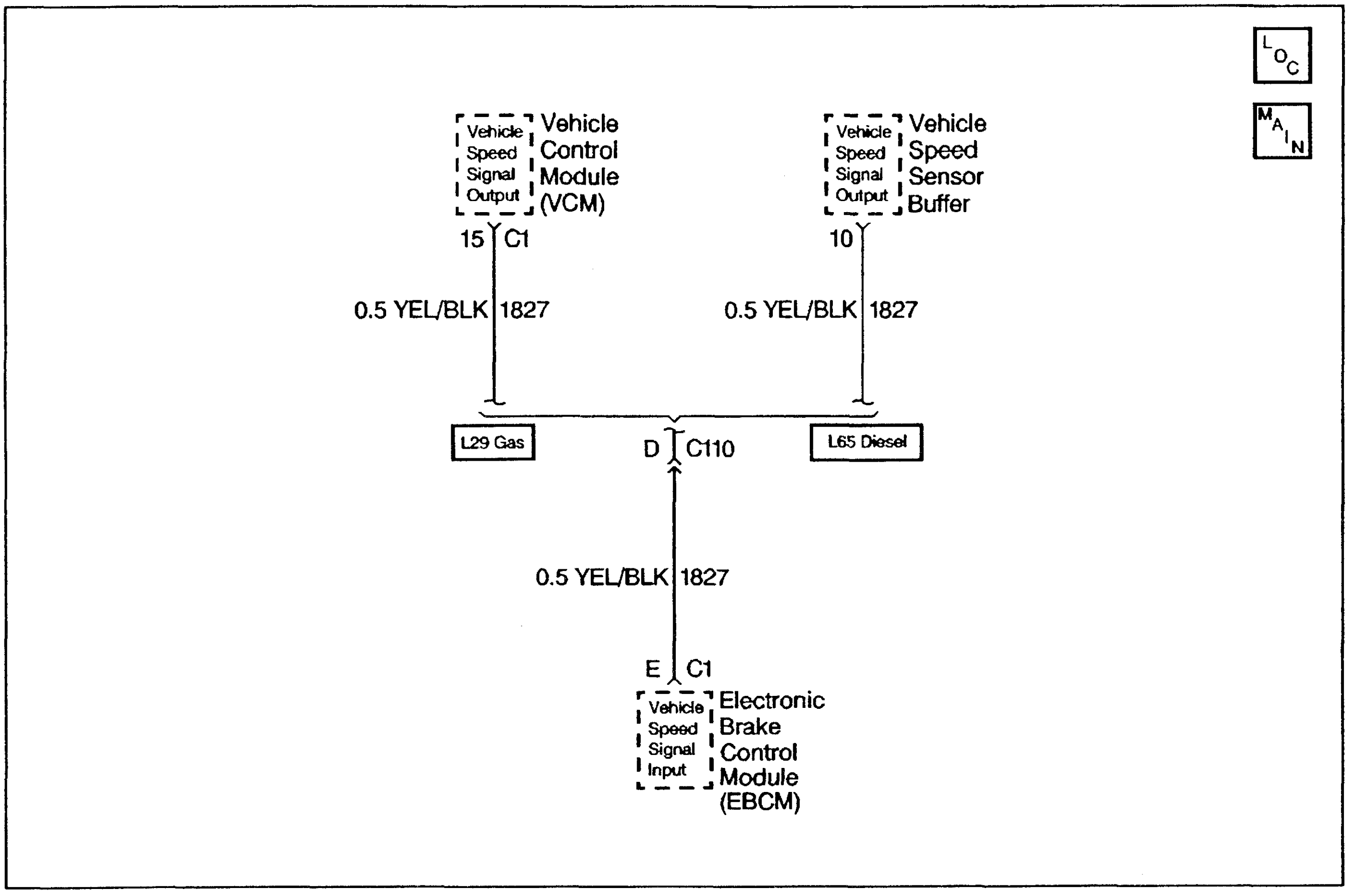
The numbers below refer to the steps in the diagnostic table:

2. This step uses the voltage output from the VCM (gas) or Vehicle Speed Sensor Buffer (diesel) to check the 1827 CKT.
3. This step checks the 1827 CKT for proper resistance.
5. This step checks for a short in the wiring between the ECBM and the VCM.

DTC C0236 Rear Wheel Speed Signal Circuit Missing (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM harness connector from the EBCM. 3. Turn the ignition to RUN. 4. Using a *J 39200*, measure the voltage at terminal E of the 10-way EBCM harness connector. Is the voltage measurement equal to or greater than the specified range?	10 V	Go to *Step 4*	Go to *Step 3*
3	1. Turn the ignition to OFF. 2. Disconnect the VCM harness connector C1 from the VCM. 3. Using a *J 39200*, measure the resistance from terminal E of the 10-way EBCM harness connector to terminal 10 of the VCM harness connector C1. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 5*	Go to *Step 8*
4	1. Turn the ignition to OFF. 2. Reconnect all connectors. 3. Turn the ignition to RUN. 4. Using a *Scan Tool*, clear DTCs. 5. Test drive the vehicle above 24 km/h (15 mph). 6. Use a *Scan Tool* to read DTCs. Did DTC C0236 set?	—	Go to *Step 6*	Go to *Step 7*
5	Using the *J 39200*, measure the resistance from terminal E of the 10-way EBCM harness connector to ground. Is the resistance measurement within the specified range?	OL	Go to Engine Controls for Vehicle Speed Sensor Diagnosis	Go to *Step 9*
6	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
7	Malfunction is intermittent, perform the following: 1. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. 2. Refer to Diagnostic Aids for more information. 3. Perform all necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
8	Repair the open in CKT 696. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
9	Repair short to ground in CKT 696. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0236 Rear Wheel Speed Signal Circuit Missing (Commercial)



396489

Circuit Description

The EBCM receives the rear wheel speed signal from the Vehicle Control Module (VCM) for gas engine vehicles or the Vehicle Speed Sensor Buffer for diesel engine vehicles. The rear wheel speed signal originates from the Vehicle Speed Sensor (VSS) which is connected to the VCM (gas) or the Vehicle Speed Sensor Buffer (diesel).

Conditions for Setting the DTC

EBCM losing the rear wheel speed signal for at least 5 seconds while the vehicle is moving above 13 km/h (8 mph) with the brake pedal released.

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0236 is an Ignition Latched DTC, which indicates that the above actions are true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

This malfunction can be caused by a malfunction in the EBCM, VCM (gas) Vehicle Speed Sensor Buffer (diesel), VSS or a fault in CKTs 821, 822 or 1827.

In addition, any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect the suspected circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water)
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds

If the DTC returns, replace the suspected harness.

Test Description

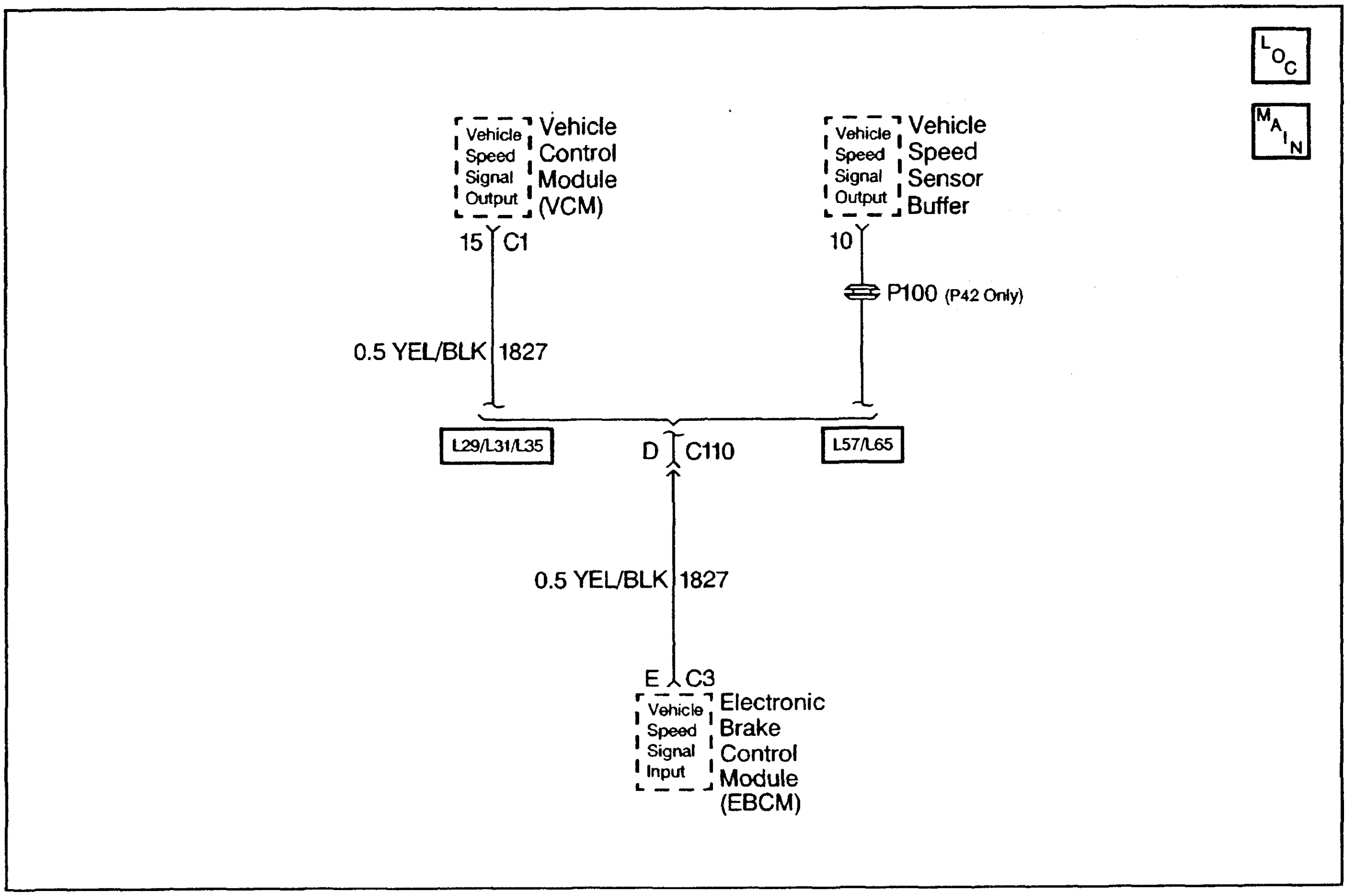
The numbers below refer to the steps in the diagnostic table:

2. This step uses the voltage output from the VCM (gas) or Vehicle Speed Sensor Buffer (diesel) to check the CKT 1827.
3. This step checks the CKT 1827 for proper resistance.
5. This step checks for a short in the wiring between the ECBM and the VCM.

DTC C0236 Rear Wheel Speed Signal Circuit Missing (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM harness connector from the EBCM. 3. Turn the ignition to RUN. 4. Using a *J 39200*, measure the voltage at terminal E of the 10-way EBCM harness connector. Is the voltage measurement equal to or greater than the specified range?	10 V	Go to *Step 4*	Go to *Step 3*
3	1. Turn the ignition to OFF. 2. Disconnect the VCM harness connector C1 from the VCM. 3. Using a *J 39200*, measure the resistance from terminal E of the 10-way EBCM harness connector to terminal 10 of the VCM harness connector C1. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 5*	Go to *Step 8*
4	1. Turn the ignition to OFF. 2. Reconnect all connectors. 3. Turn the ignition to RUN. 4. Using a *Scan Tool*, clear DTCs. 5. Test drive the vehicle above 24 km/h (15 mph). 6. Use a *Scan Tool* to read DTCs. Did DTC C0236 set?	—	Go to *Step 6*	Go to *Step 7*
5	Using the *J 39200*, measure the resistance from terminal E of the 10-way EBCM harness connector to ground. Is the resistance measurement within the specified range?	OL	Go to Engine Controls.	Go to *Step 9*
6	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
7	Malfunction is intermittent, perform the following: 1. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. 2. Refer to Diagnostic Aids for more information. 3. Perform all necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
8	Repair the open in CKT 696. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
9	Repair short to ground in CKT 696. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

DTC C0237 Rear Wheel Speed Signal Erratic (Motorhome)



191492

Circuit Description

The EBCM receives the rear wheel speed signal from the Vehicle Control Module (VCM) for gas engine vehicles or the Vehicle Speed Sensor Buffer for diesel engine vehicles. The rear wheel speed signal originates from the Vehicle Speed Sensor (VSS) which is connected to the VCM (gas) or the Vehicle Speed Sensor Buffer (diesel).

Conditions for Setting the DTC

- The EBCM seeing the rear speed signal drop out and return.
- The EBCM attempts to detect an erratic rear speed signal every 5 milliseconds. If the rear speed signal is missing for greater than 15 milliseconds while a vehicle speed greater than 32 k/mh (20 mph) with brake applied, or 20 k/mh (12 mph) with brake released a DTC C0237 will set. At this point the DTC will be condition latched. This means that the ABS system will be disabled and the ABS indicator lamp stays on as long as the condition exists.

  If the erratic DTC is set 3 consecutive times during the same ignition cycle, the DTC will set as an ignition latched DTC. This means that the ABS system will be disabled and the ABS indicator lamp stays on until the ignition is turned off; even if the fault goes away.

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0237 initially sets as a condition latched code. This means that the ABS system will be disabled and the ABS indicator lamp stays on as long as the condition exists. If the erratic DTC is set 3 consecutive times during the same ignition cycle, the DTC will set as an ignition latched DTC. This means that the ABS system will be disabled and the ABS indicator lamp stays on until the ignition is turned off; even if the fault goes away.

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

This malfunction can be caused by a malfunction in the EBCM, VCM (gas) Vehicle Speed Sensor Buffer (diesel), VSS or a fault in CKT 821, 822 or 1827.

In addition, any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

Test Description

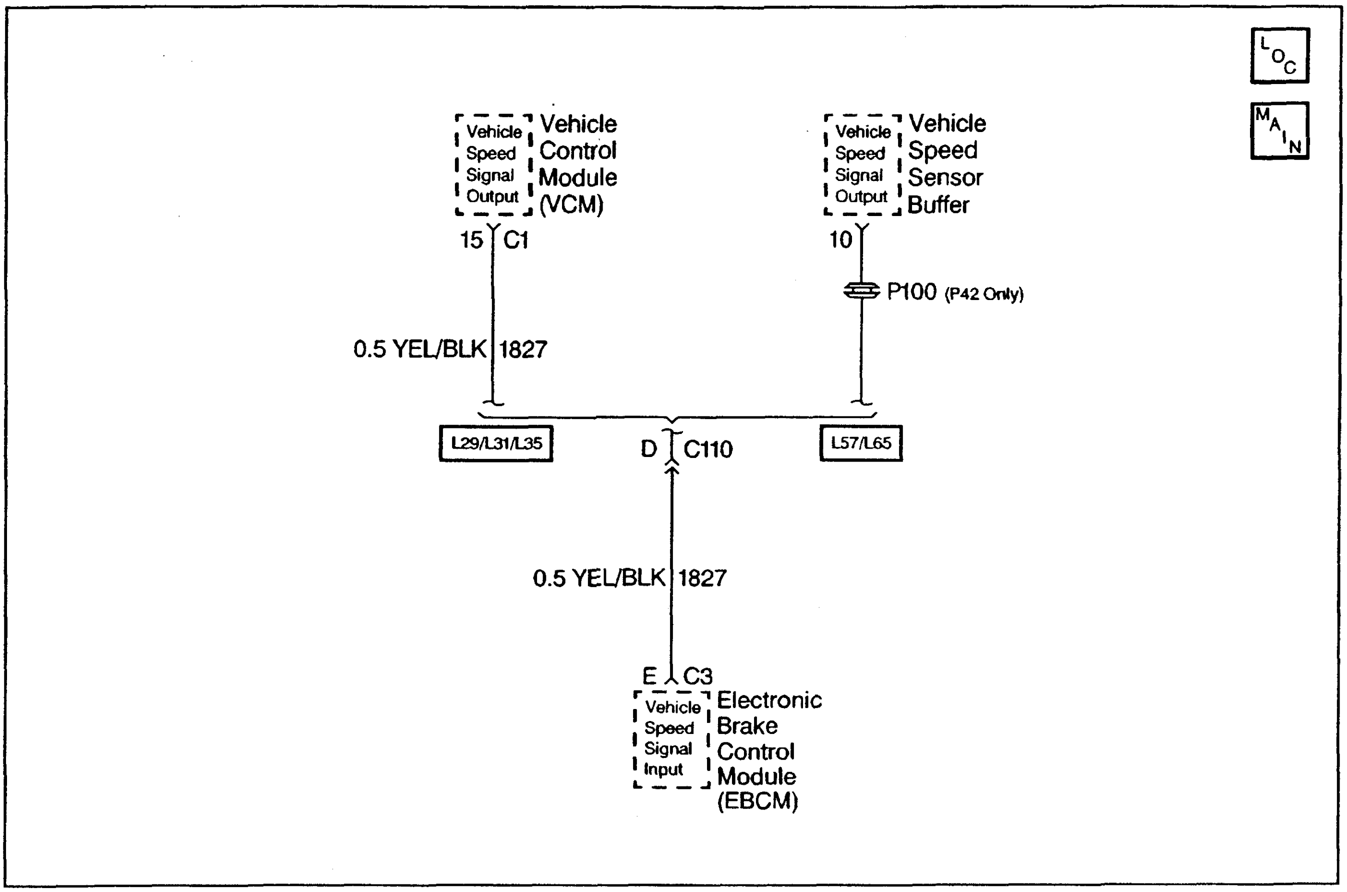
The numbers below refer to the steps in the diagnostic table:

2. This step uses the voltage output from the VCM to check the CKT 1827.
3. This step checks the CKT 1827 for proper resistance.
5. This step checks for a short in the wiring between the ECBM and the VCM.

DTC C0237 Rear Wheel Speed Signal Erratic (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM harness connector from the EBCM. 3. Turn the ignition to RUN. 4. Using a *J 39200*, measure the voltage at terminal E of the 10-way EBCM harness connector. Is the voltage measurement equal to or greater than the specified range?	10 V	Go to *Step 4*	Go to *Step 3*
3	1. Turn the ignition to OFF. 2. Disconnect the VCM harness connector C1 from the VCM. 3. Using a *J 39200*, measure the resistance from terminal E of the 10-way EBCM harness connector to terminal 10 of the VCM harness connector C1. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 5*	Go to *Step 8*
4	1. Turn the ignition to OFF. 2. Reconnect all connectors. 3. Turn the ignition to RUN. 4. Using a *Scan Tool*, clear DTCs. 5. Test drive the vehicle above 24 km/h (15 mph). 6. Use a *Scan Tool* to read DTCs. Did DTC C0237 set?	—	Go to*Step 6*	Go to *Step 7*
5	Using the *J 39200*, measure the resistance from terminal E of the 10-way EBCM harness connector to ground. Is the resistance measurement within the specified range?	OL	Go to Engine Controls for Vehicle Speed Sensor Diagnosis	Go to *Step 9*
6	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
7	Malfunction is intermittent, perform the following: 1. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. 2. Refer to Diagnostic Aids for more information. 3. Perform all necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
8	Repair the open in CKT 696. Refer to *Wiring Repairs*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
9	Repair short to ground in CKT 696. Refer to *Wiring Repairs*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0237 Rear Wheel Speed Signal Erratic (Commercial)



191492

Circuit Description

The EBCM receives the rear wheel speed signal from the Vehicle Control Module (VCM) for gas engine vehicles or the Vehicle Speed Sensor Buffer for diesel engine vehicles. The rear wheel speed signal originates from the Vehicle Speed Sensor (VSS) which is connected to the VCM (gas) or the Vehicle Speed Sensor Buffer (diesel).

Conditions for Setting the DTC

- The EBCM seeing the rear speed signal drop out and return.
- The EBCM attempts to detect an erratic rear speed signal every 5 milliseconds. If the rear speed signal is missing for greater than 15 milliseconds while a vehicle speed greater than 32 k/mh (20 mph) with brake applied, or 20 k/mh (12 mph) with brake released a DTC C0237 will set. At this point the DTC will be condition latched. This means that the ABS system will be disabled and the ABS indicator lamp stays on as long as the condition exists.

If the erratic DTC is set 3 consecutive times during the same ignition cycle, the DTC will set as an ignition latched DTC. This means that the ABS system will be disabled and the ABS indicator lamp stays on until the ignition is turned off; even if the fault goes away.

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0237 initially sets as a condition latched code. This means that the ABS system will be disabled and the ABS indicator lamp stays on as long as the condition exists. If the erratic DTC is set 3 consecutive times during the same ignition cycle, the DTC will set as an ignition latched DTC. This means that the ABS system will be disabled and the ABS indicator lamp stays on until the ignition is turned off; even if the fault goes away.

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

This malfunction can be caused by a malfunction in the EBCM, VCM (gas) Vehicle Speed Sensor Buffer (diesel), VSS or a fault in CKT 821, 822 or 1827.

In addition, any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A wire breaks inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

Test Description

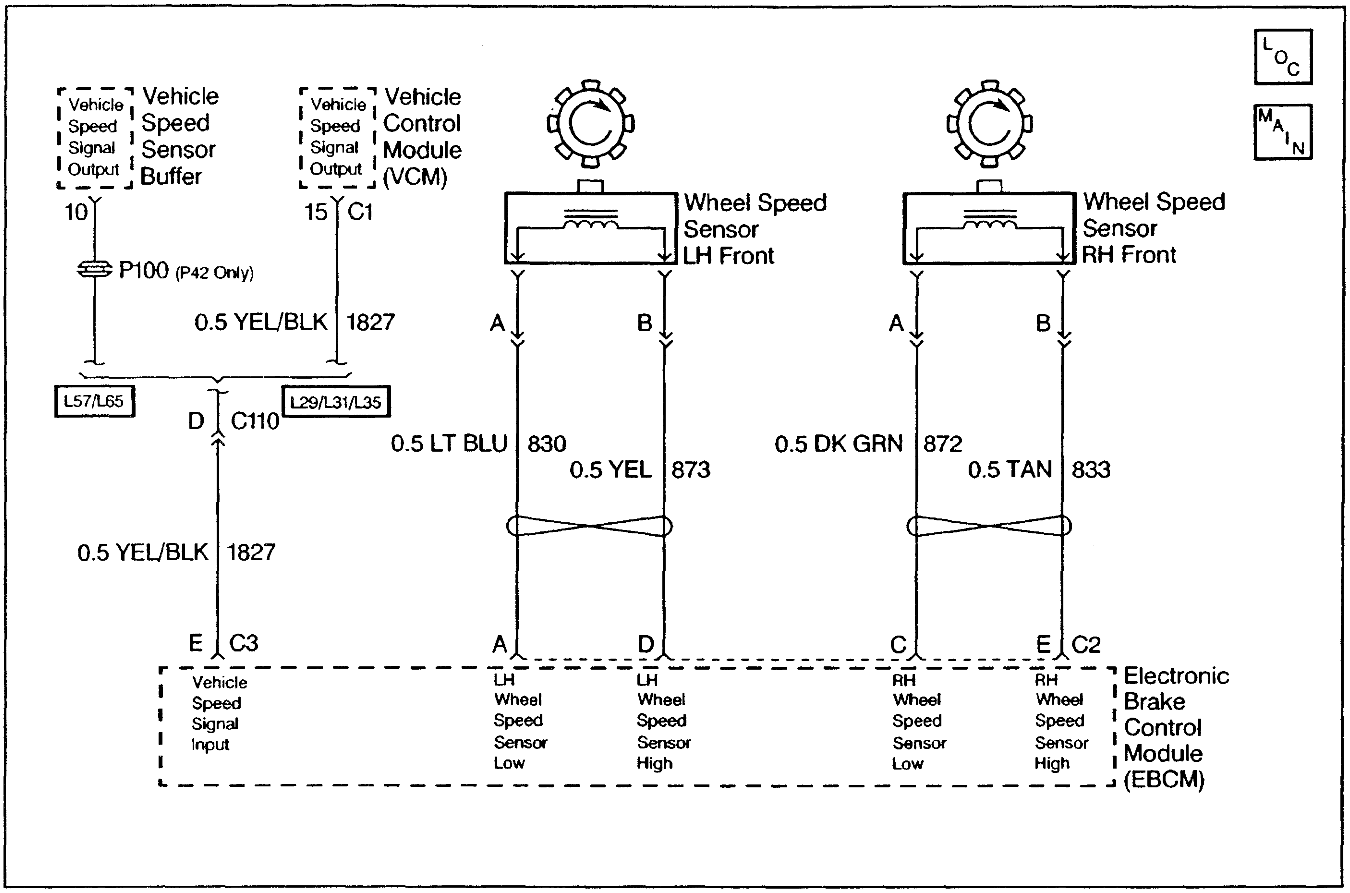
The numbers below refer to the steps in the diagnostic table:

2. This step uses the voltage output from the VCM to check the CKT 1827.
3. This step checks the CKT 1827 for proper resistance.
5. This step checks for a short in the wiring between the ECBM and the VCM.

DTC C0237 Rear Wheel Speed Signal Erratic (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM harness connector from the EBCM. 3. Turn the ignition to RUN. 4. Using a *J 39200*, measure the voltage at terminal E of the 10-way EBCM harness connector. Is the voltage measurement equal to or greater than the specified range?	10 V	Go to *Step 4*	Go to *Step 3*
3	1. Turn the ignition to OFF. 2. Disconnect the VCM harness connector C1 from the VCM. 3. Using a *J 39200*, measure the resistance from terminal E of the 10-way EBCM harness connector to terminal 10 of the VCM harness connector C1. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 5*	Go to *Step 8*
4	1. Turn the ignition to OFF. 2. Reconnect all connectors. 3. Turn the ignition to RUN. 4. Using a *Scan Tool*, clear DTCs. 5. Test drive the vehicle above 24 km/h (15 mph). 6. Use a *Scan Tool* to read DTCs. Did DTC C0237 set?	—	Go to *Step 6*	Go to *Step 7*
5	Using the *J 39200*, measure the resistance from terminal E of the 10-way EBCM harness connector to ground. Is the resistance measurement within the specified range?	OL	Refer to Engine Controls for Vehicle Speed Sensor Diagnosis	Go to *Step 9*
6	Replace the EBCM. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
7	Malfunction is intermittent, perform the following: 1. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. 2. Refer to Diagnostic Aids for more information. 3. Perform all necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
8	Repair the open in CKT 696. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
9	Repair short to ground in CKT 696. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

DTC C0238 Wheel Speed Mismatch (Motorhome)



191501

Circuit Description

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the wheel speed. The amplitude of the wheel speed signal is directly related to the distance between the wheel speed sensor coil and the toothed ring. This distance is referred to as the air gap. The EBCM can detect wheel speed signal malfunctions as they happen. An error in reported wheel speed can be compensated for by the EBCM up to a point. The error compensation will allow the EBCM to continue to function normally instead of setting a DTC. If the wheel speed mismatch increases beyond that point, the EBCM will set a DTC.

Conditions for Setting the DTC

- Any wheel speed differing from the vehicle speed by greater than 10%.
- The vehicle speed is greater than 40 km/h (25 mph)
- No unexpected wheel acceleration: anything that generates consistent differences between the wheel speed signals

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0238 is an Ignition Latched DTC, which indicates the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

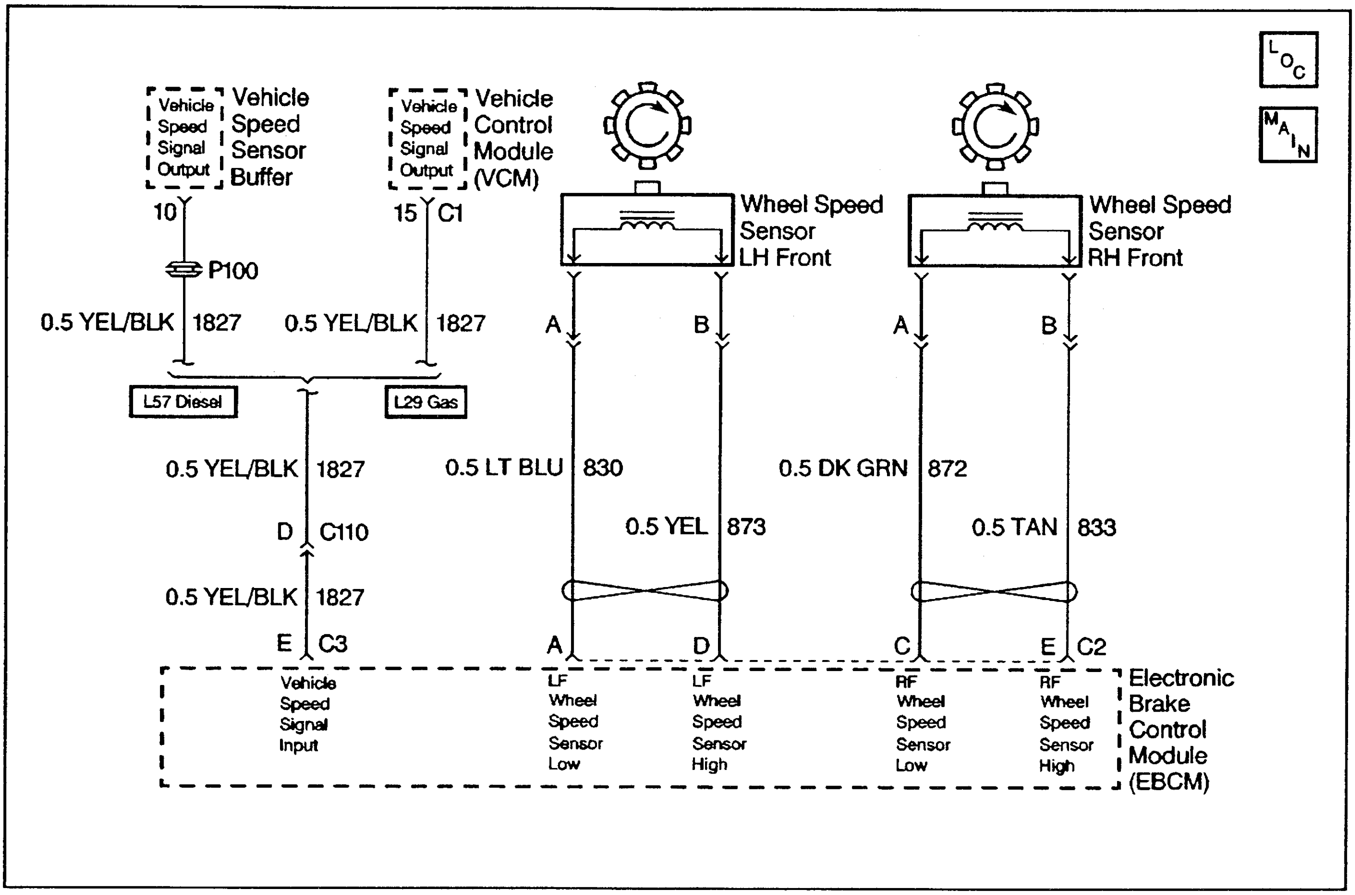
Diagnostic Aids

Installing significantly different tires on the vehicle usually sets a DTC C0238.

DTC C0238 Wheel Speed Mismatch (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	Inspect the vehicle tires for a variation in tire size Are all four tire sizes the same?	—	Go to *Step 3*	Go to Diagnostic Aids
3	1. Install the *Scan Tool.* 2. Clear all DTCs. 3. While driving the vehicle, monitor and compare all the wheel speeds using the *Scan Tool.* Does the Scan Tool indicate a mismatch in wheel speeds?	—	Go to *Step 4*	Go to Diagnostic Aids
4	Does the scan tool indicate a mismatch with the right front wheel speed?	—	Go to *DTC C0223 RF Wheel Speed Signal Erratic (Motorhome)*	Go to *Step 5*
5	Does the scan tool indicate a mismatch with the left front wheel speed?	—	Go to *DTC C0227 LF Wheel Speed Signal Erratic (Motorhome)*	Go to *Step 6*
6	Does the scan tool indicate a mismatch with the rear wheel speed?	—	Go to *DTC C0237 Rear Wheel Speed Signal Erratic (Motorhome)*	—

DTC C0238 Wheel Speed Mismatch (Commercial)



396491

Circuit Description

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the wheel speed. The amplitude of the wheel speed signal is directly related to the distance between the wheel speed sensor coil and the toothed ring. This distance is referred to as the air gap. The EBCM can detect wheel speed signal malfunctions as they happen. An error in reported wheel speed can be compensated for by the EBCM up to a point. The error compensation will allow the EBCM to continue to function normally instead of setting a DTC. If the wheel speed mismatch increases beyond that point, the EBCM will set a DTC.

Conditions for Setting the DTC

- Any wheel speed differing from the vehicle speed by greater than 10%.
- The vehicle speed is greater than 40 km/h (25 mph)
- No unexpected wheel acceleration: anything that generates consistent differences between the wheel speed signals

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTC C0238 is an Ignition Latched DTC, which indicates the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

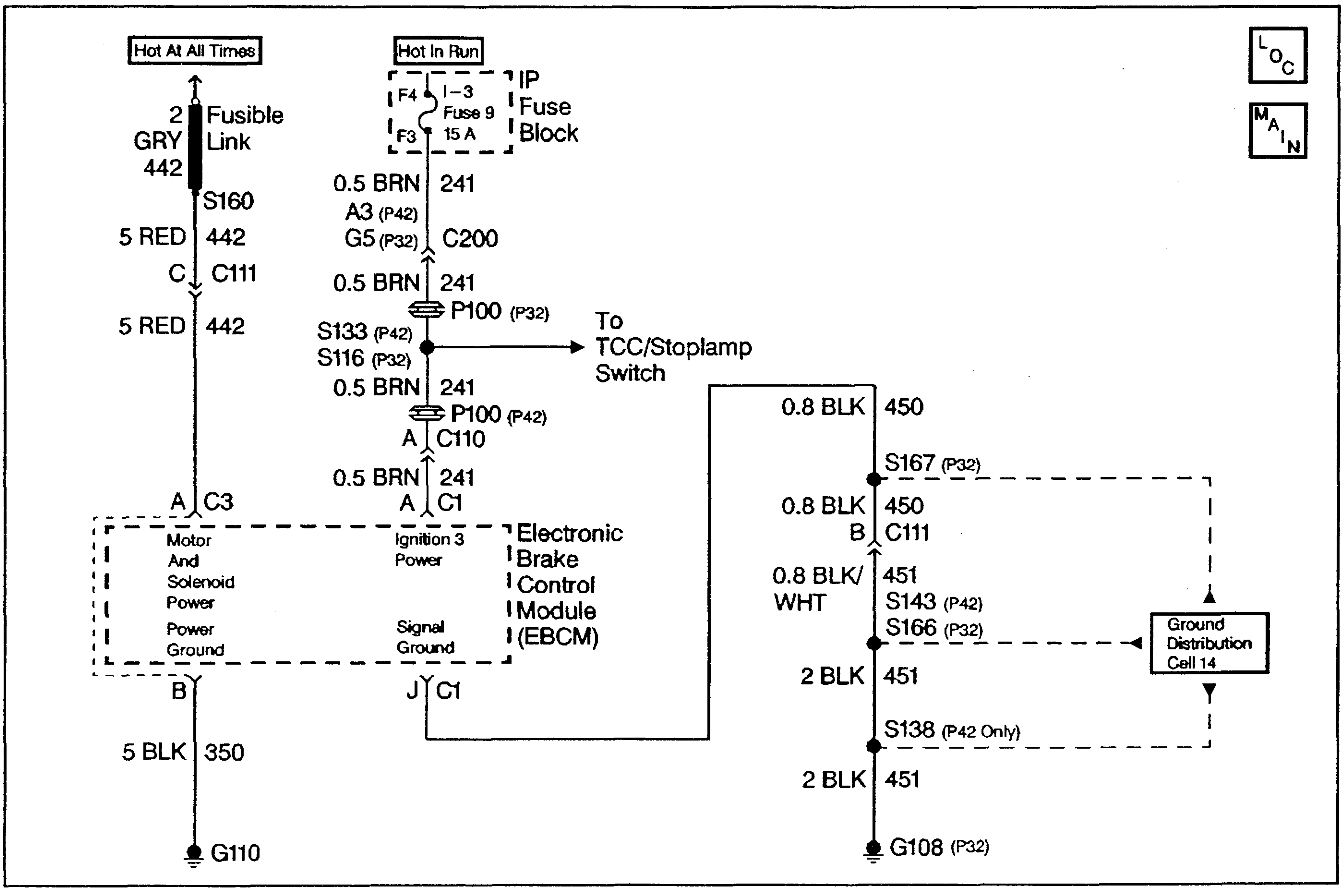
Diagnostic Aids

Installing significantly different tires on the vehicle usually sets a DTC C0238.

DTC C0238 Wheel Speed Mismatch (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	Inspect the vehicle tires for a variation in tire size Are all four tire sizes the same?	—	Go to *Step 3*	Go to Diagnostic Aids
3	1. Install the *Scan Tool*. 2. Clear all DTCs. 3. While driving the vehicle, monitor and compare all the wheel speeds using the *Scan Tool*. Does the Scan Tool indicate a mismatch in wheel speeds?	—	Go to *Step 4*	Go to Diagnostic Aids
4	Does the scan tool indicate a mismatch with the right front wheel speed?	—	Go to *DTC C0223 RF Wheel Speed Signal Erratic (Commercial)*	Go to *Step 5*
5	Does the scan tool indicate a mismatch with the left front wheel speed?	—	Go to *DTC C0227 LF Wheel Speed Signal Erratic (Commercial)*	Go to *Step 6*
6	Does the scan tool indicate a mismatch with the rear wheel speed?	—	Go to *DTC C0237 Rear Wheel Speed Signal Erratic (Commercial)*	—

DTC C0241-C0254 EBCM Control Valve Circuit (Motorhome)



191512

Circuit Description

The EBCM microprocessor will ground the indicated solenoid coil (RF dump/isolation, LF dump/isolation, or Rear dump/isolation) circuit to energize the solenoid coil whenever the solenoid valve is needed. Refer to ABS Braking Mode in *ABS System Operation (Domestic)*. The magnetic force created by the solenoid coil will close the isolation valve.

Conditions for Setting the DTC

Open Circuit

- The ABS bulb check is complete
- Low voltage exists on the EBCM solenoid driver circuit when high voltage is expected (the solenoid is not energized)

Shorted Circuit

- The ABS bulb check is complete
- High voltage is present on the EBCM solenoid driver circuit when the voltage is expected to be low (solenoid energized).

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTCs C0241–C0258 are Ignition Latched DTCs, which indicates the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

This DTC usually sets because of an open/shorted solenoid coil within the EBCM. The solenoid coil is located within the BPMV and is not serviceable. If the test does not repair the DTC, then replace the EBCM.

If this DTC sets with other DTCs, check for the following conditions:

- A poor EBCM power or signal ground
- A poor EBCM power or ignition feed

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step determines the resistance of the power ground circuit.
4. This step determines the battery voltage available to the EBCM.
7. This step determines the resistance of the signal ground circuit.
8. This step determines the ignition voltage available to the EBCM.

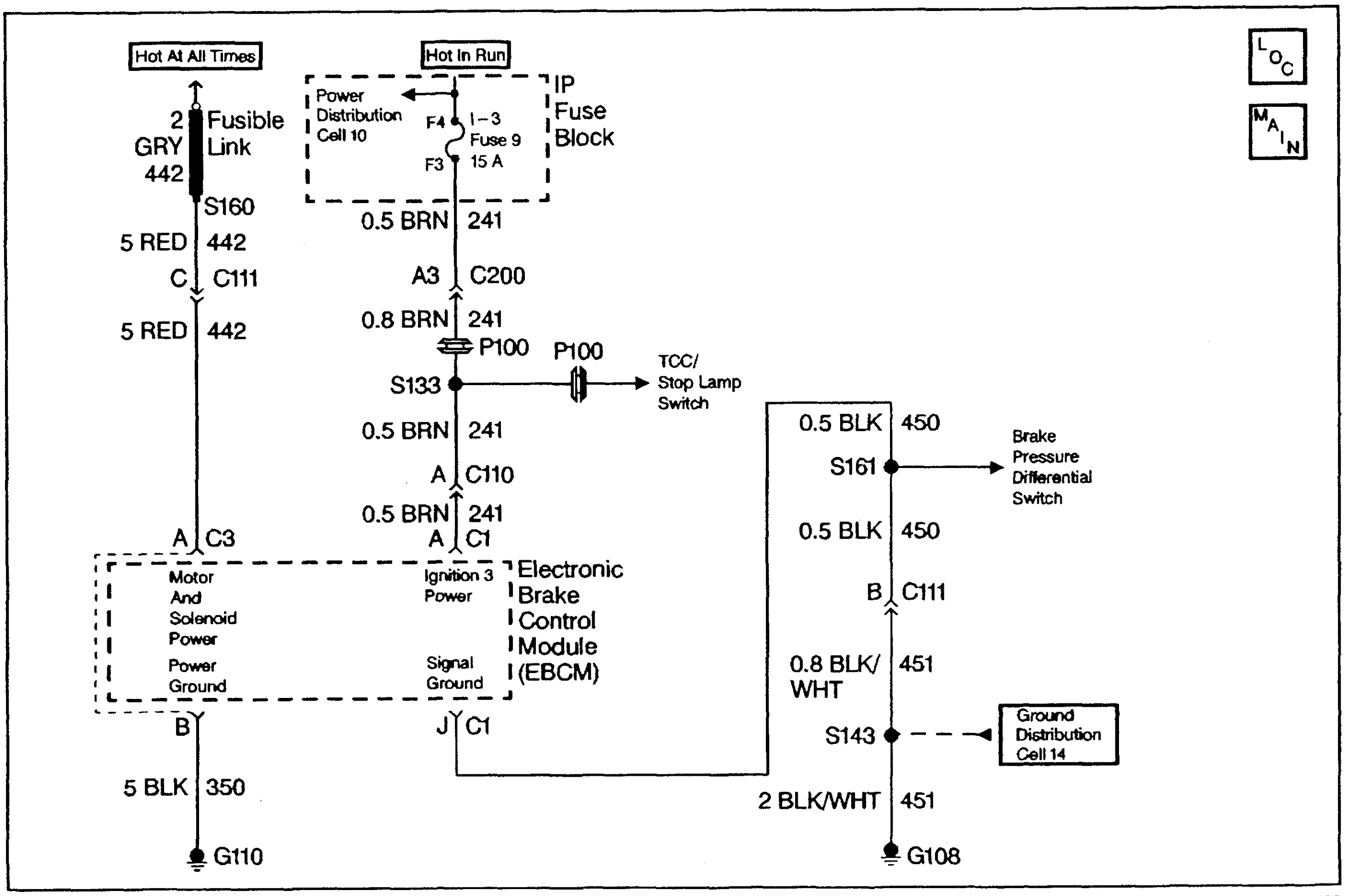
DTC C0241-C0254 EBCM Control Valve Circuit (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Turn the ignition switch to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion that could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to *Step 3*	Go to *Step 11*
3	Using a *J 39200*, measure the resistance between terminal B of the 2-way EBCM harness connector and the ground. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 4*	Go to *Step 12*
4	Using a *J 39200*, measure the voltage between terminal A of the 2-way EBCM harness connector and the ground. Is the voltage equal to or greater than the specified value?	10.0 V	Go to *Step 6*	Go to *Step 5*
5	Inspect the grey fusible link. Is the grey fusible link open?	—	Go to *Step 13*	Go to *Step 14*
6	1. Disconnect the 10-way EBCM harness connector from the EBCM. 2. Inspect the connector for damage or corrosion that could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to *Step 7*	Go to *Step 15*
7	Measure the resistance between terminal J of the 10-way EBCM harness connector and the ground using a *J 39200*. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 8*	Go to *Step 16*
8	1. Turn the ignition to RUN. 2. Using a *J 39200*, measure the voltage between terminal A of the 10-way EBCM harness connector and the ground. Is the voltage equal to or greater than the specified value?	10.0 V	Go to *Step 10*	Go to *Step 9*
9	Inspect the 15-amp I-3 fuse. Is the fuse open?	—	Go to *Step 17*	Go to *Step 18*
10	Malfunction is intermittent, perform the following: 1. Inspect the 10-way and 2-way EBCM harness connectors for poor terminal contact or corrosion. 2. Inspect CKT 442, CKT 350, CKT 241 and CKT 451 for damage that could result in an intermittent open circuit. 3. Repair any evident damage. 4. Replace the terminals if poor contact or corrosion exists. 5. Reconnect all the connectors. 6. Using the *Scan Tool*, clear all DTCs. 7. Test drive vehicle above the 16 km/h (10 mph) Does the DTC set as a current DTC?	—	Go to *Step 19*	Go to Diagnostic Aids

DTC C0241-C0254 EBCM Control Valve Circuit (Motorhome) (cont'd)

Step	Action	Value(s)	Yes	No
11	Repair the 2-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
12	Repair the open or the high resistance in the CKT 350. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
13	Repair the short to ground in the CKT 442. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
14	Repair the open or the high resistance in the CKT 442. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
15	Repair the 10-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
16	Repair the open or the high resistance in the CKT 451. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
17	Repair the short to ground in the CKT 241. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
18	Repair the open or the high resistance in the CKT 241. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
19	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0241-C0254 EBCM Control Valve Circuit (Commercial)



Circuit Description

The EBCM microprocessor will ground the indicated solenoid coil (RF dump/isolation, LF dump/isolation, or Rear dump/isolation) circuit to energize the solenoid coil whenever the solenoid valve is needed. Refer to ABS Braking Mode in *ABS System Operation (Domestic)*. The magnetic force created by the solenoid coil will close the isolation valve.

Conditions for Setting the DTC

Open Circuit

- The ABS bulb check is complete
- Low voltage exists on the EBCM solenoid driver circuit when high voltage is expected (the solenoid is not energized)

Shorted Circuit

- The ABS bulb check is complete
- High voltage is present on the EBCM solenoid driver circuit when the voltage is expected to be low (solenoid energized).

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTCs C0241–C0258 are Ignition Latched DTCs, which indicates the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

This DTC usually sets because of an open/shorted solenoid coil within the EBCM. The solenoid coil is located within the BPMV and is not serviceable. If the test does not repair the DTC, then replace the EBCM.

If this DTC sets with other DTCs, check for the following conditions:

- A poor EBCM power or signal ground
- A poor EBCM power or ignition feed

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step determines the resistance of the power ground circuit.
4. This step determines the battery voltage available to the EBCM.
7. This step determines the resistance of the signal ground circuit.
8. This step determines the ignition voltage available to the EBCM.

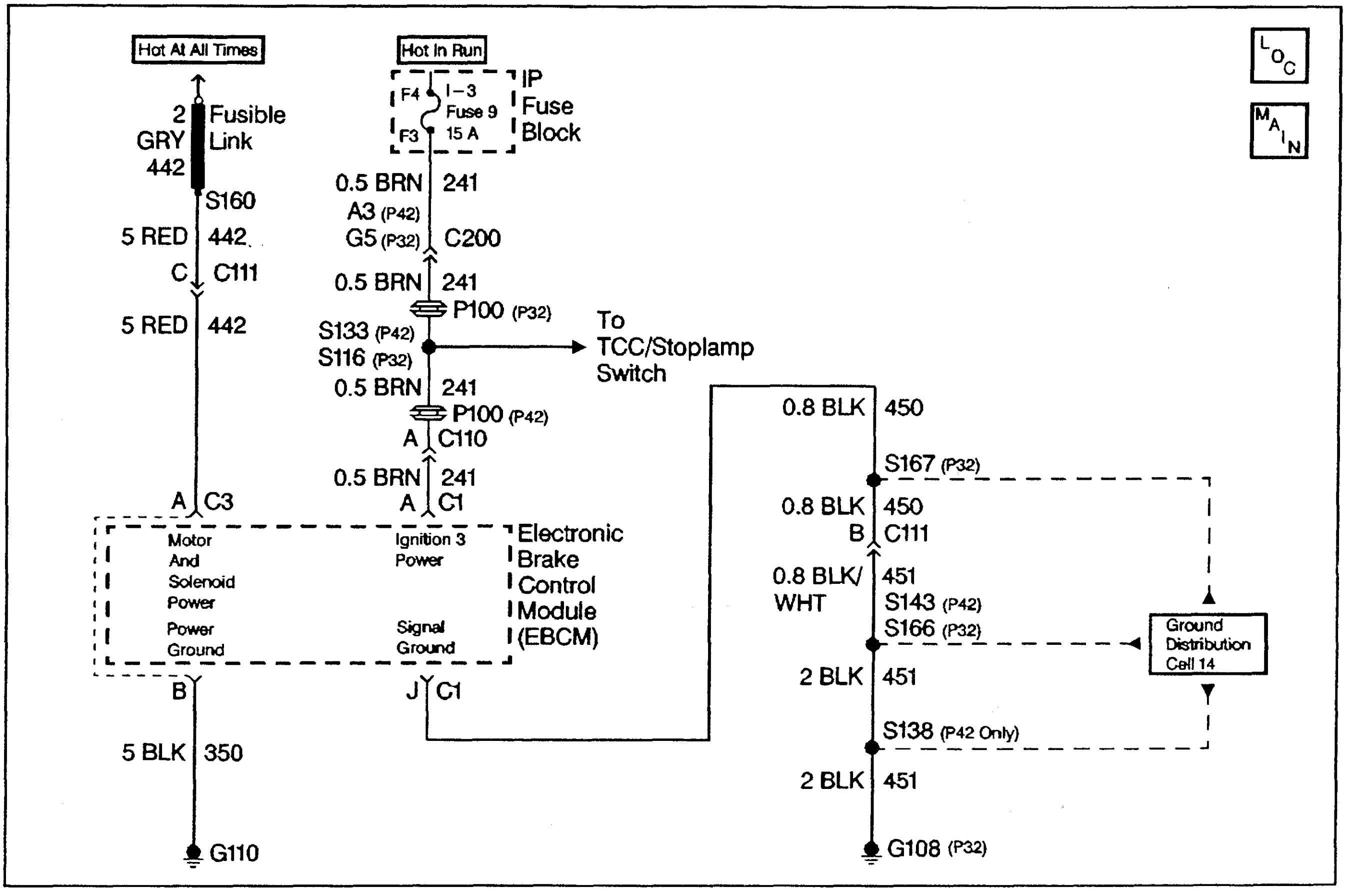
DTC C0241-C0254 EBCM Control Valve Circuit (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Turn the ignition switch to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion that could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to *Step 3*	Go to *Step 11*
3	Using a *J 39200*, measure the resistance between terminal B of the 2-way EBCM harness connector and the ground. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 4*	Go to *Step 12*
4	Using a *J 39200*, measure the voltage between terminal A of the 2-way EBCM harness connector and the ground. Is the voltage equal to or greater than the specified value?	10.0 V	Go to *Step 6*	Go to *Step 5*
5	Inspect the grey fusible link. Is the grey fusible link open?	—	Go to *Step 13*	Go to *Step 14*
6	1. Disconnect the 10-way EBCM harness connector from the EBCM. 2. Inspect the connector for damage or corrosion that could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to *Step 7*	Go to *Step 15*
7	Measure the resistance between terminal J of the 10-way EBCM harness connector and the ground using a *J 39200.* Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 8*	Go to *Step 16*
8	1. Turn the ignition to RUN. 2. Using a *J 39200*, measure the voltage between terminal A of the 10-way EBCM harness connector and the ground. Is the voltage equal to or greater than the specified value?	10.0 V	Go to *Step 10*	Go to *Step 9*
9	Inspect the 15-amp I-3 fuse. Is the fuse open?	—	Go to *Step 17*	Go to *Step 18*
10	Malfunction is intermittent, perform the following: 1. Inspect the 10-way and 2-way EBCM harness connectors for poor terminal contact or corrosion. 2. Inspect CKT 442, CKT 350, CKT 241 and CKT 451 for damage that could result in an intermittent open circuit. 3. Repair any evident damage. 4. Replace the terminals if poor contact or corrosion exists. 5. Reconnect all the connectors. 6. Using the *Scan Tool*, clear all DTCs. 7. Test drive vehicle above the 16 km/h (10 mph) Does the DTC set as a current DTC?	—	Go to *Step 19*	Go to Diagnostic Aids

DTC C0241-C0254 EBCM Control Valve Circuit (Commercial) (cont'd)

Step	Action	Value(s)	Yes	No
11	Repair the 2-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
12	Repair the open or the high resistance in the CKT 350. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
13	Repair the short to ground in the CKT 442. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
14	Repair the open or the high resistance in the CKT 442. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
15	Repair the 10-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
16	Repair the open or the high resistance in the CKT 451. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
17	Repair the short to ground in the CKT 241. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
18	Repair the open or the high resistance in the CKT 241. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
19	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

DTC C0265 or C0266 EBCM Relay Circuit (Motorhome)



191512

Circuit Description

The pump motor relay supplies power to all six solenoid coils (three isolation solenoid coils and three dump solenoid coils) and the motor when the ABS is required. The relay and the six solenoid coils are located within the EBCM.

Conditions for Setting the DTC (DTC C0265)

- The EBCM microprocessor commands the relay on
- Low voltage exists on all six solenoid driver circuits when high voltage is expected (the solenoid is not energized)

Conditions for Setting the DTC (DTC C0266)

- The ABS bulb check is complete
- High voltage exists on the pump motor driver circuit when all are expected to be low (the relay is not commanded on)

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTCs C0265 and C0266 are Ignition Latched DTCs, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids (DTC C0265)

DTC C0265 usually sets because of an open relay coil or non-closable relay contacts. The relay is located within the EBCM. The relay is not serviceable. If the test does not repair the DTC, then replace the EBCM.

If DTC C0265 appears with other DTCs repair the other DTCs first. Clear all DTCs. Then run three function tests with the *Scan Tool*. Refer to this diagnostic chart if DTC C0265 resets.

Diagnostic Aids (DTC C0266)

DTC C0266 usually sets when the relay contacts are stuck closed. The relay is located within the EBCM. The relay is not serviceable. If the test does not repair the DTC, then replace the EBCM.

If DTCs C0265 or C0266 are setting after replacing the EBCM, check the vehicle for an auxiliary device (winch, auxiliary battery system, etc.) which could cause a voltage spike on the battery feed to the EBCM. If the vehicle does have an auxiliary device, install a Metallic Oxide Varistor (MOV) in the battery feed circuit to the EBCM.

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step determines the resistance of the power ground circuit.
4. This step determines the battery voltage available to the EBCM.
7. This step determines the resistance of the signal ground circuit.
8. This step determines the ignition voltage available to the EBCM.

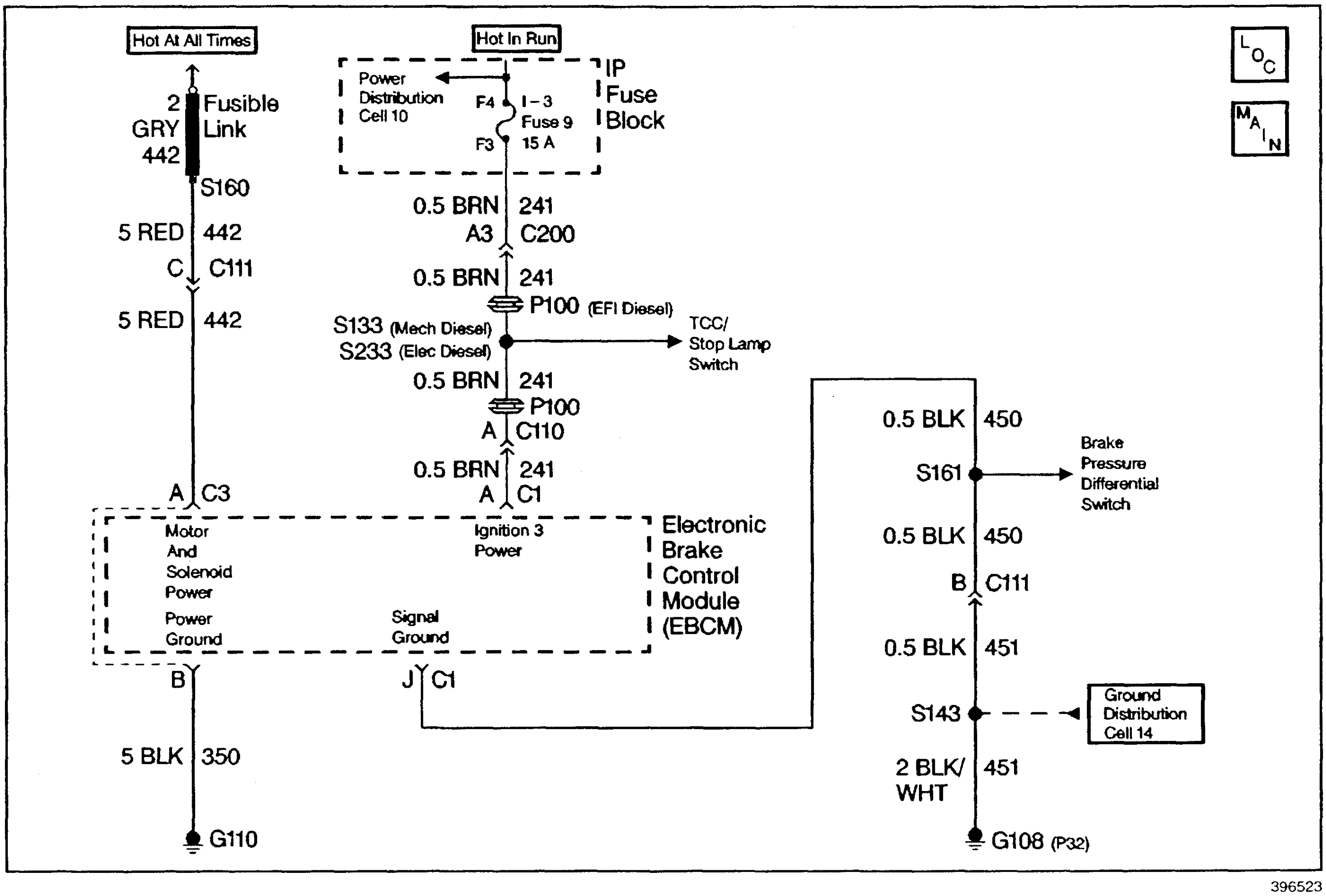
DTC C0265 or C0266 EBCM Relay Circuit (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Turn the ignition switch to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion that could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to *Step 3*	Go to *Step 11*
3	Using a *J 39200*, measure the resistance between terminal B of the 2-way EBCM harness connector and the ground. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 4*	Go to *Step 12*
4	Using a *J 39200*, measure the voltage between terminal A of the 2-way EBCM harness connector and the ground. Is the voltage equal to or greater than the specified value?	10.0 V	Go to *Step 6*	Go to *Step 5*
5	Inspect the grey fusible link. Is the grey fusible link open?	—	Go to *Step 13*	Go to *Step 14*
6	1. Disconnect the 10-way EBCM harness connector from the EBCM. 2. Inspect the connector for damage or corrosion that could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to *Step 7*	Go to *Step 15*
7	Measure the resistance between terminal J of the 10-way EBCM harness connector and the ground using a *J 39200*. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 8*	Go to *Step 16*
8	1. Turn the ignition to RUN. 2. Using a *J 39200*, measure the voltage between terminal A of the 10-way EBCM harness connector and the ground. Is the voltage equal to or greater than the specified value?	10.0 V	Go to *Step 10*	Go to *Step 9*
9	Inspect the 15-amp I-3 fuse. Is the fuse open?	—	Go to *Step 17*	Go to *Step 18*

DTC C0265 or C0266 EBCM Relay Circuit (Motorhome) (cont'd)

Step	Action	Value(s)	Yes	No
10	Malfunction is intermittent, perform the following: 1. Inspect the 10-way and 2-way EBCM harness connectors for poor terminal contact or corrosion. 2. Inspect CKT 442, CKT 350, CKT 241 and CKT 451 for damage that could result in an intermittent open circuit. 3. Repair any evident damage. 4. Replace the terminals if poor contact or corrosion exists. 5. Reconnect all the connectors. 6. Using the *Scan Tool*, clear all DTCs. 7. Test drive vehicle above the 16 km/h (10 mph) Does the DTC set as a current DTC?	—	Go to *Step 19*	Go to Diagnostic Aids
11	Repair the 2-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
12	Repair the open or the high resistance in the CKT 350. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
13	Repair the short to ground in the CKT 442. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
14	Repair the open or the high resistance in the CKT 442. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
15	Repair the 10-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
16	Repair the open or the high resistance in the CKT 451. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
17	Repair the short to ground in the CKT 241. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
18	Repair the open or the high resistance in the CKT 241. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
19	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0265 or C0266 EBCM Relay Circuit (Commercial)



Circuit Description

The pump motor relay supplies power to all six solenoid coils (three isolation solenoid coils and three dump solenoid coils) and the motor when the ABS is required. The relay and the six solenoid coils are located within the EBCM.

Conditions for Setting the DTC (DTC C0265)

- The EBCM microprocessor commands the relay on
- Low voltage exists on all six solenoid driver circuits when high voltage is expected (the solenoid is not energized)

Conditions for Setting the DTC (DTC C0266)

- The ABS bulb check is complete
- High voltage exists on the pump motor driver circuit when all are expected to be low (the relay is not commanded on)

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTCs C0265 and C0266 are Ignition Latched DTCs, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids (DTC C0265)

DTC C0265 usually sets because of an open relay coil or non-closable relay contacts. The relay is located within the EBCM. The relay is not serviceable. If the test does not repair the DTC, then replace the EBCM.

If DTC C0265 appears with other DTCs repair the other DTCs first. Clear all DTCs. Then run three function tests with the *Scan Tool*. Refer to this diagnostic chart if DTC C0265 resets.

Diagnostic Aids (DTC C0266)

DTC C0266 usually sets when the relay contacts are stuck closed. The relay is located within the EBCM. The relay is not serviceable. If the test does not repair the DTC, then replace the EBCM.

If DTCs C0265 or C0266 are setting after replacing the EBCM, check the vehicle for an auxiliary device (winch, auxiliary battery system, etc.) which could cause a voltage spike on the battery feed to the EBCM. If the vehicle does have an auxiliary device, install a Metallic Oxide Varistor (MOV) in the battery feed circuit to the EBCM.

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step determines the resistance of the power ground circuit.
4. This step determines the battery voltage available to the EBCM.
7. This step determines the resistance of the signal ground circuit.
8. This step determines the ignition voltage available to the EBCM.

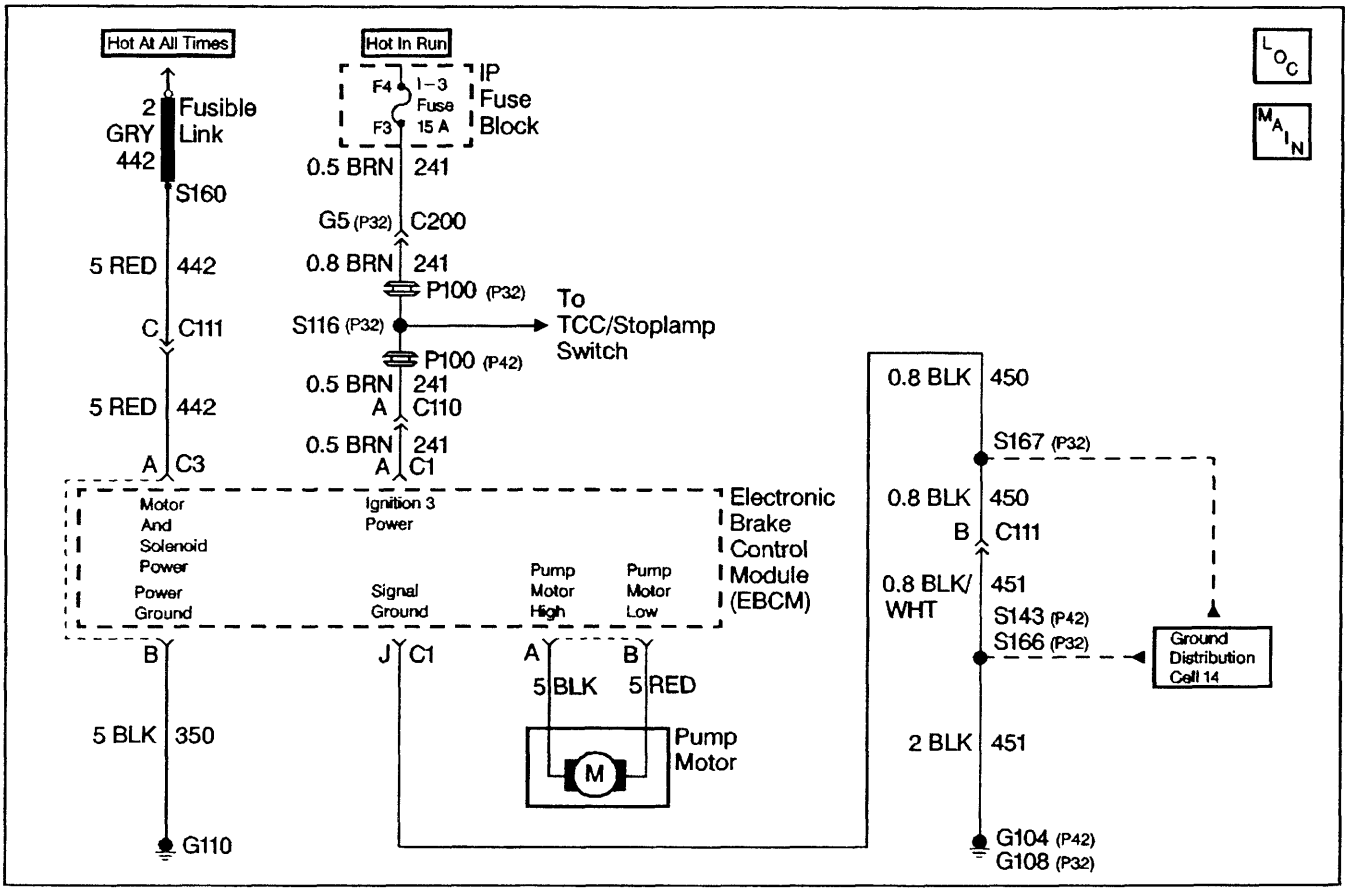
DTC C0265 or C0266 EBCM Relay Circuit (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Turn the ignition switch to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion that could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to *Step 3*	Go to *Step 11*
3	Using a *J 39200*, measure the resistance between terminal B of the 2-way EBCM harness connector and the ground. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 4*	Go to *Step 12*
4	Using a *J 39200*, measure the voltage between terminal A of the 2-way EBCM harness connector and the ground. Is the voltage equal to or greater than the specified value?	10.0 V	Go to *Step 6*	Go to *Step 5*
5	Inspect the grey fusible link. Is the grey fusible link open?	—	Go to *Step 13*	Go to *Step 14*
6	1. Disconnect the 10-way EBCM harness connector from the EBCM. 2. Inspect the connector for damage or corrosion that could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to *Step 7*	Go to *Step 15*
7	Measure the resistance between terminal J of the 10-way EBCM harness connector and the ground using a *J 39200*. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 8*	Go to *Step 16*
8	1. Turn the ignition to RUN. 2. Using a *J 39200*, measure the voltage between terminal A of the 10-way EBCM harness connector and the ground. Is the voltage equal to or greater than the specified value?	10.0 V	Go to *Step 10*	Go to *Step 9*
9	Inspect the 15-amp I-3 fuse. Is the fuse open?	—	Go to *Step 17*	Go to *Step 18*

DTC C0265 or C0266 EBCM Relay Circuit (Commercial) (cont'd)

Step	Action	Value(s)	Yes	No
10	Malfunction is intermittent, perform the following: 1. Inspect the 10-way and 2-way EBCM harness connectors for poor terminal contact or corrosion. 2. Inspect CKT 442, CKT 350, CKT 241 and CKT 451 for damage that could result in an intermittent open circuit. 3. Repair any evident damage. 4. Replace the terminals if poor contact or corrosion exists. 5. Reconnect all the connectors. 6. Using the *Scan Tool*, clear all DTCs. 7. Test drive vehicle above the 16 km/h (10 mph) Does the DTC set as a current DTC?	—	Go to *Step 19*	Go to Diagnostic Aids
11	Repair the 2-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to	—
12	Repair the open or the high resistance in the CKT 350. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
13	Repair the short to ground in the CKT 442. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
14	Repair the open or the high resistance in the CKT 442. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
15	Repair the 10-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
16	Repair the open or the high resistance in the CKT 451. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
17	Repair the short to ground in the CKT 241. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
18	Repair the open or the high resistance in the CKT 241. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
19	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

DTC C0267 or C0268 Pump Motor Circuit Open/Shorted (Motorhome)



191513

Circuit Description

The pump motor circuit is integral to the BPMV. The EBCM microprocessor energizes the relay within the EBCM in order to supply the battery voltage to the high side of the pump motor. The EBCM microprocessor grounds the low side of the pump motor when activation of the pump motor is required.

Conditions for Setting the DTC (C0267)

- The EBCM internal relay is on
- The pump motor is off
- Low voltage is present from the low side of the pump motor when high voltage is expected

Conditions for Setting the DTC (C0268)

- Vehicle speed is 13 km/h (8 mph)
- The EBCM internal relay is on
- The pump motor is commanded ON and then OFF
- High voltage exists from the low side of the pump motor for 100 milliseconds when the voltage is expected to be low

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTCs C0267/C0268 are ignition latched DTCs, which indicates that the above actions remain true until the ignition switch is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

The pump motor is integral with the BPMV. Do not service the pump motor separately. A poor power/ground connection at the 2-way EBCM connector or the 2-way motor harness from the EBCM to the pump motor can cause a DTC C0267. A seized pump motor, shorted pump motor windings or a poor power/ground at the 2-way EBCM connector can cause a DTC C0268. Replace the EBCM or the BPMV if the following tests show that the pump motor EBCM internal circuits have failed.

Important: Reset the J 39200 test leads to zero prior to making any resistance measurements. Refer to the J 39200 in the user's manual.

If DTCs C0267 or C0268 are setting after replacing the EBCM, check the vehicle for an auxiliary device (winch, auxiliary battery system, etc.) which could cause a voltage spike on the battery feed to the EBCM. If the vehicle does have an auxiliary device, install a Metallic Oxide Varistor (MOV) in the battery feed circuit to the EBCM.

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step checks for an open pump motor circuit. The pump motor circuit resistance should not be above the 0.3 ohms. Reset the *J 39200* test leads to zero prior to making this low resistance measurement.
5. This step determines the resistance of the EBCM ground circuit.
7. This step determines the ignition voltage available to the EBCM.

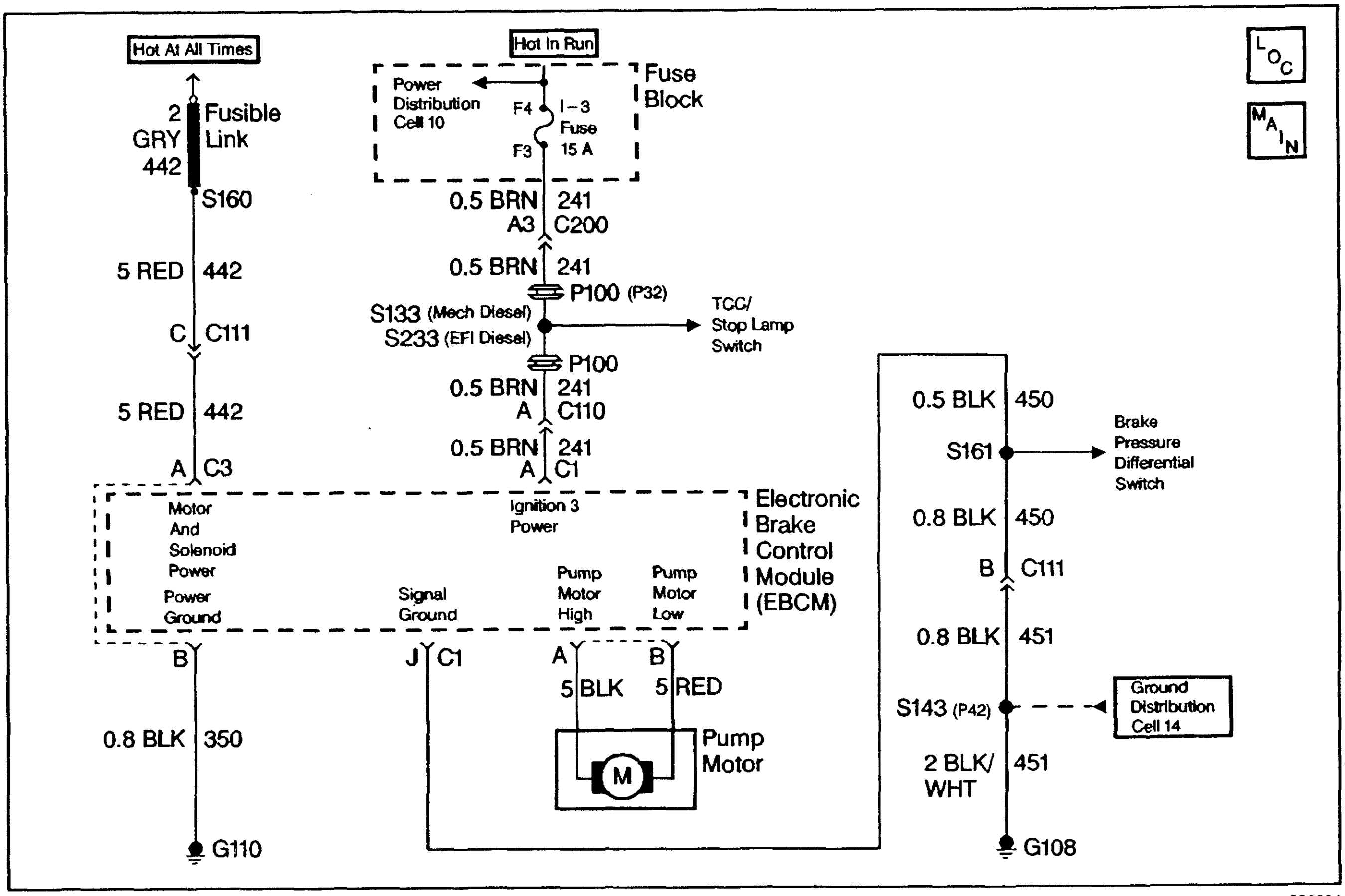
DTC C0267 or C0268 Pump Motor Circuit Open/Shorted (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way pump motor pigtail connector from the EBCM. 3. Inspect the connector and the wiring for damage or corrosion that could result in an open circuit between the pump motor and the EBCM. Is the connector and the wiring in good condition?	—	Go to *Step 3*	Go to *Step 10*
3	Measure the resistance between terminal A and terminal B of the 2-way pump motor pigtail connector using a *J 39200.* Reset the *J 39200* test leads to zero prior to making this resistance measurement. Is the resistance within the specified range?	0.1-1.0 Ω	Go to *Step 4*	Go to *Step 15*
4	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion that could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to *Step 5*	Go to *Step 9*
5	Measure the resistance between terminal B of the 2-way EBCM harness connector and the ground using a *J 39200.* Is the resistance within the specified range?	0-2 Ω	Go to *Step 6*	Go to *Step 11*
6	1. Turn the ignition to RUN. 2. Measure the voltage between terminal A of the 2-way EBCM harness connector and the ground using a *J 39200.* Is the voltage equal to or greater than the specified value?	10.0 V	Go to *Step 8*	Go to *Step 7*
7	Inspect the 60–amp ABS maxi-fuse. Is this fuse open?	—	Go to *Step 13*	Go to *Step 14*

DTC C0267 or C0268 Pump Motor Circuit Open/Shorted (Motorhome) (cont'd)

Step	Action	Value(s)	Yes	No
8	Malfunction is intermittent, perform the following: 1. Inspect the 2-way EBCM harness connectors for poor terminal contact or corrosion. 2. Inspect CKT 442 and CKT 350 for damage that could result in an intermittent open circuit. 3. Repair any evident damage. 4. Replace the terminals if poor contact or corrosion exists. 5. Reconnect all the connectors. 6. Using the *Scan Tool*, clear all DTCs. 7. Test drive the vehicle above the 16 km/h (10 mph) Does the DTC set as a current DTC?	—	Go to *Step 12*	Go to Diagnostic Aids
9	Repair the 2-way EBCM harness connector if necessary. Refer to *Connector Repairs*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
10	Repair the 2-way pump motor pigtail connector or wiring if necessary. Refer to *Connector Repairs*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
11	Repair the open or the high resistance in the CKT 350. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
12	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
13	Repair short to ground in CKT 442. Refer to *Wiring Repairs*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
14	Repair the open or the high resistance in CKT 442. Refer to *Wiring Repairs*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
15	Replace the BPMV. Refer to *Brake Pressure Modulator Valve Replacement*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0267 or C0268 Pump Motor Circuit Open/Shorted (Commercial)



Circuit Description

The pump motor circuit is integral to the BPMV. The EBCM microprocessor energizes the relay within the EBCM in order to supply the battery voltage to the high side of the pump motor. The EBCM microprocessor grounds the low side of the pump motor when activation of the pump motor is required.

Conditions for Setting the DTC (C0267)

- The EBCM internal relay is on
- The pump motor is off
- Low voltage is present from the low side of the pump motor when high voltage is expected

Conditions for Setting the DTC (C0268)

- Vehicle speed is 13 km/h (8 mph)
- The EBCM internal relay is on
- The pump motor is commanded ON and then OFF
- High voltage exists from the low side of the pump motor for 100 milliseconds when the voltage is expected to be low

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTCs C0267/C0268 are ignition latched DTCs, which indicates that the above actions remain true until the ignition switch is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

The pump motor is integral with the BPMV. Do not service the pump motor separately. A poor power/ground connection at the 2-way EBCM connector or the 2-way motor harness from the EBCM to the pump motor can cause a DTC C0267. A seized pump motor, shorted pump motor windings or a poor power/ground at the 2-way EBCM connector can cause a DTC C0268. Replace the EBCM or the BPMV if the following tests show that the pump motor EBCM internal circuits have failed.

Important: Reset the J 39200 test leads to zero prior to making any resistance measurements. Refer to the J 39200 in the user's manual.

If DTCs C0267 or C0268 are setting after replacing the EBCM, check the vehicle for an auxiliary device (winch, auxiliary battery system, etc.) which could cause a voltage spike on the battery feed to the EBCM. If the vehicle does have an auxiliary device, install a Metallic Oxide Varistor (MOV) in the battery feed circuit to the EBCM.

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step checks for an open pump motor circuit. The pump motor circuit resistance should not be above 1.0 ohms. Reset the *J 39200* test leads to zero prior to making this low resistance measurement.
5. This step determines the resistance of the EBCM ground circuit.
7. This step determines the ignition voltage available to the EBCM.

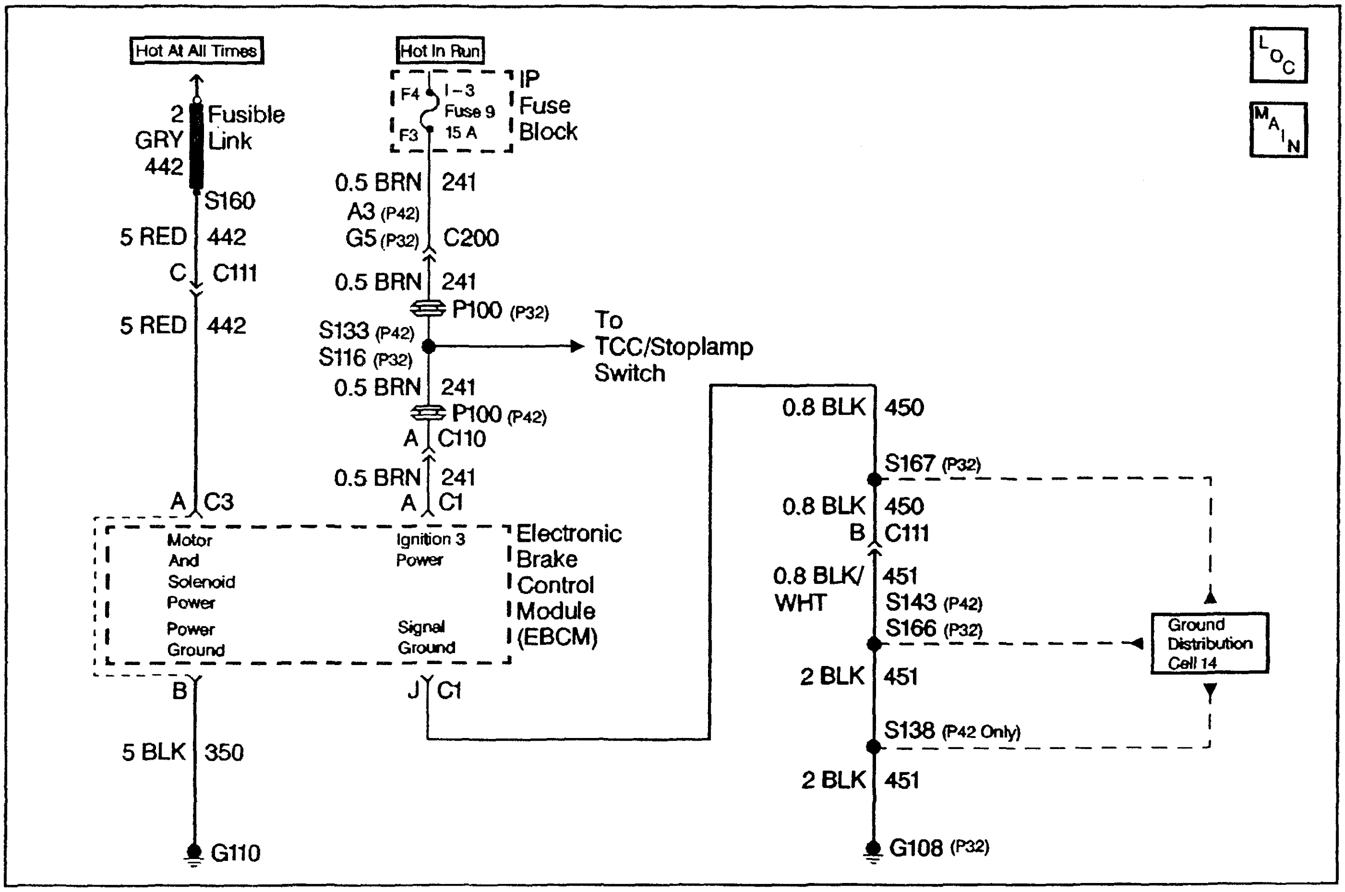
DTC C0267 or C0268 Pump Motor Circuit Open/Shorted (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way pump motor pigtail connector from the EBCM. 3. Inspect the connector and the wiring for damage or corrosion that could result in an open circuit between the pump motor and the EBCM. Is the connector and the wiring in good condition?	—	Go to *Step 3*	Go to *Step 10*
3	Measure the resistance between terminal A and terminal B of the 2-way pump motor pigtail connector using a *J 39200.* Reset the *J 39200* test leads to zero prior to making this resistance measurement. Is the resistance within the specified range?	0.1-1.0 Ω	Go to *Step 4*	Go to *Step 15*
4	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion that could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to *Step 5*	Go to *Step 9*
5	Measure the resistance between terminal B of the 2-way EBCM harness connector and the ground using a *J 39200.* Is the resistance within the specified range?	0-2 Ω	Go to *Step 6*	Go to *Step 11*
6	1. Turn the ignition to RUN. 2. Measure the voltage between terminal A of the 2-way EBCM harness connector and the ground using a *J 39200.* Is the voltage equal to or greater than the specified value?	10.0 V	Go to *Step 8*	Go to *Step 7*
7	Inspect the 60–amp ABS maxi-fuse. Is this fuse open?	—	Go to *Step 13*	Go to *Step 14*

DTC C0267 or C0268 Pump Motor Circuit Open/Shorted (Commercial) (cont'd)

Step	Action	Value(s)	Yes	No
8	Malfunction is intermittent, perform the following: 1. Inspect the 2-way EBCM harness connectors for poor terminal contact or corrosion. 2. Inspect CKT 442 and CKT 350 for damage that could result in an intermittent open circuit. 3. Repair any evident damage. 4. Replace the terminals if poor contact or corrosion exists. 5. Reconnect all the connectors. 6. Using the *Scan Tool*, clear all DTCs. 7. Test drive the vehicle above the 16 km/h (10 mph) Does the DTC set as a current DTC?	—	Go to *Step 12*	Go to Diagnostic Aids
9	Repair the 2-way EBCM harness connector if necessary. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
10	Repair the 2-way pump motor pigtail connector or wiring if necessary. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
11	Repair the open or the high resistance in the CKT 350. Refer to *Wiring Repairs* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
12	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
13	Repair short to ground in CKT 442. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
14	Repair the open or the high resistance in CKT 442. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
15	Replace the BPMV. Refer to *Brake Pressure Modulator Valve Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

DTC C0269 or C0274 Excessive Dump/Isolation Time (Motorhome)



191512

Circuit Description

The EBCM microprocessor grounds the isolation coil to energize and close the isolation valve. This will prevent any additional brake pressure applied by the driver from reaching the wheel. Further increases in brake pressure will be prohibited. Each isolation valve is closed independently to isolate each wheel.

Conditions for Setting the DTC

Isolation time (pressure hold) exceeds 120 seconds.

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTCs C0269 and C0274 are ignition latched DTCs, which indicates that the above actions remain true until the ignition switch is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

Repair any other DTCs first. Then perform the Function Test of the scan tool in order to ensure proper operation of the ABS.

If DTCs C0269 or C0274 are setting after replacing the EBCM, check the vehicle for an auxiliary device (winch, auxiliary battery system, etc.) which could cause a voltage spike on the battery feed to the EBCM. If the vehicle does have an auxiliary device, install a Metallic Oxide Varistor (MOV) in the battery feed circuit to the EBCM.

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step determines the resistance of the power ground circuit.
4. This step determines the battery voltage available to the EBCM.
7. This step determines the resistance of the signal ground circuit.
8. This step determines the ignition voltage available to the EBCM.

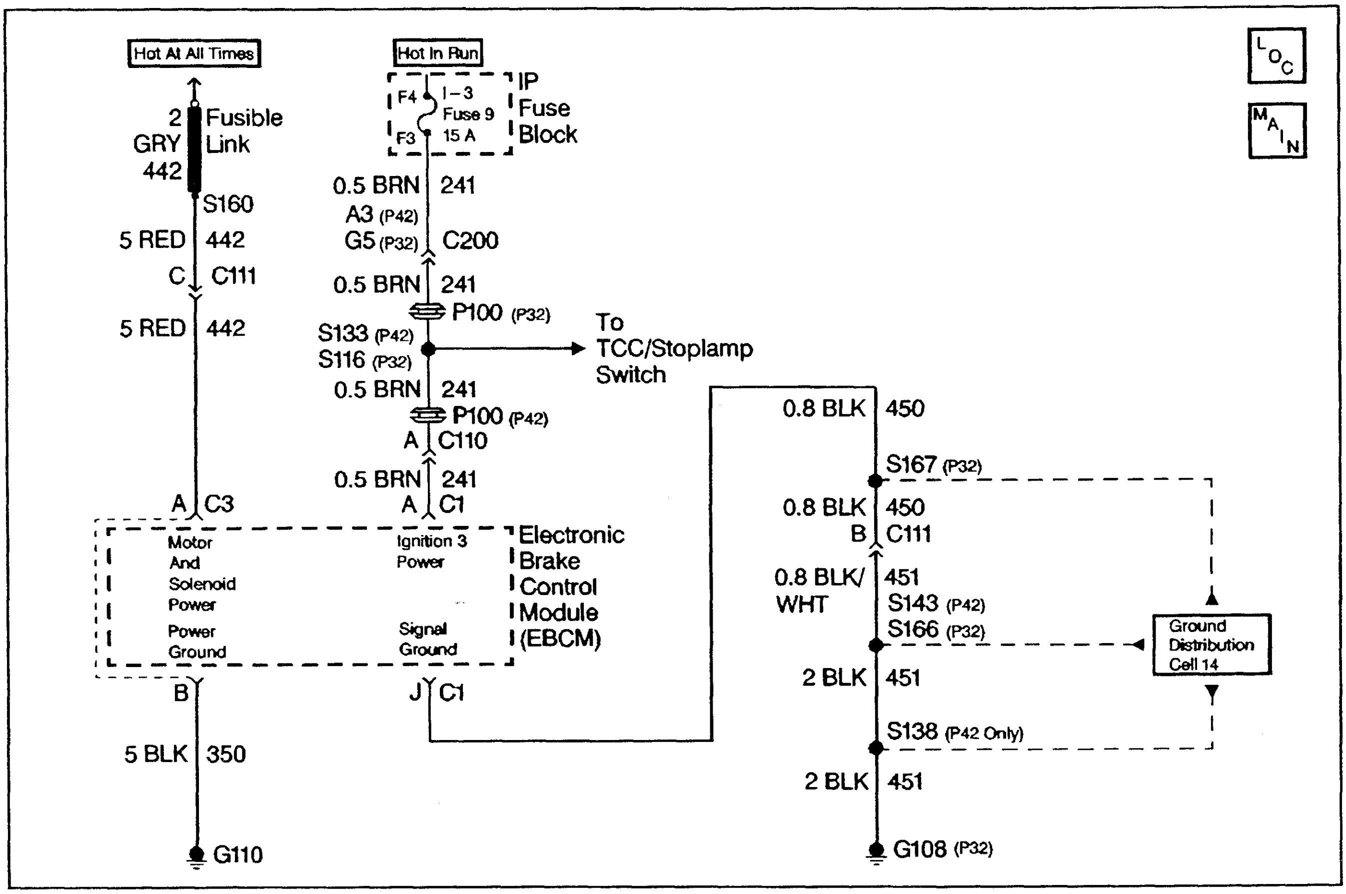
DTC C0269 or C0274 Excessive Dump/Isolation Time (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Turn the ignition switch to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion that could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to *Step 3*	Go to *Step 11*
3	Using a *J 39200*, measure the resistance between terminal B of the 2-way EBCM harness connector and the ground. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 4*	Go to *Step 12*
4	Using a *J 39200*, measure the voltage between terminal A of the 2-way EBCM harness connector and the ground. Is the voltage equal to or greater than the specified value?	10.0 V	Go to *Step 6*	Go to *Step 5*
5	Inspect the grey fusible link. Is the grey fusible link open?	—	Go to *Step 13*	Go to *Step 14*
6	1. Disconnect the 10-way EBCM harness connector from the EBCM. 2. Inspect the connector for damage or corrosion that could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to *Step 7*	Go to *Step 15*
7	Measure the resistance between terminal J of the 10-way EBCM harness connector and the ground using a *J 39200*. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 8*	Go to *Step 16*
8	1. Turn the ignition to RUN. 2. Using a *J 39200*, measure the voltage between terminal A of the 10-way EBCM harness connector and the ground. Is the voltage equal to or greater than the specified value?	10.0 V	Go to *Step 10*	Go to *Step 9*
9	Inspect the 15-amp I-3 fuse. Is the fuse open?	—	Go to *Step 17*	Go to *Step 18*
10	Malfunction is intermittent, perform the following: 1. Inspect the 10-way and 2-way EBCM harness connectors for poor terminal contact or corrosion. 2. Inspect CKT 442, CKT 350, CKT 241 and CKT 451 for damage that could result in an intermittent open circuit. 3. Repair any evident damage. 4. Replace the terminals if poor contact or corrosion exists. 5. Reconnect all the connectors. 6. Using the *Scan Tool*, clear all DTCs. 7. Test drive vehicle above the 16 km/h (10 mph) Does the DTC set as a current DTC?	—	Go to *Step 19*	Go to Diagnostic Aids

DTC C0269 or C0274 Excessive Dump/Isolation Time (Motorhome) (cont'd)

Step	Action	Value(s)	Yes	No
11	Repair the 2-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
12	Repair the open or the high resistance in the CKT 350. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
13	Repair the short to ground in the CKT 442. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
14	Repair the open or the high resistance in the CKT 442. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
15	Repair the 10-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
16	Repair the open or the high resistance in the CKT 451. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
17	Repair the short to ground in the CKT 241. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
18	Repair the open or the high resistance in the CKT 241. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
19	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0269 or C0274 Excessive Dump/Isolation Time (Commercial)



191512

Circuit Description

The EBCM microprocessor grounds the isolation coil to energize and close the isolation valve. This will prevent any additional brake pressure applied by the driver from reaching the wheel. Further increases in brake pressure will be prohibited. Each isolation valve is closed independently to isolate each wheel.

Conditions for Setting the DTC

Isolation time (pressure hold) exceeds 120 seconds.

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTCs C0269 and C0274 are ignition latched DTCs, which indicates that the above actions remain true until the ignition switch is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

Repair any other DTCs first. Then perform the Function Test of the scan tool in order to ensure proper operation of the ABS.

If DTCs C0269 or C0274 are setting after replacing the EBCM, check the vehicle for an auxiliary device (winch, auxiliary battery system, etc.) which could cause a voltage spike on the battery feed to the EBCM. If the vehicle does have an auxiliary device, install a Metallic Oxide Varistor (MOV) in the battery feed circuit to the EBCM.

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step determines the resistance of the power ground circuit.
4. This step determines the battery voltage available to the EBCM.
7. This step determines the resistance of the signal ground circuit.
8. This step determines the ignition voltage available to the EBCM.

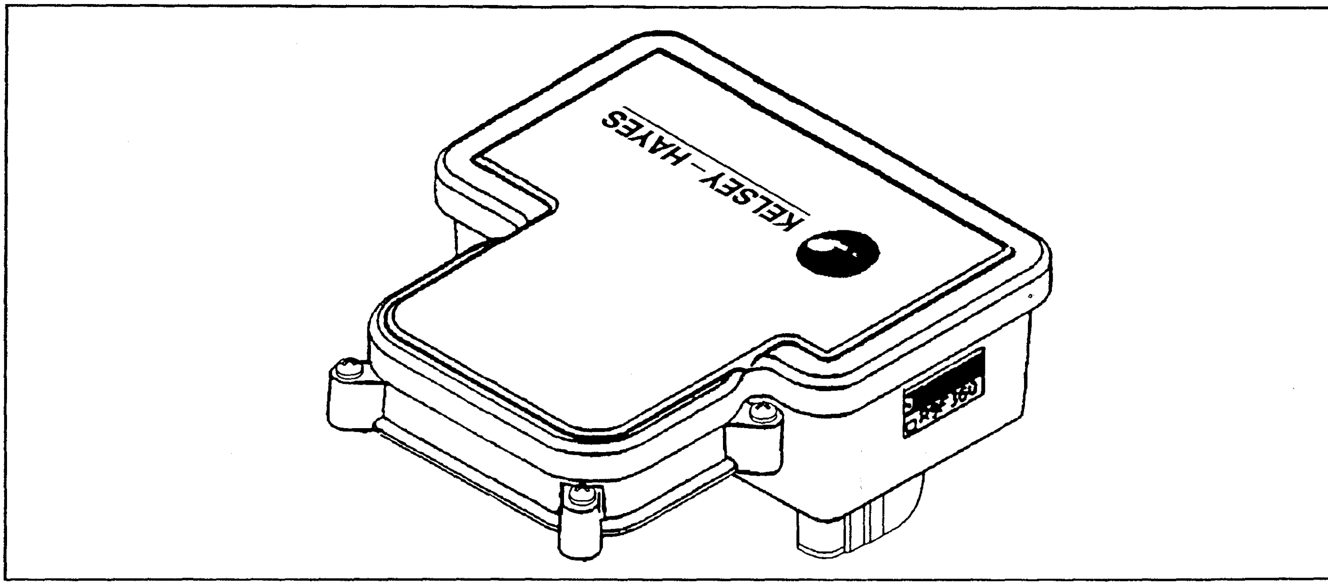
DTC C0269 or C0274 Excessive Dump/Isolation Time (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Turn the ignition switch to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion that could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to *Step 3*	Go to *Step 11*
3	Using a *J 39200*, measure the resistance between terminal B of the 2-way EBCM harness connector and the ground. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 4*	Go to *Step 12*
4	Using a *J 39200*, measure the voltage between terminal A of the 2-way EBCM harness connector and the ground. Is the voltage equal to or greater than the specified value?	10.0 V	Go to *Step 6*	Go to *Step 5*
5	Inspect the grey fusible link. Is the grey fusible link open?	—	Go to *Step 13*	Go to *Step 14*
6	1. Disconnect the 10-way EBCM harness connector from the EBCM. 2. Inspect the connector for damage or corrosion that could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to *Step 7*	Go to *Step 15*
7	Measure the resistance between terminal J of the 10-way EBCM harness connector and the ground using a *J 39200*. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 8*	Go to *Step 16*
8	1. Turn the ignition to RUN. 2. Using a *J 39200*, measure the voltage between terminal A of the 10-way EBCM harness connector and the ground. Is the voltage equal to or greater than the specified value?	10.0 V	Go to *Step 10*	Go to *Step 9*
9	Inspect the 15-amp I-3 fuse. Is the fuse open?	—	Go to *Step 17*	Go to *Step 18*
10	Malfunction is intermittent, perform the following: 1. Inspect the 10-way and 2-way EBCM harness connectors for poor terminal contact or corrosion. 2. Inspect CKT 442, CKT 350, CKT 241 and CKT 451 for damage that could result in an intermittent open circuit. 3. Repair any evident damage. 4. Replace the terminals if poor contact or corrosion exists. 5. Reconnect all the connectors. 6. Using the *Scan Tool*, clear all DTCs. 7. Test drive vehicle above the 16 km/h (10 mph) Does the DTC set as a current DTC?	—	Go to *Step 19*	Go to Diagnostic Aids

DTC C0269 or C0274 Excessive Dump/Isolation Time (Commercial) (cont'd)

Step	Action	Value(s)	Yes	No
11	Repair the 2-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
12	Repair the open or the high resistance in the CKT 350. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
13	Repair the short to ground in the CKT 442. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
14	Repair the open or the high resistance in the CKT 442. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
15	Repair the 10-way EBCM harness connector. Refer to *Connector Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
16	Repair the open or the high resistance in the CKT 451. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
17	Repair the short to ground in the CKT 241. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
18	Repair the open or the high resistance in the CKT 241. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
19	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

DTC C0271-C0273 EBCM Malfunction (Motorhome)



175132

Circuit Description

The EBCM initializes a self-test when the ignition is turned to the RUN position. This internal self-test verifies that all ABS circuitry is operating correctly.

Conditions for Setting the DTC

Any condition within the EBCM which causes a memory error will set the DTC.

Action Taken When the DTC Sets

- The ABS indicator lamp is turned on
- The ABS is disabled

These DTCs are Permanent Latched DTCs, which indicates that the above actions remain true until the DTC is cleared using a *Scan Tool.*

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

DTCs C0271–C0273 are EBCM internal diagnosis trouble codes. Replace the EBCM if these tests show that the EBCM circuitry has failed.

If DTCs C0271, C0272 or C0273 are setting after replacing the EBCM, check the vehicle for an auxiliary device (winch, auxiliary battery system, etc.) which could cause a voltage spike on the battery feed to the EBCM. If the vehicle does have an auxiliary device, install a Metallic Oxide Varistor (MOV) in the battery feed circuit to the EBCM.

Test Description

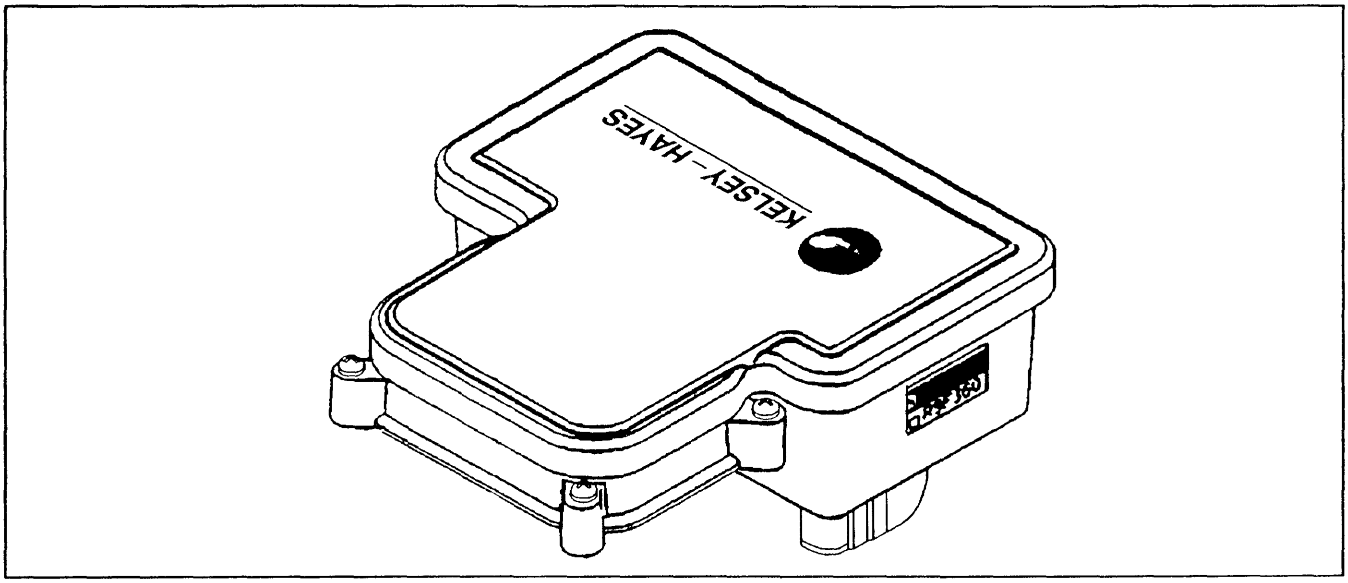
The numbers below refer to the steps in the diagnostic table:

2. This step checks if the EBCM will Clear DTCs.
3. This step checks if the DTC was set previously.

DTC C0271-C0273 EBCM Malfunction (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	Install the *Scan Tool* and attempt to clear the DTCs. Did the DTCs clear?	—	Go to *Step 3*	Go to *Step 4*
3	Check the history DTCs and the data. Was this the first time the DTC has set?	—	Go to *ABS Diagnostic System Check (Motorhome)*	Go to *Step 4*
4	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0271-C0273 EBCM Malfunction (Commercial)



175132

Circuit Description

The EBCM initializes a self-test when the ignition is turned to the RUN position. This internal self-test verifies that all ABS circuitry is operating correctly.

Conditions for Setting the DTC

Any condition within the EBCM which causes a memory error will set the DTC.

Action Taken When the DTC Sets

- The ABS indicator lamp is turned on
- The ABS is disabled

These DTCs are Permanent Latched DTCs, which indicates that the above actions remain true until the DTC is cleared using a *Scan Tool.*

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

DTCs C0271–C0273 are EBCM internal diagnosis trouble codes. Replace the EBCM if these tests show that the EBCM circuitry has failed.

If DTCs C0271, C0272 or C0273 are setting after replacing the EBCM, check the vehicle for an auxiliary device (winch, auxiliary battery system, etc.) which could cause a voltage spike on the battery feed to the EBCM. If the vehicle does have an auxiliary device, install a Metallic Oxide Varistor (MOV) in the battery feed circuit to the EBCM.

Test Description

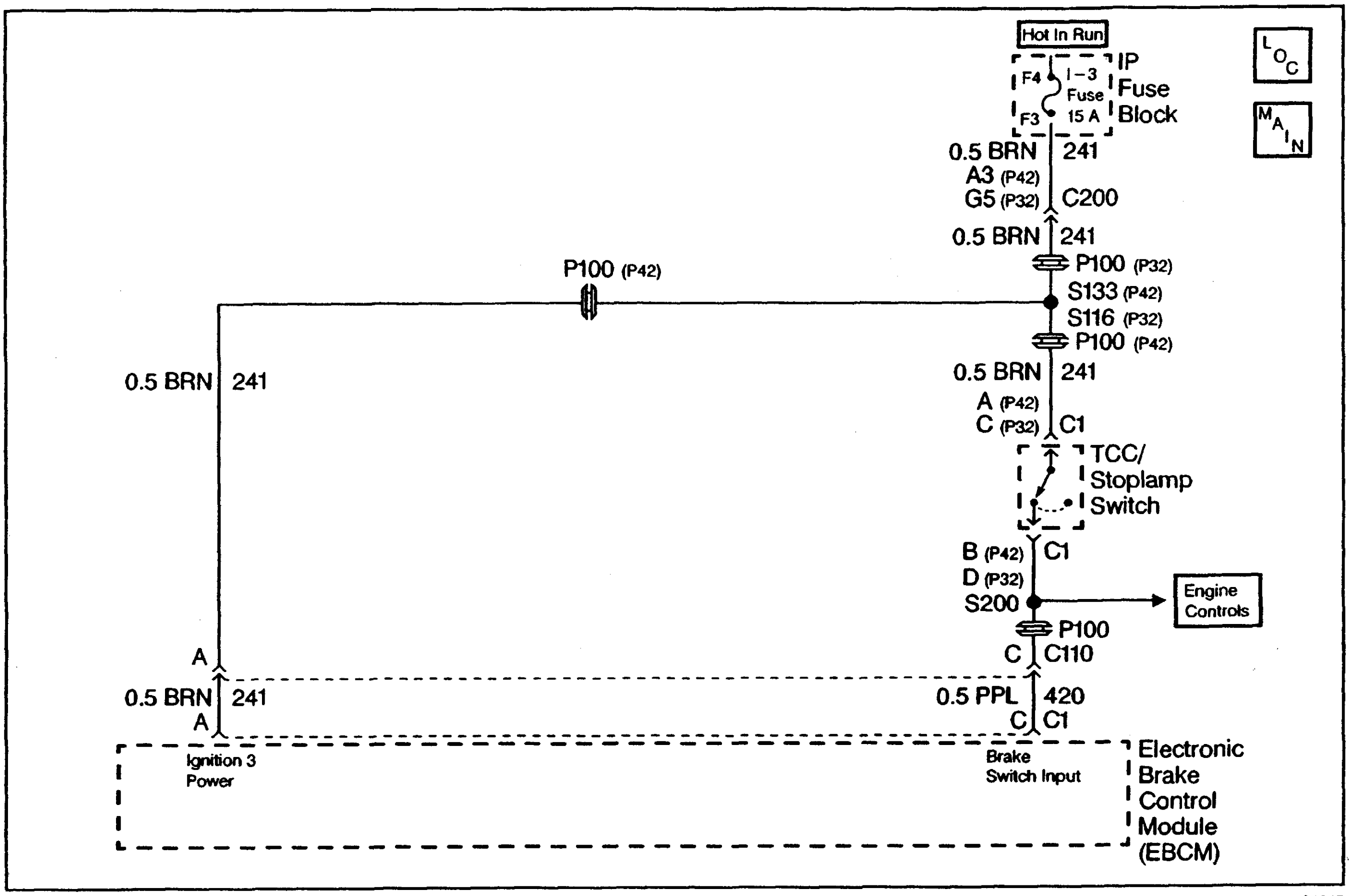
The numbers below refer to the steps in the diagnostic table:

2. This step checks if the EBCM will Clear DTCs.
3. This step checks if the DTC was set previously.

DTC C0271-C0273 EBCM Malfunction (P42)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	Install the *Scan Tool* and attempt to clear the DTCs. Did the DTCs clear?	—	Go to *Step 3*	Go to *Step 4*
3	Check the history DTCs and the data. Was this the first time the DTC has set?	—	Go to *ABS Diagnostic System Check (Commercial)*	Go to *Step 4*
4	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

DTC C0281 Brake Switch Circuit (Motorhome)



191517

Circuit Description

The Stop Lamp Switch is normally closed. With the ignition in the RUN position and the brake pedal not depressed, the EBCM will have ignition voltage present at terminal C of the 10–way connector. When the brakes are applied, the ignition voltage present at the EBCM will be zero.

Conditions for Setting the DTC

- The vehicle speed is above 15 mph
- The Stop Lamp Switch never switches during the condition above

Action Taken When the DTC Sets

- DTC C0281 is advisory code only
- The ABS indicator lamp will not be illuminated
- The ABS will not be disabled

DTC C0281 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

DTC C0281 can be set by a faulty Stop Lamp Switch, misadjusted Stop Lamp Switch or damage in CKT 420 or CKT 241.

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

Test Description

The numbers below refer to the steps in the diagnostic table:

2. This step checks the functionality of the Stop Lamp Switch circuit using the *Scan Tool.*
3. This step checks for a short to voltage in the Stop Lamp Switch circuit between the Stoplamp Switch and the EBCM.
4. This step checks the functionality of the Stop Lamp Switch circuit using the *Scan Tool.*
5. This step checks for an open in the Stop Lamp Switch circuit between the Stoplamp Switch and the EBCM.

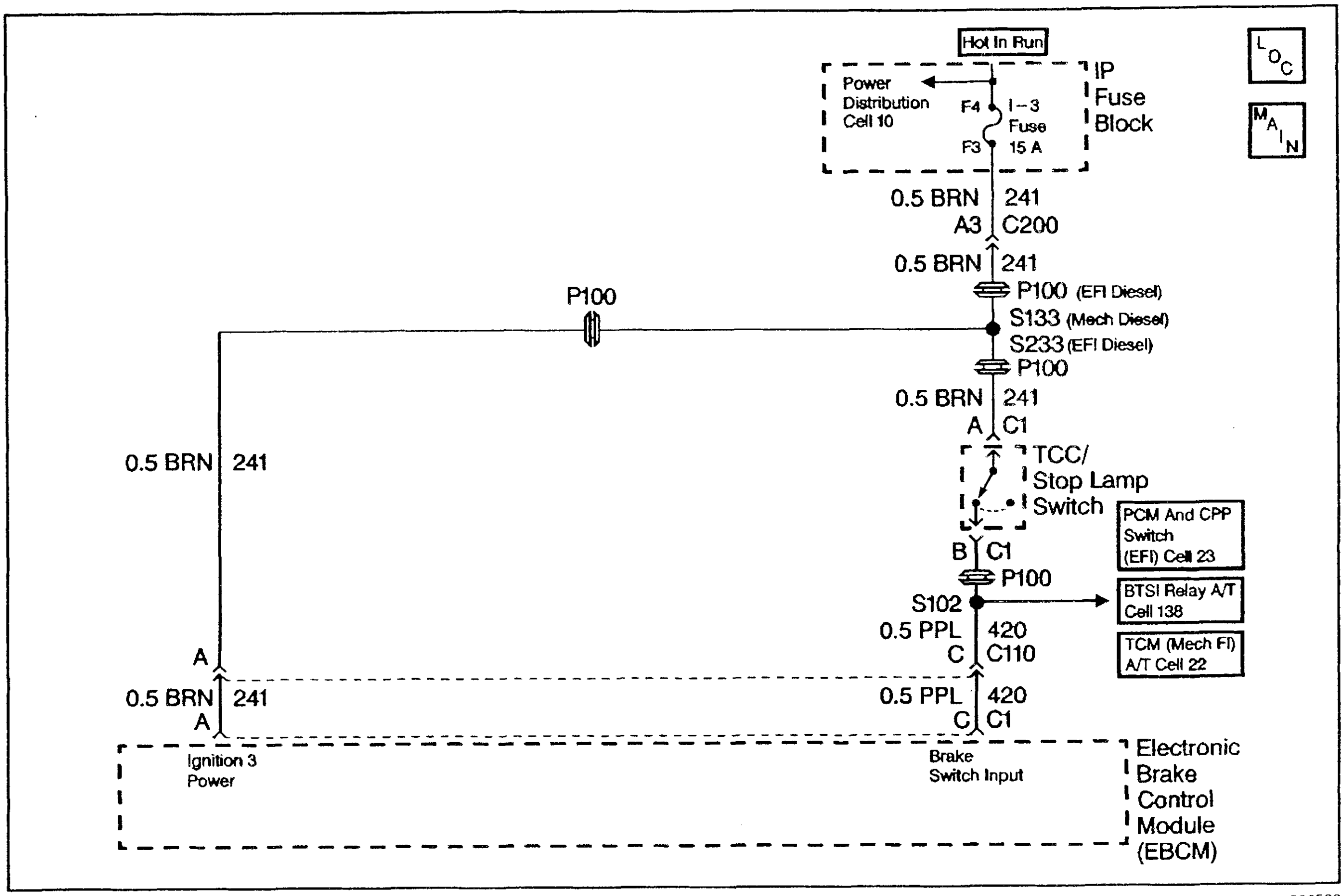
DTC C0281 Brake Switch Circuit (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Install the *Scan Tool.* 2. Turn the ignition to RUN. 3. Using the Data List function of the scan tool, check the operation of the Stop Lamp Switch while applying and releasing the brake pedal. Does the scan tool indicate that the Stop Lamp Switch to be closed constantly?	—	Go to *Step 3*	Go to *Step 4*
3	1. Turn the ignition to OFF. 2. Disconnect the Stoplamp Switch harness connector from the Stoplamp Switch. 3. Turn the ignition to RUN 4. Using the Data List function of the scan tool, check the operation of the Stop Lamp Switch. Does the scan tool indicate that the Stop Lamp Switch to be closed?	—	Go to *Step 10*	Go to *Step 8*
4	Does the scan tool indicate that the Stop Lamp Switch to be open constantly?	—	Go to *Step 5*	Go to *Step 7*
5	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM connector from the EBCM. 3. Turn the ignition to RUN. 4. Using a *J 39200*, measure the voltage between terminal C of the 10-way EBCM harness connector and ground. Is the voltage measured equal to or greater than the specified range?	10.0 V	Go to *Step 6*	Go to *Step 11*
6	1. Turn the ignition to OFF. 2. Reconnect all connectors. 3. Turn the ignition to RUN. 4. Install the *Scan Tool,* 5. Using the Data List function of the scan tool, check the operation of the Stop Lamp Switch. Does the scan tool indicate that the Stop Lamp Switch to be open constantly while applying and releasing the brake pedal?	—	Go to *Step 9*	Go to *Step 7*

DTC C0281 Brake Switch Circuit (Motorhome) (cont'd)

Step	Action	Value(s)	Yes	No
7	Malfunction is intermittent, perform the following: • Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. • Refer to Diagnostic Aids for more information. • Perform all necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
8	1. Check for misadjusted Stop Lamp Switch. 2. If the Stoplamp Switch is adjusted properly, replace the Stoplamp Switch. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
9	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
10	Repair the short to voltage in CKT 420. Refer to *Wiring Repairs*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
11	Check for the following: • Misadjusted Stop Lamp Switch • Faulty Stoplamp switch • Open circuit between Stoplamp switch and EBCM Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0281 Brake Switch Circuit (Commercial)



396526

Circuit Description

The Stop Lamp Switch is normally closed. With the ignition in the RUN position and the brake pedal not depressed, the EBCM will have ignition voltage present at terminal C of the 10–way connector. When the brakes are applied, the ignition voltage present at the EBCM will be zero.

Conditions for Setting the DTC

- The vehicle speed is above 15 mph
- The Stop Lamp Switch never switches during the condition above

Action Taken When the DTC Sets

- DTC C0281 is advisory code only
- The ABS indicator lamp will not be illuminated
- The ABS will not be disabled

DTC C0281 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

DTC C0281 can be set by a faulty Stop Lamp Switch, misadjusted Stop Lamp Switch or damage in CKT 420 or CKT 241.

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

Test Description

The numbers below refer to the steps in the diagnostic table:

2. This step checks the functionality of the Stop Lamp Switch circuit using the *Scan Tool*.
3. This step checks for a short to voltage in the Stop Lamp Switch circuit between the Stoplamp Switch and the EBCM.
4. This step checks the functionality of the Stop Lamp Switch circuit using the *Scan Tool*.
5. This step checks for an open in the Stop Lamp Switch circuit between the Stoplamp Switch and the EBCM.

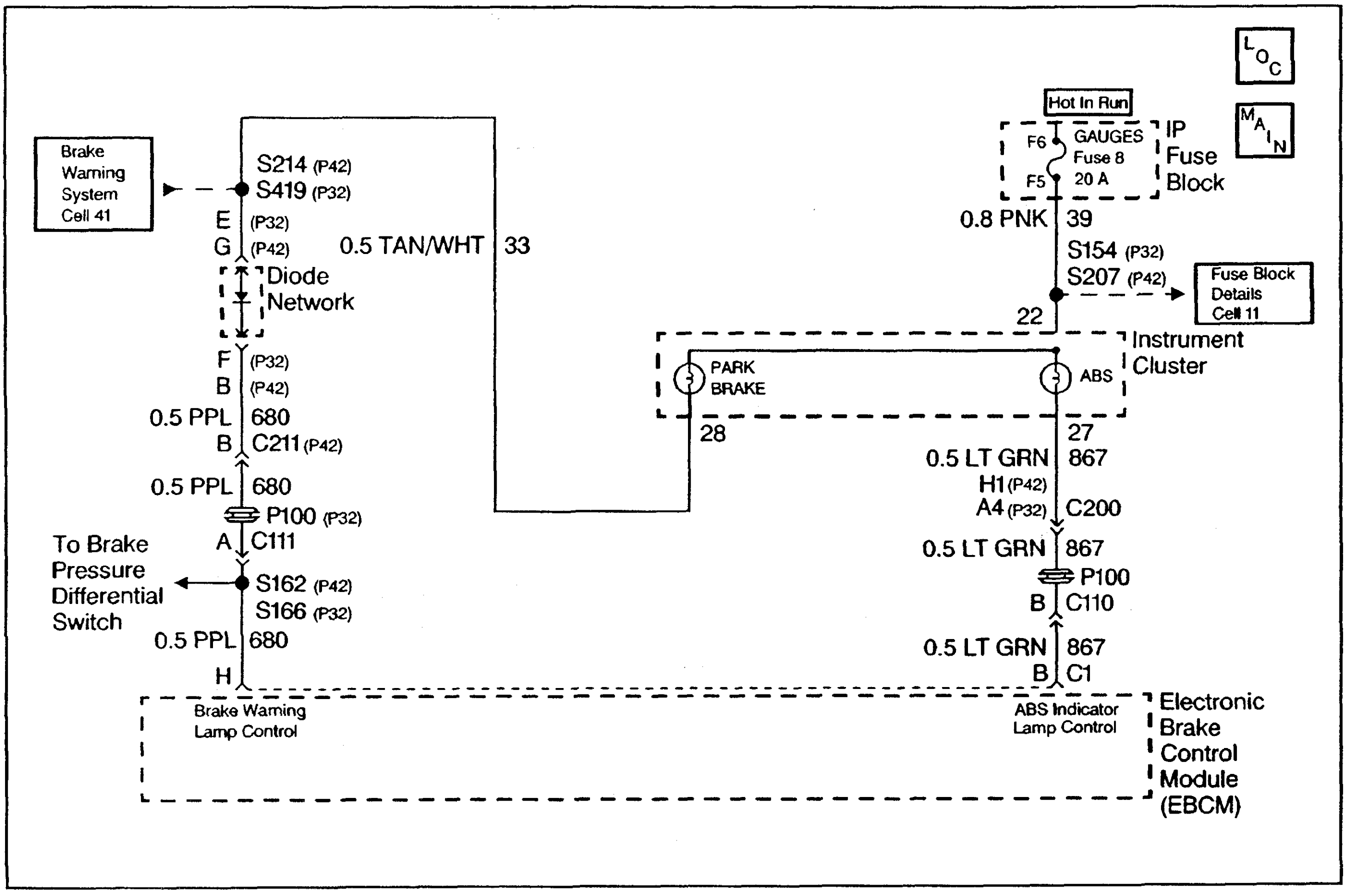
DTC C0281 Brake Switch Circuit (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Install the *Scan Tool*. 2. Turn the ignition to RUN. 3. Using the Data List function of the scan tool, check the operation of the Stop Lamp Switch while applying and releasing the brake pedal. Does the scan tool indicate that the Stop Lamp Switch to be closed constantly?	—	Go to *Step 3*	Go to *Step 4*
3	1. Turn the ignition to OFF. 2. Disconnect the Stoplamp Switch harness connector from the Stoplamp Switch. 3. Turn the ignition to RUN 4. Using the Data List function of the scan tool, check the operation of the Stop Lamp Switch. Does the scan tool indicate that the Stop Lamp Switch to be closed?	—	Go to *Step 10*	Go to *Step 8*
4	Does the scan tool indicate that the Stop Lamp Switch to be open constantly?	—	Go to *Step 5*	Go to *Step 7*
5	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM connector from the EBCM. 3. Turn the ignition to RUN. 4. Using a *J 39200*, measure the voltage between terminal C of the 10-way EBCM harness connector and ground. Is the voltage measured equal to or greater than the specified range?	10.0 V	Go to *Step 6*	Go to *Step 11*
6	1. Turn the ignition to OFF. 2. Reconnect all connectors. 3. Turn the ignition to RUN. 4. Install the *Scan Tool*, 5. Using the Data List function of the scan tool, check the operation of the Stop Lamp Switch. Does the scan tool indicate that the Stop Lamp Switch to be open constantly while applying and releasing the brake pedal?	—	Go to *Step 9*	Go to *Step 7*

DTC C0281 Brake Switch Circuit (Commercial) (cont'd)

Step	Action	Value(s)	Yes	No
7	Malfunction is intermittent, perform the following: • Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. • Refer to Diagnostic Aids for more information. • Perform all necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
8	1. Check for misadjusted Stop Lamp Switch. 2. If the Stoplamp Switch is adjusted properly, replace the Stoplamp Switch. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
9	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
10	Repair the short to voltage in CKT 420. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
11	Check for the following: • Misadjusted Stop Lamp Switch • Faulty Stoplamp switch • Open circuit between Stoplamp switch and EBCM Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

DTC C0286 ABS Indicator Lamp Circuit Shorted to B+ (Motorhome)



191520

Circuit Description

The amber ANTILOCK indicator lamp is supplied ignition voltage through the GAUGES fuse. The ABS indicator lamp is normally on (EBCM terminal B grounded) until the EBCM switches the indicator off (normal mode). This logic ensures that the indicator will be illuminated if there is a faulty EBCM.

Conditions for Setting the DTC

- High voltage is present on the ABS indicator lamp control circuit when low voltage is expected (lamp is turned on) to be low
- Anything that keeps the ABS indicator lamp circuit high when the lamp circuit is expected to be on

Action Taken When the DTC Sets

- The ABS is not disabled
- The EBCM will use the red BRAKE warning lamp to alert the driver of an ABS malfunction

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

DTC C0286 typically sets because of a shorted amber ABS indicator lamp. Yet DTC C0286 can also set because of a short to voltage in the wiring between the amber ABS indicator lamp and the EBCM.

Test Description

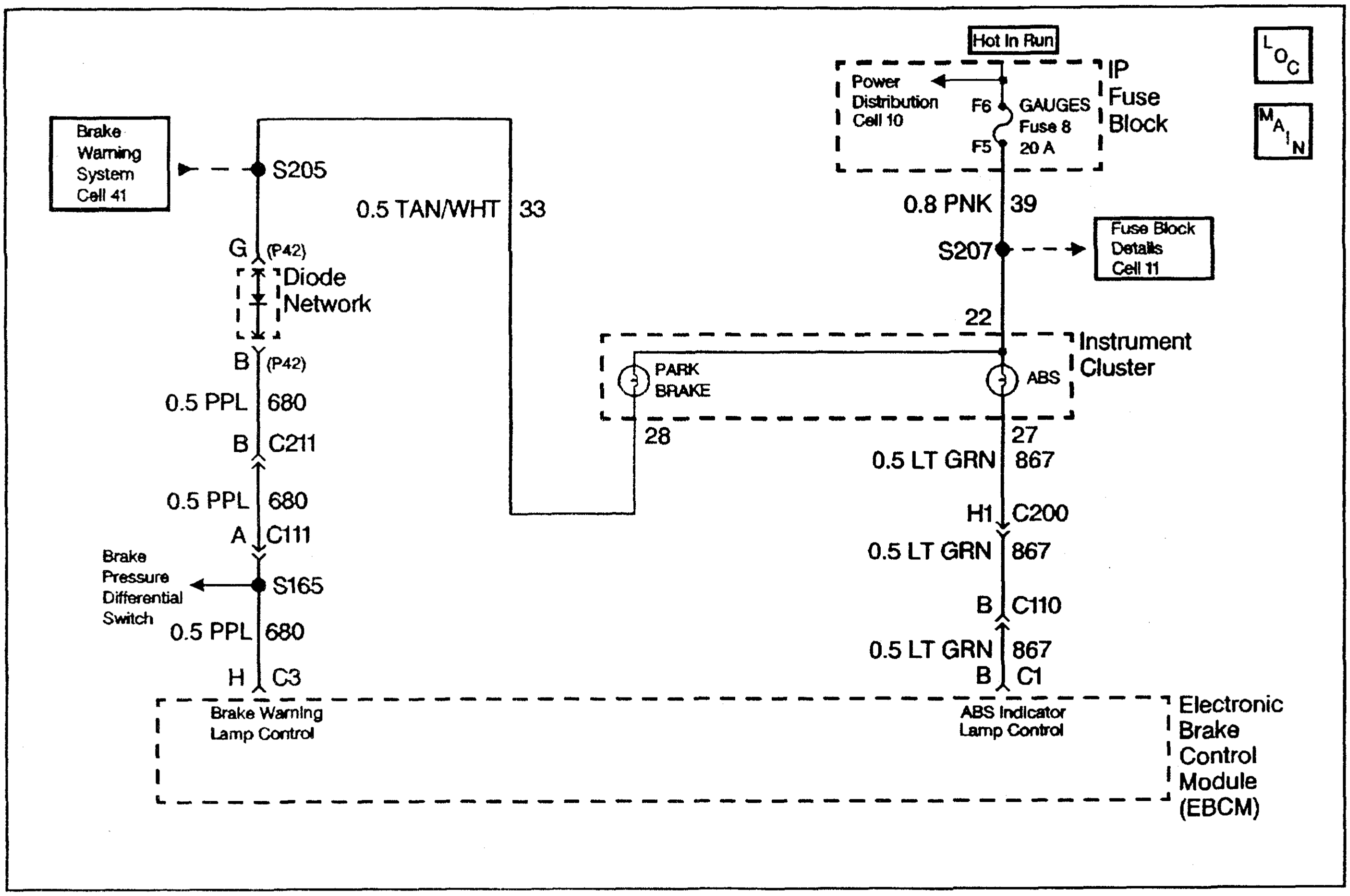
The numbers below refer to the steps in the diagnostic table:

2. This step checks for normal operation of the ABS indicator lamp.
3. This step turns off the ABS indicator lamp with a *J 36169-A*.

DTC C0286 ABS Indicator Lamp Circuit Shorted to B+ (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Turn the ignition to RUN. 2. Observe the amber ABS indicator lamp operation. 3. Did the ABS indicator lamp turn on and then turn off after 3 seconds?	—	Go to *Step 5*	Go to *Step 3*
3	1. Turn the ignition to OFF. 2. Disconnect the 10–way EBCM harness connector from the EBCM. 3. Using a *J 36169-A* with a 3 amp fuse, connect terminal B of the 10–way EBCM harness connector to ground. 4. Turn ignition to RUN. Does the ABS indicator lamp turn on?	—	Go to *Step 6*	Go to *Step 4*
4	Inspect the jumper wire fuse. Is the fuse open?	—	Go to *Step 7*	Go to *Step 5*
5	Malfunction is intermittent, perform the following: • Inspect all connectors and harnesses for damage which may result in a short to voltage when all components are connected. • Refer to Diagnostic Aids for more information. • Perform all necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	Go to Diagnostic Aids
6	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
7	Repair a short to voltage in CKT 867. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0286 ABS Indicator Lamp Circuit Shorted to B+ (Commercial)



396528

Circuit Description

The amber ANTILOCK indicator lamp is supplied ignition voltage through the GAUGES fuse. The ABS indicator lamp is normally on (EBCM terminal B grounded) until the EBCM switches the indicator off (normal mode). This logic ensures that the indicator will be illuminated if there is a faulty EBCM.

Conditions for Setting the DTC

- High voltage is present on the ABS indicator lamp control circuit when low voltage is expected (lamp is turned on) to be low
- Anything that keeps the ABS indicator lamp circuit high when the lamp circuit is expected to be on

Action Taken When the DTC Sets

- The ABS is not disabled
- The EBCM will use the red BRAKE warning lamp to alert the driver of an ABS malfunction

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

DTC C0286 typically sets because of a shorted amber ABS indicator lamp. Yet DTC C0286 can also set because of a short to voltage in the wiring between the amber ABS indicator lamp and the EBCM.

Test Description

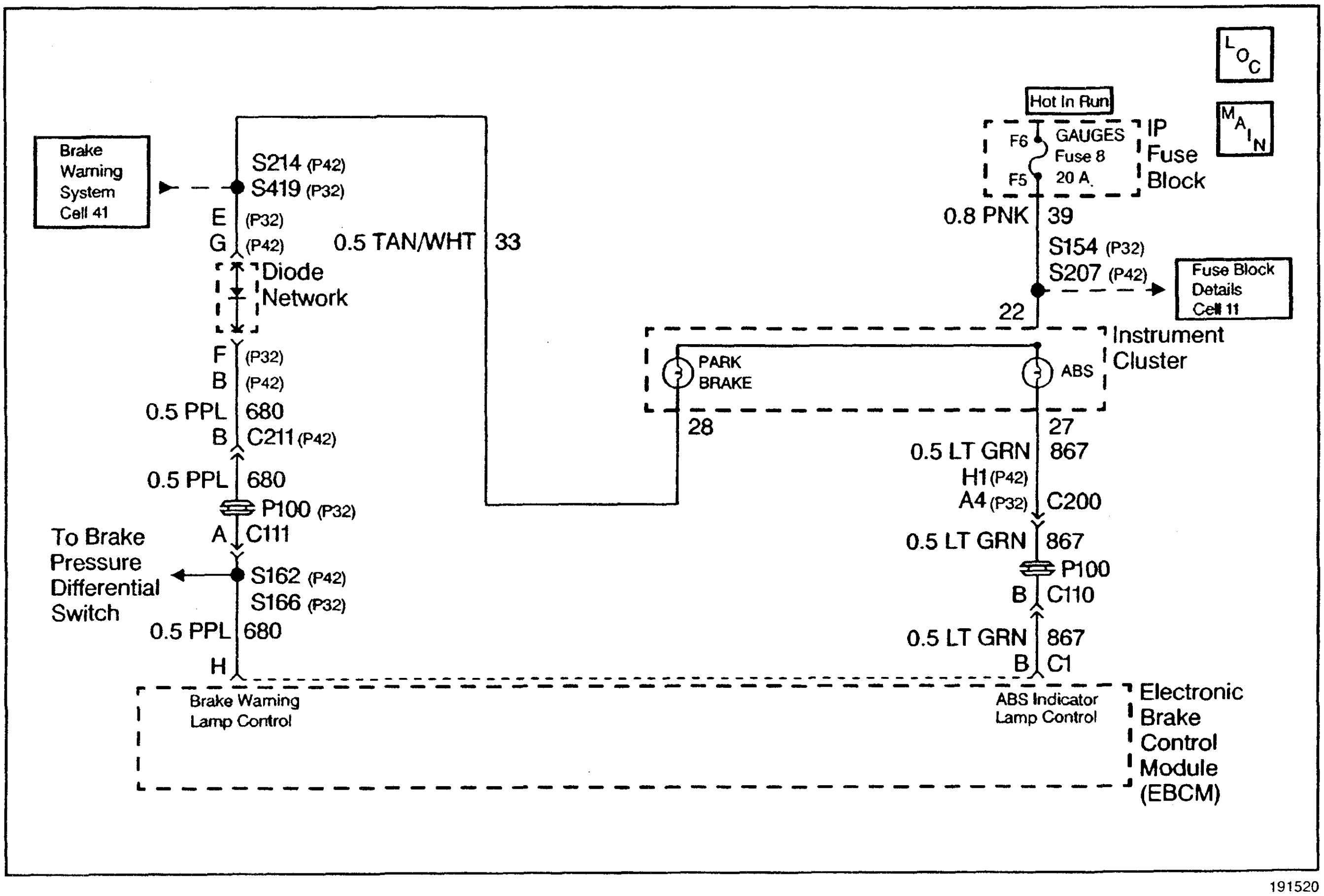
The numbers below refer to the steps in the diagnostic table:

2. This step checks for normal operation of the ABS indicator lamp.
3. This step turns off the ABS indicator lamp with *a J 36169-A*.

DTC C0286 ABS Indicator Lamp Circuit Shorted to B+ (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Turn the ignition to RUN. 2. Observe the amber ABS indicator lamp operation. 3. Did the ABS indicator lamp turn on and then turn off after 2 seconds?	—	Go to *Step 5*	Go to *Step 3*
3	1. Turn the ignition to OFF. 2. Disconnect the 10–way EBCM harness connector from the EBCM. 3. Using a *J 36169-A* with a 3 amp fuse, connect terminal B of the 10–way EBCM harness connector to ground. 4. Turn ignition to RUN. Does the ABS indicator lamp turn on?	—	Go to *Step 6*	Go to *Step 4*
4	Inspect the jumper wire fuse. Is the fuse open?	—	Go to *Step 7*	Go to *Step 5*
5	Malfunction is intermittent, perform the following: • Inspect all connectors and harnesses for damage which may result in a short to voltage when all components are connected. • Refer to Diagnostic Aids for more information. • Perform all necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	Go to Diagnostic Aids
6	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
7	Repair a short to voltage in CKT 867. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

DTC C0288 Brake Warning Lamp Circuit Shorted to B+ (Motorhome)



Circuit Description

The red BRAKE warning lamp is supplied ignition voltage through the GAUGES fuse. The BRAKE warning lamp can be illuminated by the EBCM, Brake Pressure Differential Switch or by the Park Brake Switch.

Conditions for Setting the DTC

- High voltage is present on the BRAKE warning lamp circuit when the circuit is expected to be low (lamp commanded on by the EBCM)
- Anything that keeps the Brake warning lamp circuit high when the lamp is circuit supposed to be illuminated

Action Taken When the DTC Sets

No action taken, the ABS is not disabled.

Conditions for Clearing the MIL/DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

DTC C0288 typically sets because of a shorted red BRAKE warning lamp. Yet DTC C0288 can also set because of a short to voltage in the wiring between the red BRAKE warning lamp and the EBCM.

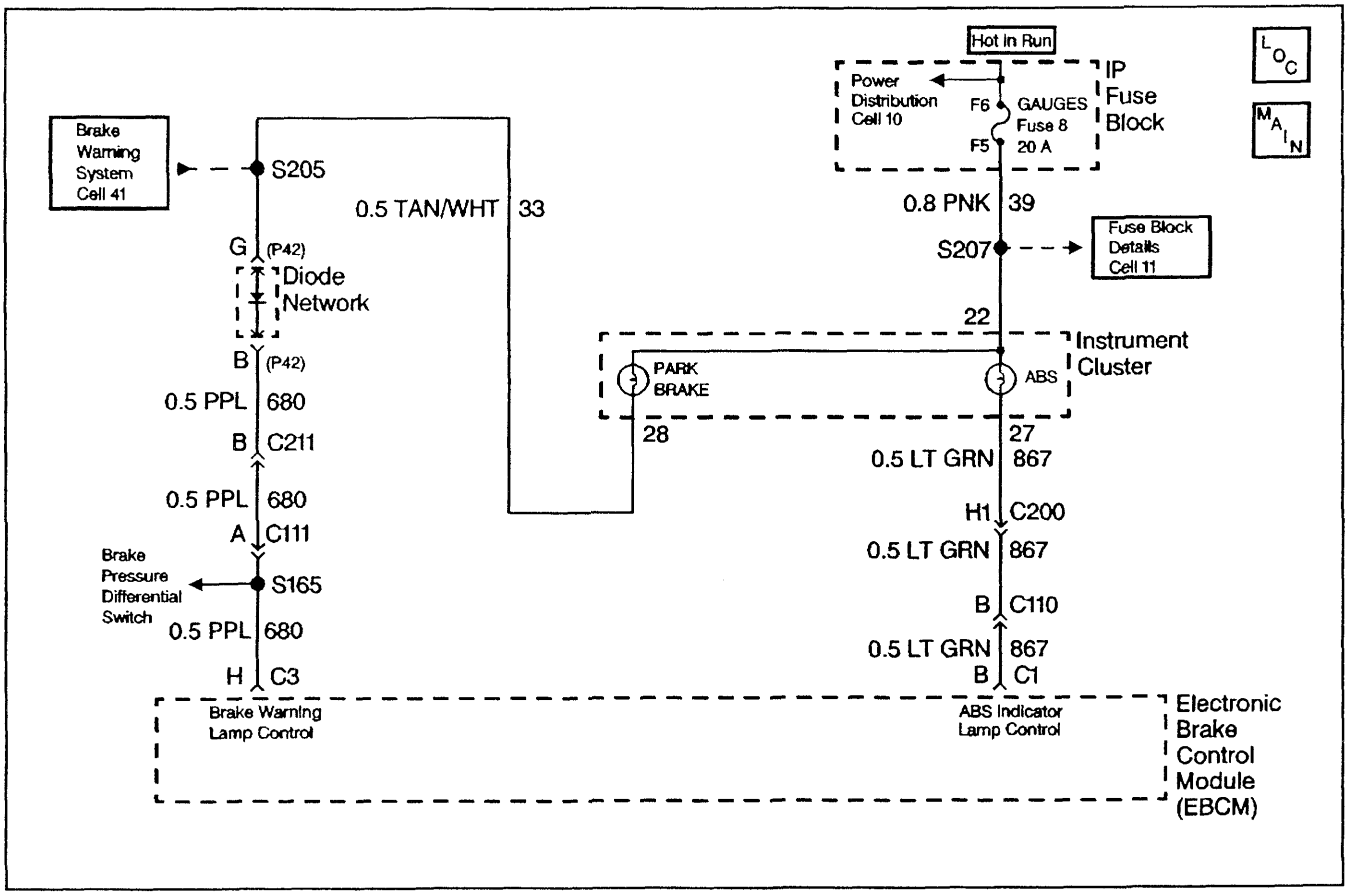
Test Description

2. Determines if the BRAKE warning lamp circuit is operating properly when controlled by the EBCM.
3. Determines if the BRAKE warning lamp circuit is operating properly without the EBCM.

DTC C0288 Brake Warning Lamp Circuit Shorted to B+ (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the ABS Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Turn the ignition to RUN. 2. Observe the red BRAKE warning lamp. Did the BRAKE warning lamp turn on and then off after three seconds?	—	Go to *Step 5*	Go to *Step 3*
3	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM harness connector from the EBCM. 3. Using a 3 amp fused jumper wire, such as J 36169, connect terminal H of the 10-way EBCM harness connector to ground. 4. Turn the ignition to RUN. Does the BRAKE warning lamp turn on?	—	Go to *Step 6*	Go to *Step 4*
4	Inspect the jumper wire fuse. Is the fuse open?	—	Go to *Step 7*	Go to *Step 5*
5	Malfunction is intermittent, Perform the following: • Inspect all connectors and harnesses for damage which may result in a short to voltage when all components are connected. • Refer to Diagnostic Aids for more information. • Perform all necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
6	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
7	Repair a short to voltage in CKT 33 or CKT 680. Refer to *Wiring Repairs.* Is repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

DTC C0288 Brake Warning Lamp Circuit Shorted to B+ (Commercial)



396528

Circuit Description

The red BRAKE warning lamp is supplied ignition voltage through the GAUGES fuse. The BRAKE warning lamp can be illuminated by the EBCM, Brake Pressure Differential Switch or by the Park Brake Switch.

Conditions for Setting the DTC

- High voltage is present on the BRAKE warning lamp circuit when the circuit is expected to be low (lamp commanded on by the EBCM)
- Anything that keeps the Brake warning lamp circuit high when the lamp is circuit supposed to be illuminated

Action Taken When the DTC Sets

No action taken, the ABS is not disabled.

Conditions for Clearing the MIL/DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

DTC C0288 typically sets because of a shorted red BRAKE warning lamp. Yet DTC C0288 can also set because of a short to voltage in the wiring between the red BRAKE warning lamp and the EBCM.

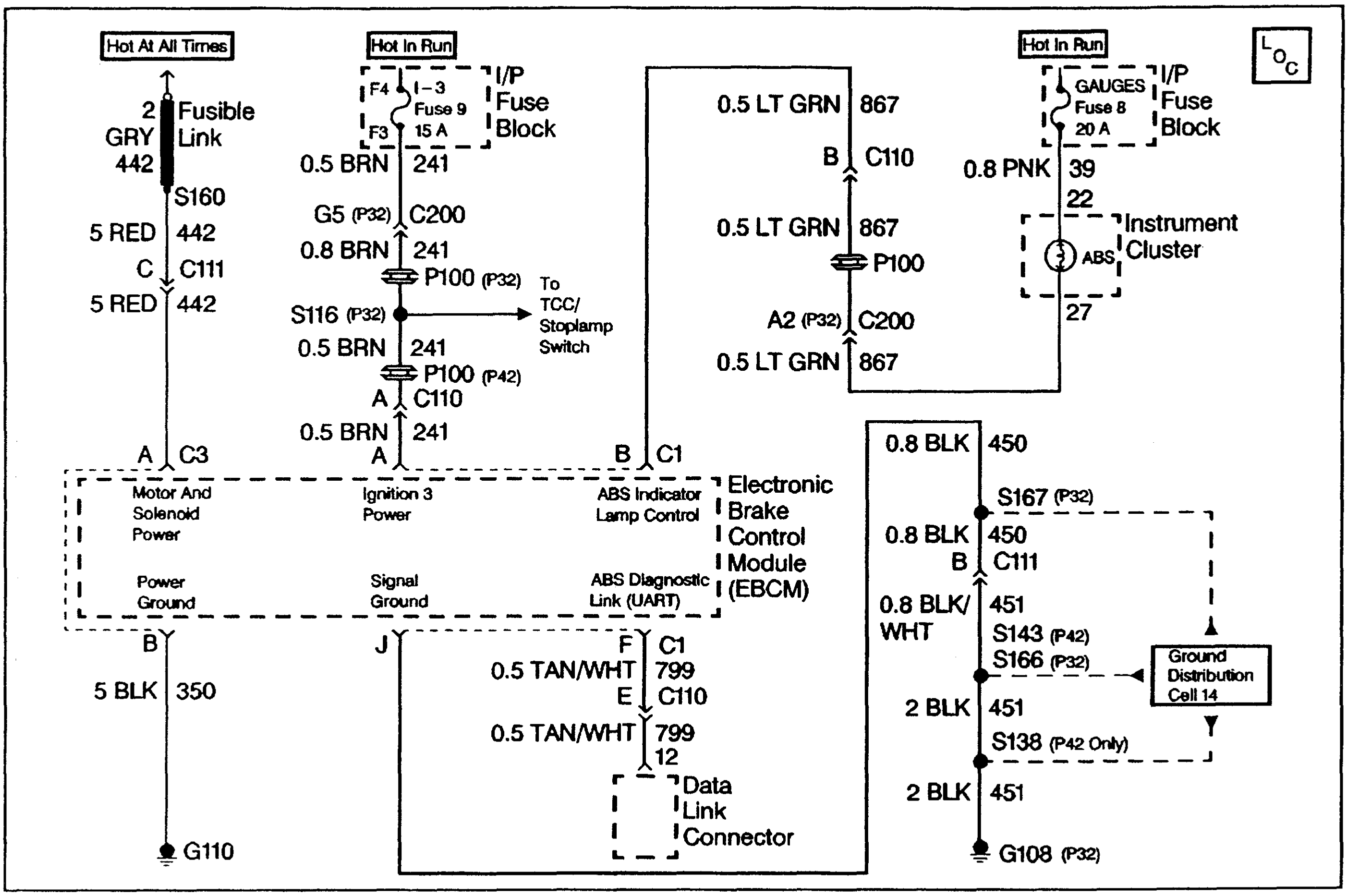
Test Description

2. Determines if the BRAKE warning lamp circuit is operating properly when controlled by the EBCM.
3. Determines if the BRAKE warning lamp circuit is operating properly without the EBCM.

DTC C0288 Brake Warning Lamp Circuit Shorted to B+ (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the ABS Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Turn the ignition to RUN. 2. Observe the red BRAKE warning lamp. Did the BRAKE warning lamp turn on and then off after three seconds?	—	Go to *Step 5*	Go to *Step 3*
3	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM harness connector from the EBCM. 3. Using a *J 36169-A*, jumper terminal H of the 10-way EBCM harness connector to ground. 4. Turn the ignition to RUN. Does the BRAKE warning lamp turn on?	—	Go to *Step 6*	Go to *Step 4*
4	Inspect the jumper wire fuse. Is the fuse open?	—	Go to *Step 7*	Go to *Step 5*
5	Malfunction is intermittent, Perform the following: • Inspect all connectors and harnesses for damage which may result in a short to voltage when all components are connected. • Refer to Diagnostic Aids for more information. • Perform all necessary repairs. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
6	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
7	Repair a short to voltage in CKT 33 or CKT 680. Refer to *Wiring Repairs.* Is repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

ABS Indicator Off No DTC Set (Motorhome)



191458

Circuit Description

The EBCM controls the ANTILOCK indicator lamp illumination by supplying a ground to the EBCM 10–way terminal B. When the vehicle is started or the ignition is turned to the RUN position, the ANTILOCK indicator should illuminate for two seconds and turn off.

Diagnostic Aids

If the ABS indicator lamp is off constantly, an open or short to voltage in the lamp circuit is present between the instrument panel and the ABS indicator relay ground (this includes the ABS indicator relay contacts). Also check for an open instrument cluster fuse or an open ABS indicator lamp.

Test Description

The numbers below refer to the steps in the diagnostic table:

2. This step manually (with fused jumper) turns on the ABS indicator lamp.
5. This step checks for a short to ground in CKT 39.
7. This step checks for an open in CKT 867.
8. This step checks for ignition voltage at the instrument cluster.

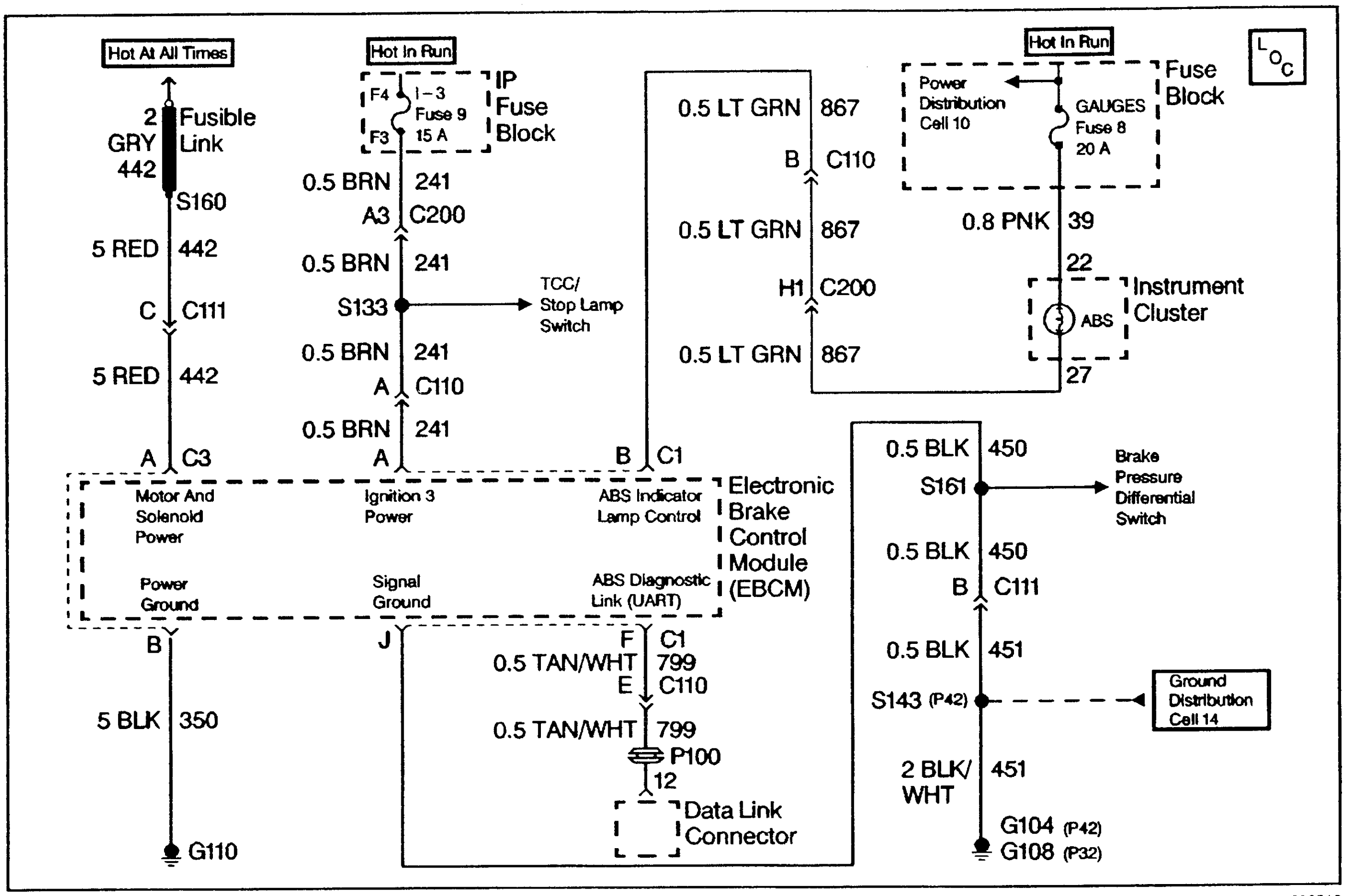
ABS Indicator Off No DTC Set (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM harness connector from the EBCM. 3. Using the *J 36169-A* Fused Jumper Wire with a 3 amp fuse, connect terminal B of the 10-way EBCM harness connector to ground. 4. Turn the ignition to RUN. Does the ABS indicator lamp turn on?	—	Go to *Step 9*	Go to *Step 3*
3	Inspect the *J 36169-A* Fused Jumper Wire fuse. Is the fuse open?	—	Go to *Step 11*	Go to *Step 4*
4	Inspect the GAUGES fuse 8. Is the fuse open?	—	Go to *Step 5*	Go to *Step 6*
5	1. Turn the ignition to OFF. 2. Replace the GAUGES fuse 8 3. Disconnect the Instrument Cluster harness connector from the instrument cluster. 4. Turn the ignition to RUN. 5. Remove and inspect the 10 amp GAUGES fuse 8 Is the GAUGES Fuse 8 open?	—	Go to *Step 15*	Go to *Step 6*
6	Remove and inspect the ABS indicator lamp. Refer to Instrument Cluster. Is the ABS indicator lamp open?	—	Go to *Step 12*	Go to *Step 7*
7	1. Turn the ignition to OFF. 2. Using the *J 39200*, measure the resistance between the 10-way EBCM connector terminal B and the Instrument Cluster terminal 27. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 8*	Go to *Step 13*
8	1. Turn the ignition to RUN 2. Using the *J 39200*, measure the voltage between the Instrument Cluster terminal 22 and ground. Is the voltage measurement equal to or greater than the specified range?	10.0 V	Go to Wiring Systems for Instrument Cluster Diagnosis	Go to *Step 14*
9	Malfunction is intermittent, perform the following: 1. Inspect the 10-way EBCM harness connector for poor terminal contact or corrosion. Inspect CKT 867 for damage which may result in an open circuit. 2. Reconnect all the connectors. 3. Clear all DTCs using the *Scan Tool.* 4. Test drive the vehicle above 16 km/h (10 mph). Is the ABS indicator lamp off constantly?	—	Go to *Step 10*	Go to Diagnostic Aids

ABS Indicator Off No DTC Set (Motorhome) (cont'd)

Step	Action	Value(s)	Yes	No
10	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
11	Repair the short to voltage in CKT 867. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
12	Replace the ABS indicator lamp. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
13	Repair the open or the high resistance in CKT 867. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
14	Repair the open in CKT 39. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
15	Repair the short to ground in CKT 39. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

ABS Indicator Off No DTC Set (Commercial)



Circuit Description

The EBCM controls the ANTILOCK indicator lamp illumination by supplying a ground to the EBCM 10–way terminal B. When the vehicle is started or the ignition is turned to the RUN position, the ANTILOCK indicator should illuminate for two seconds and turn off.

Diagnostic Aids

If the ABS indicator lamp is off constantly, an open or short to voltage in the lamp circuit is present between the instrument panel and the ABS indicator relay ground (this includes the ABS indicator relay contacts). Also check for an open instrument cluster fuse or an open ABS indicator lamp.

Test Description

The numbers below refer to the steps in the diagnostic table:

2. This step manually (with fused jumper) turns on the ABS indicator lamp.
5. This step checks for a short to ground in CKT 39.
7. This step checks for an open in CKT 867.
8. This step checks for ignition voltage at the instrument cluster.

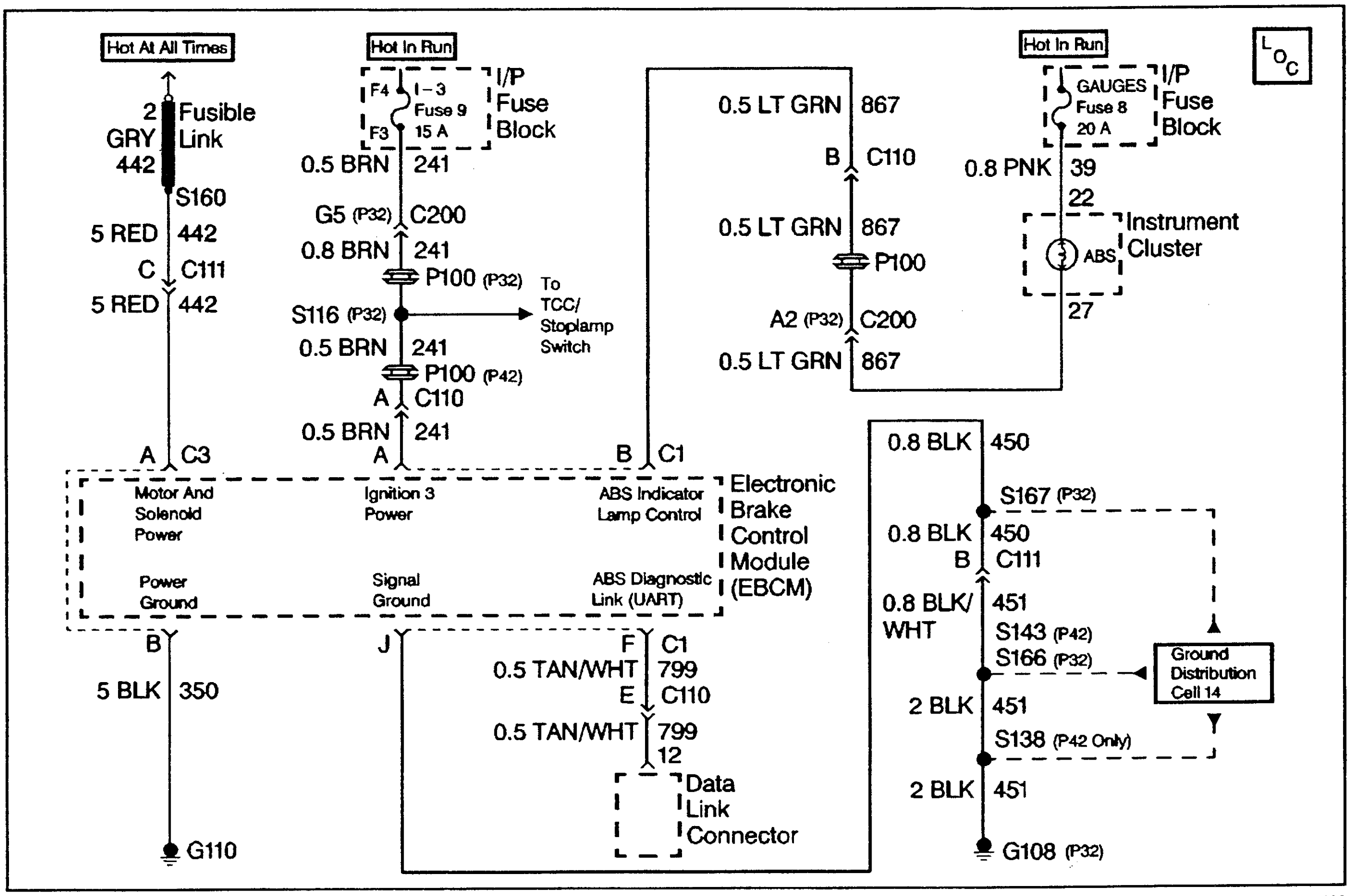
ABS Indicator Off No DTC Set (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM harness connector from the EBCM. 3. Using the *J 36169-A* Fused Jumper Wire with a 3 amp fuse, connect terminal B of the 10-way EBCM harness connector to ground. 4. Turn the ignition to RUN. Does the ABS indicator lamp turn on?	—	Go to *Step 9*	Go to *Step 3*
3	Inspect the *J 36169-A* Fused Jumper Wire fuse. Is the fuse open?	—	Go to *Step 11*	Go to *Step 4*
4	Inspect the GAUGES fuse 8. Is the fuse open?	—	Go to *Step 5*	Go to *Step 6*
5	1. Turn the ignition to OFF. 2. Replace the GAUGES fuse 8 3. Disconnect the Instrument Cluster harness connector from the instrument cluster. 4. Turn the ignition to RUN. 5. Remove and inspect the 10 amp GAUGES fuse 8 Is the GAUGES Fuse 8 open?	—	Go to *Step 15*	Go to *Step 6*
6	Remove and inspect the ABS indicator lamp. Refer to Instrument Cluster. Is the ABS indicator lamp open?	—	Go to *Step 12*	Go to *Step 7*
7	1. Turn the ignition to OFF. 2. Using the *J 39200*, measure the resistance between the 10-way EBCM connector terminal B and the Instrument Cluster terminal 27. Is the resistance measurement within the specified range?	0-2 Ω	Go to *Step 8*	Go to *Step 13*
8	1. Turn the ignition to RUN 2. Using the *J 39200*, measure the voltage between the Instrument Cluster terminal 22 and ground. Is the voltage measurement equal to or greater than the specified range?	10.0 V	Go to Wiring Systems for Instrument Cluster Diagnosis	Go to *Step 14*
9	Malfunction is intermittent, perform the following: 1. Inspect the 10-way EBCM harness connector for poor terminal contact or corrosion. Inspect CKT 867 for damage which may result in an open circuit. 2. Reconnect all the connectors. 3. Clear all DTCs using the *Scan Tool*. 4. Test drive the vehicle above 16 km/h (10 mph). Is the ABS indicator lamp off constantly?	—	Go to *Step 10*	Go to Diagnostic Aids

ABS Indicator Off No DTC Set (Commercial) (cont'd)

Step	Action	Value(s)	Yes	No
10	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
11	Repair the short to voltage in CKT 867. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
12	Replace the ABS indicator lamp. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
13	Repair the open or the high resistance in CKT 867. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
14	Repair the open in CKT 39. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
15	Repair the short to ground in CKT 39. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

ABS Indicator On No DTC Set (Motorhome)



Circuit Description

The EBCM controls the ANTILOCK indicator lamp illumination by supplying a ground to terminal B. When the vehicle is started or the ignition is turned to the RUN position, the ANTILOCK indicator should illuminate for two seconds and turn off.

Diagnostic Aids

If the ANTILOCK indicator lamp is on always with no DTCs set (never turns off after three seconds with the vehicle started or with the ignition switch in the RUN position), there is a short to ground in CKT 867 between the instrument cluster and the EBCM or the EBCM is internally shorted to ground.

Test Description

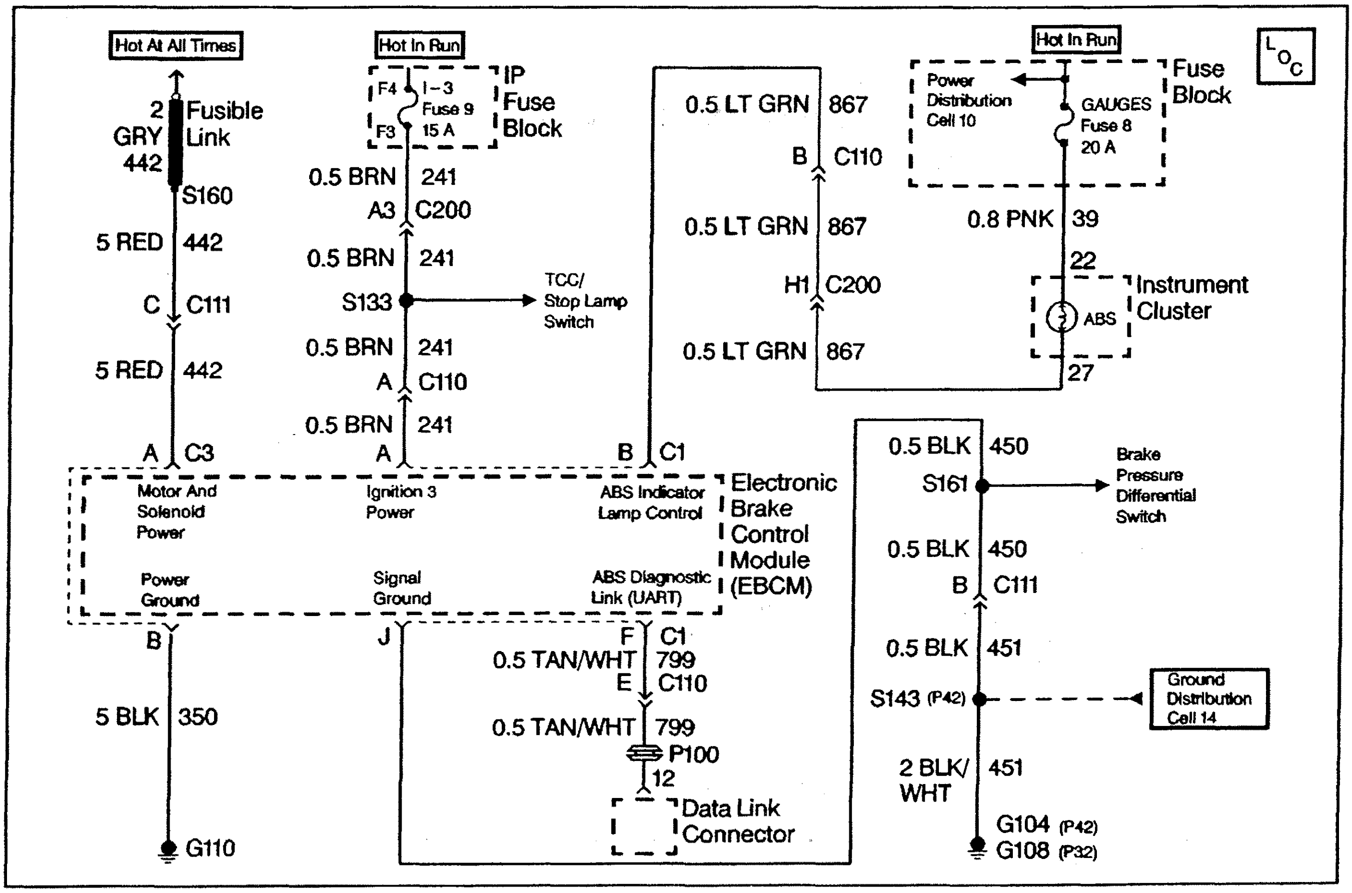
The numbers below refer to the steps in the diagnostic table:

2. This step checks for a short to ground in CKT 867.

ABS Indicator On No DTC Set (Motorhome)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Motorhome)*
2	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM harness connector from the EBCM. 3. Turn the ignition to RUN. Does the ABS indicator lamp turn on?	—	Go to *Step 3*	Go to *Step 4*
3	Repair the short to ground in CKT 867. Refer to *Wiring Repairs*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—
4	1. Inspect CKT 867 and the 10-way EBCM harness connector for physical damage which may result in a short to ground with the 10-way EBCM harness connector connected to the EBCM. 2. Reconnect all the connectors. 3. Clear all the DTCs using the scan tool. 4. Test drive the vehicle above 16 km/h (10 mph). Is the ABS indicator lamp on constantly?	—	Go to *Step 5*	Go to Diagnostic Aids
5	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement*. Is the repair complete?	—	Go to *ABS Diagnostic System Check (Motorhome)*	—

ABS Indicator On No DTC Set (Commercial)



396516

Circuit Description

The EBCM controls the ANTILOCK indicator lamp illumination by supplying a ground to terminal B. When the vehicle is started or the ignition is turned to the RUN position, the ANTILOCK indicator should illuminate for two seconds and turn off.

Diagnostic Aids

If the ANTILOCK indicator lamp is on always with no DTCs set (never turns off after three seconds with the vehicle started or with the ignition switch in the RUN position), there is a short to ground in CKT 867 between the instrument cluster and the EBCM or the EBCM is internally shorted to ground.

Test Description

The numbers below refer to the steps in the diagnostic table:

2. This step checks for a short to ground in CKT 867.

ABS Indicator On No DTC Set (Commercial)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *ABS Diagnostic System Check (Commercial)*
2	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM harness connector from the EBCM. 3. Turn the ignition to RUN. Does the ABS indicator lamp turn on?	—	Go to *Step 3*	Go to *Step 4*
3	Repair the short to ground in CKT 867. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—
4	1. Inspect CKT 867 and the 10-way EBCM harness connector for physical damage which may result in a short to ground with the 10-way EBCM harness connector connected to the EBCM. 2. Reconnect all the connectors. 3. Clear all the DTCs using the scan tool. 4. Test drive the vehicle above 16 km/h (10 mph). Is the ABS indicator lamp on constantly?	—	Go to *Step 5*	Go to Diagnostic Aids
5	Replace the EBCM. Refer to *Electronic Brake Control Module Replacement.* Is the repair complete?	—	Go to *ABS Diagnostic System Check (Commercial)*	—

Repair Instructions

ABS Bleed Procedure

Important:

- Use the two-person bleed procedure under the following conditions:
  - Installing a new Electro-Hydraulic Control Unit (EHCU) or Brake Pressure Modulator Valve (BPMV)
  - Air is trapped in the valve body
- Do not drive the vehicle until the brake pedal feels firm.
- Do not reuse brake fluid that is used during bleeding.
- Use the vacuum, the pressure and the gravity bleeding procedures only for base brake bleeding.

Two Person Procedure

1. Raise the vehicle in order to access the system bleed screws.
2. Bleed the system at the right rear wheel first.
3. Install a clear hose on the bleed screw.
4. Immerse the opposite end of the hose into a container partially filled with clean DOT 3 brake fluid.
5. Open the bleed screw 1/2 to one full turn.
6. Slowly depress the brake pedal. While the pedal is depressed to its full extent, tighten the bleed screw.
7. Release the brake pedal and wait 10–15 seconds for the master cylinder pistons to return to the home position.
8. Repeat the previous steps for the remaining wheels. The brake fluid which is present at each bleed screw should be clean and free of air.
9. This procedure may use more than a pint of fluid per wheel. Check the master cylinder fluid level every four to six strokes of the brake pedal in order to avoid running the system dry.
10. Press the brake pedal firmly and run the *Scan Tool* Function Test four times. Release the brake pedal between each test.
11. Bleed all four wheels again using steps 3–9. This will remove the remaining air from the brake system.
12. Evaluate the feel of the brake pedal before attempting to drive the vehicle.
13. Bleed the system as many times as necessary in order to obtain the appropriate feel of the pedal.

Electronic Brake Control Module Replacement

Removal Procedure

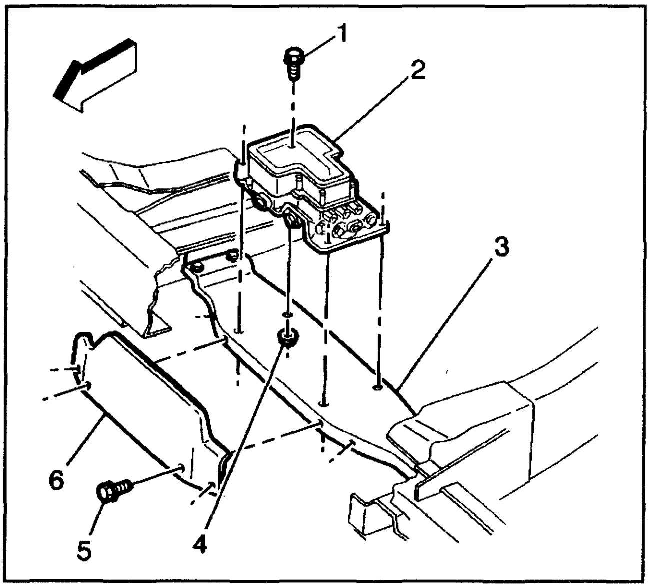
Important: After installation, calibrate the new EBCM to the tire size that is appropriate to the vehicle. Refer to Tire Size Calibration and to Trim Level Calibration portions of *ABS System Operation (Domestic)*.

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Negative Battery Cable.
2. Raise vehicle and properly support.
3. Remove the four EHCU shield bolts (5) and shield (6).
4. Loosen the four EHCU crossmember nuts.
5. Remove only the two passenger side crossmember nuts. Allow the crossmember to drop down allowing access to the EHCU.
6. Remove the four EBCM wiring harness connectors.
7. Remove the four T-25 Torx® bolts (1) that fasten the EBCM to the BPMV.
8. Remove the EBCM (2) from the BPMV (4) Removal may require a light amount of force.

Important: Do not use a tool to pry the EBCM from the BPMV. Excessive force will damage the EBCM.

9. Clean the BPMV with a clean, dry cloth.



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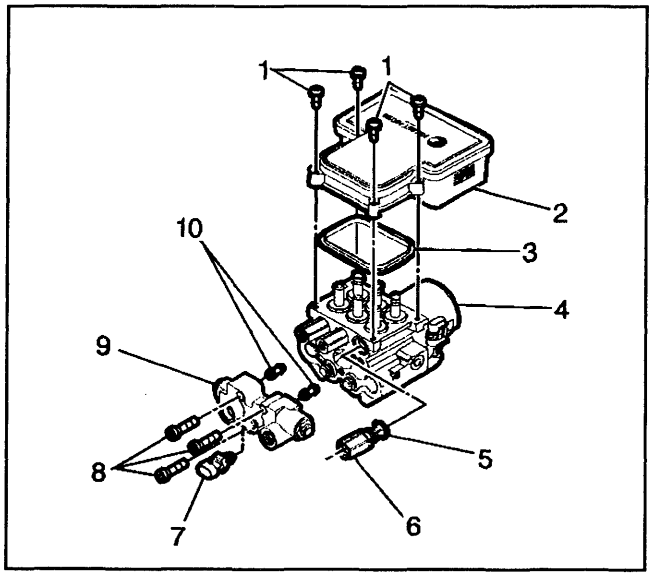

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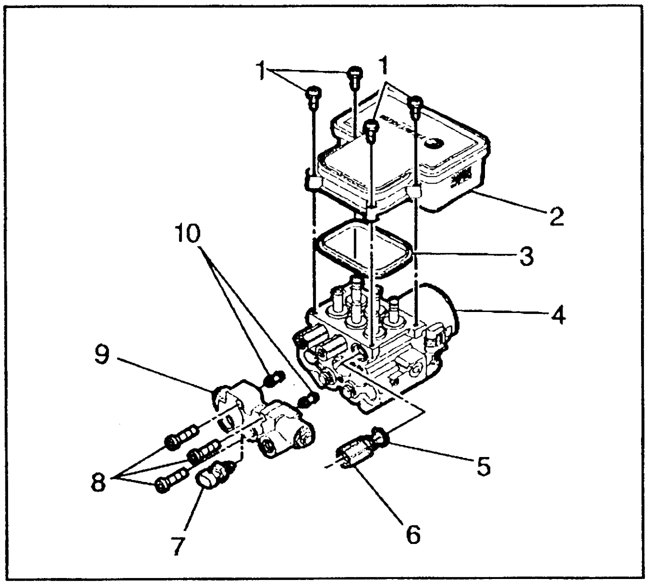

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Installation Procedure

Important: If the EBCM mounting bolts are corroded or damaged, do not reuse the old mounting bolts. Install new EBCM mounting bolts with the new EBCM.

Important: Do not use RTV or any other type of sealant on the EBCM to BPMV mating surface.

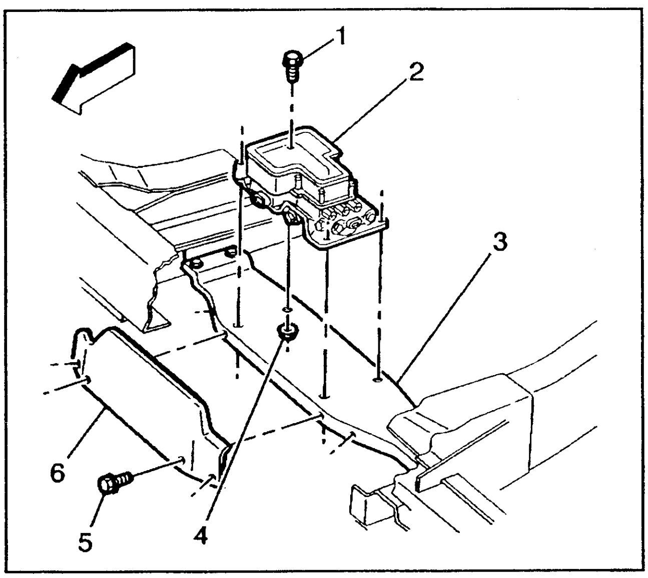
1. Install EBCM (2) to BPMV (4).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the four EBCM bolts (1).

   Tighten

   Tighten the four bolts to 5 N·m (39 lb in) in an X-pattern.
3. Connect the four electrical connectors to the EBCM.



191524

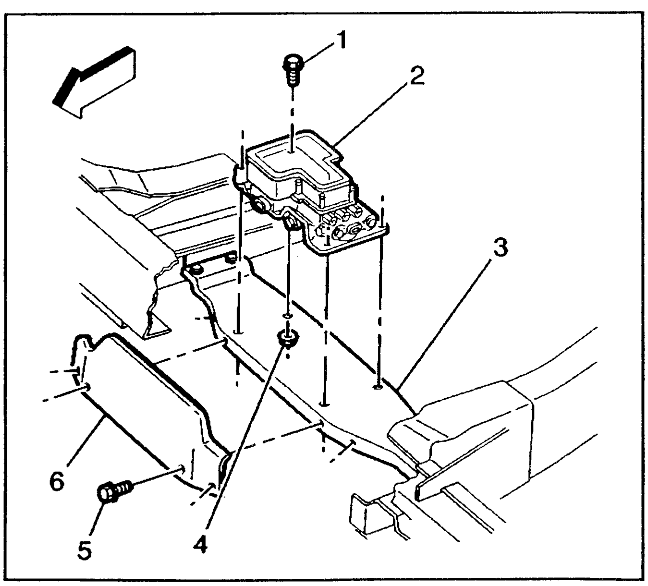
4. Install the two passenger side crossmember nuts.

   Tighten

   Tighten the two crossmember nuts to 38 N·m (30 lb ft).
5. Install the EHCU Shield.

   Tighten

   Tighten the four bolts to 11 N·m (8 lb ft).
6. Lower the vehicle
7. Connect the negative battery cable.
8. Revise the tire calibration using the *Scan Tool.*
9. Return to Diagnostic System Check. Refer to *ABS Diagnostic System Check (Motorhome)* or *ABS Diagnostic System Check (Commercial).*



191524

Brake Pressure Modulator Valve Replacement

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Negative Battery Cable.
2. Raise vehicle and properly support.
3. Remove the four EHCU shield bolts (5) and shield (6).
4. Remove the three EBCM electrical connectors.
5. Remove the combination valve electrical connector.
6. Remove the five brake lines from the BPMV.
7. Loosen the four EHCU crossmember nuts.

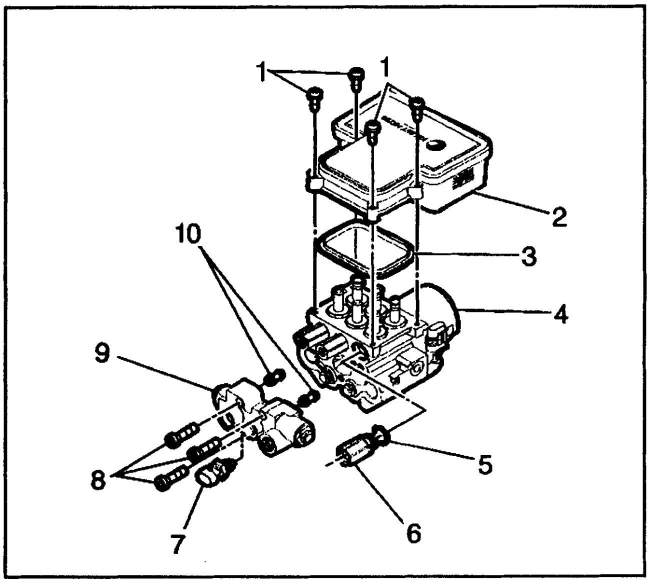
8. Remove only the two passenger side crossmember nuts. Allow the crossmember to drop down allowing access to the EHCU.
9. Remove the four EHCU bracket bolts (1).
10. Remove the EHCU from the vehicle.
11. Remove the BPMV pump motor electrical connector from the EBCM.
12. Remove the four T-25 Torx® bolts (1) that fasten the EBCM to the BPMV.
13. Remove the EBCM (2) from the BPMV (4) Removal may require a light amount of force.

Important: Do not use a tool to pry the EBCM from the BPMV. Excessive force will damage the EBCM.

14. Remove the three allen bolts(8) which fasten the combination valve to the BPMV.
15. Remove the combination valve from the BPMV.
16. Remove the two transfer tubes (10).

Important: Do not reuse the transfer tubes. Always install new transfer tubes when replacing the BPMV.

17. Remove the three tube adapters (6).
18. Remove the three BPMV mounting bracket bolts.
19. Remove the BPMV from the EHCU mounting bracket.
20. Clean the BPMV with a clean, dry cloth.



184187

Installation Procedure

Important: If the EBCM mounting bolts are corroded or damaged, do not reuse the old mounting bolts. Install new EBCM mounting bolts with the new EBCM.

1. Install the BPMV onto the EHCU mounting bracket.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the three tube adapters (6)

   Tighten

   Tighten the tube adapters to 31 N·m (23 lb ft).
3. Install two new transfer tubes (10) into the combination valve.

Important: Do not reuse the transfer tubes. Always install new transfer tubes when removing the combination valve.

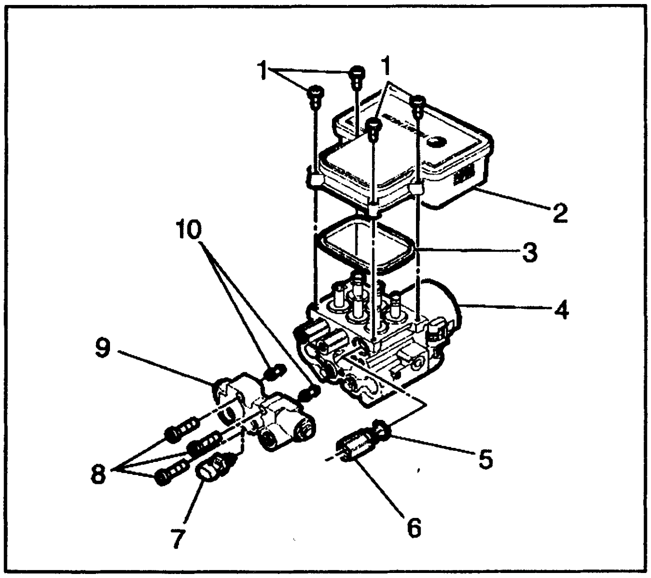
4. Install the combination valve (9) onto the BPMV.
5. Install the three combination valve fastening bolts

   Tighten

   Tighten the three allen bolts first to 8 N·m (6 lb ft) and then to 12 N·m (12 lb ft).
6. Install EBCM (2) to BPMV (4).
7. Install the four new EBCM bolts (1).

   Tighten

   Tighten the four bolts to 5 N·m (39 lb in) in an X-pattern.
8. Install the BPMV pump motor electrical connector to the EBCM.
9. Install the EHCU to vehicle



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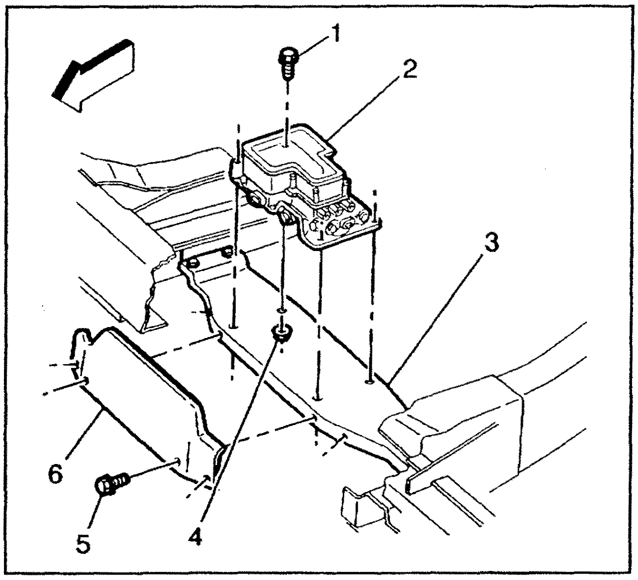


191524

10. Install the four EHCU bracket bolts (1)

    Tighten

    Tighten the four bolts to 36 N·m (27 lb in).
11. Install the two passenger side crossmember nuts.

    Tighten

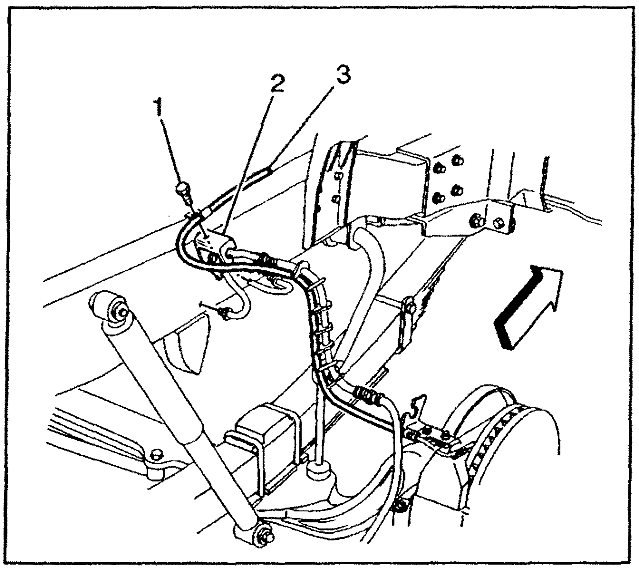
    Tighten the four EHCU crossmember bolts to 38 N·m (30 lb in).
12. Connect the three electrical connectors to the EBCM.
13. Connect the five brake line to the combination valve.

    Tighten

    Tighten the five brake lines to 30 N·m (22 lb ft).
14. Install the EHCU Shield.

    Tighten

    Tighten the four EHCU shield bolts to 11 N·m (8 lb ft).
15. Lower the vehicle
16. Connect the negative battery cable.
17. Bleed the brake system. Refer to *ABS Bleed Procedure*
18. Return to Diagnostic System Check. Refer to *ABS Diagnostic System Check (Motorhome).*



191528

Wheel Speed Sensor Replacement (Independent Front Suspension)

Removal Procedure

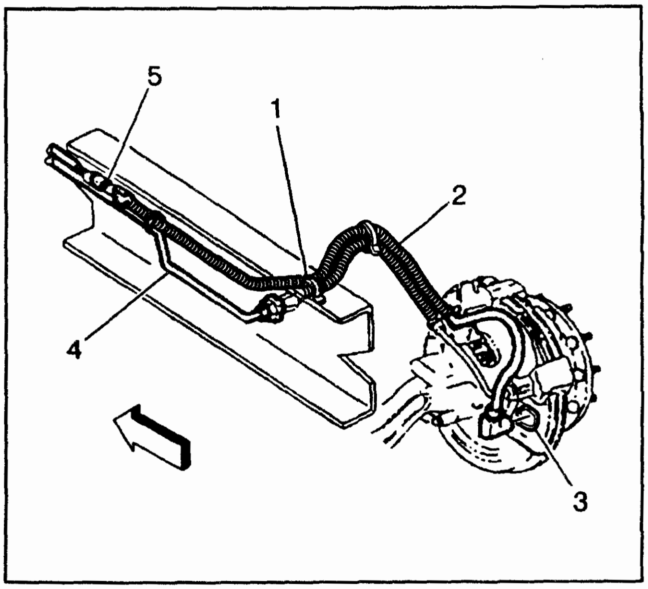
1. Disconnect the electrical connector (5).
2. Remove the nylon straps (1) retaining the sensor wire (2) to the brake line (4). Note the location of the straps.
3. Remove the wheel speed sensor from the bore.
4. Remove the speed sensor retaining clip (3). The clip may come out with the wheel speed sensor or stay in the bore. If the sensor retaining clip is still functioning correctly, save it for reinstallation. If the sensor retaining clip is not functioning correctly, replace the sensor retaining clip.

Installation Procedure

Important: You may have to use the wire retainers from the old wheel speed sensor wire on the new sensor. Do not damage the new wire when installing the retainers.

Important: Insert the sensor and the retaining clip (3) completely into the bore. The face of the sensor should contact the tone ring. The clip should stop at the retaining tabs.

1. Install the wheel speed sensor and the retaining clip (3) into the bore.
2. Secure the sensor wire (2) to the brake line (4) with a wire tie (1) in the location noted during removal.
3. Connect the electrical connector (5).

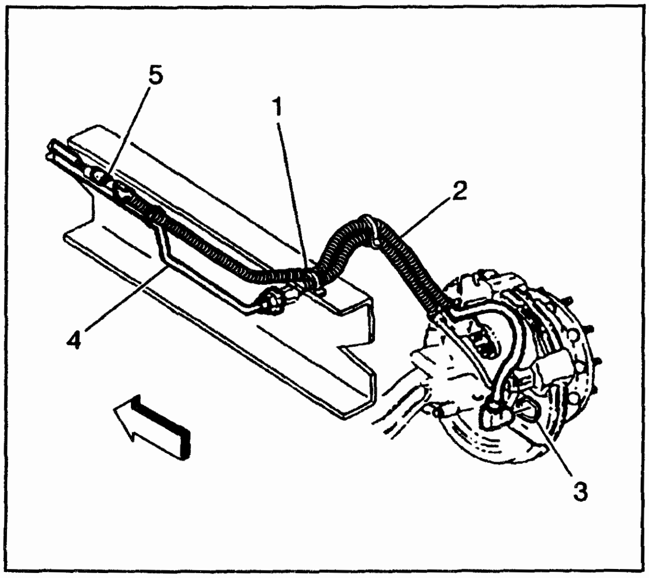


156568

Wheel Speed Sensor Replacement (I-Beam front Suspension)

Removal Procedure

1. Disconnect the wheel speed sensor electrical connector (5).
2. Remove the wheel speed sensor from the bore (3).
3. Remove the wheel speed sensor harness clip bracket (3).

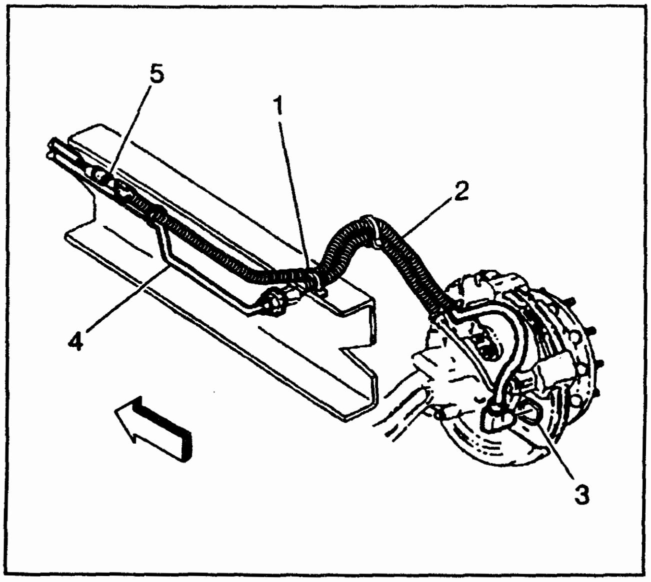


156568

Installation Procedure

Important: Insert the sensor and the retaining clip completely into the bore. The face of the sensor should contact the tone ring. The clip should stop at the retaining tabs.

1. Install the wheel speed sensor and the retaining clip into the bore (3).
2. Secure the sensor wire to the brake line with a wire tie in the location noted during removal (1).
3. Connect the electrical connector (5).



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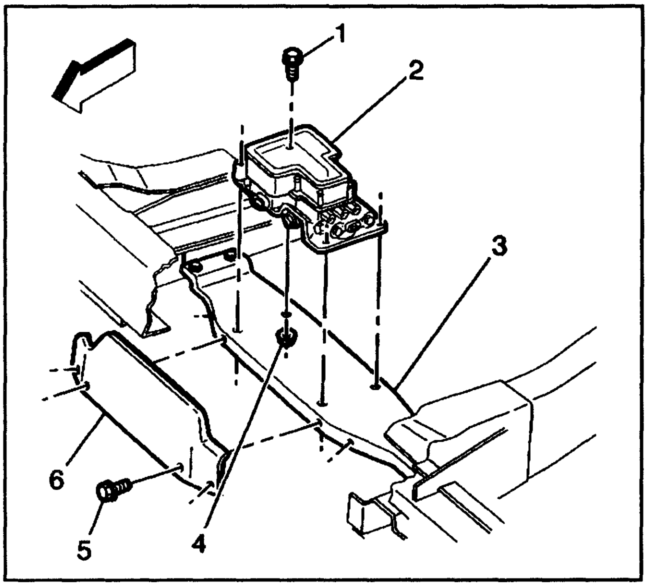


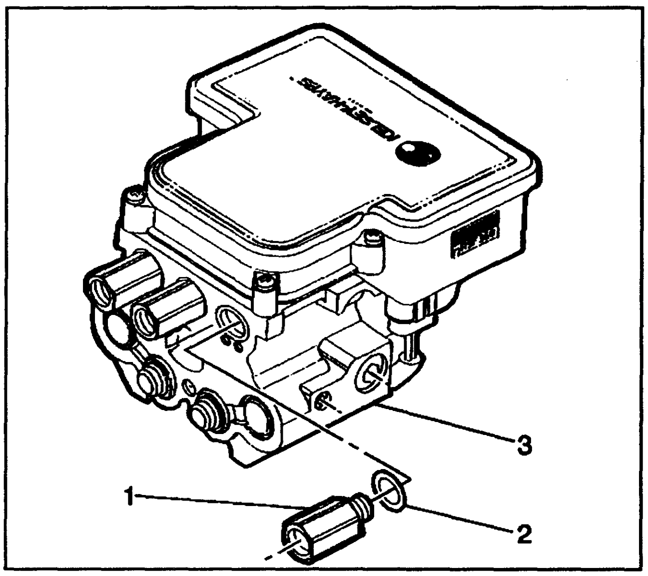
191524

Tube Adapter Replacement

Removal Procedure

Important: If you must remove more than one tube adapter at one time, stamp the BPMV with a number (1, 2 or 3) in order to indicate the number of grooves cut into the tube adapters. This procedure will aid proper reassembly.

1. Raise the vehicle and properly support.
2. Remove the three EHCU shield bolts and shield.
3. Remove the appropriate brake line from the tube adapter.



184211

4. Remove the tube adapter (1).

Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

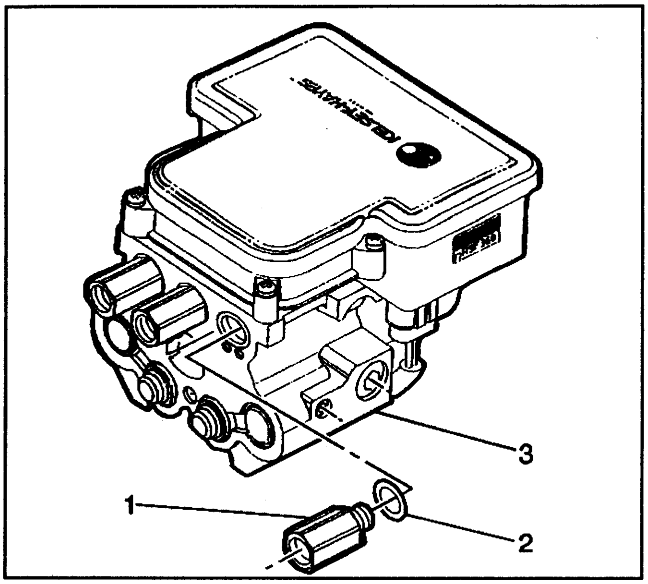
1. Install the new tube adapter (1).

   Tighten

   Tighten the tube adapter to 31 N·m (23 lb ft).
2. Install the brake line.

   Tighten

   Tighten the brake line to 30 N·m (22 lb ft).

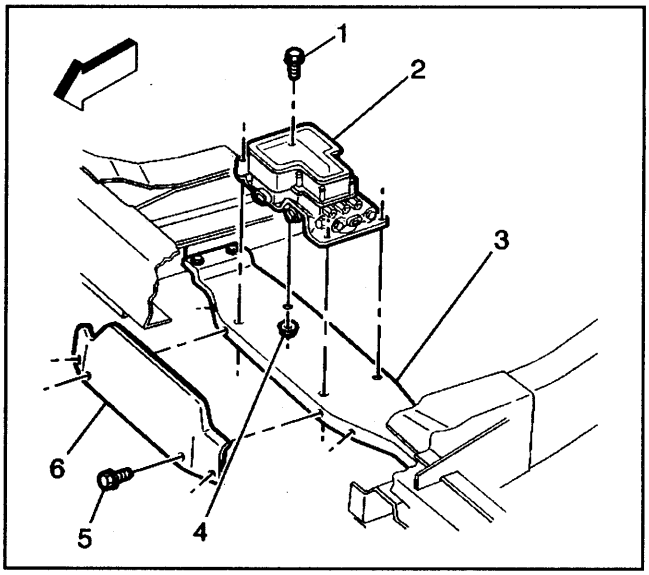


184211

3. Install the three EHCU shield bolts (5) and shield (6).

   Tighten

   Tighten the EHCU shield bolts (5) to 12 N·m (8 lb ft).
4. Bleed the system. Refer to *ABS Bleed Procedure.*



191524

Description and Operation

Service Precautions

When working on this system, observe the following precautions:

- Before welding on the vehicle with an electric welding unit, complete the following steps:
  - Turn the ignition switch OFF.
  - Disconnect the EBCM connectors.
- Do not use a fast charger for starting the engine.
- Disconnect the negative battery cable when fast charging. Refer to *Battery Disconnect Caution* in Cautions and Notices.
- Never disconnect the battery from the vehicle electrical system while the engine is running.
- Connect all wiring harness connectors securely.
- Proper speed sensor wiring, routing and retaining are necessary in order to prevent false signals due to electrical noise. You can achieve proper system operation only by restoring the system to its original condition.

  When servicing the ABS, note the routing, position, mounting and locations of the following items:
  - All components
  - The wiring
  - The connectors
  - The clips
  - The brackets
  - The brake pipes

Follow the above mentioned precautions when working on ABS. Familiarize yourself with ABS and its relationships with other components on the vehicle.

General System Description

This section covers diagnostic and service procedures for the four wheel antilock brake system (ABS). These models use the three sensor ABS. Speed information is obtained using a wheel speed sensor (WSS) at each front wheel and the vehicle speed sensor (VSS) for rear wheel speed information. ABS reduces the occurrence of wheel lockup during severe brake applications. The system regulates hydraulic pressure to all four wheels. The pressure is regulated by the brake pressure modulator valve (BPMV).

ABS is designed to provide the average driver with the following:

- Optimal steering control and stability when braking
- Optimal braking performance with available traction

Wheel Slip

The ability of a vehicle to stop is related to the friction of the road surface. At 0% slip, the tires rotate freely; at 100% slip, the tire and wheel are locked. Stopping distance increases and steering control is diminished.

With a 10%-20% slip, vehicle stopping distance will be as short as possible and steering control will be at its optimum. Some slip is necessary to stop the wheel and achieve maximum braking.

When ABS operation occurs, the driver of the vehicle should always continue to push hard on the brake pedal. Never pump the brakes. The ABS system will automatically modulate the brakes.

Steering Control

Steering control, like braking, also depends on tire traction. A locked tire in a 100% slip condition delivers less than optimum braking and directional control. Thus, some tire rotation is desirable for steering control. The tires must regain traction before steering control is restored to the vehicle.

Abbreviations and Definitions

BPMV: Brake Pressure Modulator Valve

CKT: Circuit

DLC: Data Link Connector

DMM: Digital Multimeter

DTC: Diagnostic Trouble Code

EBCM: Electronic Brake Control Module

EHCU: Electro-Hydraulic Control Unit

Infinite: Open Circuit/Unmeasurably High Resistance

LPA: Low Pressure Accumulator

OL: Open Circuit/Unmeasurably High Resistance

WSS: Wheel Speed Sensor

The EHCU is the entire ABS unit, including the BPMV and the EBCM. The BPMV is defined as the hydraulic control portion of the EHCU. The BPMV includes the internal control valves, the electric motor and the pumps. The BPMV does not include the EBCM. The EBCM is the electronic control portion of the EHCU. The EBCM mounts to the top of the BPMV. The EBCM is housed in aluminum with a black plastic top.

Basic Knowledge Required

Basic Electrical Circuits

You should have a basic knowledge of electrical circuits or you will have difficulty using this section. If you need a review of the basic Electrical troubleshooting, see the introduction to Electrical Diagnosis. Electrical Diagnosis also contains information on the basic use of circuit testing tools.

You should understand the basic electrical theory. You should also know the meaning of basic electrical concepts and measurement: voltage (volts), current (amperes) and resistance (ohms). You should understand what happens in a circuit with an open or shorted wire. You should be able to read and understand a wiring diagram.

Use of Circuit Testing Tools

You should be familiar with the high impedance Digital Multimeter (DMM) *J 39200*. You should be familiar with the meter controls and how to use them correctly. You should be able to measure voltage, resistance and current. You should also know how to use jumper wires to bypass components in order to test circuits.

ABS System Description

Electro-Hydraulic Control Unit

The Electro-Hydraulic Control Unit (EHCU) is located on the front crossmember. The EHCU assembly includes the Electronic Brake Control module (EBCM) and the Brake Pressure Modulator Valve (BPMV). The EHCU regulates hydraulic pressure in the brake system during an antilock stop.

Electronic Brake Control Module

The Electronic Brake Control Module (EBCM) is part of the EHCU. The EBCM is the electronic portion of the EHCU. The major function of the EBCM is to control the BPMV. Inputs to the EBCM include the following items:

- Three wheel speed signals
- Stop Lamp Switch
- Differential pressure switch
- Ignition switch voltage
- Unswitched battery voltage

Outputs of the EBCM include the following items:

- Three isolation solenoids (internal to the EBCM)
- Three dump solenoids (internal to the EBCM)
- The amber ABS indicator lamp
- The red BRAKE warning lamp
- The pump motor

A diagnostic serial data link (UART, ABS only) is also used for diagnostic service tools and assembly plant testing. A serial data circuit (Class 2) is used for transmitting a “rough road” signal to the PCM/VCM.

The EBCM monitors the speed of each wheel. If any wheel approaches lockup, the EBCM controls the solenoids (isolation solenoid and dump solenoid) in order to reduce brake pressure to the wheel approaching lockup. Once the wheel regains traction, brake pressure is increased until the wheel again approaches lockup. This cycle repeats until either the vehicle comes to a stop, the brake is released, or the wheel is no longer approaching lockup. The EBCM also runs self diagnostics in order to check for any system malfunctions. Refer to *Self-Diagnostics*. If the EBCM detects a malfunction with the system, the ECBM will illuminate the amber ABS indicator in order to alert the driver of a malfunction.

Brake Pressure Modulator Valve

The Brake Pressure Modulator Valve (BPMV) is part of the EHCU. The BPMV is the hydraulic portion of the EHCU. The EBCM controls the BPMV. The BPMV is split into the following three hydraulic channels:

- Left front
- Right front
- Rear

Each channel has an isolation valve and a dump valve. The front channels share a low pressure accumulator, attenuator, and a pump. The rear channel shares use of the pump, but uses it's own low pressure accumulator and attenuator.

Wheel Speed Sensors

The front Wheel Speed Sensors (WSS) are a magnetic coil/pickup type. Each WSS produces an AC voltage signal which is transmitted to the EBCM in order to indicate how fast the wheel is turning. The speed of the wheel is directly proportional to the frequency and amplitude of the wheel speed signal.

Wheel Speed Sensor Tone Wheels

Each Wheel Speed Sensor uses a tone wheel in order to produce an AC voltage signal. Tone wheels are metal rings with teeth on the outside diameter. The AC voltage is produced as the teeth pass through the magnetic field of the WSS pole piece. The tone wheels are attached to the rotor. Any imperfections in the tone rings, such as a broken tooth or a missing tooth, can cause an inaccurate wheel speed signal.

Tire Size Calibration

The EBCM accepts wheel speed signals from several different sizes of tire and wheel combinations. All vehicles are pre-programmed from the factory with the proper tire size calibration. Whenever you replace the EBCM or change the tire size, you must reset the tire size calibration in the EBCM using the scan tool. Refer to *Scan Tool Diagnosis*. Once programmed, this calibration will remain, even if the battery is disconnected or if the EBCM is removed from the vehicle.

ABS Sysem Operation (Domestic)

ABS Indicator Lamp Operation

The system uses an amber ABS indicator lamp in the instrument cluster in order to show system operation and malfunctions.

Normal Lamp Operation

A bulb check occurs each time the ignition switch is turned to the RUN position. The ANTILOCK and BRAKE lamps should turn on, remain on for about two seconds, then turn off. The ABS indicator lamp also indicates system malfunctions. When the EBCM detects a malfunction in the system, the EBCM turns the ANTILOCK and sometimes the BRAKE lamp on. The lamp may remain on or turn off depending on the malfunction. In order to determine the specific cause of the malfunction, refer to *Diagnostic System Check*.

Tires and ABS

Correct tire size, proper inflation, accurate alignment and even wear are needed for good brake performance. These items are essential for proper ABS performance.

Spare Tire

Use of the spare tire supplied with the vehicle will not affect the performance of the system.

Replacement Tires

If the replacement tires are not the same size as the original tires, you must change the tire size calibration within the EBCM using a *Scan Tool.* Refer to Tire Size Calibration portion of *ABS System Description.* Failure to change the tire calibration when replacing the original tires with a different size tire can affect the performance of the ABS.

Self-Tests

The ABS performs the following two system self-tests:

- The first self-test is performed when the ignition is turned to RUN. Both the ABS indicator lamp and the BRAKE warning lamp will turn on for 2 seconds, then they will turn off. This test confirms correct operation of the EBCM and the lamps. If one of the lamps remains on, either the ABS or the base brake system will require service.
- The second self-test is performed when the vehicle reaches a speed of greater than 4.8 km/h (3 mph). At this time the internal EBCM relay, six solenoid coils and BPMV pump motor are cycled and checked for shorts/opens. The BPMV pump will make a slight sound when this function occurs.

Normal Braking Mode

Refer to Normal Braking Mode in *BPMV Hydraulic Flow Chart.*

During normal braking, pressure is applied through the brake pedal. Fluid travels from the master cylinder (2), through the combination valve (3) and into the BPMV (15). Once in the BPMV, the fluid travels through the normally-open isolation valves (4, 6 and 14), through the normally-closed dump valves (7, 10 and 13) and out into the brakes (8 and 11).

During normal braking, the pumps (5 and 16) are not turned on. The low pressure accumulators (9) are empty. Only residual pressure is stored in these accumulators.

The EBCM constantly monitors wheel speed sensor inputs for rapid deceleration. If the ABS becomes disabled for any reason, the driver will always have base brakes. The normally-open isolation valves and normally-closed dump valves will remain in these positions in order to allow normal fluid pressure to the wheels.

ABS will not operate without wheel slip. The vehicle must be going at least 13 km/h (8 mph) in order to begin ABS operation.

ABS Braking Mode

The ABS will monitor the three-wheel speed sensors and control the hydraulic pressure changes at each wheel until the vehicle has come to a complete stop or until the driver has released the brake pedal. The system operates through the following process:

1. Pressure isolation/maintain
2. Pressure decrease
3. Pressure increase
4. Brake release (fluid return)

Sequence Of Events

1. With the vehicle at 13 km/h (8 mph) or greater, the driver depresses the brake pedal.
2. The wheel speed begins to decrease as the master cylinder pressure and brake pressure increase.
3. As the wheel speed continues to decrease from vehicle speed, the normally-open isolation valve for the affected channel closes to stop additional pressure to the wheel. The master cylinder pressure continues to increase as the driver depresses the pedal, but the wheel brake pressure is now limited to the ABS system pressure.
4. When the EBCM determines that the wheel is about to lock-up, the normally-closed dump valve opens. This bleeds off some of the pressure at the wheel cylinder (or caliper) in order to allow the wheel to return to a speed closer to the speed of the vehicle.
5. The dump valve is again closed and the isolation valve remains closed in order to allow the wheel speed to completely recover from the lock-up.
6. Once the vehicle has recovered from the lock-up tendency, the isolation valve is momentarily pulsed open in order to allow the master cylinder pressure and pump pressure to reach the brakes. This controlled pressure rise continues until the wheel is at optimum brake output or until the brake pressure is brought up to master cylinder output pressure. The ABS allows the brake fluid to flow to the wheel, build pressure and try to force another departure, repeating Step 3 through Step 6. The following paragraphs describe the various modes in detail.

Isolation Mode (Pressure Maintain)

Refer to Isolation Mode in *BPMV Hydraulic Flow Chart.*

Isolation will occur when the driver applies excessive braking for the given road conditions, causing the wheels to decelerate at a rate which exceeds the vehicle's capability.

If the information from the wheel speed sensors indicate excessive wheel deceleration (imminent lock-up), the first step in the antilock sequence is to isolate the brake pressure being applied by the driver.

The EBCM applies a voltage to the isolation coil in order to close the isolation valve (4). This will prevent any additional brake pressure applied by the driver from reaching the wheel. With the isolation valve closed, further increases in brake pressure from the driver will be prohibited.

Dump Mode (Pressure Decrease)

Refer to Dump Mode in *BPMV Hydraulic Flow Chart.*

Once the pressure is isolated, it must be reduced in order to get the wheels rolling once again. Reducing pressure is accomplished by dumping a portion of the brake fluid pressure into a low pressure accumulator (LPA).

The EBCM energizes the dump valve coil(s) in order to open the dump valve (5), allowing fluid from the wheels to be dumped into the LPA (6). Very short activation pulses open and close the dump valve passageway in order to control this action. Brake pressure is lowered at the wheel and allows the affected wheel to begin rolling again.

The fluid taken from the wheels forces a spring back. The fluid is stored in the LPA at approximately 1034 kPa (150 psi). A portion of the fluid also primes the pump (3) so it can begin building reapply pressure. The dump valves are opened independently in order to control the deceleration of the wheel.

Reapply Mode (Pressure Increase)

Refer to Reapply Mode in *BPMV Hydraulic Flow Chart.*

The reapply sequence is initiated in order to obtain optimum braking at each wheel. The isolation valve (4) is momentarily pulsed open in order to allow the master cylinder (2) and pump (3) pressure to reach the brakes. This controlled pressure rise continues until the wheel is at optimum brake output or until the brake pressure is brought up to the master cylinder output pressure.

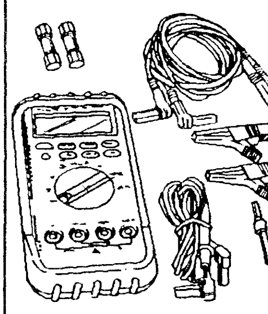
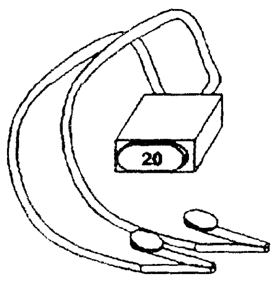
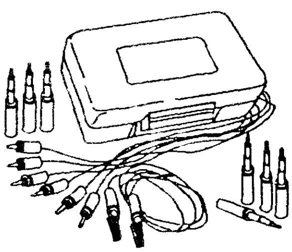
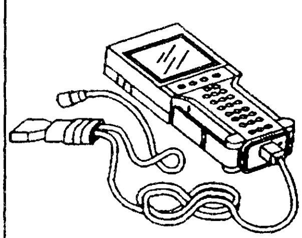
If more pressure is required, more fluid is drawn from the master cylinder and applied to the brakes. The driver will feel pedal pulsations or pedal drop. This is normal and expected when in the antilock mode.

As fluid is reapplied, the wheels begin to slow down at the optimum rate. If the wheels approach imminent lock-up again, the module will isolate, dump and reapply. These control cycles (isolation, dump and reapply) occur in millisecond intervals, allowing several cycles to occur each second.

Brake Release

At the end of the antilock stop, when the driver releases the brake pedal, the motor will remain on for a short time in order to help drain any fluid left in the LPA. As the fluid drains back into the system, the spring force in the LPA pushes the piston to the home position. The isolation valve is turned off and fluid returns through the isolation orifice.

Special Tools and Equipment

Illustration	Tool Number/ Description
 3430	J 39200 Digital Multi-Meter
 1025	J 36169 Fused Jumper Wire
 11799	J 35616 Connector Adapter Test Kit
 39438	Tech 2 or Tech 2 Flash

Section 5

Brakes

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Antilock Brake System

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Combination Valve to BPMV	16 N·m	12 lb ft
EBCM Bracket Mounting Bolts	36 N·m	28 lb ft
EBCM to BPMV	5 N·m	44 lb in
EHCU to Bracket	9 N·m	7 lb ft
EHCU Crossmember Bolts	36 N·m	28 lb ft
Front Brake Line to Combination Valve	24 N·m	18 lb ft
Front Wheel Speed Sensor Mounting Bolts	26 N·m	19 lb ft
Hydraulic Lines to Tube Adapters	30 N·m	22 lb ft
Rear Brake Line to Combination Valve	24 N*m	18 lb ft
Splash Shield Mounting Bolts	11 N·m	9 lb ft
Tube Adapters to BPMV	31 N·m	23 lb ft
Wheel Speed Sensor Harness Clip to Shock Tower	11 N·m	9 lb ft

ABS Diagnostic Specifications

WSS Temperature vs. Sensor Resistance

°C	°F	Ohms
Temperature vs Resistance Values (Approximate)		
−40 to 4	−40 to 40	1575 to 2420
5 to 43	41 to 110	1980 to 2800
44 to 93	111 to 200	2250 to 3280
94 to 150	201 to 302	2750 to 3850

Service Parts Group Numbers

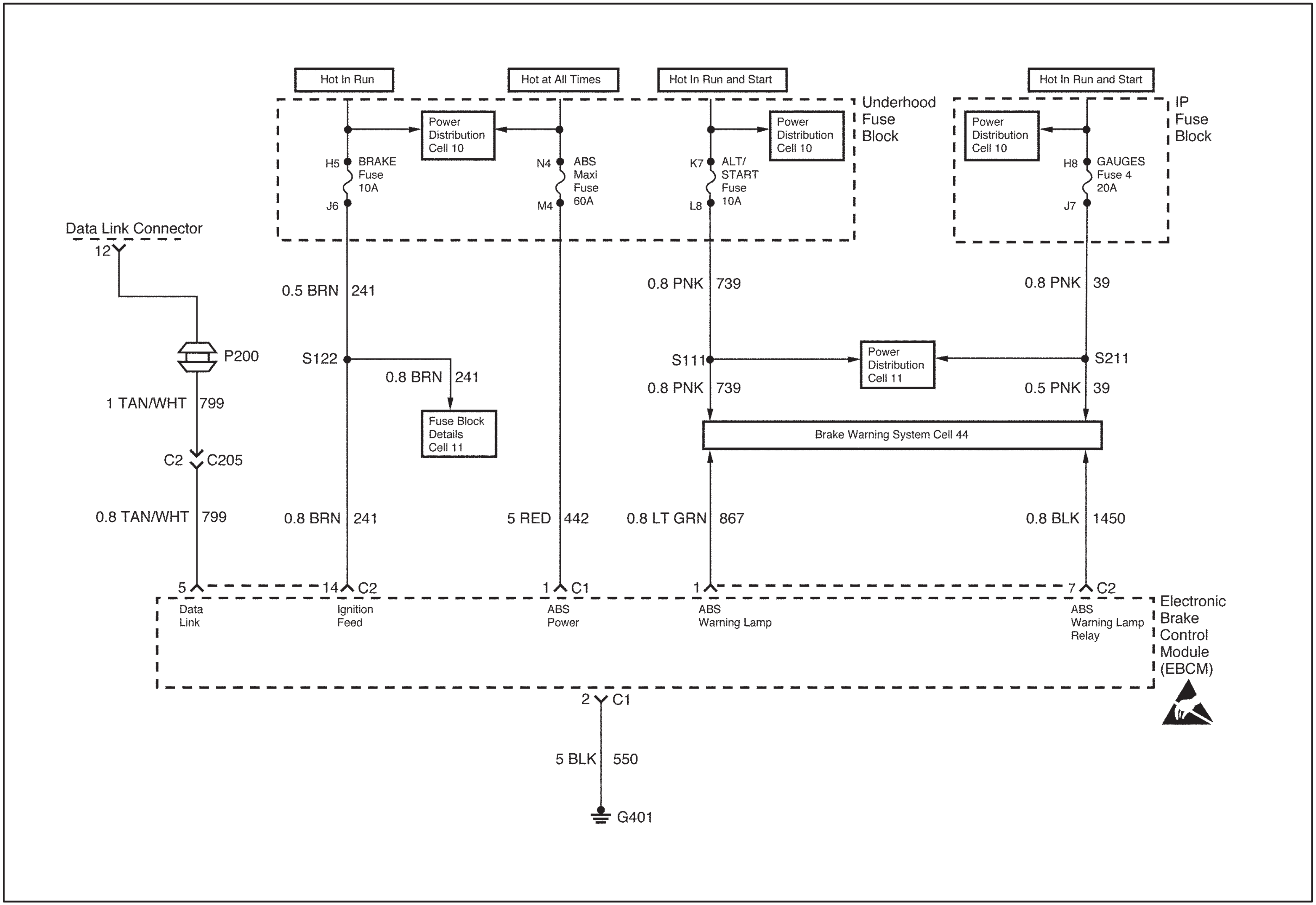
Application	Service Parts Group Number
Brake Pressure Modulator Valve	4.730
Electronic Brake Control Module	4.720
Stoplamp Switch	2.447
Wheel Speed Sensor	4.710

Schematic and Routing Diagrams

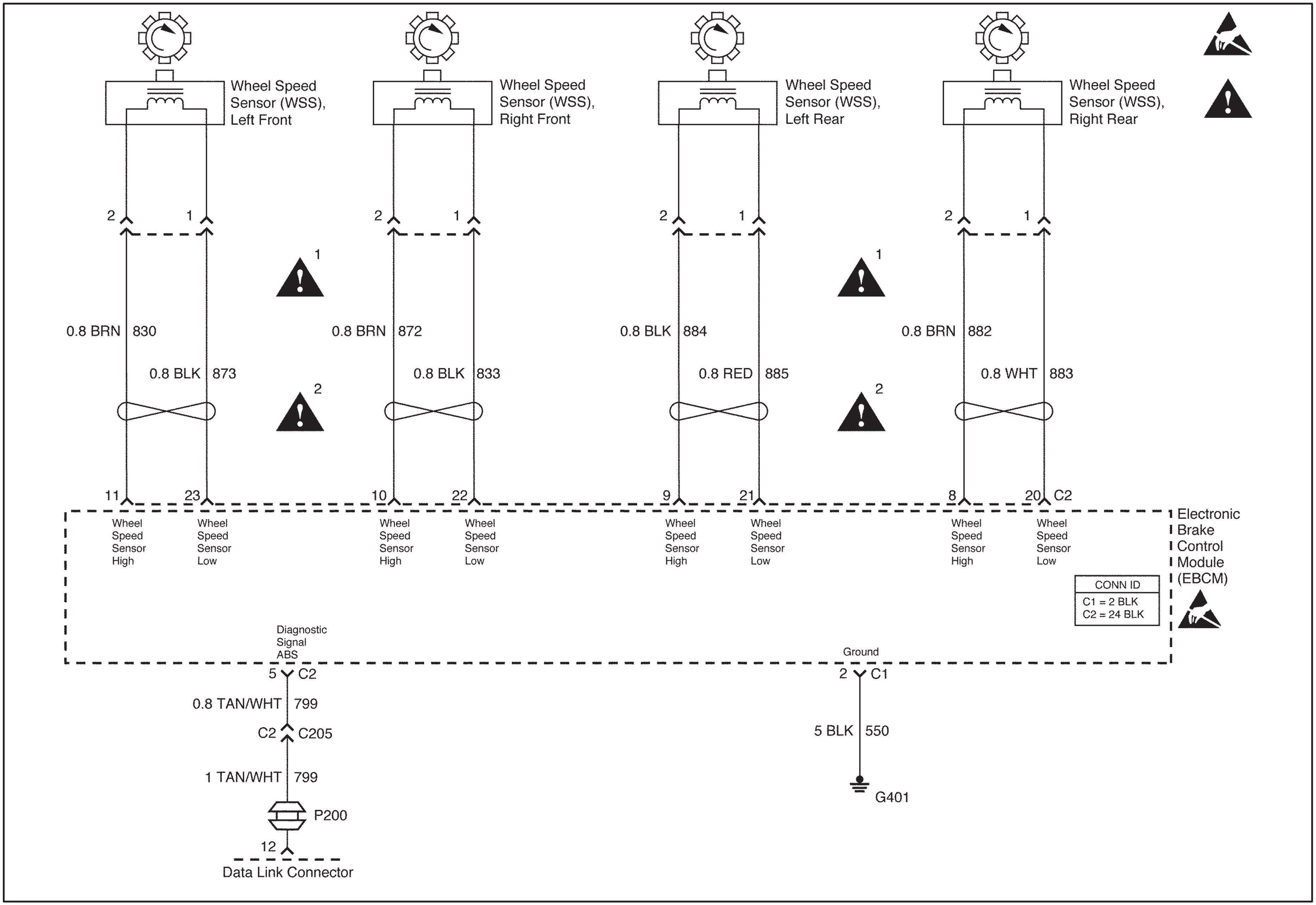
ABS Schematic Icons

Icon	Icon Definition
 19384	Refer to *ESD Notice* in Cautions and Notices in the WCC Service Manual.
 296880	**Important:** The wheel speed sensor (WSS) pigtail has female terminals. The ABS harness has female terminals. A Delphi© coupling with male terminals (P/N 12146445) is used to make the two harnesses. Be sure to check the connectors at both ends of this coupling during a visual diagnostic inspection of these circuits.
 296880	**Important:** Twisted-pair wires provide an effective “shield” that helps protect sensitive electronic components from electrical interference. Depending on application, twisted-pair wires are used on wiring harnesses connecting the following components: electronic brake control module (EBCM) wheel speed sensor (WSS). In order to prevent electrical interference from degrading the performance of the connected components, you must maintain the proper specification when making any repairs to the twisted-pair wires shown: • The wires must be twisted a minimum of nine (9) turns per 30.5 cm (12 in) as measured anywhere along the length of the wires. • The outside diameter of the twisted wires must not exceed 6.0 mm (0.236 in). Refer to *Splicing Twisted or Shielded Cable* in Wiring Systems.

Antilock Brake System Schematics (P22 Motorhome) (Cell 44: Power Distribution/Ground Distribution)

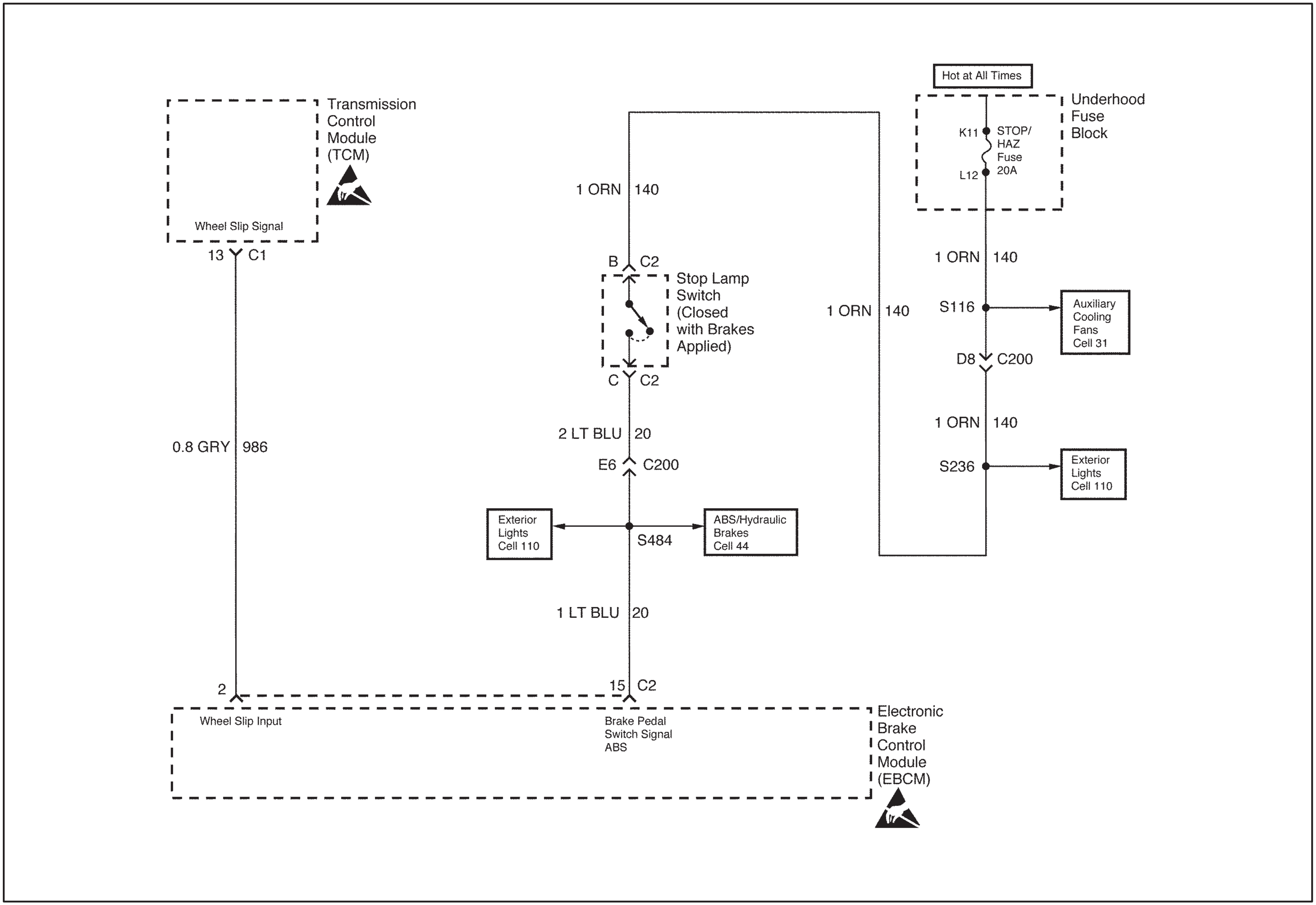


Antilock Brake System Schematics (P22 Motorhome) (Cell 44: DLC, EBCM, EBCM Grounds and Wheel Speed Sensors)



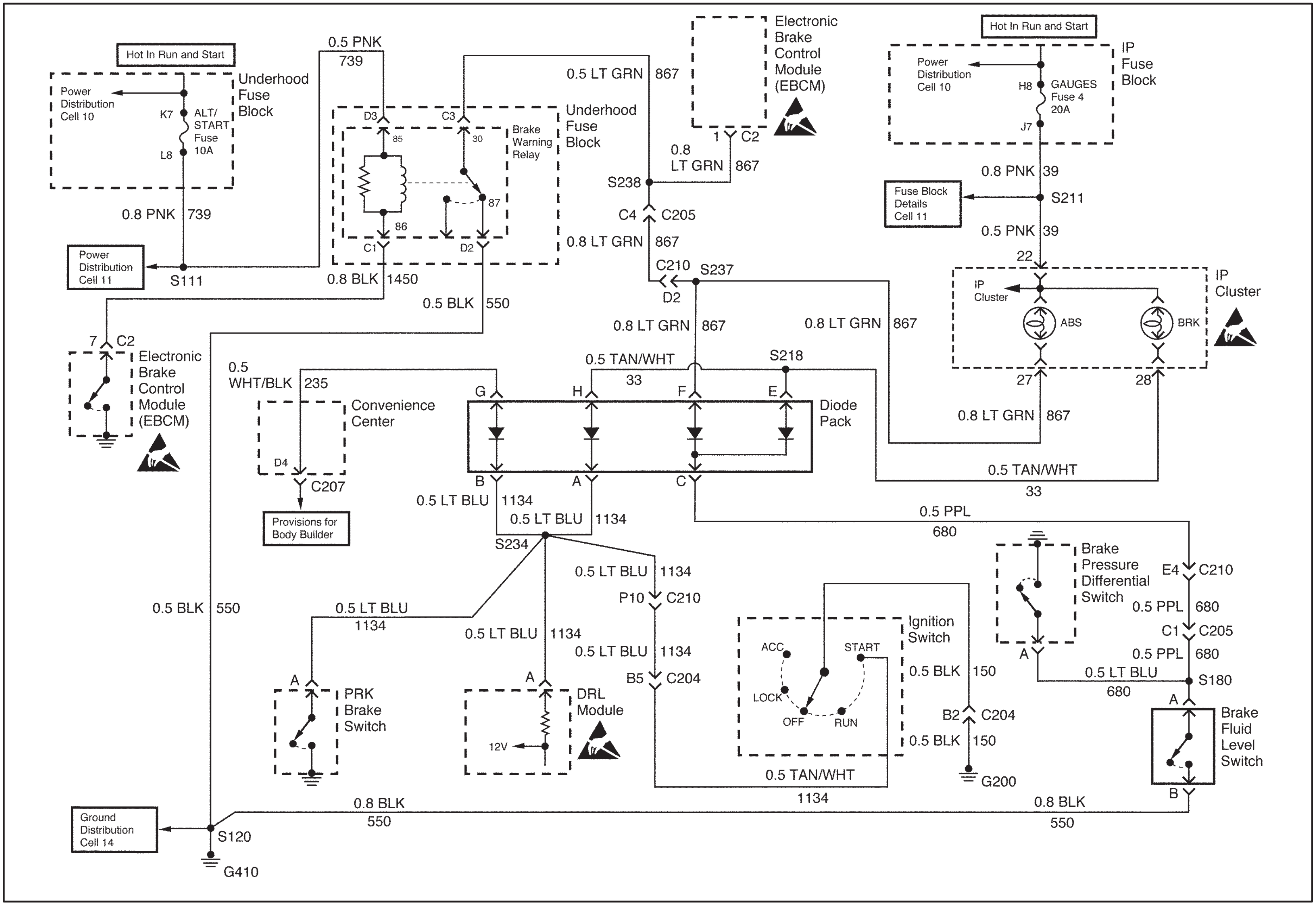
WRK55002

Antilock Brake System Schematics (P22 Motorhome) (Cell 44: Transmission Control Module and Stop Lamp Switch)



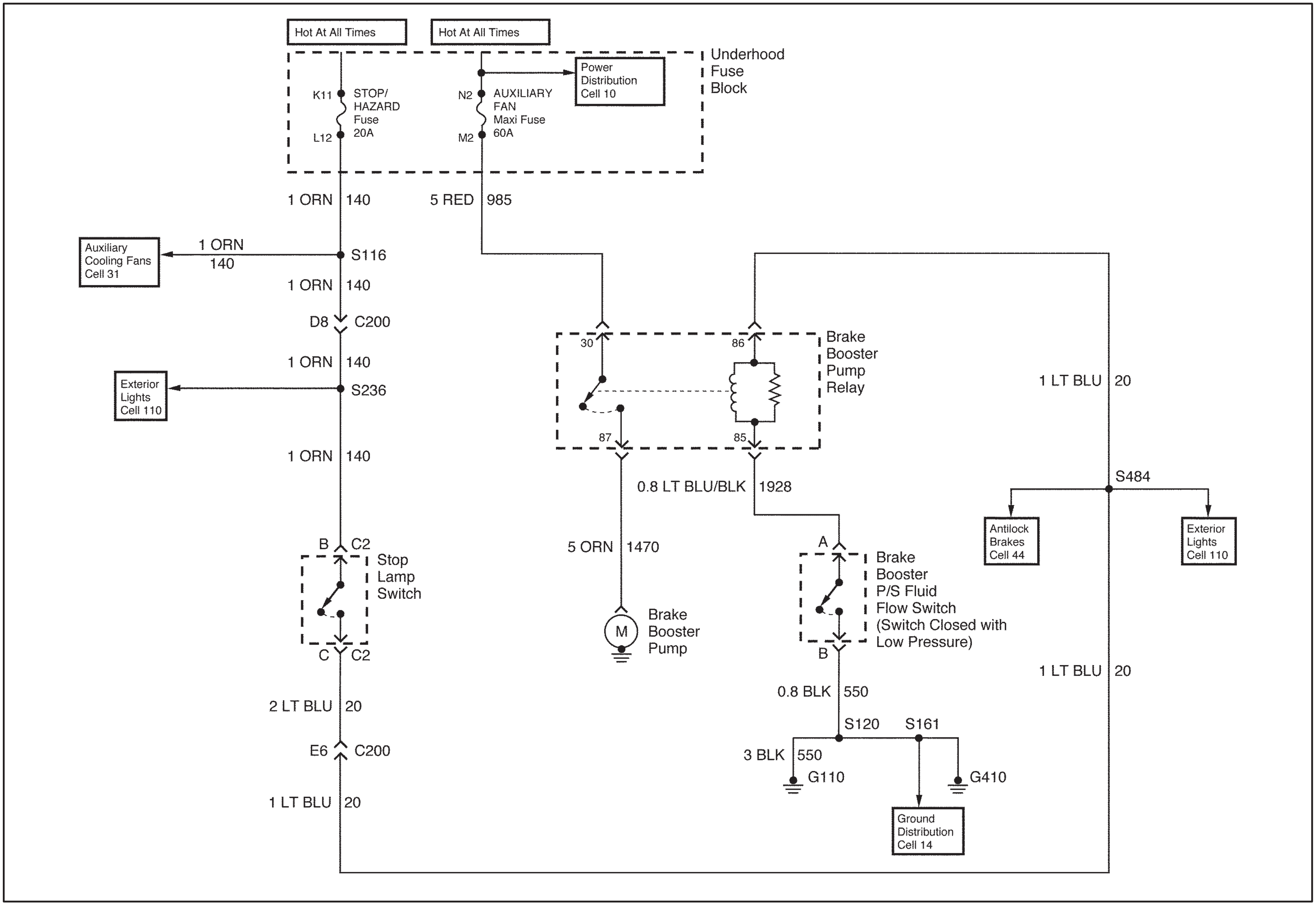
WRK55003

Antilock Brake System Schematics (P22 Motorhome) (Cell 44: Brake Warning System)



WRK55004

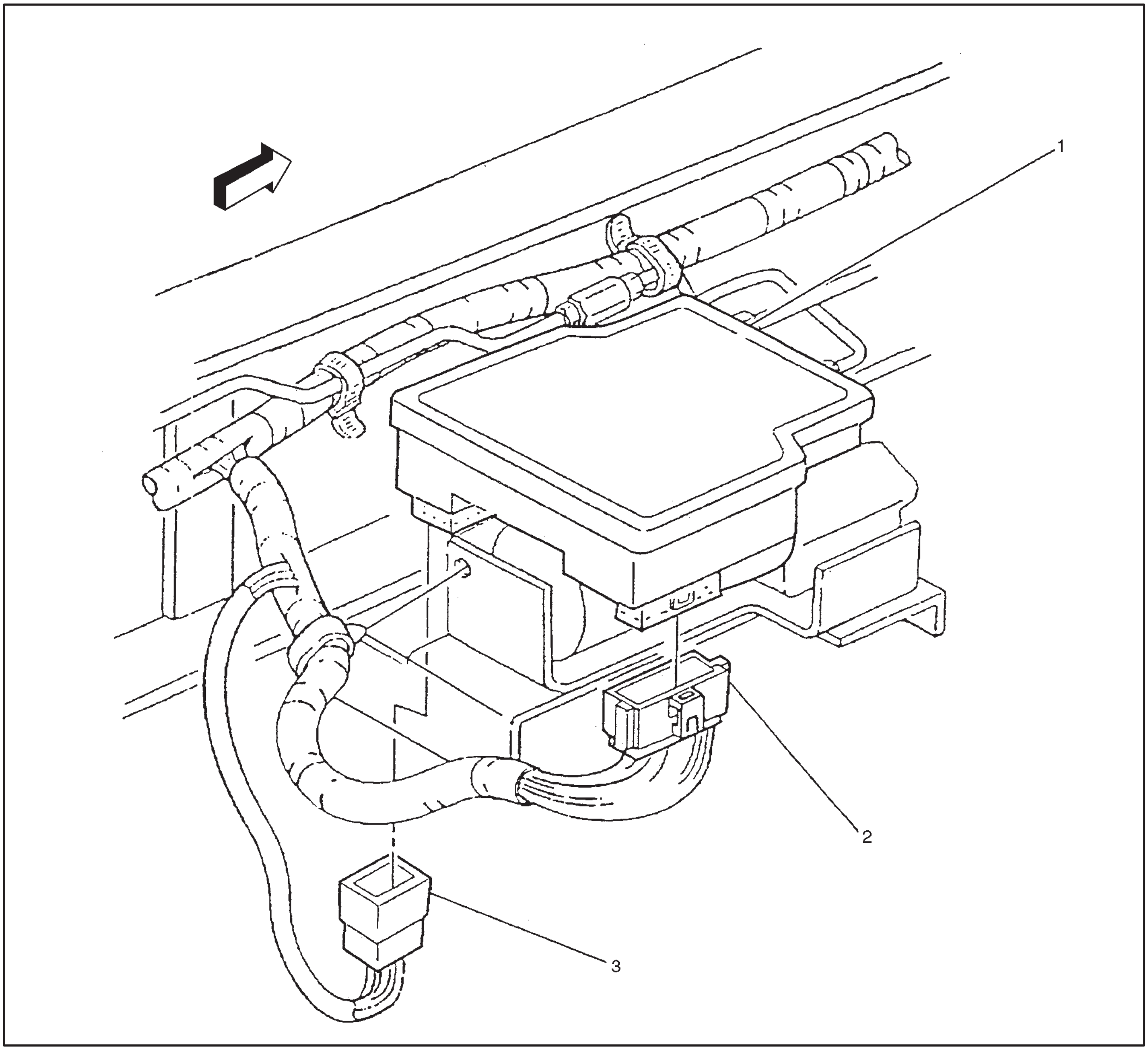
Antilock Brake System Schematics (P22 Motorhome) (Cell 44: Brake Booster Pump)



WRK55005

ABS Component Views

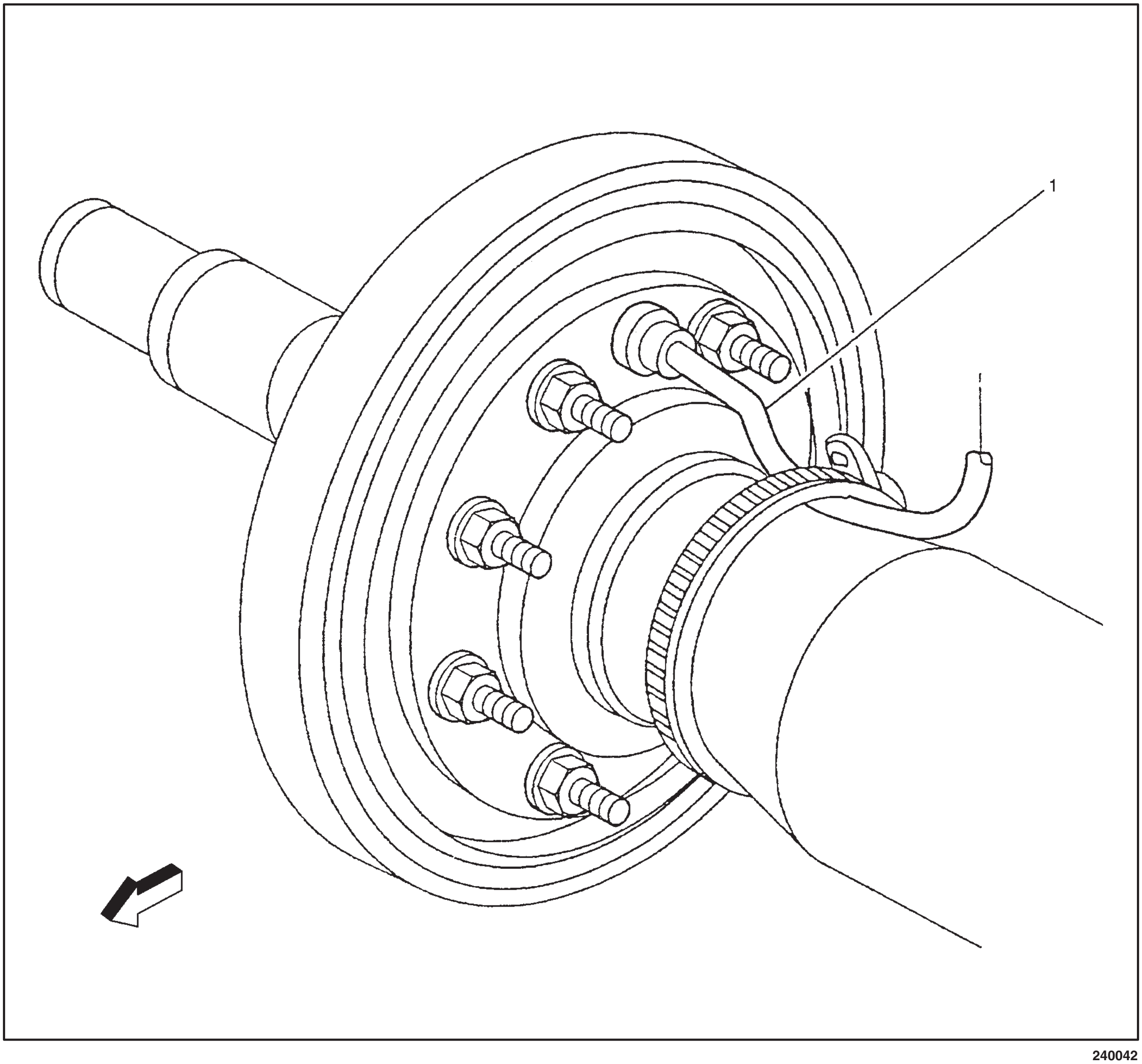
ABS-Hydraulic Harness to Electronic Brake Control Module (EBCM), Right Side Forward View



Legend

(1) Electronic Brake Control Module (EBCM)
(2) EBCM C2 (24 cavities)
(3) EBCM C1 (2 cavities)

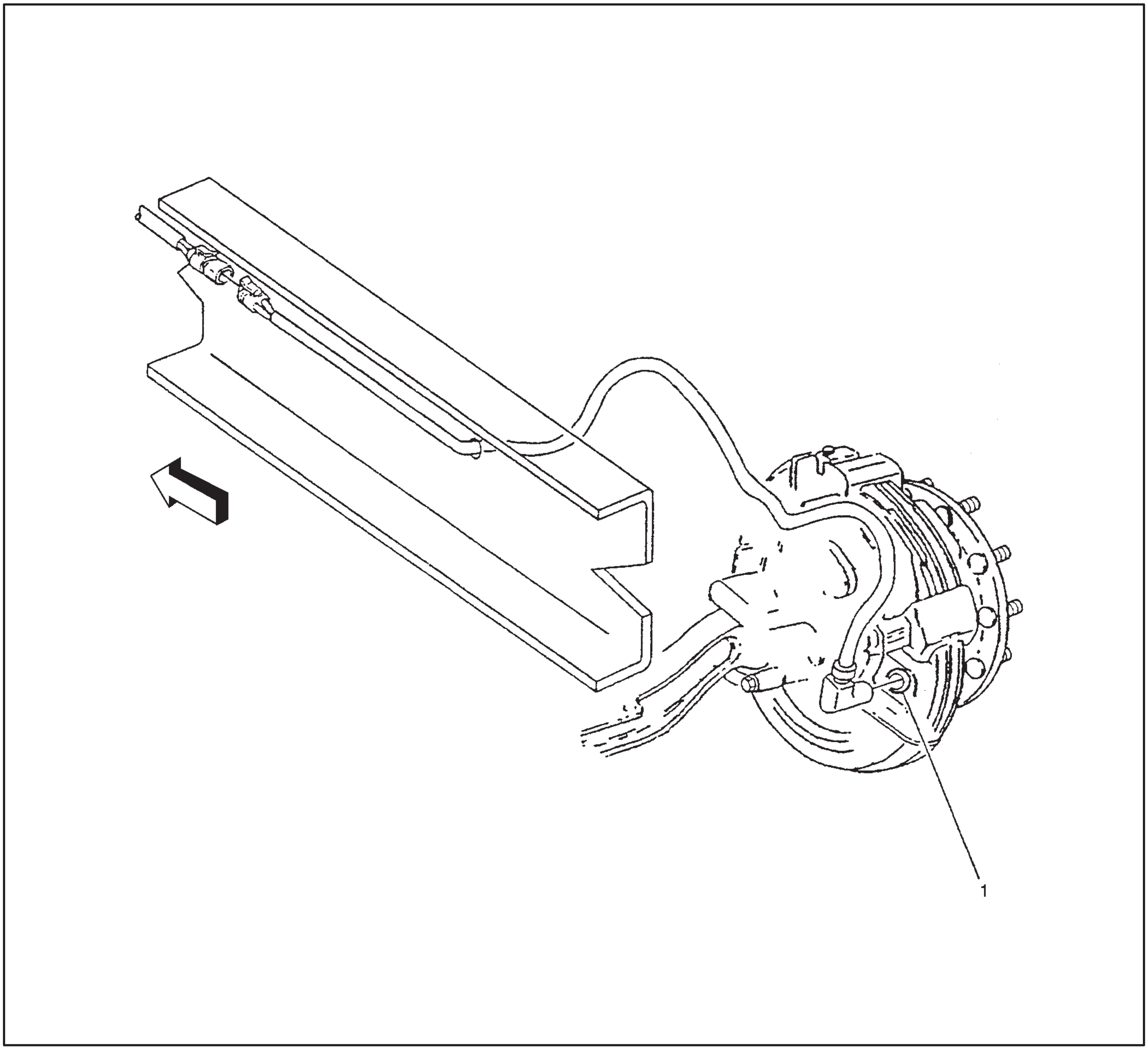
Rear Wheel Speed Sensor (WSS)



Legend

(1) Rear Wheel Speed Sensor (WSS)

Front Wheel Speed Sensor (WSS)

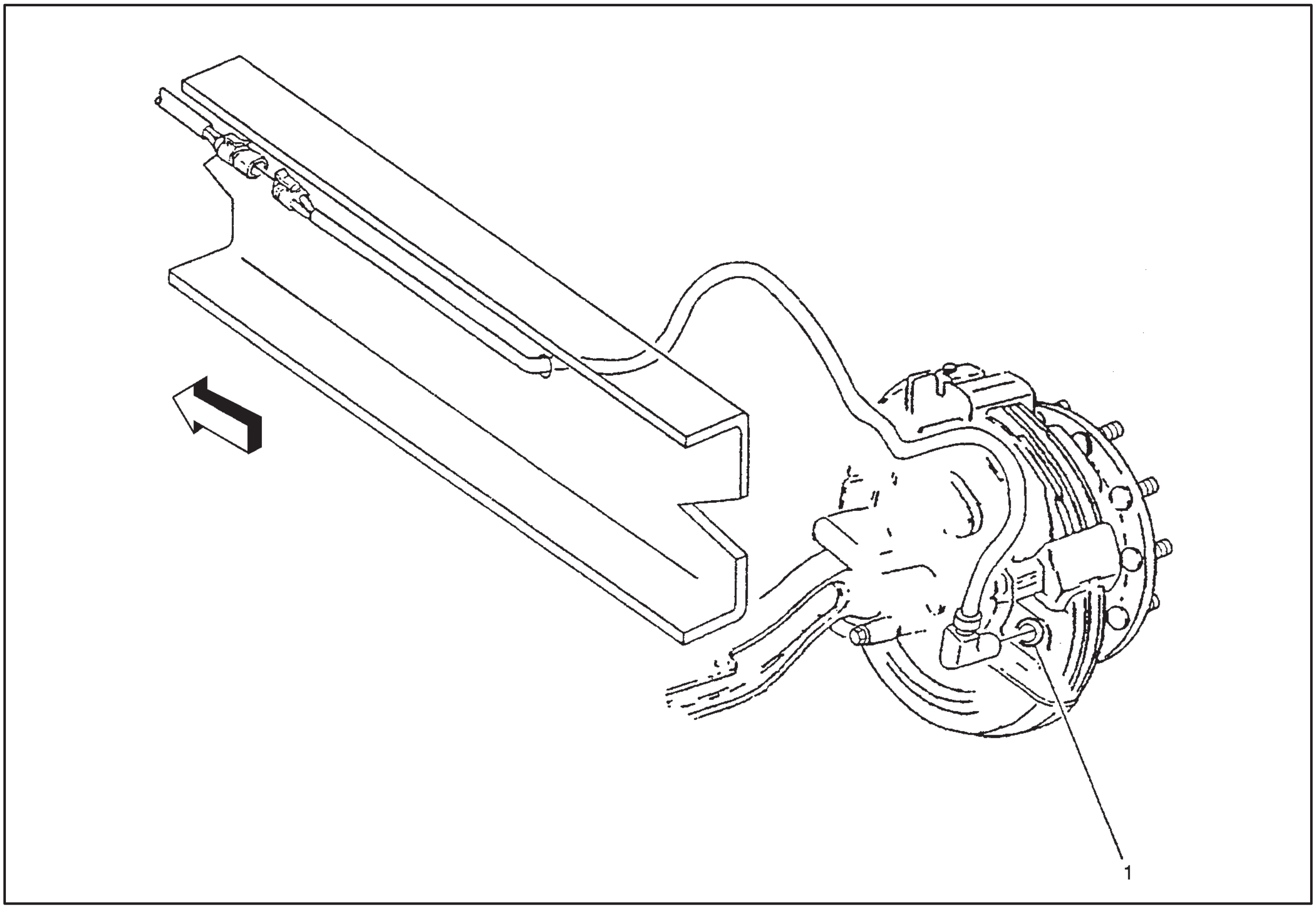


231740

Legend

(1) Right Side Front Wheel Speed Sensor (WSS)

Rear Wheel Speed Sensors (WSS), RH View

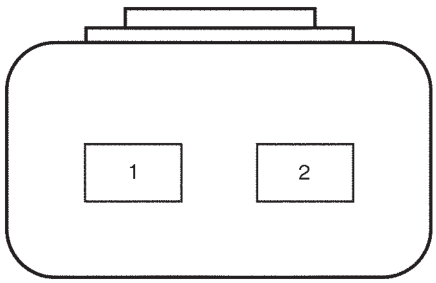


Legend

(1) Left Side Rear Wheel Speed Sensor (WSS)

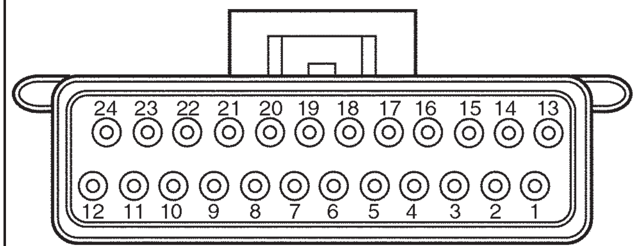
Antilock Brake System Connector End Views

Electronic Brake Control Module (EBCM) Connector C1



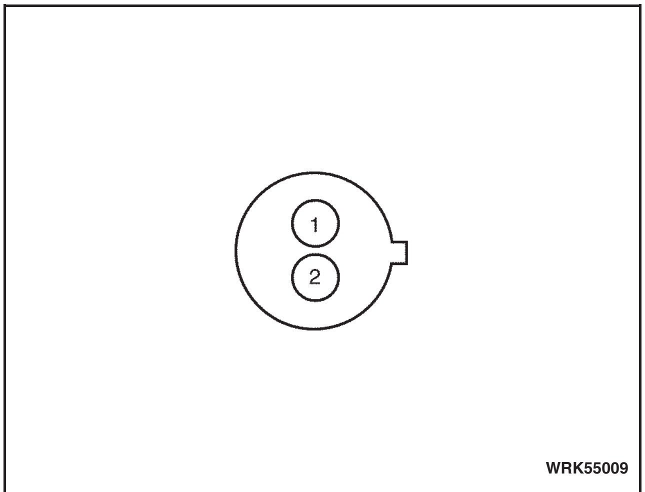
Connector Part Information	• 2 Way (BLK)		
Pin	Wire Color	Circuit No.	Function
1	RED	442	Pump Motor Power Feed
2	BLK	550	Ground

Electronic Brake Control Module (EBCM) Connector C2



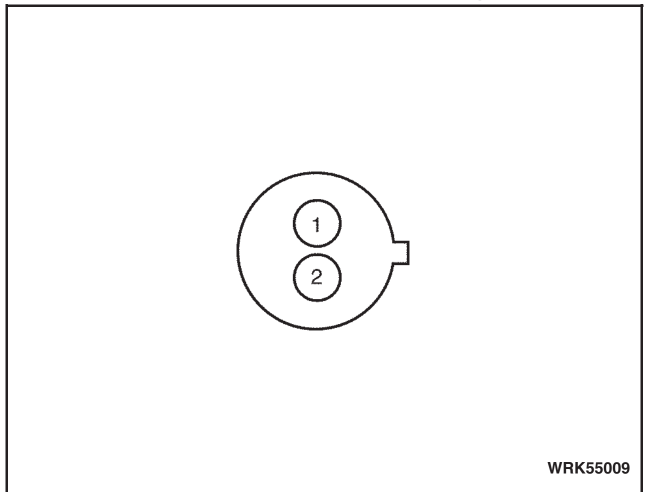
Connector Part Information	• 24 Way (BLK)		
Pin	Wire Color	Circuit No.	Function
1	LT GRN	867	ABS Indicator Lamp Monitor
2	GRY	986	Wheel Slip Signal Output
3	—	—	Not Used
4	—	—	Not Used
5	TAN/WHT	799	Serial Data Communication
6	—	—	Not Used
7	BLK	1450	ABS Warning Lamp Relay
8	BRN	882	Right Rear Wheel Speed Sensor High
9	BLK	884	Left Rear Wheel Speed Sensor High
10	DK GRN	872	Right Front Wheel Speed Sensor High
11	LT BLU	830	Left Front Wheel Speed Sensor High
12	—	—	Not Used
13	—	—	Not Used
14	BRN	241	Switched Ignition Feed Input
15	LT BLU	20	Stop Lamp Switch Input (Brake Switch)
16	—	—	Not Used
17	—	—	Not Used
18	—	—	Not Used
19	—	—	Not Used
20	WHT	883	Right Rear Wheel Speed Sensor Low
21	RED	885	Left Rear Wheel Speed Sensor Low
22	TAN	833	Right Front Wheel Speed Sensor Low
23	YEL	873	Left Rear Wheel Speed Sensor Low
24	—	—	Not Used

Wheel Speed Sensor (WSS) Left Rear



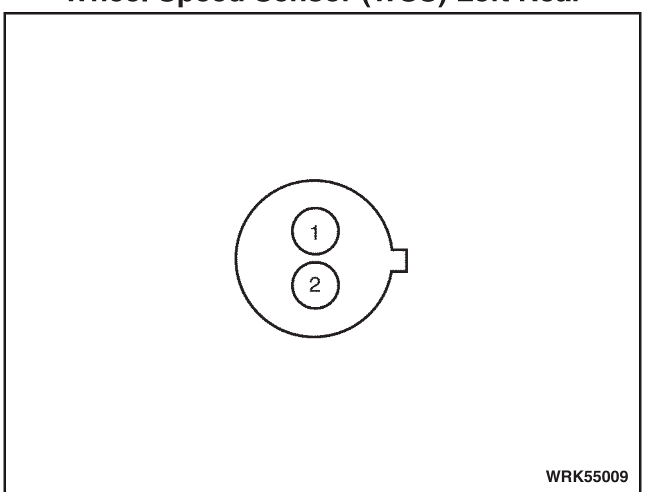
Connector Part Information	• 15339791		
Pin	**Wire Color**	**Circuit No.**	**Function**
1	RED	885	Wheel Speed Sensor Return Left Rear
2	BLK	884	Wheel Speed Sensor Signal Left Rear

Wheel Speed Sensor (WSS) Right Front



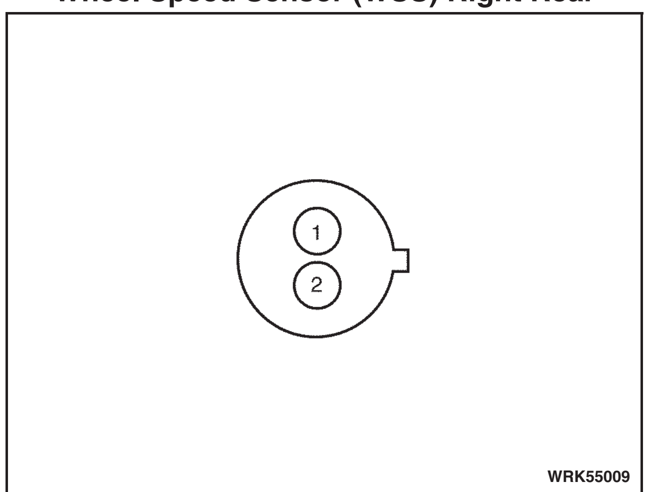
Connector Part Information	• 15339791		
Pin	**Wire Color**	**Circuit No.**	**Function**
1	DK GRN	872	Wheel Speed Sensor Signal Right Front
2	TAN	833	Wheel Speed Sensor Return Right Front

Wheel Speed Sensor (WSS) Left Rear



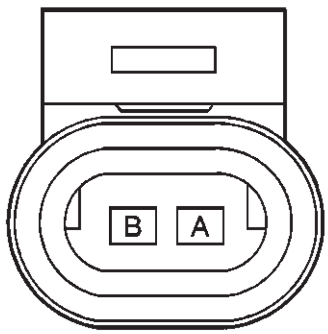
Connector Part Information	• 15339791		
Pin	**Wire Color**	**Circuit No.**	**Function**
1	YEL	873	Wheel Speed Sensor Return Left Front
2	LT BLU	830	Wheel Speed Sensor Signal Left Front

Wheel Speed Sensor (WSS) Right Rear



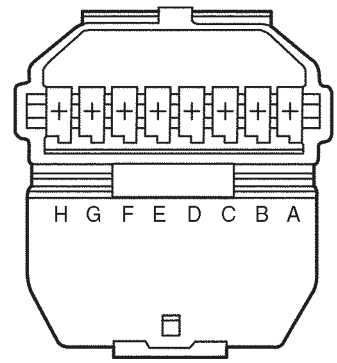
Connector Part Information	• 15339791		
Pin	**Wire Color**	**Circuit No.**	**Function**
1	WHT	883	Wheel Speed Sensor Return Right Rear
2	BRN	882	Wheel Speed Sensor Signal Right Rear

Brake Fluid Level Switch



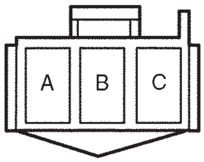
Connector Part Information	• 12162194 • 2 Way F Metri-Pack 150 Series, Sealed (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PPL	680	Brake Fluid Level Switch Output Brake Warning Indicator Lamp
B	BLK	550	Ground

Diode Network



Connector Part Information	• 12015308 • 8 Way F Edgeboard Series, Standard (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	1134	Park Brake Input
B	LT BLU	1134	Park Brake Input
C	PPL	680	Brake Fluid Level Input
D	—	—	Not Used
E	TAN/WHT	33	Brake Lamp Control
F	LT GRN	867	ABS Lamp Control
G	WHT/BLK	235	Body Builder
H	TAN/WHT	33	Brake Lamp Control

Stop Lamp Switch C2



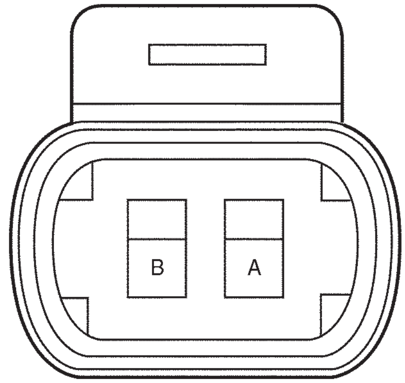
Connector Part Information	• 2 Way (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	WHT	17	Stop Lamp Output
B	ORN	140	Switch Feed
C	LT BLU	20	CHMSL Output

Pressure Differential Switch

NO ART AVAILABLE

Connector Part Information	• 2 Way F Insert Molded Style (NAT)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	680	Pressure Signal
B	—	—	Not Used

Hydrobooster P/S Fluid Flow Switch



Connector Part Information	• 12162196 • 2-Way F Metri-Pack 150.2 Series (GRY)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU/BLK	1928	Brake Booster Pump Relay Control
B	BLK	550	Ground to G110/G140

Diagnostic Information and Procedures

A Diagnostic Starting Point

The Diagnostic System Check will provide the following information:

- Identification of the control module(s) which command the system.
- The ability of the control module(s) to communicate through the serial data circuit.
- Identification of stored diagnostic trouble codes (DTCs) and their status.

The use of the ABS Diagnostic System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

Scan Tool Diagnostics

Refer to the *Scan Tool Manual* for complete information on scan tool diagnostics.

F0 – Diagnostic Trouble Codes (DTC)

The Diagnostic Trouble Codes (DTC) function has three modes that are described below:

- DTC Information: In this mode, current or history DTC(s) stored by the EBCM can be displayed.
- History Data: In this mode, DTC data is stored for the last 12 DTC events. This data includes the following information at the time when the DTC(s) was set:
  - The DTC number
  - Number of occurrences of the DTC
  - Number of ignition cycles since last occurrence
  - Was EBCM in an ABS mode when the DTC occurred
  - Composite vehicle speed (3 speed sensor inputs, averaged) when the DTC occurred
  - Was vehicle in a 4WD when the DTC occurred
  - Brake switch status
  - Differential Pressure switch status
- Clear DTC Information: In this mode, current and history DTCs are cleared. History data is not cleared from the EBCM.

F1 – Data Display

The Data Display function contains two special function “hot keys,” and a data list which details ABS parameters. The hot keys perform the following functions:

- DTCs – used to instantly read stored DTCs
- Quick Snap – used to record instant events

F2 – Special Functions

In this test mode, the scan tool can be used to perform functional tests on the ABS which help verify proper operation. Malfunction conditions can be further identified by testing and observing the test results. DTCs must be cleared before any tests in Special Functions can be performed. In a vehicle equipped with ABS, the Special Functions are grouped as following:

ABS

- Function Test
- Automated Bleed
- ABS Motor
- System Identification
- Tire Size Calibration
- ABS Lamp
- Solenoid Tests (for all Dump and Isolation solenoid valves)
- ABS Relay
- Brake Lamp

Function Test

The Function Test cycles each valve solenoid and the pump motor (as well as the necessary relays) to check component operation. If a malfunction is detected, the EBCM will set DTC(s), which will be displayed upon completion of the test. Perform the test as follows:

1. Ignition OFF.
2. Install the scan tool.
3. Turn ignition to RUN.
4. Select the scan tool’s Special Functions.
5. Select the Function Test.
6. Run the Function Test.
7. Note any DTCs set.

Automated Bleed

Automated Bleed cycles each valve solenoid and the pump motor in a special sequence (as well as the necessary relays) in order to bleed air out of the BPMV after removal or installation of brake lines, or BPMV replacement. Perform the test as follows:

1. Ignition OFF.
2. Install the scan tool.
3. Turn ignition to RUN.
4. Select the scan tool’s Special Functions.
5. Select the Automated Bleed function.
6. Run the Automated Bleed function.

ABS Motor

This function tests the ABS pump motor to check component operation. If a malfunction is detected, the EBCM will set DTC(s), and the ABS indicator lamp will turn on. Perform the test as follows:

1. Ignition OFF.
2. Install the scan tool.
3. Turn ignition to RUN.
4. Select the scan tool’s Special Functions.
5. Select the ABS Motor Test.
6. Run the ABS Motor Test.

System Identification

This function is used to identify the hardware and software revision of the EHCU.

1. Ignition OFF.
2. Install the scan tool.
3. Turn ignition to RUN.
4. Select the scan tool's Special Functions.
5. Select System Identification.
6. Make note of the relevant information.

Tire Size Calibration

This function allows the EBCM tire size to be set or changed when a new EBCM is installed, or different tires/wheels are installed on the vehicle.

1. Turn ignition OFF.
2. Install the scan tool.
3. Turn ignition to RUN.
4. Select the scan tool's Special Functions.
5. Select Tire Size Calibration..
6. Make the necessary changes to existing tire size setting.

ABS Lamp

This test allows activation of the ABS indicator. The ABS Lamp test aids in diagnosing indicator malfunctions. The test allows the operator to turn the indicator on and off manually.

BRAKE Lamp

This test allows activation of the BRAKE indicator. The BRAKE Lamp test aids in diagnosing indicator malfunctions. The test allows the operator to flash the indicator on and off manually.

Solenoid Tests (Isolation Valves)

The Solenoid Test for isolation valves activates the selected wheel circuit Isolation valve, placing it in the pressure hold position. When in the pressure hold position, the valve will not allow master cylinder pressure to be delivered to the hydraulic wheel circuit. This is done under ABS operating conditions because the EBCM has determined that the wheel is moving too slowly, so it holds additional master cylinder pressure from it in an attempt to allow it to rotate at an appropriate speed. The scan tool commands the valve to close, which should allow the technician to spin the wheel even though an assistant is applying pressure to the brake pedal. Perform the test as follows:

1. Ignition OFF.
2. Install the scan tool.
3. Turn ignition to RUN.
4. Raise vehicle such that wheels are about 6 inches off the floor with the transmission in neutral.
5. Select the scan tool's Special Functions.
6. Select the desired Isolation Solenoid test. Have an assistant command the Isolation valve ON with the scan tool.
7. Have the assistant press and hold the brake pedal.
8. Attempt to move the wheel being tested by hand; it should move even though the assistant is applying pressure to the brake pedal. The wheels may be difficult to turn by hands, but can be moved if the system is working properly.

Solenoid Tests (Dump Valves)

The Solenoid Test for Dump valves activates the selected hydraulic wheel circuit Dump valve, placing it in the pressure release position. When in the pressure release position, the valve will allow wheel caliper pressure to be returned to the master cylinder circuit. This is done under ABS operating conditions because the EBCM has determined that the wheel is moving too slowly, and holding additional master cylinder pressure from it has not allowed it to rotate at an appropriate speed. The scan tool commands the valve to release hydraulic pressure to the affected brake caliper, which should allow the technician to spin the wheel even though an assistant is applying pressure to the brake pedal. Perform the test as follows:

1. Ignition OFF.
2. Install the scan tool.
3. Turn ignition to RUN.
4. Raise vehicle such that wheels are about 6 inches off the floor with the transmission in neutral.
5. Have an assistant press and hold the brake pedal.
6. Select the scan tools Special Functions.
7. Select the desired Dump Solenoid Test. Have the assistant command the Dump valve ON with the scan tool.
8. Attempt to move the wheel being tested by hand; it should move even though the assistant is applying pressure to the brake pedal. The wheels may be difficult to turn by hands, but can be moved if the system is working properly.

ABS Relay

This function allows.

1. Ignition OFF.
2. Install the scan tool.
3. Turn ignition to RUN.
4. Select the scan tool's Special Functions.
5. Select the ABS Relay.
6. Take note of the relay status as the relay is cycled.

F3 – Snapshot

In this test mode, the scan tool captures the data listed in the data displays before and after a snapshot.

The following triggering conditions are available:

- DTC – In this mode, the snapshot will be triggered on a specific (operator selected) DTC.
- Any DTC – in this mode, the snapshot will trigger on any DTC.
- Auto Trigger – will trigger a snapshot under two conditions:
  - Wheel speed out of range – Snapshot will trigger when a WSS/VSS input is +/– 7 mph out of range in relation to other WSS/VSS inputs.
  - ABS Stop – Snapshot will trigger when an ABS event occurs.

Self-Diagnostics

The EBCM performs self-diagnostics of the ABS. The EBCM detects and isolates system failures. When a malfunction is detected, the EBCM sets a corresponding diagnostic trouble code (DTC).

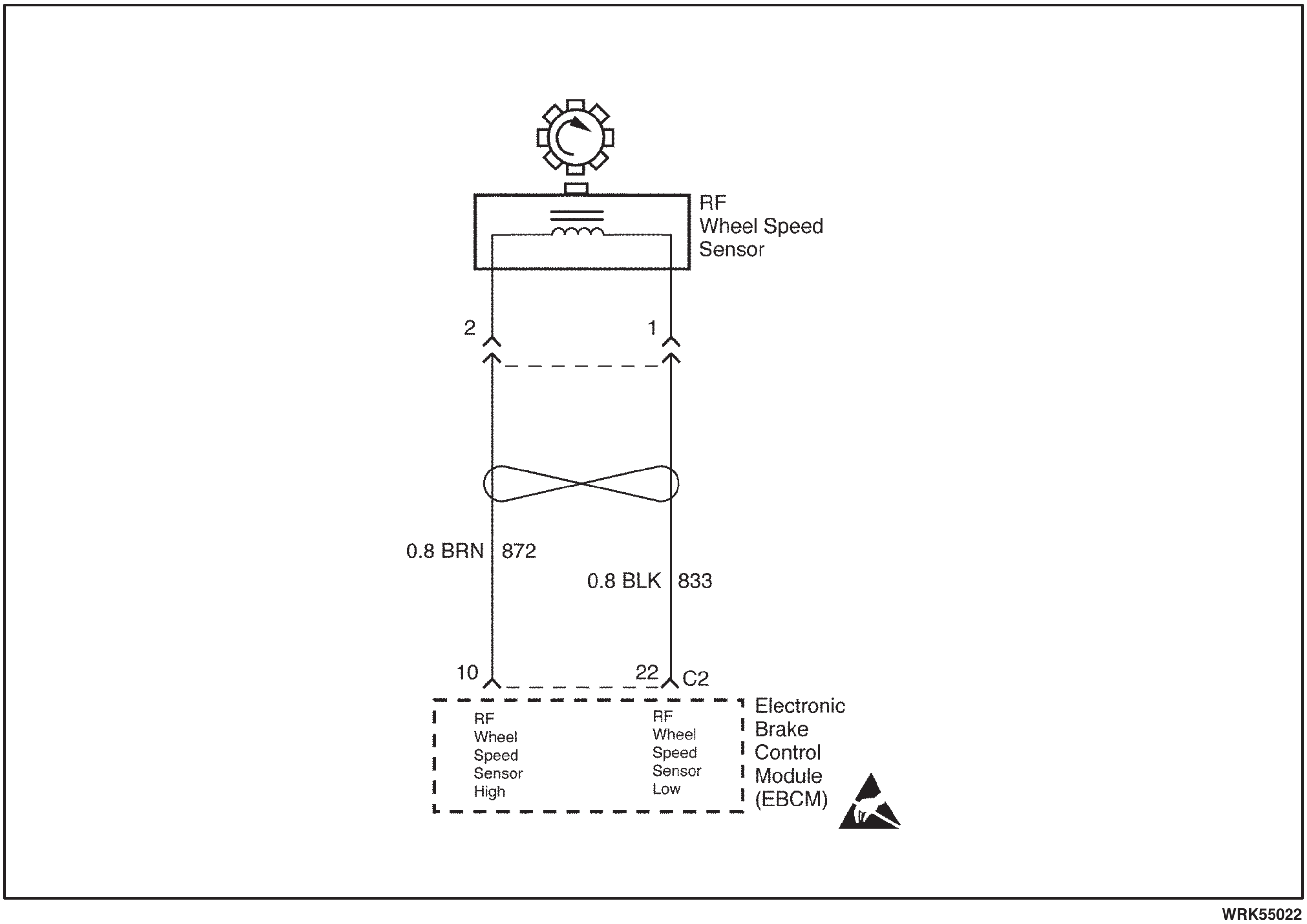
Diagnostic Trouble Code (DTC) List

DTC	Description
DTC 21	*Right Front Wheel Speed Sensor Circuit Open or Shorted to Battery*
DTC 22	*Right Front Wheel Speed Signal Missing*
DTC 23	*Right Front Wheel Speed Signal Erratic*
DTC 25	*Left Front Wheel Speed Sensor Circuit Open or Shorted to Battery*
DTC 26	*Left Front Wheel Speed Signal Missing*
DTC 27	*Left Front Wheel Speed Signal Erratic*
DTC 31	*Right Rear Wheel Speed Sensor Circuit Open or Shorted to Battery*
DTC 32	*Right Rear Wheel Speed Signal Missing*
DTC 33	*Right Rear Wheel Speed Signal Erratic*
DTC 35	*Left Rear Wheel Speed Sensor Circuit Open or Shorted to Battery*
DTC 36	*Left Rear Wheel Speed Signal Missing*
DTC 37	*Left Rear Wheel Speed Signal Erratic*
DTC 38	*Wheel Speed Signal Malfunction*
DTC 41	*Right Front Isolation Solenoid Circuit Open*
DTC 42	*Right Front Dump Solenoid Circuit Open*
DTC 43	*Right Front Isolation Solenoid Circuit Shorted*
DTC 44	*Right Front Dump Solenoid Circuit Shorted*

Diagnostic Trouble Code (DTC) List (cont'd)

DTC 45	*Left Front Isolation Solenoid Circuit Open*
DTC 46	*Left Front Dump Solenoid Circuit Open*
DTC 47	*Left Front Isolation solenoid Circuit Shorted*
DTC 48	*Left Front Dump Solenoid Circuit Shorted*
DTC 51	*Right Rear Isolation Solenoid Circuit Open*
DTC 52	*Right Rear Dump Solenoid Circuit Open*
DTC 53	*Right Rear Isolation Solenoid Circuit Shorted*
DTC 54	*Right Rear Dump Solenoid Circuit Shorted*
DTC 55	*Left Rear Isolation Solenoid Circuit Open*
DTC 56	*Left Rear Dump Solenoid Circuit Open*
DTC 57	*Left Rear Isolation Solenoid Circuit Shorted*
DTC 58	*Left Rear Dump Solenoid Circuit Shorted*
DTC 65	*Pump Motor Relay Circuit Open*
DTC 66	*Pump Motor Relay Circuit Shorted*
DTC 67	*Pump Motor Circuit Open*
DTC 68	*Pump Motor Locked or Pump Motor Circuit Shorted*
DTC 69	*Excessive Dump Time*
DTC 71–73	*EBCM Memory Errors*
DTC 74	*Excessive Isolation Time*
DTC 81	*Stop Lamp Switch Circuit Always Closed or Shorted to Ground*
DTC 86	*ABS Indicator Lamp Circuit Shorted to Battery*

DTC 21 RF Wheel Speed Sensor Circuit Open



Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed gap. This distance is referred to as the air gap.

Conditions for Setting the DTC

- No output from the right front wheel speed sensor for 1.0 second
- Excessive right front wheel speed sensor resistance for 1.0 second

Action Taken When the DTC Sets

- The ABS indicator lamp turns on.
- The ABS disables.

DTC 21 is a Condition Latched DTC, which indicates that the above actions remain true only as long as the condition persists.

Conditions for Clearing the DTC

Repair the conditions responsible for setting the DTC.

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5 percent salt water solution (2 teaspoons of salt to 12 oz of water).
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds.

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Front.*

Test Description

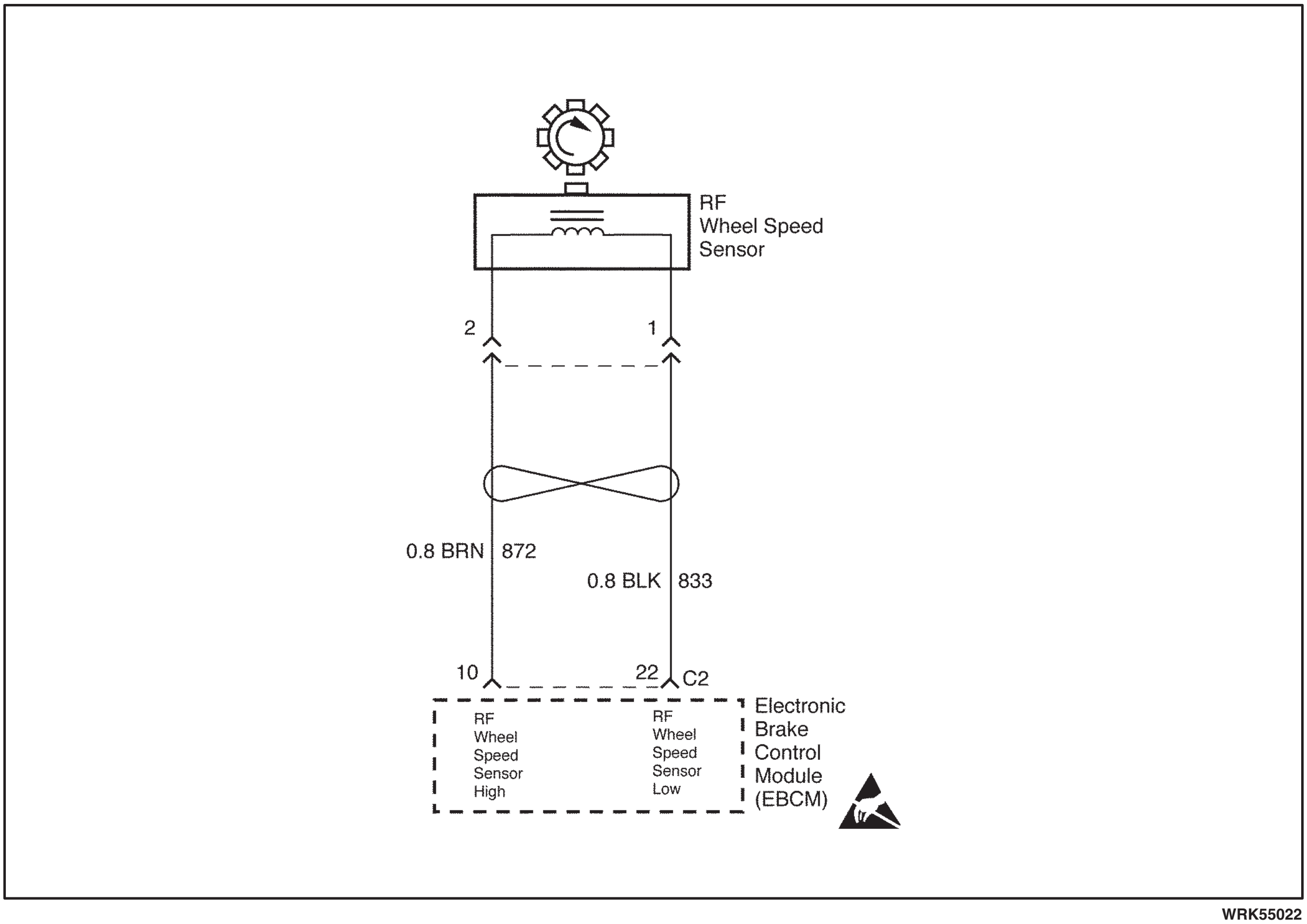
The numbers below refer to the steps in the diagnostic table:

2. This step checks the resistance of the right front wheel speed sensor circuit.
3. This step checks the resistance of the right front wheel speed sensor wiring.
4. This step checks the resistance of the right front wheel speed sensor.

DTC 21 RF Wheel Speed Sensor Circuit Open

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Turn ignition to OFF. 2. Disconnect the 24-way EBCM harness connector. 3. Using a *J 39200*, measure the resistance between terminals 10 and 22 of the 24-way EBCM harness connector. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 5*	Go to *Step 3*
3	1. Disconnect the right front wheel speed sensor harness connector from the wheel speed sensor pigtail. 2. Using a *J 36169-A*, connect terminal A and terminal B of the 2-way wheel speed sensor harness connector (chassis harness side). 3. Using a *J 39200*, measure the resistance between terminals 10 and 22 of the 24-way EBCM harness connector. Is the resistance measurement within the specific range?	0–2 ohms	Go to *Step 4*	Go to *Step 7*
4	Using a *J 39200*, measure the resistance between terminal A and terminal B of the right front wheel speed sensor pigtail. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 5*	Go to *Step 8*
5	1. Inspect the 24-way EBCM harness connector terminals 10 and 22 for poor terminal contact or corrosion. 2. Inspect CKT 833 and CKT 872 for damage that could result in an open circuit. Repair damage if evident. 3. Replace the terminals if poor contact or corrosion exists. 4. Reconnect all the connectors. 5. Using the *Scan Tool*, clear all DTCs. 6. Test drive the vehicle above 16 km/h (10 mph). Does DTC 21 set as a current DTC?	—	Go to *Step 6*	Go to *Diagnostic Aids*
6	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
7	Repair the open or high resistance in CKT 833 or CKT 872. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
8	Replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Front.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—

DTC 22 RF Wheel Speed Signal Missing



Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed gap. This distance is referred to as the air gap.

Conditions for Setting the DTC

- The right front wheel speed is less than 6 km/h (4 mph)
- All other wheel speeds greater than 13 km/h (8 mph)
- No unexpected wheel acceleration/deceleration
- Any condition that keeps the right front wheel speed sensor low while the vehicle is moving above 13 km/h (8 mph)

Action Taken When the DTC Sets

- The ABS indicator lamp turns on.
- The ABS disables.

DTC 22 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

Repair the conditions responsible for setting the DTC.

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5 percent salt water solution (2 teaspoons of salt to 12 oz of water).
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds.

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Front.*

Test Description

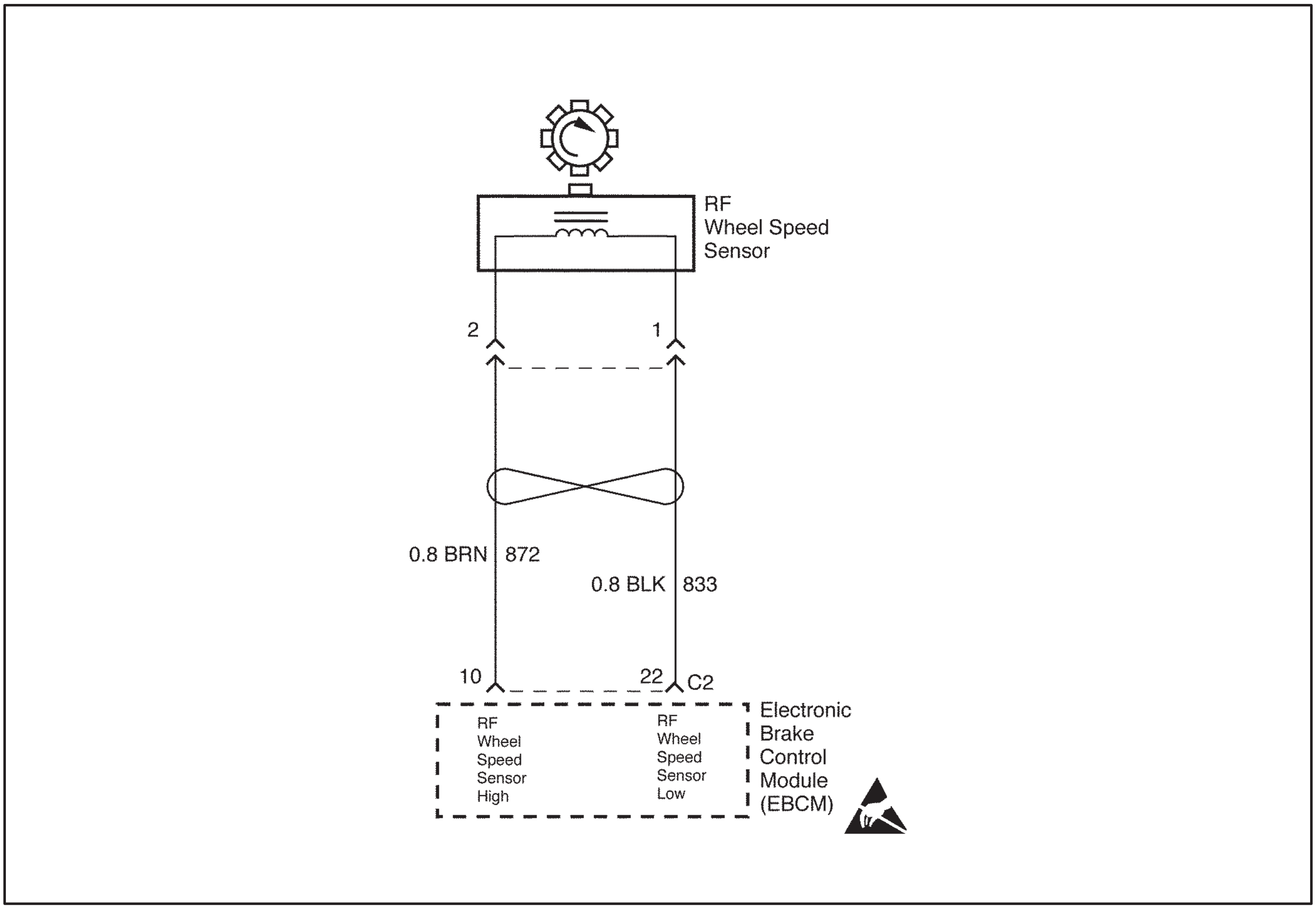
The numbers below refer to the steps in the diagnostic table:

2. This step checks the resistance of the right front wheel speed sensor circuit.
3. This step checks the resistance of the right front wheel speed sensor wiring.
4. This step checks the resistance of the right front wheel speed sensor.

DTC 22 RF Wheel Speed Signal Missing

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Turn ignition to OFF. 2. Disconnect the 24-way EBCM harness connector. 3. Using a *J 39200*, measure the resistance between terminals 10 and 22 of the 24-way EBCM harness connector. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 5*	Go to *Step 3*
3	1. Disconnect the right front wheel speed sensor harness connector from the wheel speed sensor pigtail. 2. Using a *J 36169-A*, connect terminal A and terminal B of the 2-way wheel speed sensor harness connector (chassis harness side). 3. Using a *J 39200*, measure the resistance between terminals 10 and 22 of the 24-way EBCM harness connector. Is the resistance measurement within the specific range?	0–2 ohms	Go to *Step 4*	Go to *Step 7*
4	Using a *J 39200*, measure the resistance between terminal A and terminal B of the right front wheel speed sensor pigtail. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 5*	Go to *Step 8*
5	1. Inspect the 24-way EBCM harness connector terminals 10 and 22 for poor terminal contact or corrosion. 2. Inspect CKT 833 and CKT 872 for damage that could result in an open circuit. Repair damage if evident. 3. Replace the terminals if poor contact or corrosion exists. 4. Reconnect all the connectors. 5. Using the *Scan Tool*, clear all DTCs. 6. Test drive the vehicle above 16 km/h (10 mph). Does DTC 22 set as a current DTC?	—	Go to *Step 6*	Go to *Diagnostic Aids*
6	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
7	Repair the open or high resistance in CKT 833 or CKT 872. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
8	Replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Front.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—

DTC 23 RF Wheel Speed Signal Erratic



WRK55022

Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed gap. This distance is referred to as the air gap.

Conditions for Setting the DTC

- An average wheel speed for all wheel speed signals greater than 40 km/h (25 mph)
- An average right front wheel speed greater than 40 km/h (25 mph)
- No speed signal input to the EBCM from the right front wheel speed sensor for 15 ms
- Anything which suddenly causes (intermittent) the right front wheel speed signal to drop to zero while the vehicle is moving greater than 40 km/h (25 mph)

Action Taken When the DTC Sets

- The ABS indicator lamp turns on.
- The ABS disables.

DTC 23 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

Repair the conditions responsible for setting the DTC.

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5 percent salt water solution (2 teaspoons of salt to 12 oz of water).
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds.

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Front.*

Test Description

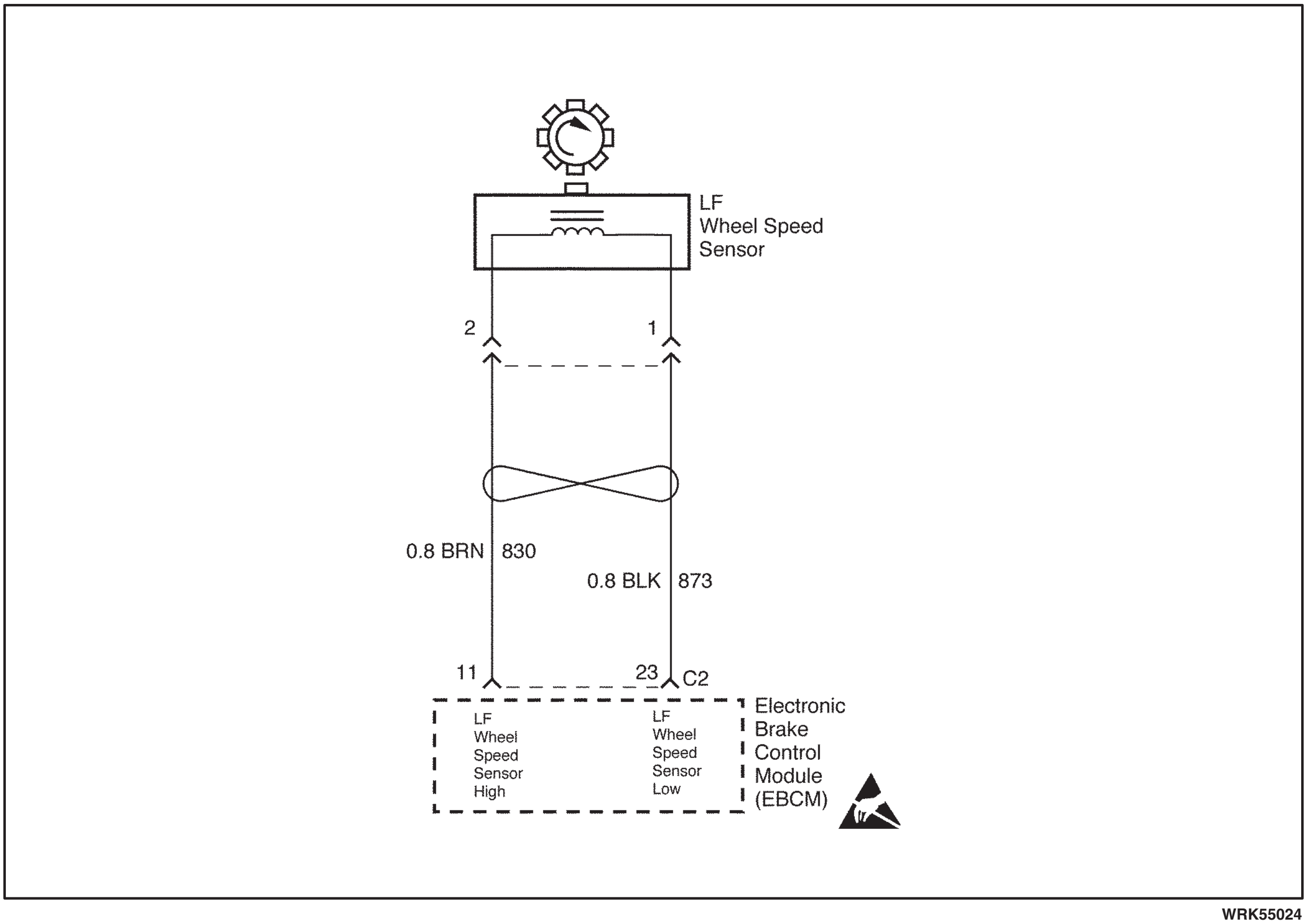
The numbers below refer to the steps in the diagnostic table:

3. This step checks the resistance of the right front wheel speed sensor.
4. This step checks the voltage output of the right front wheel speed sensor.
5. This step checks for a short in the wiring between the right front wheel speed sensor circuits.
6. This step checks for a short to ground in the right front wheel speed sensor circuits.

DTC 23 RF Wheel Speed Signal Erratic

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Turn ignition to OFF. 2. Disconnect the 24-way EBCM harness connector from the EBCM. 3. Inspect the EBCM harness connector for signs of damage or corrosion. 4. Inspect the wheel speed sensor harness and the sensor harness connector for signs of damage or corrosion. Are all the connections clean and tight?	—	Go to *Step 3*	Go to *Step 6*
3	Using a *J 39200*, measure the resistance between terminals 10 and 22 of the 24-way EBCM harness connector. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 5*	Go to *Step 4*
4	1. Disconnect the wheel speed sensor from the wheel speed sensor harness pigtail connector. 2. Using a *J 39200*, measure the resistance between terminal A and terminal B of the right front wheel speed sensor pigtail connector. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 7*	Go to *Step 8*
5	1. Reconnect all the connectors. 2. Verify that the right front wheel speed sensor is securely mounted and that the tone wheel is in good condition. Are the wheel speed sensor and the tone wheel in good condition?	—	Go to *Diagnostic Aids*	—
6	Make the necessary repairs to the 24-way EBCM harness connector. Refer to *Connector Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
7	Repair the open or high resistance in CKT 833 or CKT 872. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
8	Replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Front.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—

DTC 25 LF Wheel Speed Sensor Circuit Open



Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed gap. This distance is referred to as the air gap.

Conditions for Setting the DTC

- No output from the left front wheel speed sensor for 1.0 second
- Excessive left front wheel speed sensor resistance for 1.0 second

Action Taken When the DTC Sets

- The ABS indicator lamp turns on.
- The ABS disables.

DTC 25 is a Condition Latched DTC, which indicates that the above actions remain true only as long as the condition persists.

Conditions for Clearing the DTC

Repair the conditions responsible for setting the DTC.

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5 percent salt water solution (2 teaspoons of salt to 12 oz of water).
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds.

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Front.*

Test Description

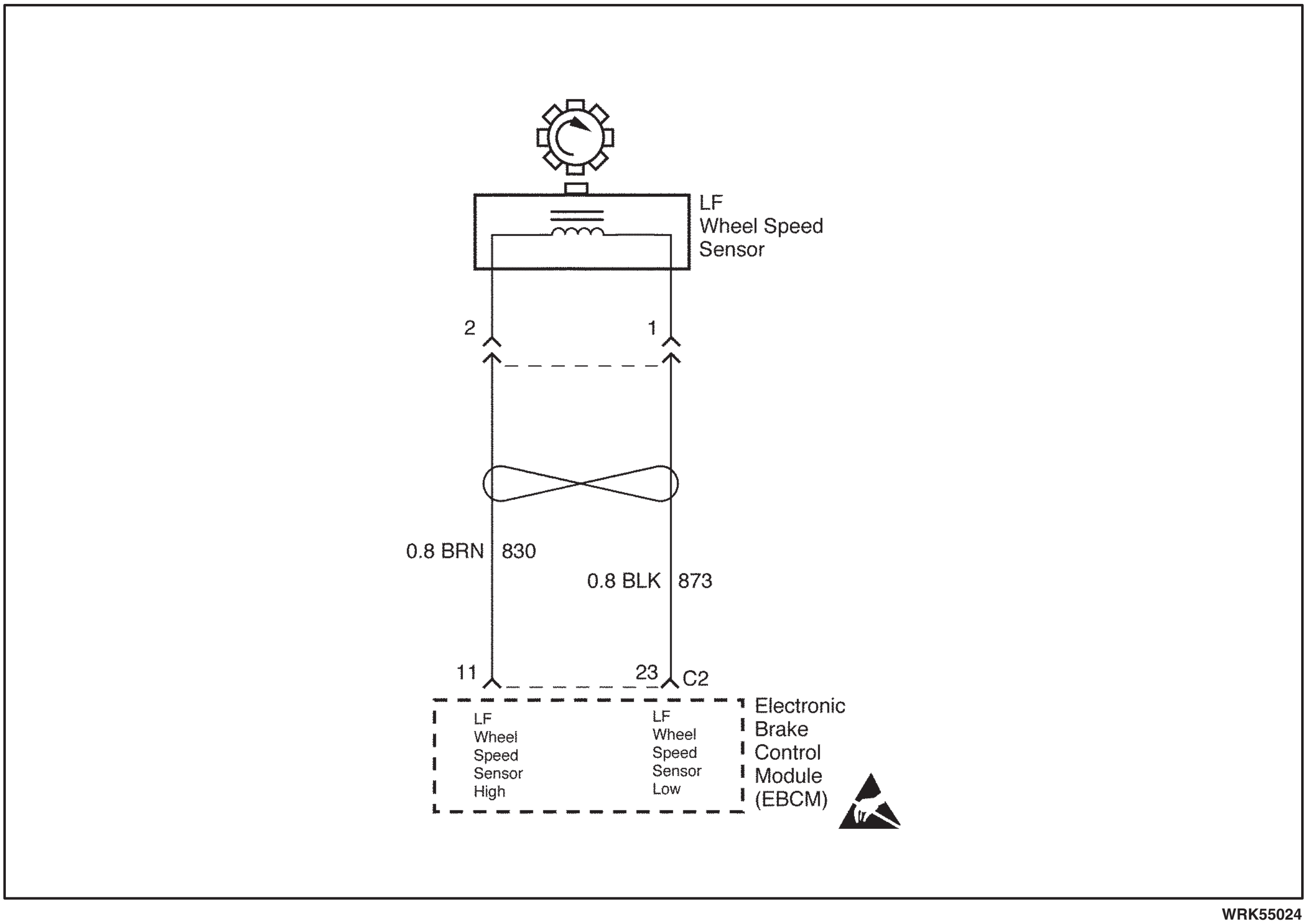
The numbers below refer to the steps in the diagnostic table:

2. This step checks the resistance of the left front wheel speed sensor circuit.
3. This step checks the resistance of the left front wheel speed sensor wiring.
4. This step checks the resistance of the left front wheel speed sensor.

DTC 25 LF Wheel Speed Sensor Circuit Open

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Turn ignition to OFF. 2. Disconnect the 24-way EBCM harness connector. 3. Using a *J 39200*, measure the resistance between terminal 11 and terminal 23 of the 24-way EBCM harness connector. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 5*	Go to *Step 3*
3	1. Disconnect the left front wheel speed sensor harness connector from the wheel speed sensor pigtail. 2. Using a *J 36169-A*, connect terminal A and terminal B of the 2-way wheel speed sensor harness connector (chassis harness side). 3. Using a *J 39200*, measure the resistance between terminals 11 and 23 of the 24-way EBCM harness connector. Is the resistance measurement within the specific range?	0–2 ohms	Go to *Step 4*	Go to *Step 7*
4	Using a *J 39200*, measure the resistance between terminal A and terminal B of the left front wheel speed sensor pigtail. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 5*	Go to *Step 8*
5	1. Inspect the 24-way EBCM harness connector terminals 11 and 23 for poor terminal contact or corrosion. 2. Inspect CKT 830 and CKT 873 for damage that could result in an open circuit. Repair damage if evident. 3. Replace the terminals if poor contact or corrosion exists. 4. Reconnect all the connectors. 5. Using the *Scan Tool*, clear all DTCs. 6. Test drive the vehicle above 16 km/h (10 mph). Does DTC 25 set as a current DTC?	—	Go to *Step 6*	Go to *Diagnostic Aids*
6	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
7	Repair the open or high resistance in CKT 830 or CKT 873. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
8	Replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Front.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—

DTC 26 LF Wheel Speed Signal Missing



Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed gap. This distance is referred to as the air gap.

Conditions for Setting the DTC

- The left front wheel speed is less than 6 km/h (4 mph)
- All other wheel speeds greater than 13 km/h (8 mph)
- No unexpected wheel acceleration/deceleration
- Any condition that keeps the left front wheel speed sensor low while the vehicle is moving above 13 km/h (8 mph)

Action Taken When the DTC Sets

- The ABS indicator lamp turns on.
- The ABS disables.

DTC 26 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

Repair the conditions responsible for setting the DTC.

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5 percent salt water solution (2 teaspoons of salt to 12 oz of water).
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds.

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Front.*

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step checks the resistance of the left front wheel speed sensor.
4. This step checks the voltage output of the left front wheel speed sensor.
5. This step checks for a short in the wiring between the left front wheel speed sensor circuits.
6. This step checks for a short to ground in the left front wheel speed sensor circuits.

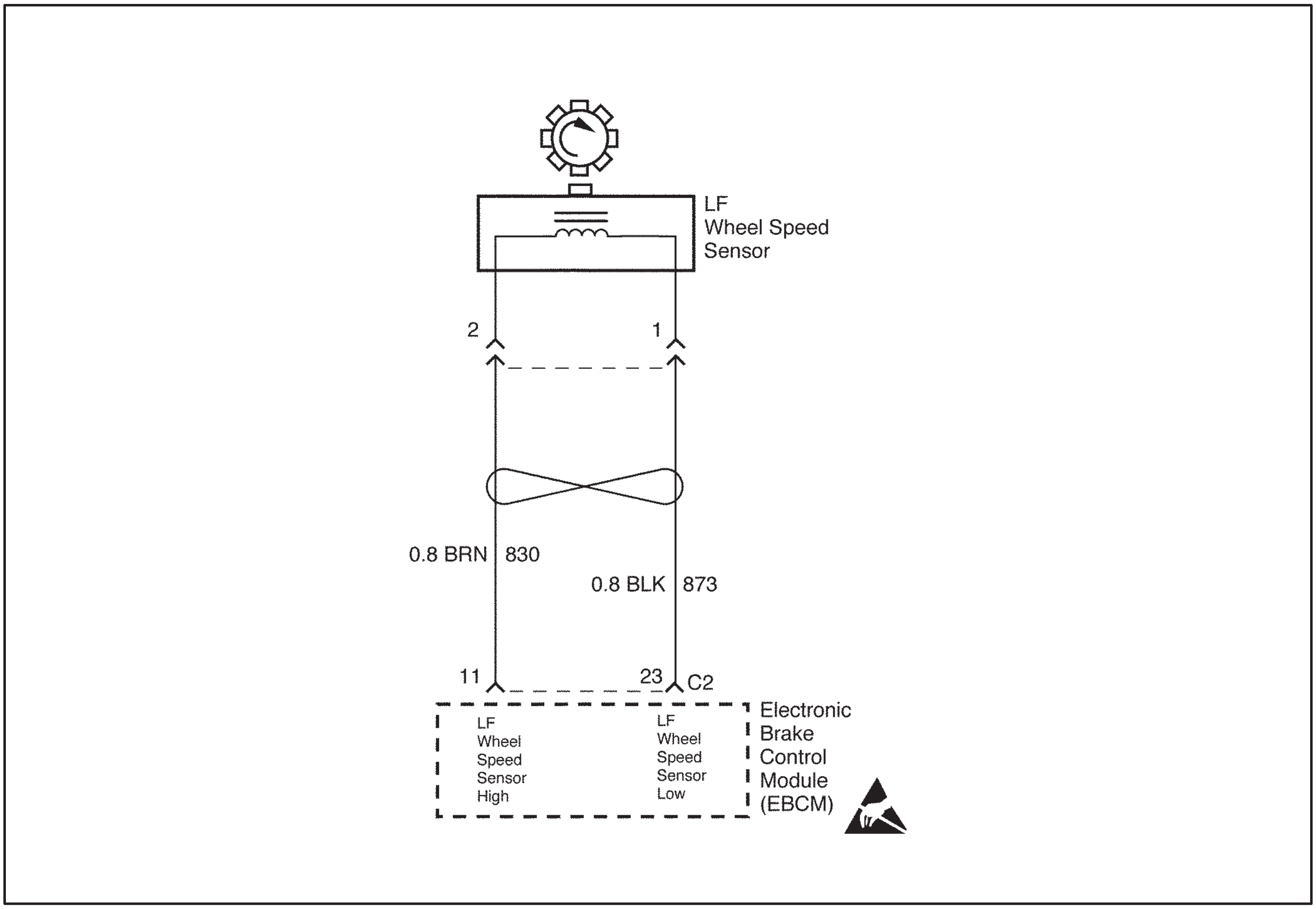
DTC 26 LF Wheel Speed Signal Missing

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Turn the ignition to OFF. 2. Inspect the left front wheel speed sensor, sensor wire and the connectors for signs of damage or corrosion. 3. Inspect the wheel speed sensor and the toothed ring for looseness, paying particular attention to the toothed ring. Any deviation will affect the wheel speed sensor output signal. 4. Inspect the 24-way EBCM harness connector and harness for signs of damage or corrosion. Is there evidence of physical damage?	—	Go to *Step 8*	Go to *Step 3*
3	1. Disconnect the left front wheel speed sensor harness connector from the wheel speed sensor. 2. Using a *J 39200*, measure the resistance between terminal A and terminal B of the left front wheel speed sensor pigtail connector. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 4*	Go to *Step 9*
4	1. With the *J 39200* still connected, select the A/C voltage scale. 2. Spin the wheel by hand while observing the voltage reading. Is the voltage measured equal to or greater than the specified value?	100 mV	Go to *Step 5*	Go to *Step 9*
5	1. Disconnect the 24-way EBCM harness connector from the EBCM. 2. Using a *J 39200*, measure the resistance between terminal 11 and terminal 23 of the 24-way EBCM harness connector. Is the resistance measurement within the specific range?	OL	Go to *Step 6*	Go to *Step 11*

DTC 26 LF Wheel Speed Signal Missing (cont'd)

Step	Action	Value(s)	Yes	No
6	1. Reconnect the left front wheel speed sensor. 2. Using a *J 39200*, measure the resistance between terminal 11 of the 24-way EBCM harness connector and ground. Is the resistance measurement equal to the specified value?	OL	Go to *Step 7*	Go to *Step 12*
7	1. Inspect the 24-way EBCM harness connector terminals 11 and 23 for poor terminal contact or corrosion. 2. Inspect CKT 830 and CKT 873 for damage that could result in a shorted circuit. Repair any evident damage. 3. Replace the terminals if poor contact or corrosion exists. 4. Reconnect all the connectors. 5. Using the *Scan Tool*, clear all DTCs. 6. Test drive the vehicle above 16 km/h (10 mph). Does DTC 26 set as a current DTC?	—	Go to *Step 10*	Go to *Diagnostic Aids*
8	Make necessary repairs. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
9	Replace the left front wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Front.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—
10	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
11	Repair the short between CKT 830 and CKT 873. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
12	Replace the short to ground in CKT 830 or CKT 873. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—

DTC 27 LF Wheel Speed Signal Erratic



WRK55024

Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed gap. This distance is referred to as the air gap.

Conditions for Setting the DTC

- An average wheel speed for all wheel speed signals greater than 40 km/h (25 mph)
- An average left front wheel speed greater than 40 km/h (25 mph)
- No speed signal input to the EBCM from the left front wheel speed sensor for 15 ms
- Anything which suddenly causes (intermittent) the left front wheel speed signal to drop to zero while the vehicle is moving greater than 40 km/h (25 mph)

Action Taken When the DTC Sets

- The ABS indicator lamp turns on.
- The ABS disables.

DTC 27 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

Repair the conditions responsible for setting the DTC.

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5 percent salt water solution (2 teaspoons of salt to 12 oz of water).
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds.

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Front.*

Test Description

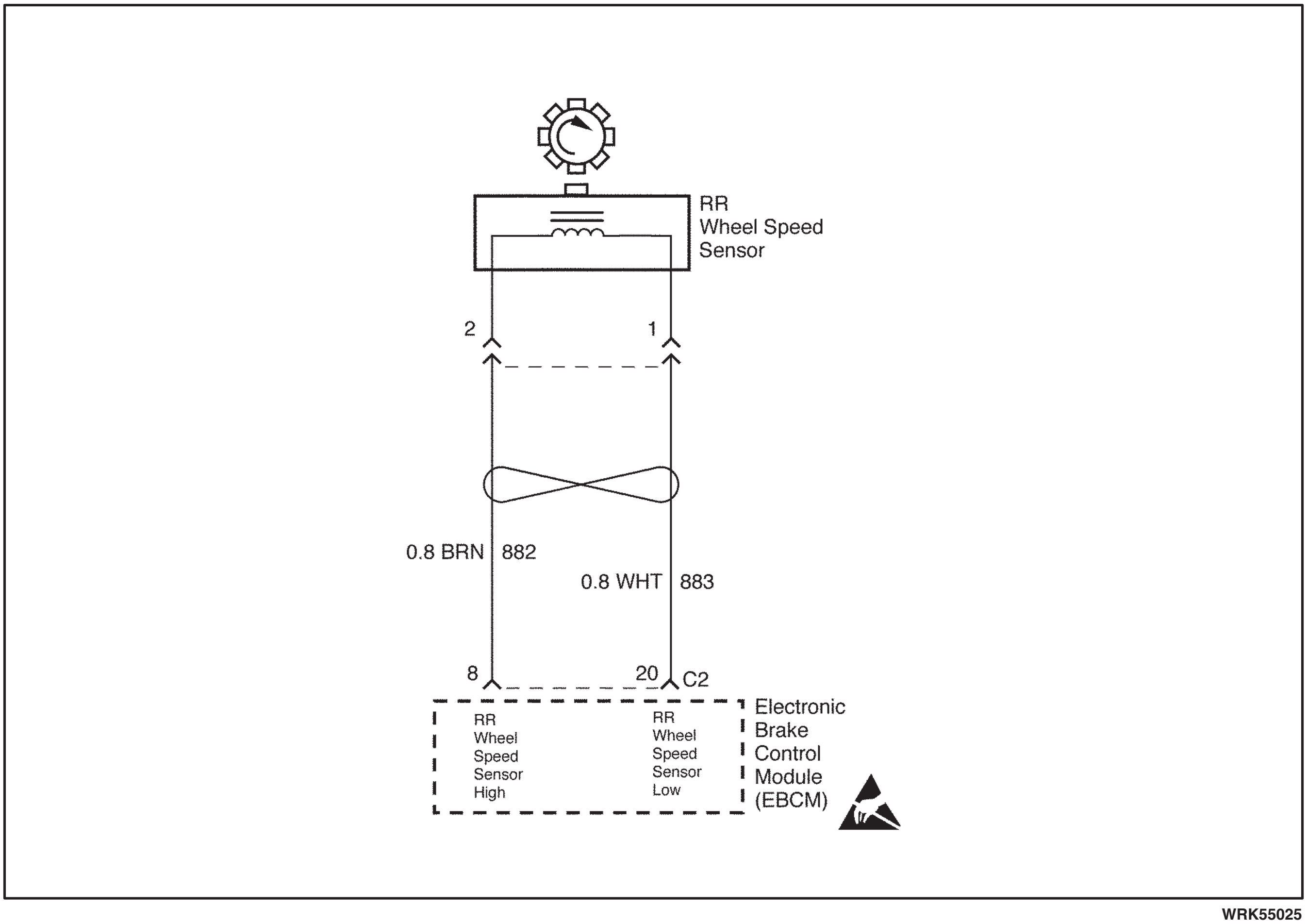
The numbers below refer to the steps in the diagnostic table:

2. This step checks the EBCM 24-way connector for looseness, corrosion, etc..
3. This step measures the resistance of the EBCM 24-way connector terminal 11 and terminal 23.
4. This step measures the resistance at the left front wheel speed sensor connector.
6. This step inspects the left front wheel speed sensor and the tone wheel for physical damage or excessive clearance.

DTC 27 LF Wheel Speed Signal Erratic

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Turn ignition to OFF. 2. Disconnect the 24-way EBCM harness connector from the EBCM. 3. Inspect the EBCM harness connector for signs of damage or corrosion. 4. Inspect the wheel speed sensor harness and the sensor harness connector for signs of damage or corrosion. Are all the connections clean and tight?	—	Go to *Step 3*	Go to *Step 6*
3	Using a *J 39200*, measure the resistance between terminals 11 and 23 of the 24-way EBCM harness connector. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 5*	Go to *Step 4*
4	1. Disconnect the wheel speed sensor from the wheel speed sensor harness pigtail connector. 2. Using a *J 39200*, measure the resistance between terminal A and terminal B of the left front wheel speed sensor pigtail connector. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 7*	Go to *Step 8*
5	1. Reconnect all the connectors. 2. Verify that the left front wheel speed sensor is securely mounted and that the tone wheel is in good condition. Are the wheel speed sensor and the tone wheel in good condition?	—	Go to *Diagnostic Aids*	—
6	Make the necessary repairs to the 24-way EBCM harness connector. Refer to *Connector Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
7	Repair the open or high resistance in CKT 830 or CKT 873. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
8	Replace the left front wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Front.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—

DTC 31 RR Wheel Speed Signal Circuit Open



Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed gap. This distance is referred to as the air gap.

Conditions for Setting the DTC

- No output from the right rear wheel speed sensor for 1.0 second
- Excessive right rear wheel speed sensor resistance for 1.0 second

Action Taken When the DTC Sets

- The ABS indicator lamp turns on.
- The ABS disables.

DTC 31 is a Condition Latched DTC, which indicates that the above actions remain true only as long as the condition persists.

Conditions for Clearing the DTC

Repair the conditions responsible for setting the DTC.

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5 percent salt water solution (2 teaspoons of salt to 12 oz of water).
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds.

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Rear.*

Test Description

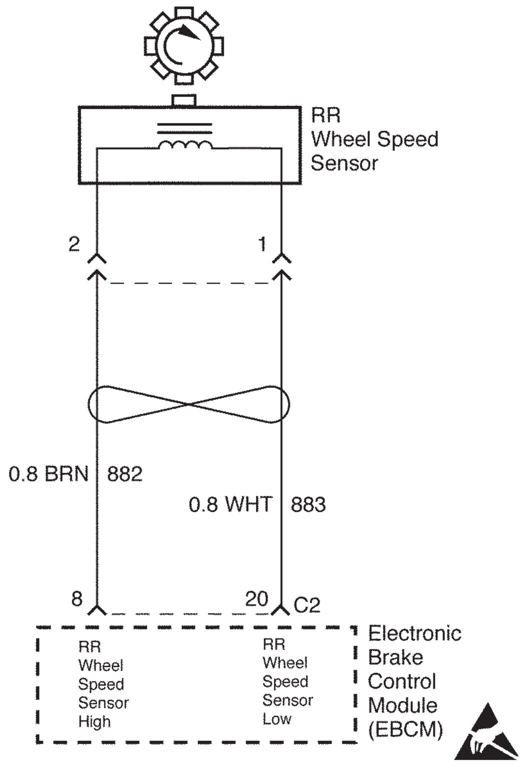
The numbers below refer to the steps in the diagnostic table:

2. This step checks the resistance of the right rear wheel speed sensor circuit.
3. This step checks the resistance of the right rear wheel speed sensor wiring.
4. This step checks the resistance of the right rear wheel speed sensor.

DTC 31 RR Wheel Speed Signal Circuit Open

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Turn ignition to OFF. 2. Disconnect the 24-way EBCM harness connector. 3. Using a *J 39200*, measure the resistance between terminals 8 and 20 of the 24-way EBCM harness connector. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 5*	Go to *Step 3*
3	1. Disconnect the right rear wheel speed sensor harness connector from the wheel speed sensor pigtail. 2. Using a *J 36169-A*, jumper terminal A and terminal B of the 2-way wheel speed sensor harness connector (chassis harness side). 3. Using a *J 39200*, measure the resistance between terminals 8 and 20 of the 24-way EBCM harness connector. Is the resistance measurement within the specific range?	0–2 ohms	Go to *Step 4*	Go to *Step 7*
4	Using a *J 39200*, measure the resistance between terminal A and terminal B of the right rear wheel speed sensor pigtail. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 5*	Go to *Step 8*
5	1. Inspect the 24-way EBCM harness connector terminals 8 and 20 for poor terminal contact or corrosion. 2. Inspect CKT 882 and CKT 883 for damage that could result in an open circuit. Repair damage if evident. 3. Replace the terminals if poor contact or corrosion exists. 4. Reconnect all the connectors. 5. Using the *Scan Tool*, clear all DTCs. 6. Test drive the vehicle above 16 km/h (10 mph). Does DTC 31 set as a current DTC?	—	Go to *Step 6*	Go to *Diagnostic Aids*
6	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
7	Repair the open or high resistance in CKT 882 or CKT 883. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
8	Replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Rear.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—

DTC 32 RR Wheel Speed Signal Missing



WRK55025

Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed gap. This distance is referred to as the air gap.

Conditions for Setting the DTC

- The right rear wheel speed is less than 6 km/h (4 mph)
- All other wheel speeds greater than 13 km/h (8 mph)
- No unexpected wheel acceleration/deceleration
- Any condition that keeps the right rear wheel speed sensor low while the vehicle is moving above 13 km/h (8 mph)

Action Taken When the DTC Sets

- The ABS indicator lamp turns on.
- The ABS disables.

DTC 32 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

Repair the conditions responsible for setting the DTC.

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5 percent salt water solution (2 teaspoons of salt to 12 oz of water).
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds.

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Rear.*

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step checks the resistance of the right rear wheel speed sensor.
4. This step checks the voltage output of the right rear wheel speed sensor.
5. This step checks for a short in the wiring between the right rear wheel speed sensor circuits.
6. This step checks for a short to ground in the right rear wheel speed sensor circuits.

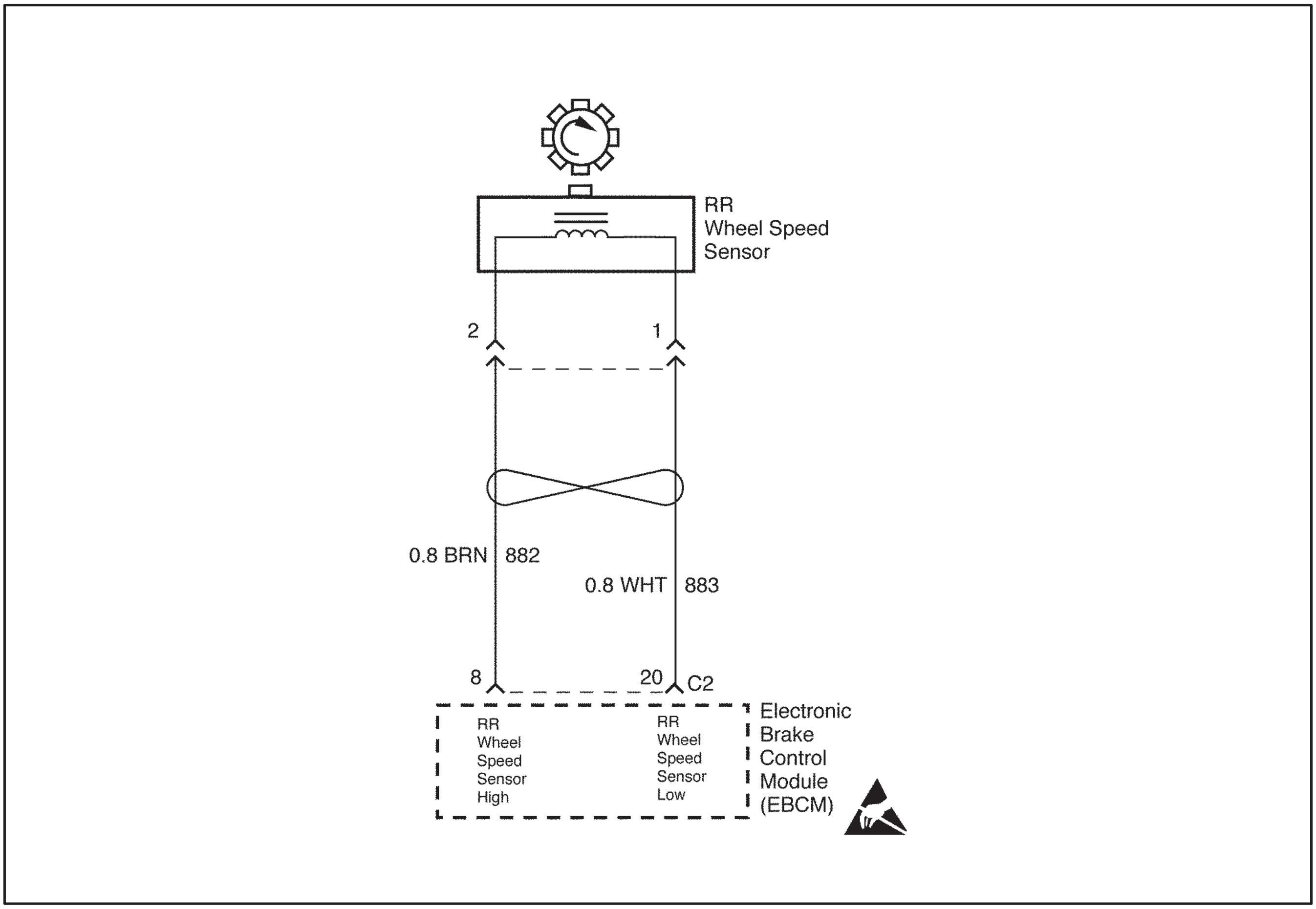
DTC 32 RR Wheel Speed Signal Missing

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Turn the ignition to OFF. 2. Inspect the right rear wheel speed sensor, sensor wire and the connectors for signs of damage or corrosion. 3. Inspect the wheel speed sensor and the toothed ring for looseness, paying particular attention to the toothed ring. Any deviation will affect the wheel speed sensor output signal. 4. Inspect the 24-way EBCM harness connector and harness for signs of damage or corrosion. Is there evidence of physical damage?	—	Go to *Step 8*	Go to *Step 3*
3	1. Disconnect the right rear wheel speed sensor harness connector from the wheel speed sensor. 2. Using a *J 39200*, measure the resistance between terminal A and terminal B of the right rear wheel speed sensor pigtail connector. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 4*	Go to *Step 9*
4	1. With the *J 39200* still connected, select the A/C voltage scale. 2. Spin the wheel by hand while observing the voltage reading. Is the voltage measured equal to or greater than the specified value?	100 mV	Go to *Step 5*	Go to *Step 9*
5	1. Disconnect the 24-way EBCM harness connector from the EBCM. 2. Using a *J 39200*, measure the resistance between terminal 8 and terminal 20 of the 24-way EBCM harness connector. Is the resistance measurement within the specific range?	OL	Go to *Step 6*	Go to *Step 11*

DTC 32 RR Wheel Speed Signal Missing (cont'd)

Step	Action	Value(s)	Yes	No
6	1. Reconnect the right rear wheel speed sensor. 2. Using a *J 39200*, measure the resistance between terminal 8 of the 24-way EBCM harness connector and ground. Is the resistance measurement equal to the specified value?	OL	Go to *Step 7*	Go to *Step 12*
7	1. Inspect the 24-way EBCM harness connector terminals 8 and 20 for poor terminal contact or corrosion. 2. Inspect CKT 882 and CKT 883 for damage that could result in a shorted circuit. Repair any evident damage. 3. Replace the terminals if poor contact or corrosion exists. 4. Reconnect all the connectors. 5. Using the *Scan Tool*, clear all DTCs. 6. Test drive the vehicle above 16 km/h (10 mph). Does DTC 32 set as a current DTC?	—	Go to *Step 10*	Go to *Diagnostic Aids*
8	Make necessary repairs. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
9	Replace the right rear wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Rear.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—
10	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
11	Repair the short between CKT 882 and CKT 883. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
12	Replace the short to ground in CKT 882 or CKT 883. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—

DTC 33 RR Wheel Speed Signal Erratic



WRK55025

Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed gap. This distance is referred to as the air gap.

Conditions for Setting the DTC

- The right rear wheel speed is less than 6 km/h (4 mph)
- All other wheel speeds greater than 13 km/h (8 mph)
- No unexpected wheel acceleration/deceleration
- Any condition that keeps the right rear wheel speed sensor low while the vehicle is moving above 13 km/h (8 mph)

Action Taken When the DTC Sets

- The ABS indicator lamp turns on.
- The ABS disables.

DTC 33 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

Repair the conditions responsible for setting the DTC.

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5 percent salt water solution (2 teaspoons of salt to 12 oz of water).
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds.

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Rear.*

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step checks the resistance of the right rear wheel speed sensor.
4. This step checks the voltage output of the right rear wheel speed sensor.
5. This step checks for a short in the wiring between the right rear wheel speed sensor circuits.
6. This step checks for a short to ground in the right rear wheel speed sensor circuits.

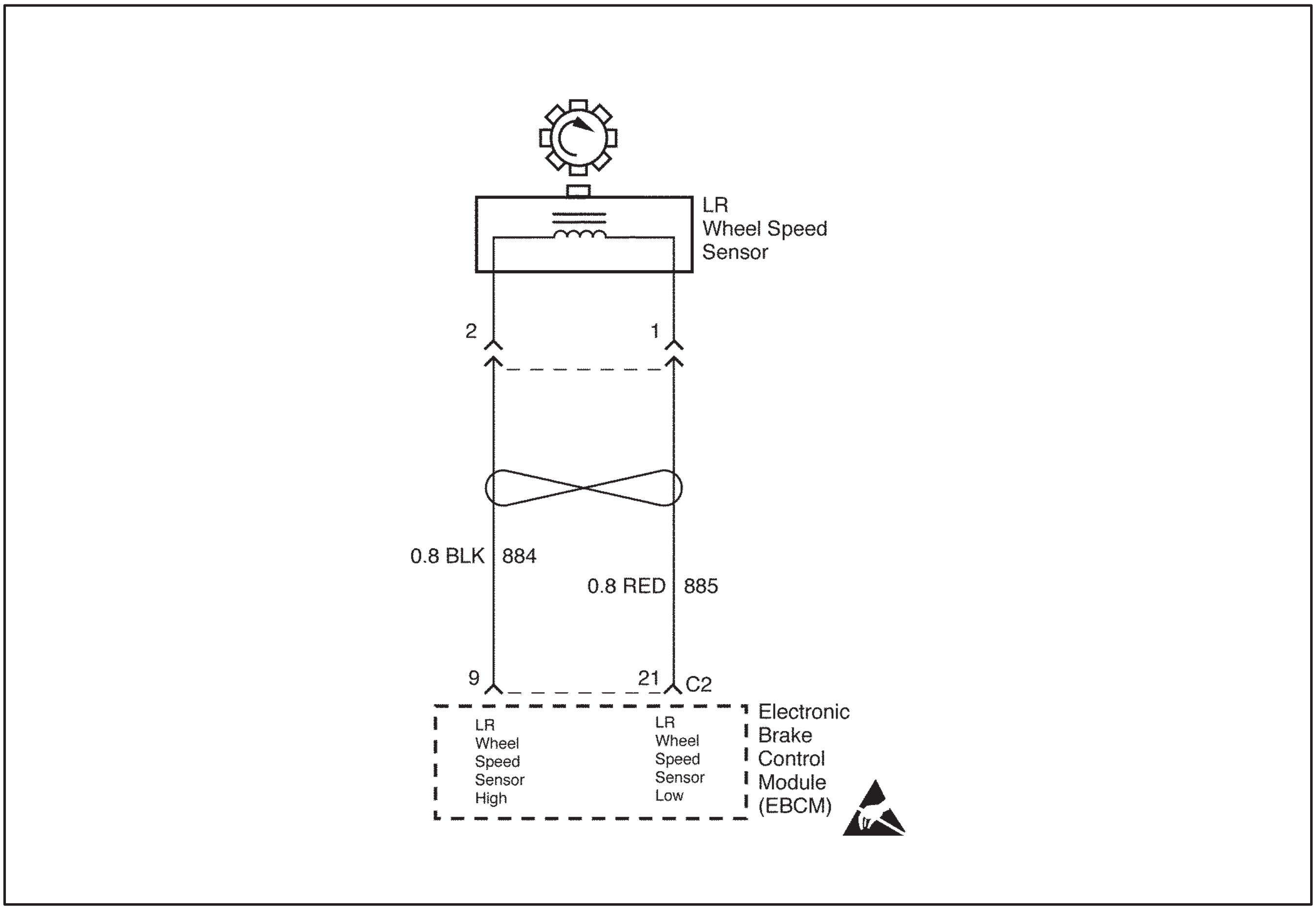
DTC 33 RR Wheel Speed Signal Erratic

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Turn the ignition to OFF. 2. Inspect the right rear wheel speed sensor, sensor wire and the connectors for signs of damage or corrosion. 3. Inspect the wheel speed sensor and the toothed ring for looseness, paying particular attention to the toothed ring. Any deviation will affect the wheel speed sensor output signal. 4. Inspect the 24-way EBCM harness connector and harness for signs of damage or corrosion. Is there evidence of physical damage?	—	Go to *Step 8*	Go to *Step 3*
3	1. Disconnect the right rear wheel speed sensor harness connector from the wheel speed sensor. 2. Using a *J 39200*, measure the resistance between terminal A and terminal B of the right rear wheel speed sensor pigtail connector. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 4*	Go to *Step 9*
4	1. With the *J 39200* still connected, select the A/C voltage scale. 2. Spin the wheel by hand while observing the voltage reading. Is the voltage measured equal to or greater than the specified value?	100 mV	Go to *Step 5*	Go to *Step 9*
5	1. Disconnect the 24-way EBCM harness connector from the EBCM. 2. Using a *J 39200*, measure the resistance between terminal 8 and terminal 20 of the 24-way EBCM harness connector. Is the resistance measurement within the specific range?	OL	Go to *Step 6*	Go to *Step 11*

DTC 33 RR Wheel Speed Signal Erratic (cont'd)

Step	Action	Value(s)	Yes	No
6	1. Reconnect the right rear wheel speed sensor. 2. Using a *J 39200*, measure the resistance between terminal 8 of the 24-way EBCM harness connector and ground. Is the resistance measurement equal to the specified value?	OL	Go to *Step 7*	Go to *Step 12*
7	1. Inspect the 24-way EBCM harness connector terminals 8 and 20 for poor terminal contact or corrosion. 2. Inspect CKT 882 and CKT 883 for damage that could result in a shorted circuit. Repair any evident damage. 3. Replace the terminals if poor contact or corrosion exists. 4. Reconnect all the connectors. 5. Using the *Scan Tool*, clear all DTCs. 6. Test drive the vehicle above 16 km/h (10 mph). Does DTC 33 set as a current DTC?	—	Go to *Step 10*	Go to *Diagnostic Aids*
8	Make necessary repairs. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
9	Replace the right rear wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Rear.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—
10	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
11	Repair the short between CKT 882 and CKT 883. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
12	Replace the short to ground in CKT 882 or CKT 883. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—

DTC 35 LR Wheel Speed Signal Circuit Open



WRK55026

Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed gap. This distance is referred to as the air gap.

Conditions for Setting the DTC

- No output from the left rear wheel speed sensor for 1.0 second
- Excessive left rear wheel speed sensor resistance for 1.0 second

Action Taken When the DTC Sets

- The ABS indicator lamp turns on.
- The ABS disables.

DTC 35 is a Condition Latched DTC, which indicates that the above actions remain true only as long as the condition persists.

Conditions for Clearing the DTC

Repair the conditions responsible for setting the DTC.

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5 percent salt water solution (2 teaspoons of salt to 12 oz of water).
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds.

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Rear.*

Test Description

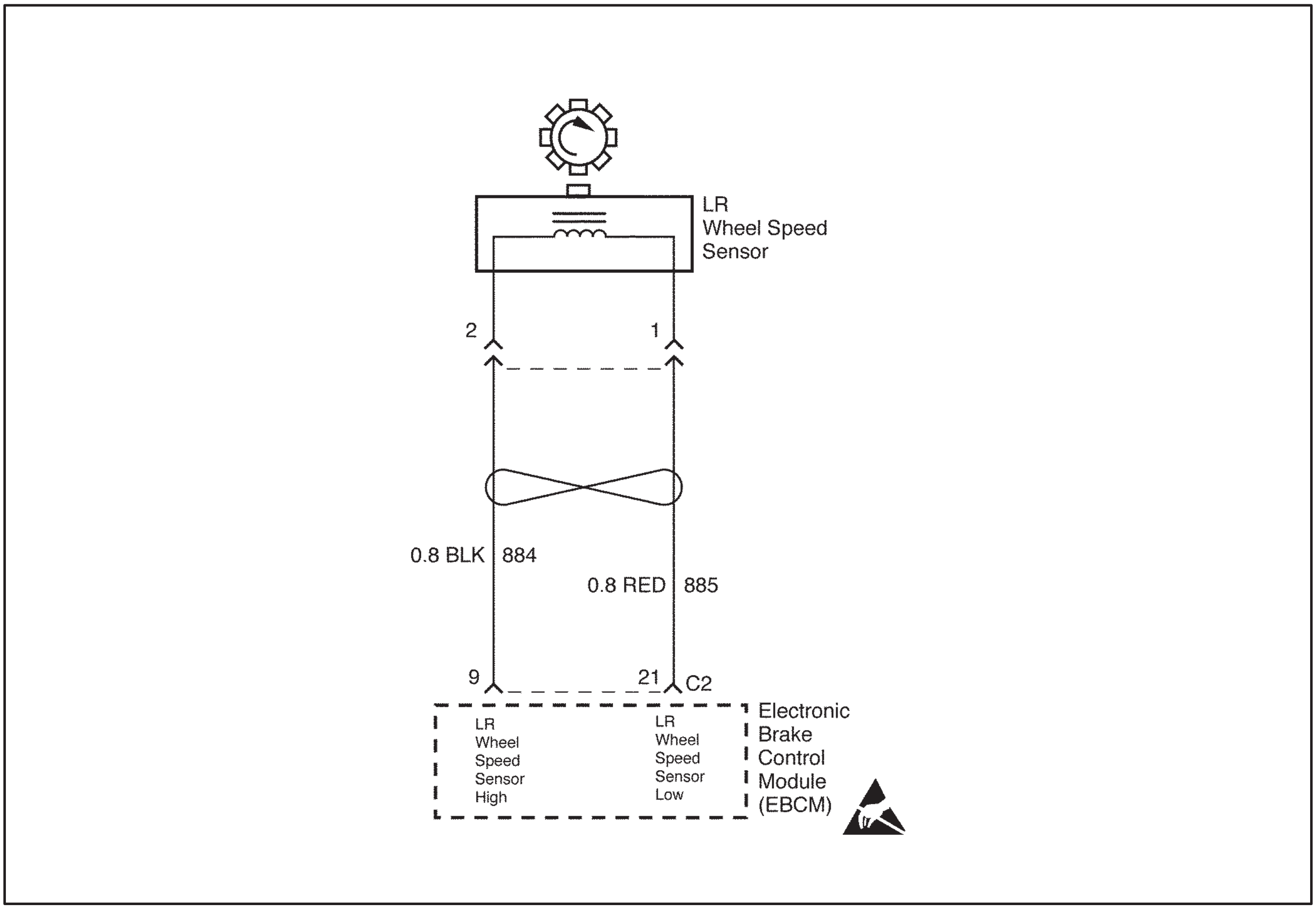
The numbers below refer to the steps in the diagnostic table:

2. This step checks the resistance of the left rear wheel speed sensor circuit.
3. This step checks the resistance of the left rear wheel speed sensor wiring.
4. This step checks the resistance of the left rear wheel speed sensor.

DTC 35 LR Wheel Speed Signal Circuit Open

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Turn ignition to OFF. 2. Disconnect the 24-way EBCM harness connector. 3. Using a *J 39200*, measure the resistance between terminals 9 and 21 of the 24-way EBCM harness connector. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 5*	Go to *Step 3*
3	1. Disconnect the left rear wheel speed sensor harness connector from the wheel speed sensor pigtail. 2. Using a *J 36169-A*, jumper terminal A and terminal B of the 2-way wheel speed sensor harness connector (chassis harness side). 3. Using a *J 39200*, measure the resistance between terminals 9 and 21 of the 24-way EBCM harness connector. Is the resistance measurement within the specific range?	0–2 ohms	Go to *Step 4*	Go to *Step 7*
4	Using a *J 39200*, measure the resistance between terminal A and terminal B of the left rear wheel speed sensor pigtail. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 5*	Go to *Step 8*
5	1. Inspect the 24-way EBCM harness connector terminals 9 and 21 for poor terminal contact or corrosion. 2. Inspect CKT 884 and CKT 885 for damage that could result in an open circuit. Repair damage if evident. 3. Replace the terminals if poor contact or corrosion exists. 4. Reconnect all the connectors. 5. Using the *Scan Tool*, clear all DTCs. 6. Test drive the vehicle above 16 km/h (10 mph). Does DTC 35 set as a current DTC?	—	Go to *Step 6*	Go to *Diagnostic Aids*
6	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
7	Repair the open or high resistance in CKT 884 or CKT 885. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
8	Replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Rear.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—

DTC 36 LR Wheel Speed Signal Missing



WRK55026

Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed gap. This distance is referred to as the air gap.

Conditions for Setting the DTC

- The left rear wheel speed is less than 6 km/h (4 mph)
- All other wheel speeds greater than 13 km/h (8 mph)
- No unexpected wheel acceleration/deceleration
- Any condition that keeps the left rear wheel speed sensor low while the vehicle is moving above 13 km/h (8 mph)

Action Taken When the DTC Sets

- The ABS indicator lamp turns on.
- The ABS disables.

DTC 36 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

Repair the conditions responsible for setting the DTC.

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5 percent salt water solution (2 teaspoons of salt to 12 oz of water).
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds.

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Rear.*

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step checks the resistance of the left rear wheel speed sensor.
4. This step checks the voltage output of the left rear wheel speed sensor.
5. This step checks for a short in the wiring between the left rear wheel speed sensor circuits.
6. This step checks for a short to ground in the left rear wheel speed sensor circuits.

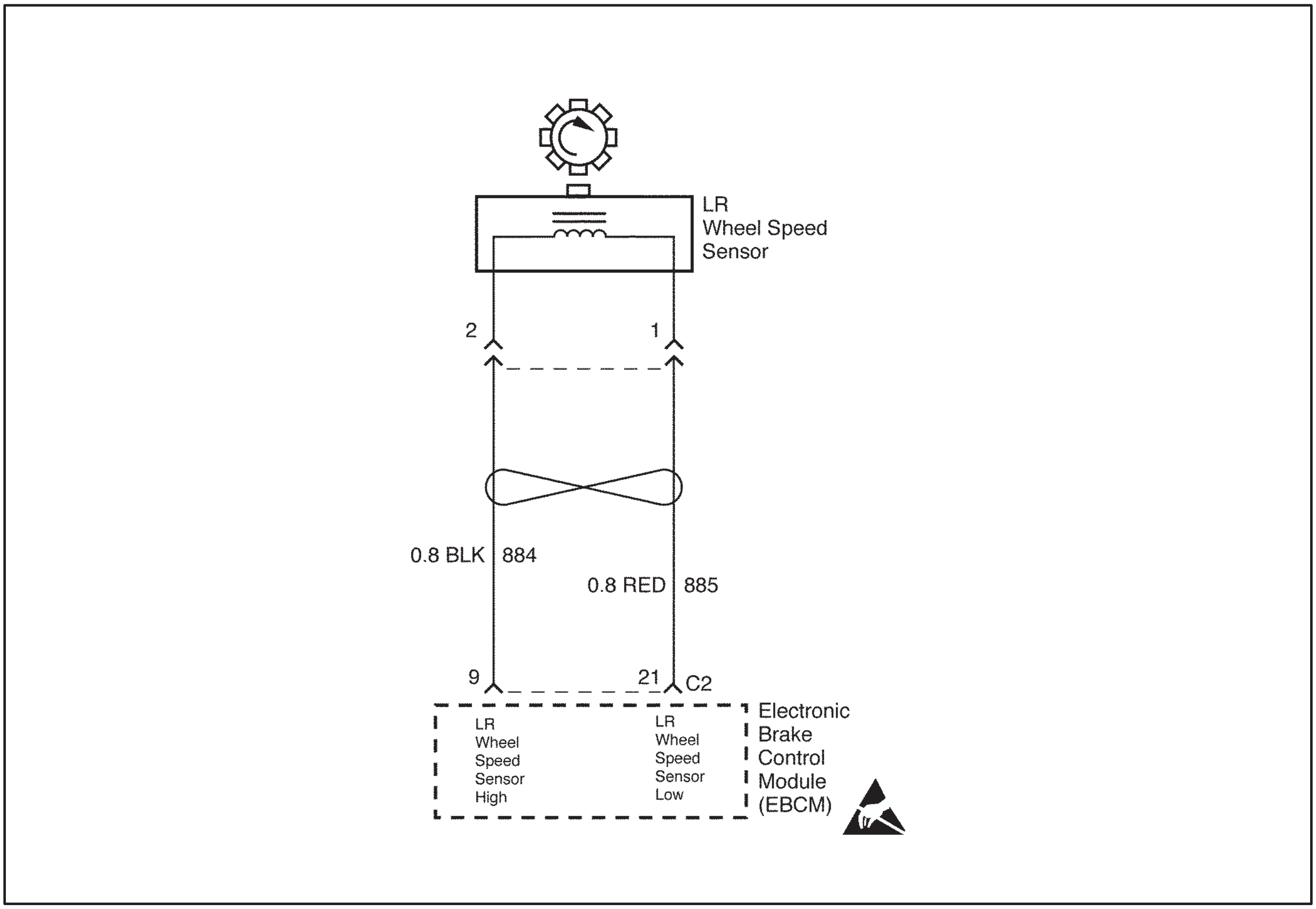
DTC 36 LR Wheel Speed Signal Missing

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Turn the ignition to OFF. 2. Inspect the left rear wheel speed sensor, sensor wire and the connectors for signs of damage or corrosion. 3. Inspect the wheel speed sensor and the toothed ring for looseness, paying particular attention to the toothed ring. Any deviation will affect the wheel speed sensor output signal. 4. Inspect the 24-way EBCM harness connector and harness for signs of damage or corrosion. Is there evidence of physical damage?	—	Go to *Step 8*	Go to *Step 3*
3	1. Disconnect the left rear wheel speed sensor harness connector from the wheel speed sensor. 2. Using a *J 39200*, measure the resistance between terminal A and terminal B of the left rear wheel speed sensor pigtail connector. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 4*	Go to *Step 9*
4	1. With the *J 39200* still connected, select the A/C voltage scale. 2. Spin the wheel by hand while observing the voltage reading. Is the voltage measured equal to or greater than the specified value?	100 mV	Go to *Step 5*	Go to *Step 9*
5	1. Disconnect the 24-way EBCM harness connector from the EBCM. 2. Using a *J 39200*, measure the resistance between terminal 9 and terminal 21 of the 24-way EBCM harness connector. Is the resistance measurement within the specific range?	OL	Go to *Step 6*	Go to *Step 11*

DTC 36 LR Wheel Speed Signal Missing (cont'd)

Step	Action	Value(s)	Yes	No
6	1. Reconnect the left rear wheel speed sensor. 2. Using a *J 39200*, measure the resistance between terminal 9 of the 24-way EBCM harness connector and ground. Is the resistance measurement equal to the specified value?	OL	Go to *Step 7*	Go to *Step 12*
7	1. Inspect the 24-way EBCM harness connector terminals 9 and 21 for poor terminal contact or corrosion. 2. Inspect CKT 884 and CKT 885 for damage that could result in a shorted circuit. Repair any evident damage. 3. Replace the terminals if poor contact or corrosion exists. 4. Reconnect all the connectors. 5. Using the *Scan Tool*, clear all DTCs. 6. Test drive the vehicle above 16 km/h (10 mph). Does DTC 36 set as a current DTC?	—	Go to *Step 10*	Go to *Diagnostic Aids*
8	Make necessary repairs. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
9	Replace the left rear wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Rear.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—
10	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
11	Repair the short between CKT 884 and CKT 885. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
12	Replace the short to ground in CKT 884 or CKT 885. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—

DTC 37 LR Wheel Speed Signal Erratic



WRK55026

Circuit Description

The wheel speed sensor coil emits an electromagnetic field. A toothed ring on the wheel passes by the wheel speed sensor and disrupts this electromagnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed gap. This distance is referred to as the air gap.

Conditions for Setting the DTC

- An average wheel speed for all wheel speed signals greater than 40 km/h (25 mph)
- An average left rear wheel speed greater than 40 km/h (25 mph)
- No speed signal input to the EBCM from the left rear wheel speed sensor for 15 ms
- Anything which suddenly causes (intermittent) the left rear wheel speed signal to drop to zero while the vehicle is moving greater than 40 km/h (25 mph)

Action Taken When the DTC Sets

- The ABS indicator lamp turns on.
- The ABS disables.

DTC 37 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

Repair the conditions responsible for setting the DTC.

Diagnostic Aids

Any of the following conditions may cause an intermittent malfunction:

- A poor connection
- Wire insulation that is rubbed through
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

If the customer says that the ABS indicator lamp is on only during humid conditions such as rain, snow, or vehicle wash, then thoroughly inspect all wheel speed sensor circuits for signs of water intrusion. Use the following procedure:

1. Spray the suspected area with a 5 percent salt water solution (2 teaspoons of salt to 12 oz of water).
2. Drive the vehicle above 24 km/h (15 mph) for at least 30 seconds.

If the DTC returns, replace the suspected harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion. If evidence of corrosion exists, replace the wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Rear.*

Test Description

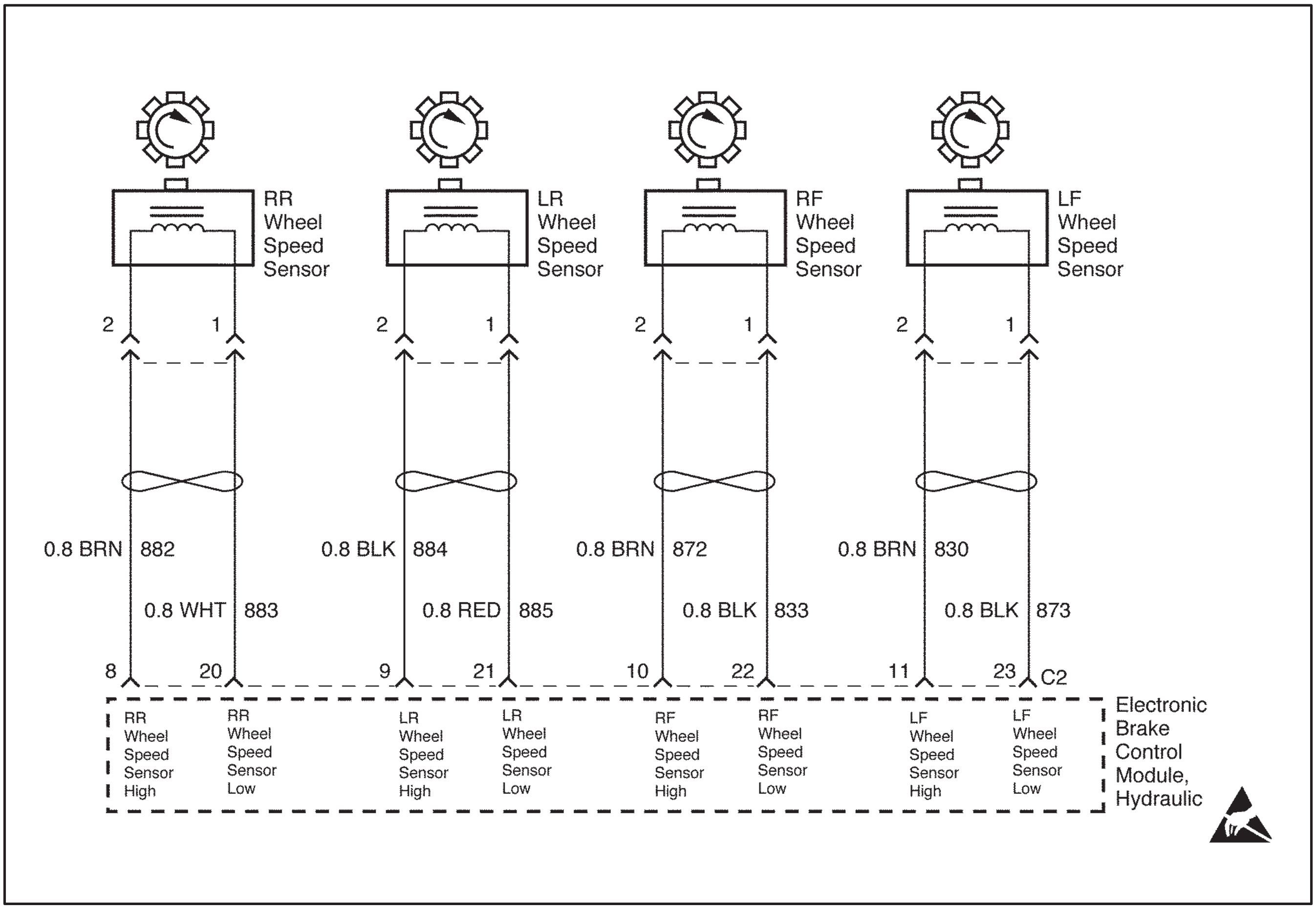
The numbers below refer to the steps in the diagnostic table:

2. This step checks the EBCM 24-way connector for looseness, corrosion, etc..
3. This step measures the resistance of the EBCM 24-way connector terminal 11 and terminal 23.
4. This step measures the resistance at the left rear wheel speed sensor connector.
6. This step inspects the left rear wheel speed sensor and the tone wheel for physical damage or excessive clearance.

DTC 37 LR Wheel Speed Signal Erratic

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Turn ignition to OFF. 2. Disconnect the 24-way EBCM harness connector from the EBCM. 3. Inspect the EBCM harness connector for signs of damage or corrosion. 4. Inspect the wheel speed sensor harness and the sensor harness connector for signs of damage or corrosion. Are all the connections clean and tight?	—	Go to *Step 3*	Go to *Step 6*
3	Using a *J 39200*, measure the resistance between terminals 9 and 21 of the 24-way EBCM harness connector. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 5*	Go to *Step 4*
4	1. Disconnect the wheel speed sensor from the wheel speed sensor harness pigtail connector. 2. Using a *J 39200*, measure the resistance between terminal A and terminal B of the left front wheel speed sensor pigtail connector. Is the resistance measurement within the specific range?	1500–2500 ohms	Go to *Step 7*	Go to *Step 8*
5	1. Reconnect all the connectors. 2. Verify that the left rear wheel speed sensor is securely mounted and that the tone wheel is in good condition. Are the wheel speed sensor and the tone wheel in good condition?	—	Go to *Diagnostic Aids*	—
6	Make the necessary repairs to the 24-way EBCM harness connector. Refer to *Connector Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
7	Repair the open or high resistance in CKT 884 or CKT 885. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
8	Replace the left rear wheel speed sensor. Refer to *Wheel Speed Sensor Replacement – Rear.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—

DTC 38 Wheel Speed Mismatch



WRK55029

Circuit Description

As the toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal (AC) voltage signal. The frequency and amplitude of the sinusoidal (AC) voltage signal are proportional to the wheel speed. The amplitude of the wheel speed signal is directly related to the distance between the wheel speed sensor coil and the toothed ring. This distance is referred to as the air gap. The EBCM can detect wheel speed signal malfunctions as they happen. An error in reported wheel speed can be compensated for by the EBCM up to a point. The error compensation will allow the EBCM to continue to function normally instead of setting a DTC. If the wheel speed mismatch increases beyond that point, the EBCM will set DTC 38.

Conditions for Setting the DTC

- One mismatched wheel speed more than double or less than half the other three
- A vehicle speed greater than 19 km/h (12 mph)
- No unexpected wheel acceleration
- Anything that generates consistent differences between the wheel speed signals

Action Taken When the DTC Sets

- The ABS indicator lamp turns on.
- The ABS disables.

DTC 38 is an Ignition Latched DTC, which indicates that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool*

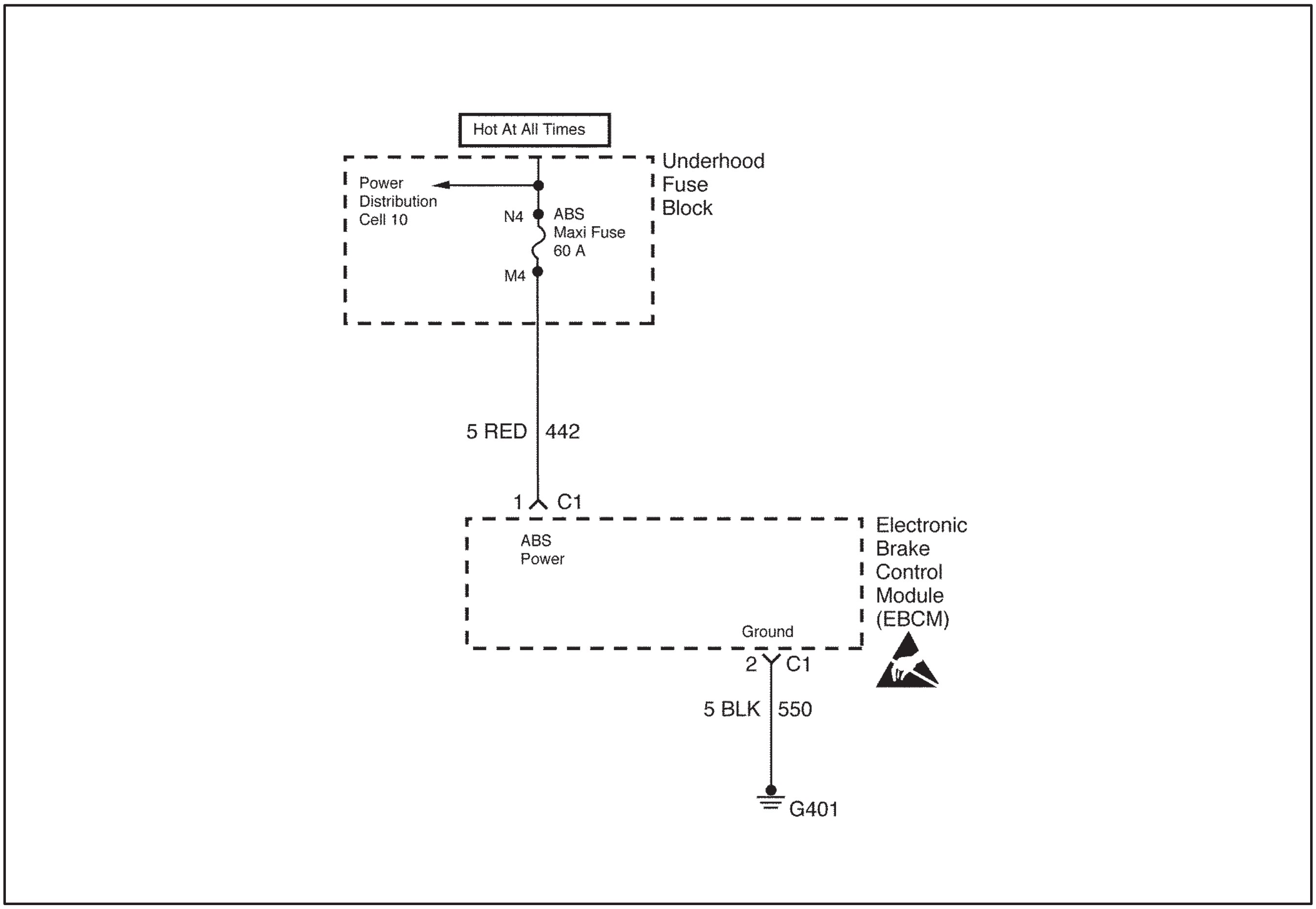
Diagnostic Aids

Installing significantly different tires on the vehicle usually sets a DTC 38.

DTC 38 Wheel Speed Mismatch

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	Inspect the vehicle tires for a variation in tire size. Are all four tires sizes the same?	—	Go to *Step 3*	Go to *Diagnostic Aids*
3	1. Using the *Scan Tool*, clear all DTCs. 2. While driving the vehicle, monitor and compare all the wheel speeds. Does the *Scan Tool* indicate a mismatch in wheel speeds?	—	Go to *Step 4*	Go to *Diagnostic Aids*
4	Does the *Scan Tool* indicate a mismatch with the right front wheel speed?	—	Go to *DTC 23 RF Wheel Speed Signal Erratic*	Go to *Step 5*
5	Does the *Scan Tool* indicate a mismatch with the left front wheel speed?	—	Go to *DTC 27 LF Wheel Speed Signal Erratic*	Go to *Step 6*
6	Does the *Scan Tool* indicate a mismatch with the right rear wheel speed?	—	Go to *DTC 33 RR Wheel Speed Signal Erratic*	Go to *Step 7*
7	Does the *Scan Tool* indicate a mismatch with the left rear wheel speed?	—	Go to *DTC 37 LR Wheel Speed Signal Erratic*	—

DTC 41–58 EBCM Control Valve Circuit



WRK55039

Circuit Description

The EBCM microprocessor will ground the indicated solenoid coil (RF dump/isolation, LF dump/isolation, RR dump/isolation, or LR dump/isolation) circuit to energize the solenoid coils whenever the solenoid valve is needed. Refer to *Electronic Brake Control Module (EBCM) Replacement.*

Conditions for Setting the DTC

Open Circuit

- The ABS bulb check is complete
- Low voltage exists on the EBCM solenoid driver circuit when high voltage is expected (the solenoid is not energized)

Shorted Circuit

- The ABS bulb check is complete
- High voltage is present on the EBCM solenoid driver circuit when the voltage is expected to be low (solenoid energized).

Action Taken When the DTC Sets

- The ABS indicator lamp turns on.
- The ABS disables

DTCs 41–58 are Ignition Latched DTCs, which indicate the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

Repair the conditions responsible for setting the DTC.

Diagnostic Aids

This DTC usually sets because of an open/shorted solenoid coils within the EBCM. The solenoid coil is located within the BPMV and is not serviceable. If the test does not repair the DTC, then replace the EBCM.

If this DTC sets with other DTCs, check for the following conditions:

- A poor EBCM power or signal ground
- A poor EBCM power or ignition feed

Test Description

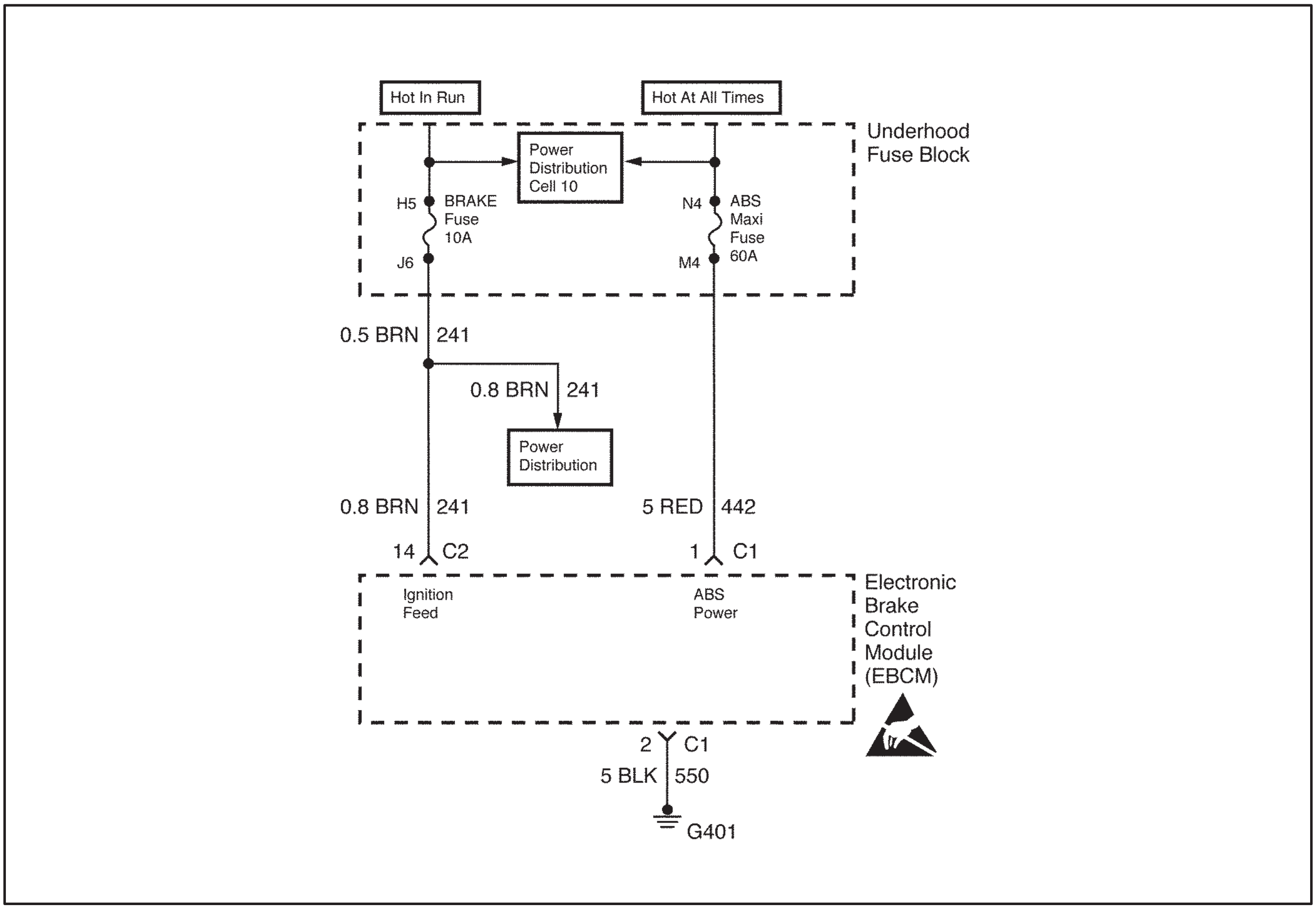
The numbers below refer to the steps in the diagnostic table:

3. This step checks the resistance of the ground circuit.
4. This step checks the ignition voltage available to the EBCM

DTC 41–58 EBCM Control Valve Circuit

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion that could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to *Step 3*	Go to *Step 7*
3	Using a *J 39200*, measure the resistance between terminal 2 of the 2-way EBCM harness connector and ground. Is the resistance measurement within the specific range?	0–2 ohms	Go to *Step 4*	Go to *Step 8*
4	1. Turn the ignition to RUN. 2. Using a *J 39200*, measure the resistance between terminal 1 of the 2-way EBCM harness connector and ground. Is the voltage measured equal to or greater than the specified value?	10 V	Go to *Step 6*	Go to *Step 5*
5	Inspect the 60-amp ABS fuse. Is the fuse open?	—	Go to *Step 10*	Go to *Step 11*
6	1. Inspect the 2-way EBCM harness connector for poor terminal contact or corrosion. 2. Inspect CKT 142 and CKT 150 for damage that could result in a shorted circuit. Repair any evident damage. 3. Replace the terminals if poor contact or corrosion exists. 4. Reconnect all the connectors. 5. Using the *Scan Tool*, clear all DTCs. 6. Test drive the vehicle above 16 km/h (10 mph). Does the DTC set as a current DTC?	—	Go to *Step 9*	Go to *Diagnostic Aids*
7	Repair the 2-way EBCM harness connector if necessary Is the repair complete?	—	Go to *A Diagnostic System Check*	—
8	Repair the open or the high resistance in CKT 150. Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
9	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—
10	Repair the short to ground in CKT 142. Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
11	Repair the open or the high resistance in CKT 142. Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—

DTC 65 or 66 EBCM Relay Circuit



WRK55027

Circuit Description (DTC 65/66)

The pump motor relay supplies power to all eight solenoid coils (four isolation solenoid coils and four dump solenoid coils) and the pump motor when the ABS is required. The relay and the eight solenoid coils are located within the EBCM.

Conditions for Setting the DTC (DTC 65)

- The EBCM microprocessor commands the relay on
- Low voltage exists on all eight solenoid driver circuits when high voltage is expected (the solenoid is not energized)

Conditions for Setting the DTC (DTC 66)

- The ABS bulb check is complete
- High voltage exists on the eight solenoid circuits when all are expected to be low (the relay is not commanded on)

Action Taken When the DTC Sets

- The ABS indicator lamp turns on.
- The ABS disables

DTCs 65 and 66 are Ignition Latched DTCs, which indicate that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

Repair the conditions responsible for setting the DTC.

Diagnostic Aids (DTC 65)

DTC 65 usually sets because of an open relay coil or non-closable relay contacts. The relay is located within the EBCM. The relay is not serviceable. If the test does not repair the DTC, then replace the EBCM.

If DTC 65 appears with other DTCs, repair the other DTCs first. Clear all DTCs. Then run three function tests with the *Scan Tool*. Refer to this diagnostic chart if DTC 65 resets.

Diagnostic Aids (DTC 66)

DTC 66 usually sets when the relay contacts are stuck closed. The relay is located within the EBCM. The relay is not serviceable. If the test does not repair the DTC, then replace the EBCM.

Test Description

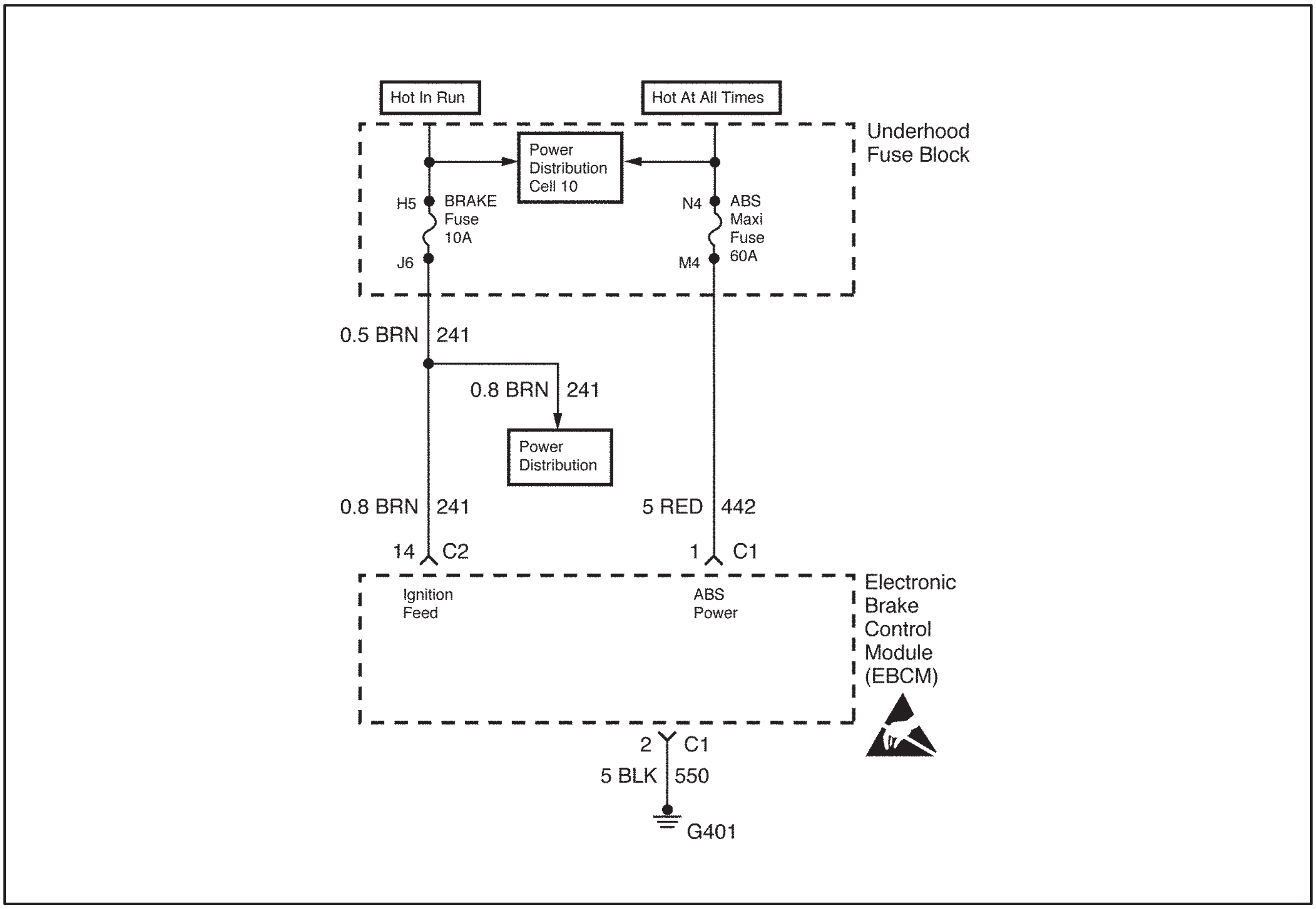
The numbers below refer to the steps in the diagnostic table:

3. This step checks the resistance of the ground circuit.
4. This step checks the ignition voltage available to the EBCM

DTC 65 or 66 EBCM Relay Circuit

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion that could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to *Step 3*	Go to *Step 7*
3	Using a *J 39200*, measure the resistance between terminal 2 of the 2-way EBCM harness connector and ground. Is the resistance measurement within the specific range?	0–2 ohms	Go to *Step 4*	Go to *Step 8*
4	1. Turn the ignition to RUN. 2. Using a *J 39200*, measure the resistance between terminal 1 of the 2-way EBCM harness connector and ground. Is the voltage measured equal to or greater than the specified value?	10 V	Go to *Step 6*	Go to *Step 5*
5	Inspect the 60-amp ABS maxi-fuse. Is the fuse open?	—	Go to *Step 10*	Go to *Step 11*
6	1. Inspect the 2-way EBCM harness connector for poor terminal contact or corrosion. 2. Inspect CKT 142 and CKT 150 for damage that could result in a shorted circuit. Repair any evident damage. 3. Replace the terminals if poor contact or corrosion exists. 4. Reconnect all the connectors. 5. Using the *Scan Tool*, clear all DTCs. 6. Test drive the vehicle above 16 km/h (10 mph). Does the DTC set as a current DTC?	—	Go to *Step 9*	Go to *Diagnostic Aids*
7	Repair the 2-way EBCM harness connector if necessary. Refer to *Connector Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
8	Repair the open or the high resistance in CKT 150. Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
9	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—
10	Repair the short to ground in CKT 142. Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
11	Repair the open or the high resistance in CKT 142. Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—

DTC 67 or 68 Pump Motor Circuit Open/Shorted



WRK55027

Circuit Description

The pump motor circuit is integral to the BPMV. The EBCM microprocessor energizes the relay within the EBCM in order to supply the battery voltage to the high side of the pump motor. The EBCM microprocessor grounds the low side of the pump motor when activation of the pump motor is required.

Conditions for Setting the DTC (DTC 67)

- The EBCM internal relay is on
- The pump motor is off
- Low voltage is present from the low side of the pump motor when high voltage is expected

Conditions for Setting the DTC (DTC 68)

- Vehicle speed is 13 km/h (8 mph)
- The EBCM internal relay is on
- The pump motor is commanded ON and then OFF
- High voltage exists from the low side of the pump motor for 100 ms when the voltage is expected to be low

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTCs 67 and 68 are Ignition Latched DTCs, which indicate that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* Clear DTCs function

Diagnostic Aids

The pump motor is integral with the BPMV. Do not service the pump motor separately. A poor power/ground connection at the 2-way EBCM connector or the 2-way pump motor harness from the EBCM to the pump motor can cause a DTC 67. A seized pump motor, shorted pump motor windings or a poor power/ground at the 2-way EBCM connector can cause a DTC 68. Replace the EBCM or the BPMV if the following tests show that the pump motor EBCM internal circuits have failed.

Important: Reset the *J 39200* test leads to zero prior to making any resistance measurements. Refer to the *J 39200* in the user's manual.

Test Description

The numbers below refer to the steps in the diagnostic table:

3. This step checks for an open pump motor circuit. The pump motor circuit resistance should not be above 0.3 ohms. Reset the *J 39200* test leads to zero prior to making this low resistance measurement.
5. This step determines the resistance of the EBCM ground circuit.
7. This step determines the ignition voltage available to the EBCM.

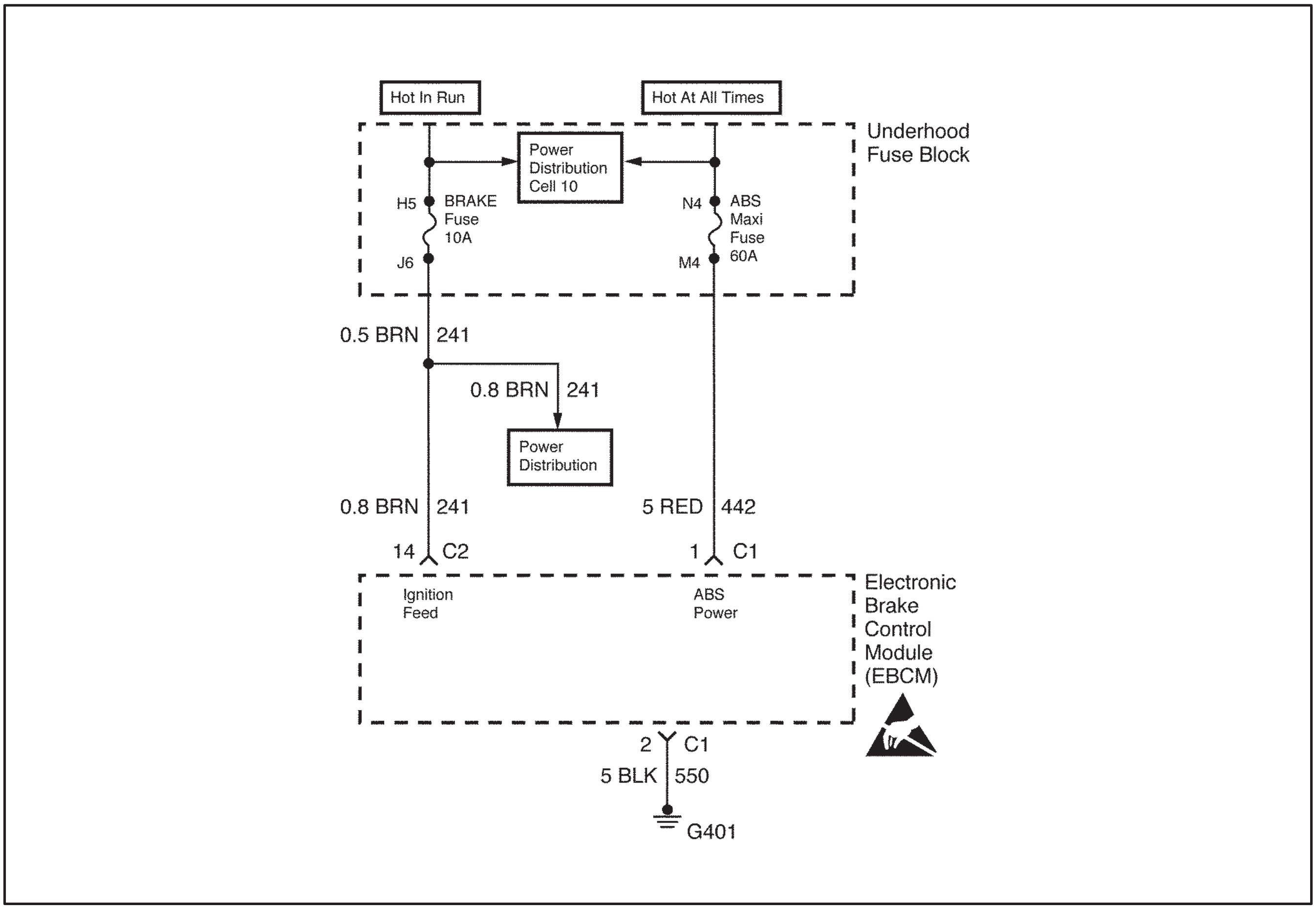
DTC 67 or 68 Pump Motor Circuit Open/Shorted

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way pump motor pigtail connector from the EBCM. 3. Inspect the connector and the wiring for damage or corrosion that could result in an open circuit between the pump motor and the EBCM. Is the connector and the wiring in good condition?	—	Go to *Step 3*	Go to *Step 10*
3	Using a *J 39200*, measure the resistance between terminals 1 and 2 of the 2-way pump motor pigtail connector. Is the resistance within the specific range?	0.1–1.0 ohms	Go to *Step 4*	Go to *Step 15*
4	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion that could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to *Step 5*	Go to *Step 9*
5	Using a *J 39200*, measure the resistance between terminal 2 of the 2-way EBCM harness connector and the ground. Is the resistance within the specific range?	0–2 ohms	Go to *Step 6*	Go to *Step 11*
6	1. Turn the ignition to RUN. 2. Using a *J 39200*, measure the voltage between terminal 1 of the 2-way EBCM harness connector and ground. Is the voltage equal to or greater than the specified value?	10.0 V	Go to *Step 8*	Go to *Step 7*
7	Inspect the 60-amp ABS maxi-fuse. Is the fuse open?	—	Go to *Step 13*	Go to *Step 14*
8	1. Inspect the 2-way EBCM harness connector for poor terminal contact or corrosion. Inspect CKT 142 and CKT 150 for damage that could result in an open circuit. Repair any evident damage. Replace the terminals if poor contact or corrosion exists. 2. Reconnect all the connectors. 3. Using the *Scan Tool*, clear all DTCs. 4. Test drive the vehicle above 16 km/h (10 mph). Does the DTC set as a current DTC?	—	Go to *Step 12*	Go to *Diagnostic Aids*

DTC 67 or 68 Pump Motor Circuit Open/Shorted (cont'd)

Step	Action	Value(s)	Yes	No
9	Repair the 2-way EBCM harness connector if necessary. Refer to *Connector Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
10	Repair the 2-way pump motor pigtail connector or wiring if necessary. Refer to *Connector Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
11	Repair the open or the high resistance in CKT 150. Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
12	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—
13	Repair the short to ground in CKT 142. Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
14	Repair the open or the high resistance in CKT 142. Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
15	Replace the BPMV assembly. Refer to *Brake Pressure Modulator Valve (BPMV) Replacement*.. Is the repair complete?	—	Go to *A Diagnostic System Check*	—

DTC 69 or 74 Excessive Dump/Isolation Time



WRK55027

Circuit Description (DTC 69)

The EBCM microprocessor grounds the dump valve coil(s) to energize and open the dump valve, allowing fluid to be dumped into the LPA. This is done with very short activation pulses opening and closing the dump valve passageway. Brake pressure is lowered at the wheel and allows the affected wheel to begin rolling again. Each dump valve is opened independently to control the deceleration of the wheel.

Circuit Description (DTC 74)

The EBCM microprocessor grounds the isolation coil to energize and close the isolation valve. This will prevent any additional brake pressure applied by the driver from reaching the wheel. Further increases in brake pressure will be prohibited. Each isolation valve is closed independently to isolate each wheel. The EBCM microprocessor also uses a software subroutine to monitor for any ABS event which would initiate an isolation command. This subroutine is performed every 1.0 second.

Conditions for Setting the DTC (DTC 69)

Dump time (pressure reduction) exceeds 9 seconds, which can be caused from the following conditions:

- Locked rotors
- Excessively low road surface friction

Conditions for Setting the DTC (DTC 74)

Isolation time (pressure hold) exceeding 120 consecutive 1.0 second checks

Action Taken When the DTC Sets

- The ABS indicator lamp turns on
- The ABS disables

DTCs 69 or 74 are Ignition Latched DTCs, which indicate that the above actions remain true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions for Clearing the DTC

Repair the conditions responsible for setting the DTC

Diagnostic Aids

If any other DTCs are set, repair those DTCs first. If there are no DTCs set, ensure the ABS is operating properly by performing *Using the Scan Tool Function Test.*

Test Description

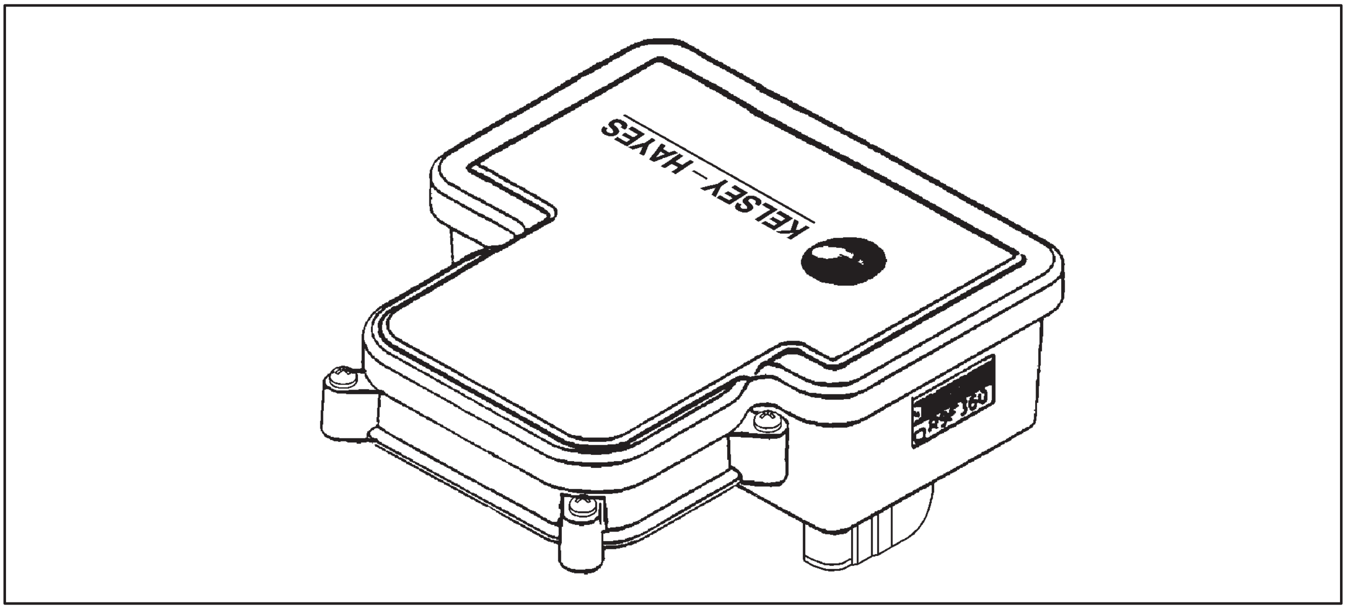
The numbers below refer to the steps in the diagnostic table:

3. This step determines the resistance of the ground circuit.
4. This step determines the ignition voltage available to the EBCM.

DTC 69 or 74 Excessive Dump/Isolation Time

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion that could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to *Step 3*	Go to *Step 7*
3	Using a *J 39200*, measure the resistance between terminal 2 of the 2-way EBCM harness connector and ground. Is the resistance measurement within the specific range?	0–2 ohms	Go to *Step 4*	Go to *Step 8*
4	1. Turn the ignition to RUN. 2. Using a *J 39200*, measure the resistance between terminal 1 of the 2-way EBCM harness connector and ground. Is the voltage equal to or greater than the specified value?	10.0 V	Go to *Step 6*	Go to *Step 5*
5	Inspect the 60-amp ABS maxi-fuse. Is the fuse open?	—	Go to *Step 10*	Go to *Step 11*
6	1. Inspect the 2-way EBCM harness connector for poor terminal contact or corrosion. 2. Inspect CKT 142 and CKT 150 for damage that could result in a shorted circuit. Repair any evident damage. 3. Replace the terminals if poor contact or corrosion exists. 4. Reconnect all the connectors. 5. Using the *Scan Tool*, clear all DTCs. 6. Test drive the vehicle above 16 km/h (10 mph). Does the DTC set as a current DTC?	—	Go to *Step 9*	Go to *Diagnostic Aids*
7	Repair the 2-way EBCM harness connector if necessary. Refer to *Connector Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
8	Repair the open or the high resistance in CKT 150. Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
9	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—
10	Repair the short to ground in CKT 142. Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
11	Repair the open or the high resistance in CKT 142. Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—

DTC 71–73 EBCM Malfunction



175132

Circuit Description

The EBCM initializes a self-test when the ignition is turned to the RUN position. This internal self-test verifies that all ABS circuitry is operating correctly.

Conditions for Setting the DTC

Any condition within the EBCM which causes a memory error will set this DTC.

Action Taken When the DTC Sets

- The ABS indicator lamp is turned on
- The ABS is disabled

These DTCs are Permanent Latched DTCs, which indicate that the above actions remain true until the DTC is cleared using a *Scan Tool*.

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC
- Use the *Scan Tool* DTCs function

Diagnostic Aids

DTCs 71–73 are EBCM internal diagnosis trouble codes. Replace the EBCM if these tests show that the EBCM circuitry has failed.

Test Description

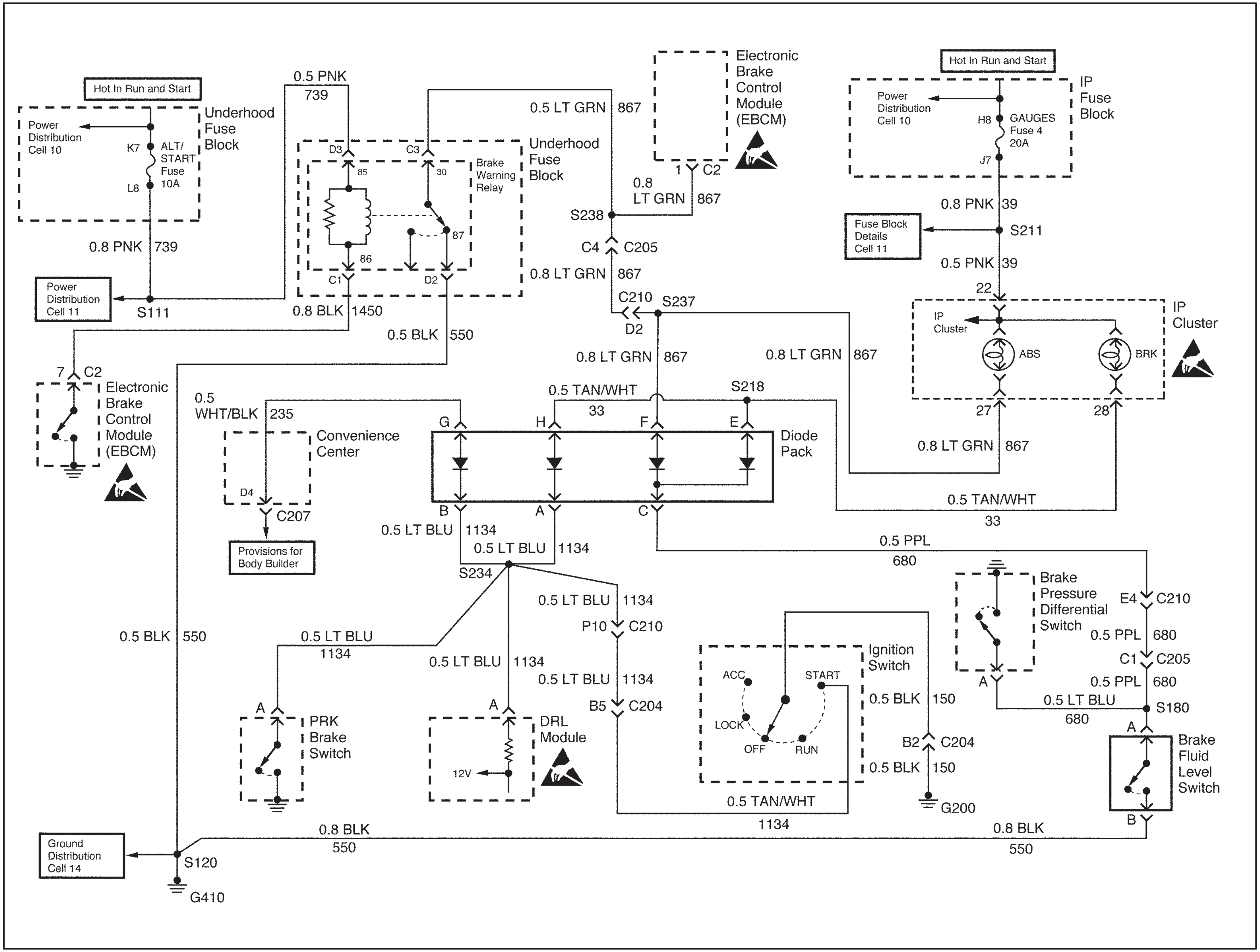
The numbers below refer to the steps in the diagnostic table:

2. This step checks if the EBCM will Clear DTCs.
3. This step checks if the DTC has been set previously.

DTC 71–73 EBCM Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	Install the *Scan Tool* and attempt to clear the DTCs. Did the DTCs clear?	—	Go to *Step 3*	Go to *Step 4*
3	Check the history DTCs and the data. Was this the first time the DTC has set?	—	Go to *A Diagnostic System Check*	Go to *Step 4*
4	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—

DTC 81 Brake Switch Circuit



Circuit Description

The Stop Lamp Switch is normally closed. With the ignition in the RUN position and the brake pedal not depressed, the EBCM will have ignition voltage present at terminal 15 of the 24-way EBCM connector. When the brakes are applied, the voltage present at terminal 15 of the EBCM will be zero.

Conditions for Setting the DTC

- Vehicle above 56 km/h (35 mph) for 10 seconds, followed by vehicle at rest for 1 second
- Stop lamp never switching during the above condition

Action Taken When the DTC Sets

- The ABS indicator lamp will not be illuminated
- The ABS will not be disabled

DTC 81 is advisory code only. the DTC is stored in memory, but the ABS indicator lamp will not light, and ABS will not be disabled.

Conditions for Clearing the DTC

Repair the conditions responsible for setting the DTC.

Diagnostic Aids

DTC 81 can be set by a faulty Stop Lamp Switch, misadjusted Stop Lamp Switch or damage in power and ground circuits. Also, a driver who rides the brake at power-up through 24 km/h (15 mph) can set this DTC.

Thoroughly check any circuitry that is suspected of causing the intermittent complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness

Test Description

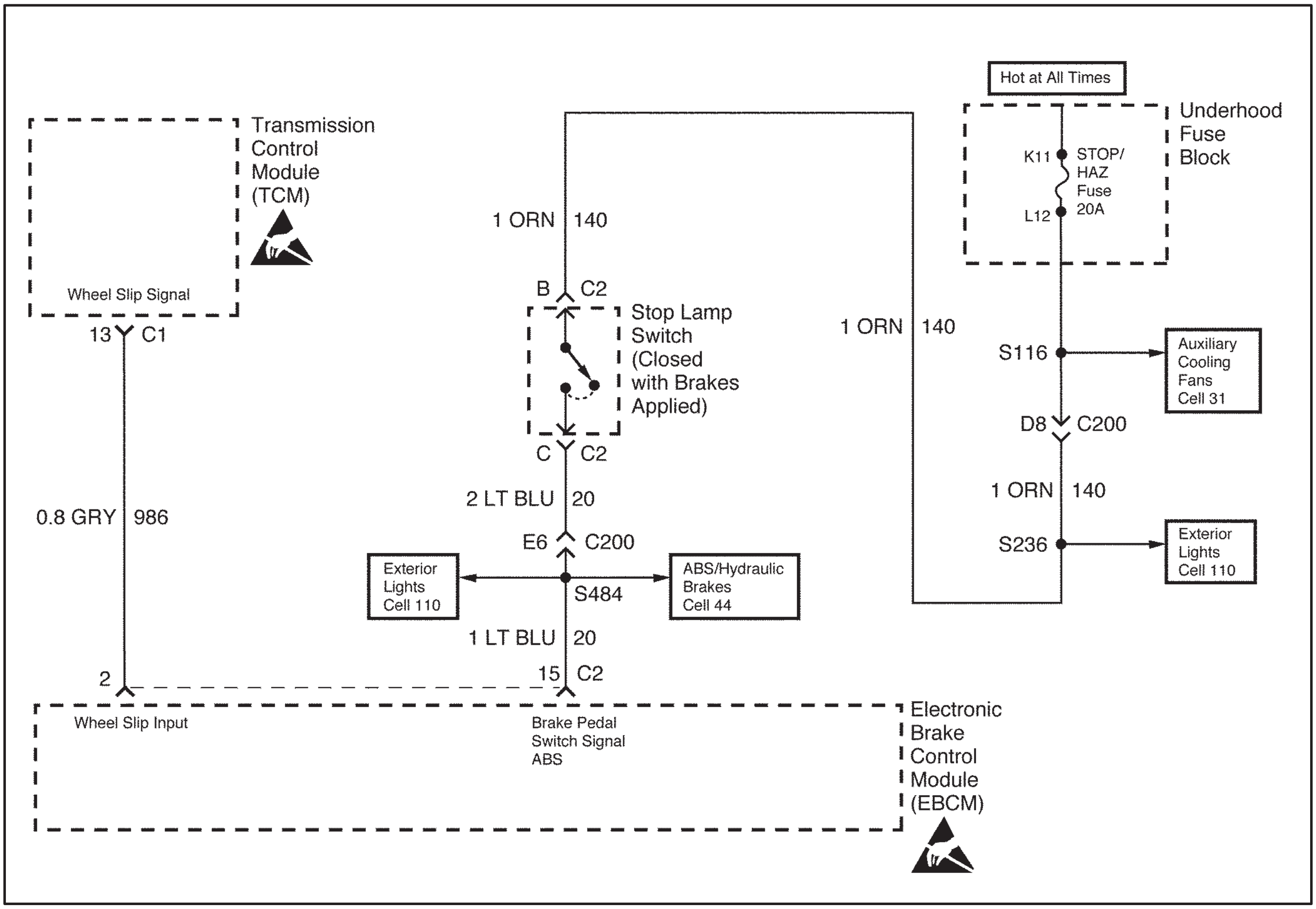
The numbers below refer to the steps in the diagnostic table:

2. This step checks the functionality of the Stop Lamp Switch circuit using the *Scan Tool.*
3. This step checks the functionality of the Stop Lamp Switch circuit (including the Inverter Driving Module) using a *J 39200*.
4. This step checks the functionality of the Stop Lamp Switch circuit up to the Inverting Driving Module.
8. This step checks for a short to ground in the Stop Lamp Switch circuit between the Inverting Driver Module and the EBCM.
9. This step checks the resistance in the ground circuit to the Inverting Driver Module.
10. This step checks the ignition voltage at the Inverting Driver Module.

DTC 81 Brake Switch Circuit

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Install the *Scan Tool*. 2. Turn the ignition to RUN. 3. Using the Data List function of the scan tool, check the operation of the Stop Lamp Switch while applying and releasing the brake pedal. Does the scan tool indicate that the Stop Lamp Switch is opening and closing?		Go to *Step 8*	Go to *Step 3*
3	1. Turn the ignition to OFF. 2. Disconnect the 24-way EBCM harness connector. 3. Using a *J 39200*, measure the resistance between terminal 15 of the 24-way connector and ground while applying and releasing the brake pedal. Is the resistance measured switching between the specified range?	0 ohms – OL	Go to *Step 8*	Go to *Step 4*
4	1. Disconnect the Stop Lamp Switch harness connector from the Stop Lamp Switch. 2. Using a *J 39200*, measure the resistance between terminal 15 of the 24-way EBCM harness connector and terminal B. Is the resistance within the specific range?	0–2 ohms	Go to *Step 5*	Go to *Step 10*
5	1. Turn the ignition to RUN. 2. Using a *J 39200*, measure the resistance between terminal B of the Stop Lamp Switch harness connector and ground. Is the resistance within the specified range?	0–2 ohms	Go to *Step 6*	Go to *Step 9*
6	Check for a properly adjusted Stop Lamp Switch. Is the Stop Lamp Switch adjustment correct?	—	Go to *Step 7*	Go to *Step 11*
7	Using a *J 39200*, measure the resistance between terminal B of the Stop Lamp Switch while applying and releasing the brake pedal. Is the resistance measured switching between the specified range?	0 ohms – OL	Go to *Diagnostic Aids*	Go to *Step 12*
8	1. Inspect the 24-way EBCM harness connector for poor terminal contact or corrosion. 2. Inspect CKT 848 for damage that could result in an open circuit. Repair any evident damage. 3. Replace the terminals if poor contact or corrosion exists. 4. Reconnect all the connectors. 5. Using the *Scan Tool*, clear all DTCs. 6. Test drive the vehicle above 16 km/h (10 mph). Does the DTC 81 set as a current DTC?	—	Go to *Step 13*	Go to *Diagnostic Aids*
9	Repair the short to ground in CKT 451 or 808. Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
10	Repair the open or the high resistance in CKT 848. Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
11	Repair the misadjusted Stop Lamp Switch. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
12	Replace the Stop Lamp Switch. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
13	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—

DTC 86 ABS Indicator Lamp Circuit Shorted to B+



WRK55031

Circuit Description

The amber ABS indicator lamp operates in 2 modes; normal and backup. In the normal mode, ignition voltage is supplied to the ABS indicator lamp through the IGN SW fuse. The indicator is normally on unless the EBCM switches the indicator off, by activating the ABS indicator lamp relay. If the EBCM senses that a fault has occurred, it will set a DTC and light the ABS indicator lamp by supplying a ground to the ABS indicator lamp relay. In the backup mode, the ABS telltale relay circuit will ensure that the ABS indicator lamp is lit if the 24-way connector is disconnected or poorly seated, or if the EBCM has failed during normal operation. If either of these fault conditions occur, the ABS telltale relay will de-energize, which connects an alternate ground path to the ABS indicator lamp circuit through terminal C2 and terminal C1 of the ABS indicator relay.

Conditions for Setting the DTC

- High voltage present on the ABS indicator lamp control circuit when low voltage is expected (lamp is turned on)
- Anything that keeps the ABS indicator lamp circuit high when the lamp is expected to be on

Action Taken When the DTC Sets

The ABS is not disabled.

Conditions for Clearing the DTC

- Repair the conditions responsible for setting the DTC.
- Use the *Scan Tool* Clear DTCs function.

Diagnostic Aids

DTC 86 typically sets because of a shorted ABS indicator lamp. Yet DTC 86 can also set because of a short to voltage in the wiring between the ABS indicator lamp and the EBCM.

Test Description

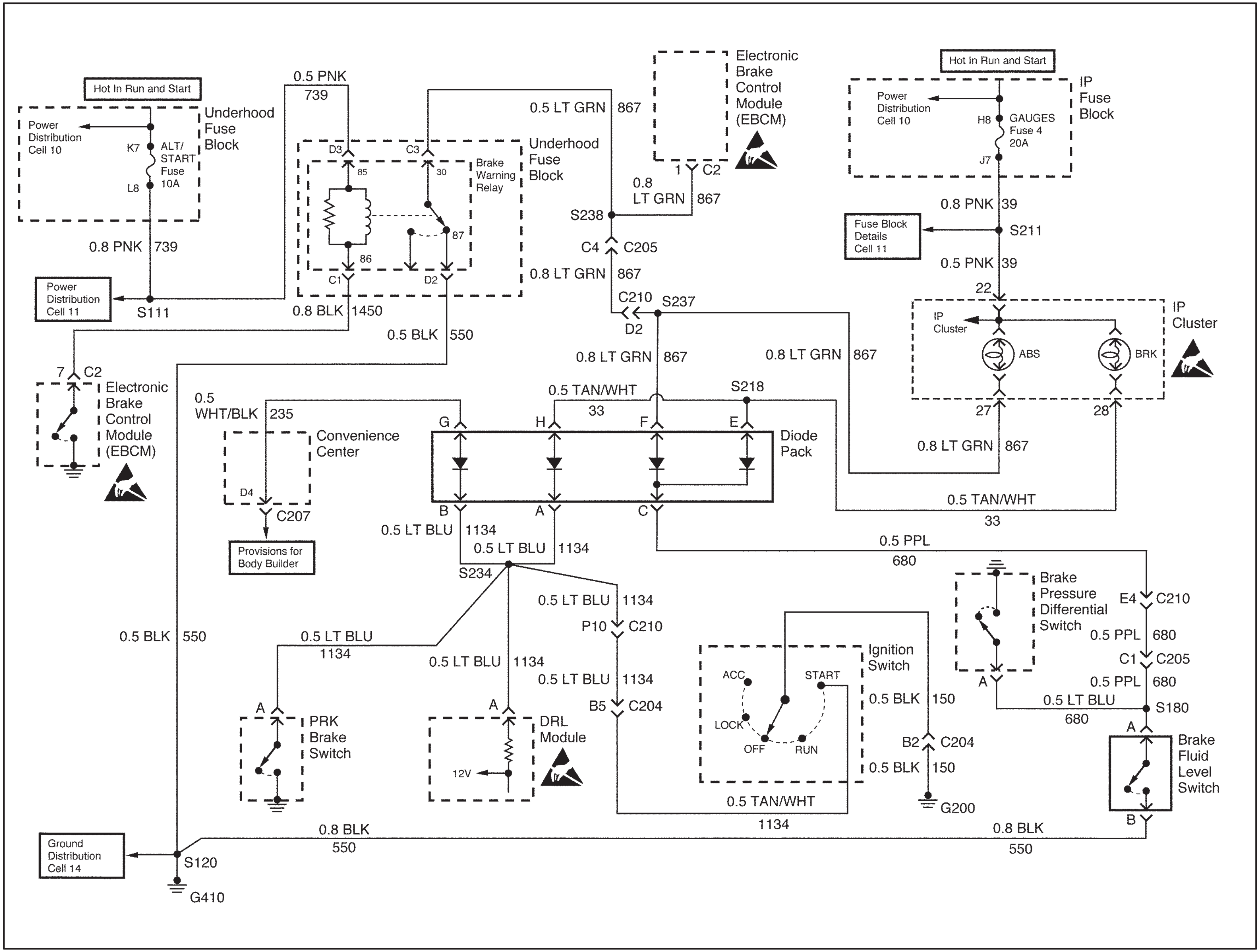
The numbers below refer to the steps in the diagnostic table:

2. This step checks for normal operation of the ABS indicator lamp.
3. This step turns off the ABS indicator lamp with a *J 36169-A.*

DTC 86 ABS Indicator Lamp Circuit Shorted to B+

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Turn the ignition to RUN 2. Observe the amber ABS indicator lamp operation. Did the ABS indicator lamp turn on and then turn off after 3 seconds.	—	Go to *Step 5*	Go to *Step 3*
3	1. Turn the ignition to OFF. 2. Disconnect the 24-way EBCM harness connector from the EBCM. 3. Using a *J 36169-A* with a 10-amp fuse, connect terminal 2 of the 24-way EBCM harness connector to ground. Is the resistance measured switching between the specified range?	—	Go to *Step 5*	Go to *Step 4*
4	1. Turn the ignition to OFF. 2. Disconnect the ABS indicator relay. 3. Turn the ignition to RUN. 4. Using a *J 39200*, measure the voltage between terminal C2 and ground. Is the voltage equal to or greater than the specified value?	10 V	Go to *Step 7*	Go to *Step 8*
5	1. Inspect the 24-way EBCM harness connector for poor terminal contact or corrosion. 2. Inspect CKT 1899 for damage which may result in a shorted circuit. Repair any evident damage. 3. Replace the terminal if poor contact or corrosion exists. 4. Reconnect all the connectors. 5. Using the *Scan Tool*, clear all DTCs. 6. Test drive the vehicle above 16 km/h (10 mph). Does the DTC 86 set as a current DTC?	—	Go to *Step 6*	Go to *Diagnostic Aids*
6	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—
7	Repair a short to voltage in CKT 1899. Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
8	Replace the ABS indicator relay. Is the repair complete?	—	Go to *A Diagnostic System Check*	—

ABS Indicator Lamp Off Constantly, No DTCs



Circuit Description

The ABS indicator lamp is normally on (voltage supplied through the normally closed contacts or the ABS indicator relay) unless the ABS indicator relay is switched off by the EBCM. This logic ensures that the ABS indicator lamp will always be turned on if there is an open or high resistance in CKT 1899 or a faulty EBCM. When the EBCM needs to turn the ABS indicator lamp off, it will ground CKT 1899 to energize the coil in the ABS indicator relay and open the relay contacts.

Diagnostic Aids

If the ABS indicator lamp is off constantly, there is an open or short to voltage in the lamp circuit between the instrument panel and the ABS indicator relay ground (this includes the ABS indicator relay contacts). Also check for an open instrument panel fuse or an open bulb.

Test Description

The numbers below refer to the steps in the diagnostic table:

2. This step checks for normal operation of the ABS indicator lamp.
3. Manually (with fused jumper) turn on ABS indicator lamp by bypassing the ABS indicator relay.
5. This step checks for a short to ground in CKT 1899.

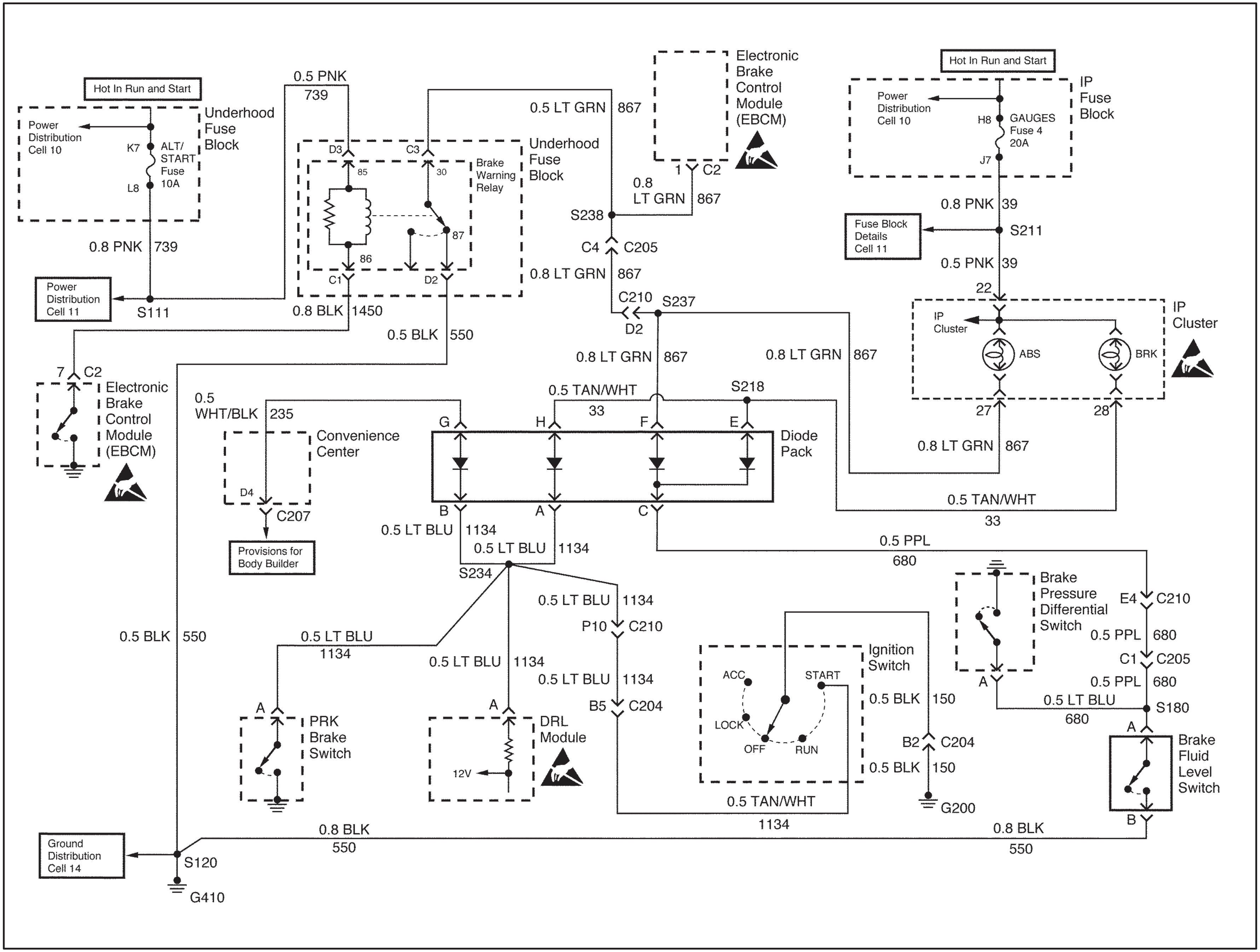
ABS Indicator Lamp Off Constantly, No DTCs

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Disconnect the EBCM. 2. Turn ignition to RUN. Does the ABS indicator lamp turn on?	—	Go to *Step 6*	Go to *Step 3*
3	1. Turn the ignition to OFF. 2. Disconnect the ABS indicator relay. 3. Using a fused jumper wire, such as *J 36169*, connect terminal A7 (terminal C4 for B Models) of the relay center harness connector to ground. 4. Turn the ignition to RUN. Does the ABS indicator lamp turn on?	—	Go to *Step 4*	Go to *Step 8*
4	Using a *J 39200*, measure the resistance between relay center harness connector terminal B8 (terminal C3 for B Models) and ground. Is the resistance measurement within the specific range?	0–2 ohms	Go to *Step 5*	Go to *Step 11*
5	Using a *J 39200*, measure the resistance between relay center harness connector terminal A9 (terminal C2 for B Models) and ground. Is the resistance measurement within the specific range?	OL (infinite)	Go to *Step 13*	Go to *Step 12*
6	1. Inspect the 24-way EBCM harness connector terminal 7 for damage which may result in a short to ground with the EBCM harness connector connected to the EBCM. 2. Inspect CKT 1899 for damage that could result in a short to ground. Repair any evident damage. 3. Reconnect all the connectors. 4. Using the *Scan Tool*, clear all DTCs. 5. Test drive the vehicle above 16 km/h (10 mph). Is the ABS indicator lamp off constantly?	—	Go to *Step 7*	Malfunction is intermittent. Go to *Diagnostic Aids*
7	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—
8	Check for an open ABS indicator lamp. Is the ABS indicator lamp open?	—	Go to *Step 10*	Go to *Step* 9
9	Repair the open or the high resistance in CKT 867. Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
10	Replace ABS indicator lamp. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
11	Repair the open or the high resistance in CKT 150. Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—

ABS Indicator Lamp Off Constantly, No DTCs (cont'd)

Step	Action	Value(s)	Yes	No
12	Repair short to ground in CKT 1899. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
13	Replace ABS indicator relay. Is the repair complete?	—	Go to *A Diagnostic System Check*	—

ABS Indicator Lamp On Constantly, No DTCs



Circuit Description

The ABS indicator lamp is normally on (voltage supplied through the normally closed contacts or the ABS indicator relay) unless the ABS indicator relay is switched off by the EBCM. This logic ensures that the ABS indicator lamp will always be turned on if there is an open or high resistance in CKT 1899 or a faulty EBCM. When the EBCM needs to turn the ABS indicator lamp off, it will ground CKT 1899 to energize the coil in the ABS indicator relay and open the relay contacts.

Diagnostic Aids

If the ABS indicator lamp is on constantly, the EBCM is not capable of turning the lamp off or there is a short to ground in the circuit.

Test Description

The numbers below refer to the steps in the diagnostic table:

2. This step checks for normal operation of the ABS indicator lamp.
3. Manually (with fused jumper) turn on ABS indicator lamp by bypassing the ABS indicator relay.

ABS Indicator Lamp Off Constantly, No DTCs

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Disconnect the 24-way EBCM harness connector. 2. Using a fused jumper wire, such as *J 36169*, connect terminal 7 of the 24-way harness connector to ground. 3. Turn ignition to RUN. Does the ABS indicator lamp turn on?	—	Go to *Step 6*	Go to *Step 3*
3	1. Turn the ignition to OFF. 2. Remove the ABS indicator relay. 4. Turn the ignition to RUN. Does the ABS indicator lamp turn off?	—	Go to *Step 4*	Go to *Step 7*
4	Using a *J 39200*, measure the resistance between the ABS indicator relay harness connector terminal B7 (terminal C1 for B Model) and ground. Is the voltage measured equal to or greater than the specified value?	12 V	Go to *Step 5*	Go to *Step 8*
5	Using a *J 39200*, measure the resistance between the relay center harness connector terminal A9 (terminal C2 for B Models) and the EBCM harness connector terminal 7. Is the resistance measurement within the specific range?	0–2 ohms	Go to *Step 9*	Go to *Step 10*
6	1. Inspect the 24-way EBCM harness connector terminal 7 for poor terminal contact or corrosion. Replace terminals if poor contact or corrosion exists. 2. Inspect CKT 1899 for damage that could result in an open circuit. Repair any evident damage. 3. Reconnect all connectors. 4. Using the *Scan Tool*, clear all DTCs. 5. Test drive the vehicle above 16 km/h (10 mph). Is the ABS indicator lamp on constantly?	—	Go to *Step 11*	Malfunction is intermittent. Go to *Diagnostic Aids*
7	Repair short to ground in CKT 867. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
8	Repair the open or high resistance in CKT 38 (CKT 341 for B Model). Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
9	Replace ABS indicator relay. Is the repair complete?	—	Go to *A Diagnostic System Check*	—

ABS Indicator Lamp Off Constantly, No DTCs (cont'd)

Step	Action	Value(s)	Yes	No
10	Repair the open or high resistance in CKT 1899. Refer to *Wiring Repairs* in Wiring System. Is the repair complete?	—	Go to *A Diagnostic System Check*	—
11	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check*	—

Repair Instructions

Automated Bleed Procedure

Important:

- Use the two-person bleed procedure under the following conditions:
  - Installing a new Electro-Hydraulic Control Unit (EHCU) or Brake Pressure Modulator Valve (BPMV)
  - Air is trapped in the valve body
- Do not drive the vehicle until the brake pedal feels firm.
- Do not reuse brake fluid that is used during bleeding.
- Use the vacuum, the pressure and the gravity bleeding procedures only for base brake bleeding.

Two Person Procedure

1. Raise the vehicle in order to access the system bleed screws.
2. Bleed the system at the right rear wheel first.
3. Install a clear hose on the bleed screw.
4. Immerse the opposite end of the hose into a container partially filled with clean DOT 3 brake fluid.
5. Open the bleed screw 1/2 to one full turn.
6. Slowly depress the brake pedal. While the pedal is depressed to its full extent, tighten the bleed screw.
7. Release the brake pedal and wait 10–15 seconds for the master cylinder pistons to return to the home position.
8. Repeat the previous steps for the remaining wheels. The brake fluid which is present at each bleed screw should be clean and free of air.
9. This procedure may use more than a pint of fluid per wheel. Check the master cylinder fluid level every four to six strokes of the brake pedal in order to avoid running the system dry.
10. Press the brake pedal firmly and run the *Scan Tool* Function Test four times. Release the brake pedal between each test.
11. Bleed all four wheels again using steps 3–9. This will remove the remaining air from the brake system.
12. Evaluate the feel of the brake pedal before attempting to drive the vehicle.
13. Bleed the system as many times as necessary in order to obtain the appropriate feel of the pedal.

Electronic Brake Control Module (EBCM) Replacement

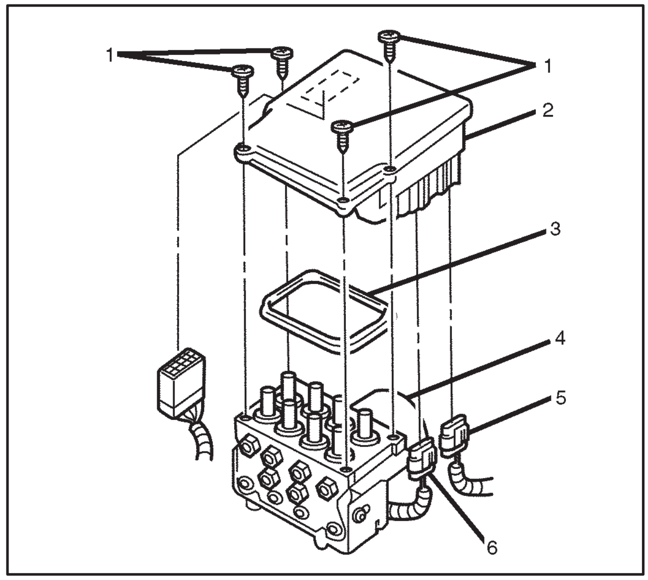
Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Remove the four EBCM wiring harness connectors.
3. Remove the four T-25 Torx® bolts (1) that fasten the EBCM to the BPMV.

Notice: Do not use a tool to pry the EBCM from the BPMV. Excessive force will damage the EBCM.

4. Remove the EBCM (2) from the BPMV (4). Removal may require a light amount of force.
5. Clean the BPMV with a clean, dry cloth.



WRK55013

Installation Procedure

Important:

- After installation, calibrate the new EBCM to the tire size that is appropriate to the vehicle. Refer to *ABS Description.*
- If the EBCM mounting bolts are corroded or damaged, do not reuse the old mounting bolts. Install new EBCM mounting bolts with the new EBCM.
- Do not use RTV or any other type of sealant on the EBCM to BPMV mating surface.

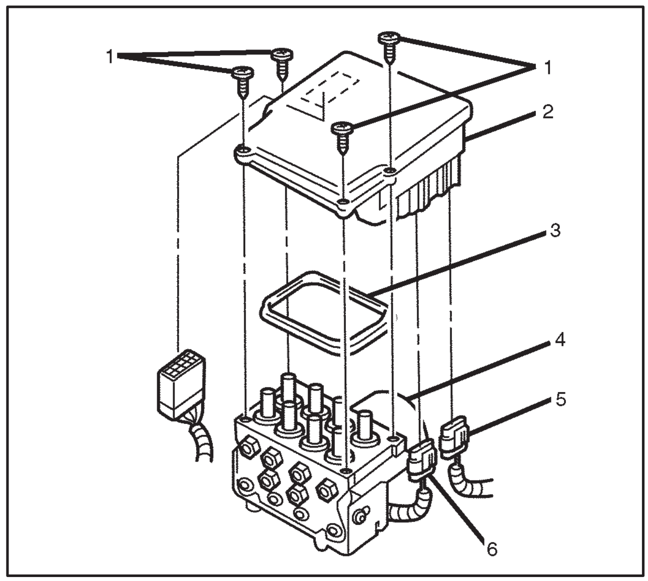
1. Install EBCM (2) to BPMV (4).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

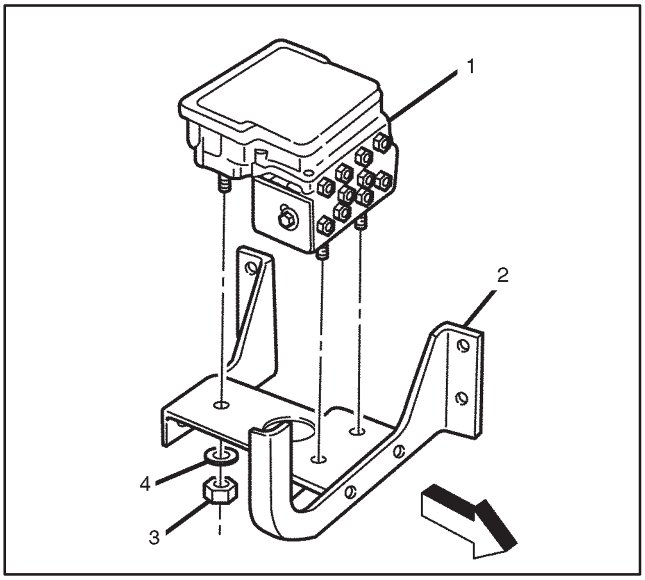
2. Install the four EBCM bolts (1).

   Tighten

   Tighten the four bolts to 5 N·m (39 lb in) in an X-pattern.
3. Connect the four electrical connectors to the EBCM.
4. Connect the negative battery cable.
5. Revise the tire calibration using the scan tool.
6. Return to Diagnostic System Check. Refer to *A Diagnostic System Check.*



WRK55013



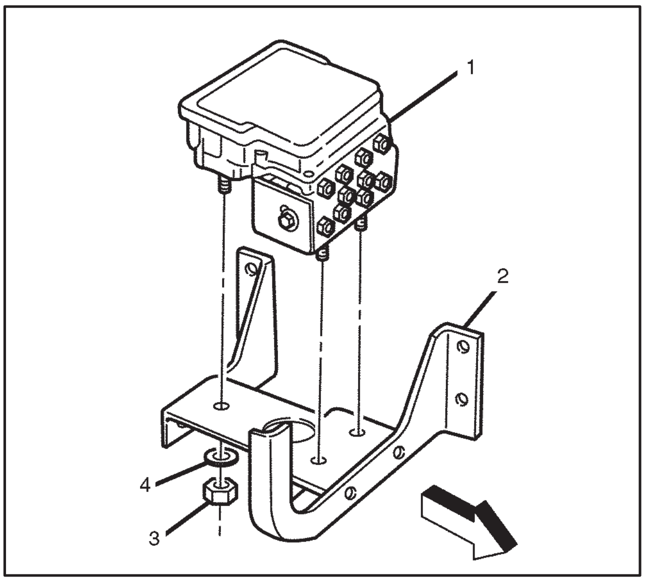
WRK55014

Brake Pressure Modulator Valve (BPMV) Replacement

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Remove the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement* in this supplement.
3. Remove the combination valve electrical connector.
4. Remove the five brake lines from the BPMV.
5. Remove the three BPMV mounting bracket nuts (3) and washers (4).
6. Remove the BPMV (4) from the EHCU mounting bracket (2).
7. If necessary, remove the combination valve and tube adapters.
8. Clean the BPMV (1) with a clean, dry cloth.



WRK55014

Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the BPMV (1) onto the EHCU mounting bracket (2).
2. Install the BPMV to mounting bracket washers (4) and nuts (3).

   Tighten

   Tighten the three BPMV mounting nuts (3) to 9 N·m (7 lb ft).
3. Install the three tube adapters, if removed.

   Tighten

   Tighten the tube adapters to 31 N·m (23 lb ft).
4. Install the combination valve onto the BPMV, if removed.
5. Install the three combination valve fastening bolts, if removed.

   Tighten

   Tighten the three Allen bolts firs to 8 N·m (6 lb ft) and then to 16 N·m (12 lb ft).
6. Connect the five brake lines to the combination valve.

   Tighten

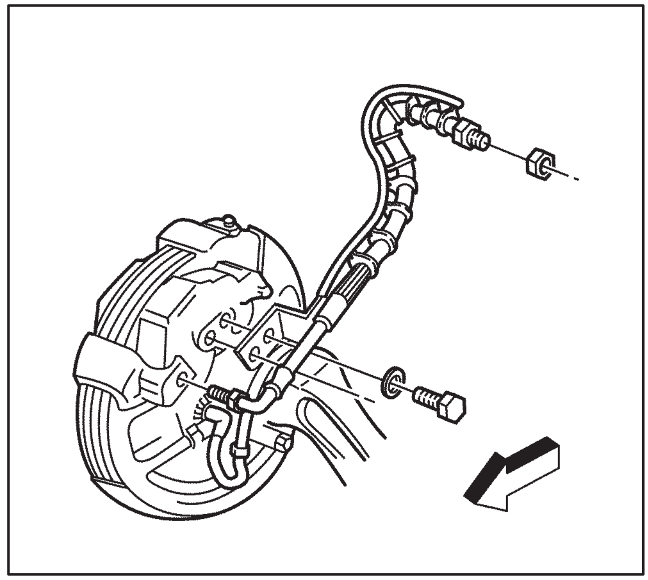
   Tighten the five brake lines to 30 N·m (22 lb ft).
7. Install the combination valve electrical connector.
8. Install the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement* in this supplement.
9. Connect the negative battery cable.
10. Bleed the brake system Refer to *automated Bleed Procedure.*

11.Return to Diagnostic System Check. Refer to *A Diagnostic System Check.*

Wheel Speed Sensor Replacement – Front

Removal Procedure

1. Disconnect the electrical connector.
2. Remove the nylon straps retaining the sensor wire to the brake line. Note the location of the straps.
3. Remove the wheel speed sensor from the bore.
4. Remove the speed sensor retaining clip. The clip may come out with the wheel speed sensor or stay in the bore. If the sensor retaining clip is still functioning correctly, save it for reinstallation. If the sensor retaining clip is not functioning correctly, replace the sensor retaining clip.



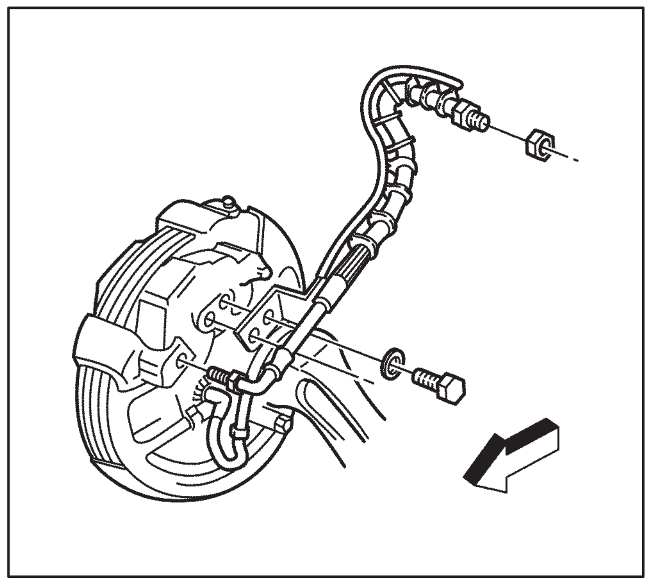
WRK55015

Installation Procedure

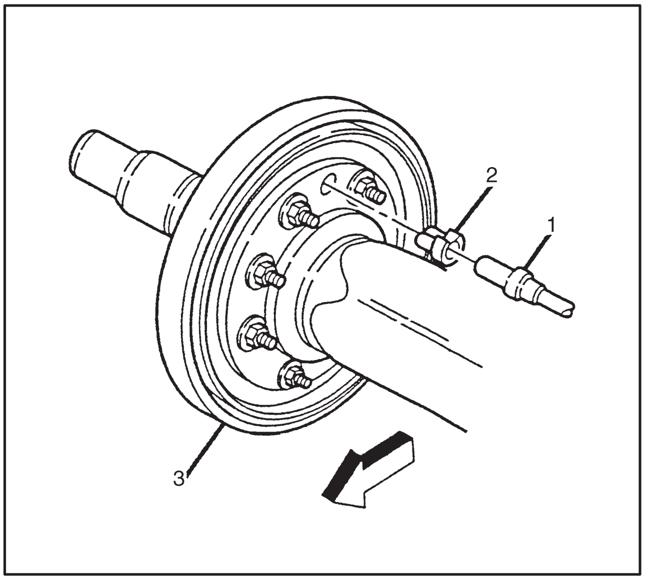
Important: You may have to use the wire retainers from the old wheel speed sensor wire on the new sensor. Do not damage the new wire when installing the retainers.

Important: When the wheel speed sensor is fully installed in the block bore, it contacts the tone ring which is attached to the wheel hub. Normal bearing play between the sensor tip and tone ring in the wheel hub will move the sensor tip away from the tone ring. This automatically establishes the proper air gap.

1. Install the wheel speed sensor retaining clip completely into the bore. The clip should stop at the retaining tabs. Insert the wheel speed sensor into the clip. The wheel speed sensor should contact the tone ring.
2. Secure the sensor wire to the brake line with a wire tie in the location noted during removal.
3. Connect the electrical connector.



WRK55015

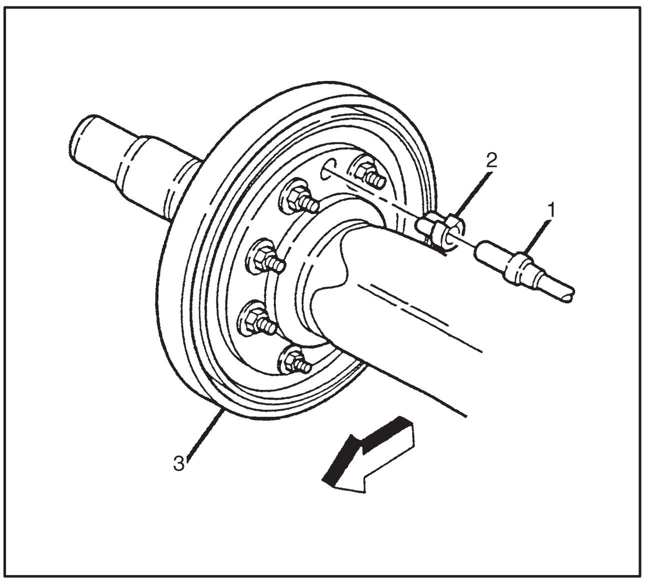


156576

Wheel Speed Sensor Replacement – Rear

Removal Procedure

1. Disconnect the electrical connector.
2. Remove the nylon straps retaining the sensor wire to the brake line. Note the location of the straps.
3. Remove the wheel speed sensor (1) from the bore.
4. Remove the speed sensor retaining clip (2). The clip may come out with the wheel speed sensor or stay in the bore. If the sensor retaining clip is still functioning correctly, save it for reinstallation. If the sensor retaining clip is not functioning correctly, replace the sensor retaining clip.



156576

Installation Procedure

Important: You may have to use the wire retainers from the old wheel speed sensor wire on the new sensor. Do not damage the new wire when installing the retainers.

Important: When the wheel speed sensor is fully installed in the block bore, it contacts the tone ring which is attached to the wheel hub. Normal bearing play between the sensor tip and tone ring in the wheel hub will move the sensor tip away from the tone ring. This automatically establishes the proper air gap.

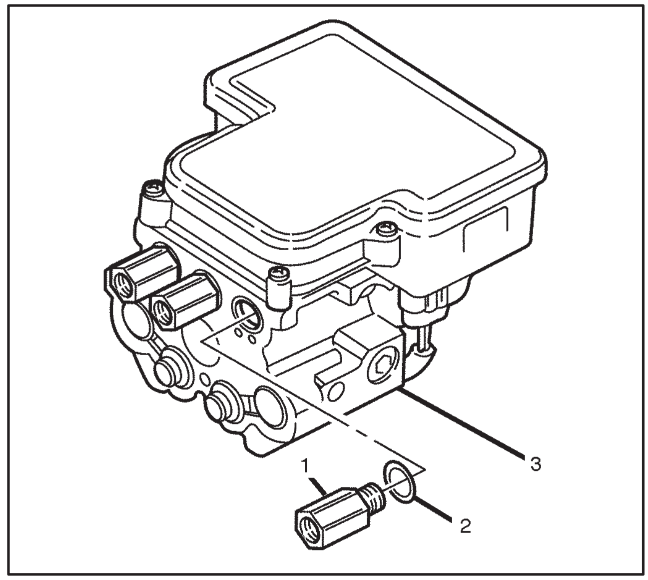
1. Install the wheel speed sensor retaining clip (2) completely into the bore. The clip should stop at the retaining tabs. Insert the wheel speed sensor (1) into the clip. The wheel speed sensor should contact the tone ring.
2. Secure the sensor wire to the brake line with a wire tie in the location noted during removal.
3. Connect the electrical connector.

Tube Adapter Replacement

Removal Procedure

Important: If you must remove more than one tube adapter at one time, stamp the BPMV with a number (1, 2 or 3) in order to indicate the number of grooves cut into the tube adapters. This procedure will aid proper reassembly.

1. Remove the appropriate brake line from the tube adapter.
2. Remove the tube adapter (1).



WRK55017

Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

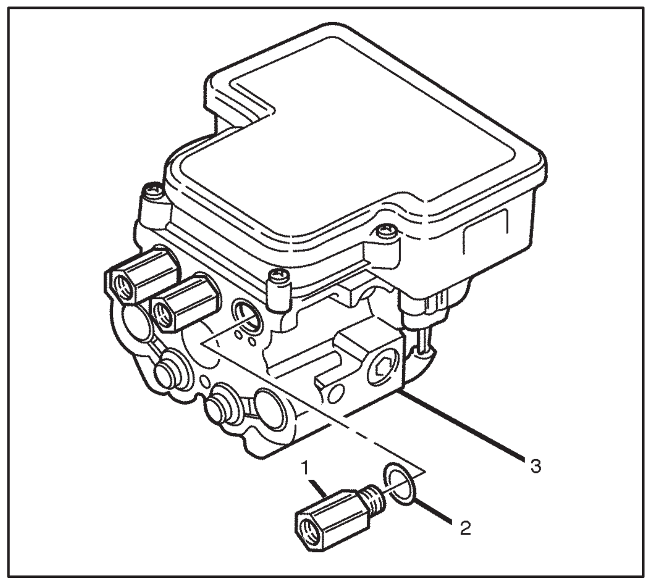
1. Install the new tube adapter (1).

   Tighten

   Tighten the tube adapter to 31 N·m (23 lb ft).
2. Install the brake line.

   Tighten

   Tighten the brake line to 30 N·m (22 lb ft).
3. Bleed the system. Refer to *Automated Bleed Procedure.*



WRK55017

Description and Operation

Service Precautions

When working on this system, observe the following precautions:

- Before welding on the vehicle with an electric welding unit, complete the following steps:
  - Turn the ignition switch OFF.
  - Disconnect the EBCM connectors.
- Do not use a fast charger for starting the engine.

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

- Disconnect the negative battery cable when fast charging.
- Never disconnect the battery from the vehicle electrical system while the engine is running.
- Connect all wiring harness connectors securely.
- Proper speed sensor wiring, routing and retaining are necessary in order to prevent false signals due to electrical noise. You can achieve proper system operating only by restoring the system to its original condition.
- When servicing the ABS, note the routing, position, mounting and locations of the following items:
  - All components
  - The wiring
  - The connectors
  - The clips
  - The brackets
  - The brake pipes

Follow the above-mentioned precautions when working on ABS. Familiarize yourself with ABS and its' relationships with other components on the vehicle.

You must have a basic knowledge of the following items before using this section. Without this basic knowledge, you will have difficulties using the diagnostic procedures contained in this section.

If you need a review of basic electrical troubleshooting, refer to *Troubleshooting with a Digital Multimeter* in Wiring Systems. Additionally, General Motors Service Training offers courses in electrical and electronic service.

General System Description

This section covers diagnostic and service procedures for the four wheel antilock brake system (ABS). These models use the three sensor ABS. Speed information is obtained using a wheel speed sensor (WSS) at each front wheel and the vehicle speed sensor (VSS) for rear wheel speed information.

ABS reduces the occurrence of wheel lockup during severe braking applications. The system regulates hydraulic pressure to all four wheels. The pressure is regulated by the brake pressure modulator valve (BPMV).

ABS is designed to provide the average driver with the following:

- Optimal steering control and stability when braking
- Optimal braking performance with available traction

Wheel Slip

The ability of a vehicle to stop is related to the friction of the road surface. At 0 percent slip, the tires rotate freely; at 100 percent clip, the tire and wheel are locked. Stopping distance increases and steering control is diminished.

With a 10–20 percent slip, vehicle stopping distance will be as short as possible and steering control will be at its optimum. Some slip is necessary to stop the wheel and achieve maximum braking.

When ABS operation occurs, the drive of the vehicle should always continue to push hard on the brake pedal. Never pump the brakes. The ABS system will automatically modulate the brakes.

Steering Control

Steering control, like braking, also depends on tire traction. A locked tire in a 100% slip condition delivers less than optimum braking and directional control. Thus, some tire rotation is desirable for steering control. The tires must regain traction before steering control is restored to the vehicle.

Abbreviations and Definitions

BPMV: Brake Pressure Modulator Valve
CKT: Circuit
DLC: Data Link Connector
DMM: Digital Multimeter
DTC: Diagnostic Trouble Code
EBCM: Electronic Brake Control Module
EHCU: Electro-Hydraulic Control Unit
Infinite: Open Circuit/Unmeasurable High Resistance
LPA: Low Pressure Accumulator
OL: Open Circuit/Unmeasurable High Resistance
WSS: Wheel Speed Sensor

The EHCU is the entire ABS unit, including the BPMV and the EBCM. The BPMV is defined as the hydraulic control portion of the EHCU. The BPMV includes the internal control valves, the electric motor and the pumps. The BPMV does not include the EBCM. The EBCM is the electronic control portion of the EHCU. The EBCM mounts to the top of the BPMV. The EBCM is housed in aluminum with a black plastic top.

Basic Knowledge Required

Basic Electrical Circuit

You should understand the basic electrical theory. You should also know the meaning of basic electrical concepts and measurement: voltage (volts), current (amperes) and resistance (ohms). You should understand what happens in a circuit with an open or shorted wire. You should be able to read and understand a wiring diagram.

Use of Circuit Testing Tools

You should be familiar with the high impedance Digital Multimeter (DMM) *J 39200*. You should be familiar with the meter controls and how to use them correctly. You should be able to measure voltage, resistance and current. You should also know how to use jumper wires to bypass components in order to test circuits.

ABS Description

Electro-Hydraulic Control Unit

The Electro-Hydraulic Control Unit (EHCU) is located on the left frame rail behind the cab. The EHCU assembly includes the Electronic Brake Control module (EBCM) and the Brake Pressure Modulator Valve (BPMV). The EHCU regulates hydraulic pressure in the brake system during an antilock stop.

Electronic Brake Control Module

The Electronic Brake Control Module (EBCM) is part of the EHCU. The EBCM is the electronic portion of the EHCU. The major function of the EBCM is to control the BPMV. Inputs to the EBCM include the following items:

- Four wheel speed signals
- Stop lamp switch
- Differential pressure switch
- Ignition switch voltage
- Unswitched battery voltage

Outputs of the EBCM include the following items:

- Four isolation solenoids (internal to the EBCM)
- Four dump solenoids (internal to the EBCM)
- The amber ABS indicator lamp
- The red BRAKE warning lamp
- The pump motor

A diagnostic serial data link (UART, ABS only) is also used for diagnostic service tools and assembly plant testing. A serial data circuit (Class 2) is used for transmitting a “rough road” signal to the PCM.

The EBCM monitors the speed of each wheel. If any wheel approaches lockup, the EBCM controls the solenoids (isolation solenoid and dump solenoid) in order to reduce brake pressure to the wheel approaching lockup. Once the wheel regains traction, brake pressure is increased until the wheel again approaches lockup. This cycle repeats until either the vehicle comes to a stop, the brake is released, or the wheel is no longer approaching lockup. The EBCM also runs self diagnostics in order to check for any system malfunctions. Refer to *Self-Diagnostics*. If the EBCM detects a malfunction with the system, the EBCM will illuminate the amber ABS indicator in order to alert the driver of a malfunction.

Brake Pressure Modulator Valve

The Brake Pressure Modulator Valve (BPMV) is part of the EHCU. The BPMV is the hydraulic portion of the EHCU. The EBCM controls the BPMV. The BPMV is split into the following four hydraulic channels:

- Left front
- Right front
- Left rear
- Right rear

Each channel has an isolation valve and a dump valve.

Wheel Speed Sensors

The Wheel Speed Sensors (WSS) are a magnetic coil/pickup type. Each WSS produces an AC voltage signal which is transmitted to the EBCM in order to indicate how fast the wheel is turning. The speed of the wheel is directly proportional to the frequency and amplitude of the wheel speed signal.

Wheel Speed Sensor Tone Wheels

Each Wheel Speed Sensor (WSS) uses a tone wheel in order to produce an alternating current (AC) voltage signal. Tone wheels are metal rings with teeth on the outside diameter. The AC voltage is produced as the teeth pass through the magnetic field of the WSS pole piece. The tone wheels are attached to the rotor or the drum. Any imperfections in the tone rings, such as a broken tooth or a missing tooth, can cause an inaccurate wheel speed signal.

Tire Size Calibration

The EBCM accepts wheel speed signals from several different sizes of tire and wheel combinations. All vehicles are preprogrammed from the factory with the proper tire size calibration. Whenever you replace the EBCM or change the tire size, you must reset the tire size calibration in the EBCM using *Scan Tool*.

Trim Level Calibration

The ABS can operate with different brake types and different wheel bases from several different vehicle configurations. All vehicles are pre-programmed from the factory with the proper trim level calibration. This trim level calibration corresponds to the different wheel bases and axles/brake types available on each vehicle. Whenever you replace the EBCM or change the wheel base of the vehicle, you must recalibrate the trim level within the EBCM.

Use the *Scan Tool.* You must first obtain the wheel base and axle type using RPO codes (refer to *General Information*) in order to select the correct trim level on the *Scan Tool*. Once programmed, this calibration will remain, even if the battery is disconnected or if the EBCM is removed from the vehicle.

ABS Operation

ABS Indicator Lamp Operation

The system uses an amber ABS indicator lamp in the instrument cluster in order to show system operation and malfunctions.

Normal Lamp Operation

A bulb check occurs each time the ignition switch is turned to the RUN position. The ANTILOCK and BRAKE lamps should turn on, remain on for about two seconds, then turn off. The ABS indicator lamp also indicates system malfunctions. When the EBCM detects a malfunction in the system, the EBCM turns the ANTILOCK and sometimes the BRAKE lamp on. The lamp may remain on or turn off depending on the malfunction. In order to determine the specific cause of the malfunction, refer to the appropriate diagnostic system check.

Tires and ABS

Correct tire size, proper inflation, accurate alignment and even wear are needed for good brake performance. These items are essential for proper ABS performance.

Spare Tire

Use of the spare tire supplied with the vehicle will not affect the performance of the system.

Replacement Tires

If the replacement tires are not the same size as the original tires, you must change the tire size calibration within the EBCM using a *Scan Tool*. Failure to change the tire calibration when replacing the original tires with a different size tire can affect the performance of the ABS.

Self-Tests

The ABS performs the following two system self-tests:

The first self-test is performed when the ignition is turned to RUN. Both the ABS indicator lamp and the BRAKE warning lamp will turn on for 2 seconds, then they will turn off. This test confirms correct operation of the EBCM and the lamps. If one of the lamps remains on, either the ABS or the base brake system will require service.

The second self-test is performed when the vehicle reaches a speed of greater than 4.8 km/h (3 mph). At this time the internal EBCM relay, six solenoid coils and BPMV pump motor are cycled and checked for shorts/opens. The BPMV pump will make a slight sound when this function occurs.

Normal Braking Mode

During normal braking, pressure is applied through the brake pedal. Fluid travels from the master cylinder, through the combination valve and into the BPMV. Once in the BPMV, the fluid travels through the normally-open isolation valves, through the normally-closed dump valves and out into the brakes.

During normal braking, the pumps are not turned on. The low pressure accumulators are empty. Only residual pressure i stored in these accumulators.

The EBCM constantly monitors wheel speed sensor inputs for rapid deceleration. If the ABS becomes disabled for any reason, the driver will always have base brakes. The normally-open isolation valves and normally-closed dump valves will remain in these positions in order to allow normal fluid pressure to the wheels.

ABS will not operate without wheel slip. The vehicle must be going at least 13 km/h (8 mph) in order to begin ABS operation.

ABS Braking Mode

The ABS will monitor the three-wheel speed sensors and control the hydraulic pressure changes at each wheel until the vehicle has come to a complete stop or until the driver has released the brake pedal. The system operates through the following process:

1. Pressure isolation/maintain
2. Pressure decrease
3. Pressure increase
4. Brake release (fluid return)

Sequence of Events

1. With the vehicle at 13 km/h)8 mph) or greater, the driver depresses the brake pedal.
2. The wheel speed begins to decrease as the master cylinder pressure and brake pressure increase.
3. As the wheel speed continues to decrease from vehicle speed, the normally-open isolation valve for the affected channel closes to stop additional pressure to the wheel. The master cylinder pressure continues to increase as the driver depresses the pedal, but the wheel brake pressure is now limited to the ABS system pressure.
4. When the EBCM determines that the wheel is about to lock up, the normally-closed dump valve opens. This bleeds off some of the pressure at the wheel cylinder (or caliper) in order to allow the wheel to return to a speed closer to the speed of the vehicle.
5. The dump valve is again closed and the isolation valve remains closed in order to allow the wheel speed to completely recover from the lock-up.
6. Once the vehicle has recovered from the lock-up tendency, the isolation valve is momentarily pulsed open in order to allow the master cylinder pressure and pump pressure to reach the brakes. This controlled pressure rise continues until the wheel is at optimum brake output or until the brake pressure is brought up to master cylinder output pressure. The ABS allows the brake fluid to flow to the wheel, build pressure and try to force another departure, repeating Step 3 through Step 6. The following paragraphs describe the various modes in detail.

Isolation Mode (Pressure Maintain)

Isolation will occur when the driver applies excessive braking for the given road conditions, causing the wheels to decelerate at a rate which exceeds the vehicle's capability.

If the information from the wheel speed sensors indicate excessive wheel deceleration (imminent lock-up), the first step in the antilock sequence is to isolate the brake pressure being applied by the driver.

The EBCM applies a voltage to the isolation coil in order to close the isolation valve. This will prevent any additional brake pressure applied by the driver from reaching the wheel. With the isolation valve closed, further increases in brake pressure from the driver will be prohibited.

Dump Mode (Pressure Decrease)

Once the pressure is isolated, it must be reduced in order to get the wheels rolling once again. Reducing pressure is accomplished by dumping a portion of the brake fluid pressure into a Low Pressure Accumulator (LPA).

The EBCM energizes the dump valve coil(s) in order to open the dump valve, allowing fluid from the wheels to be dumped into the LPA. Very short activation pulses open and close the dump valve passageway in order to control this action. Brake pressure is lowered at the wheel and allows the affected wheel to begin rolling again.

The fluid taken from the wheels forces a spring back. The fluid is stored in the LPA at approximately 1034 kPa (150 psi). A portion of the fluid also primes the pump so it can begin building reapply pressure. The dump valves are opened independently in order to control the deceleration of the wheel.

Reapply Mode (Pressure Increase)

The reapply sequence is initiated in order to obtain optimum braking at each wheel. The isolation valve is momentarily pulsed open in order to allow the master cylinder and pump pressure to reach the brakes. This controlled pressure rise continues until the wheel is at optimum brake output or until the brake pressure is brought up to the master cylinder output pressure.

If more pressure is required, more fluid is drawn from the master cylinder and applied to the brakes. The driver will feel pedal pulsations or pedal drop. This is normal and expected when in the antilock mode.

As fluid is reapplied, the wheels begin to slow down at the optimum rate. If the wheels approach imminent lock-up again, the module will isolate, dump and reapply. These control cycles (isolation, dump and reapply) occur in millisecond intervals, allowing several cycles to occur each second.

Brake Release

At the end of the antilock stop, when the driver releases the brake pedal, the motor will remain on for a short time in order to help drain any fluid left in the LPA. As the fluid drains back into the system, the spring force in the LPA pushes the piston to the home position. The isolation valve is turned off and fluid returns through the isolation orifice.

Special Tools and Equipment

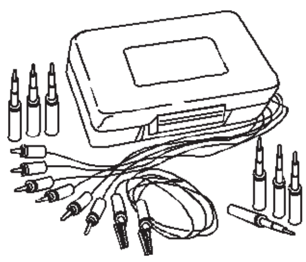
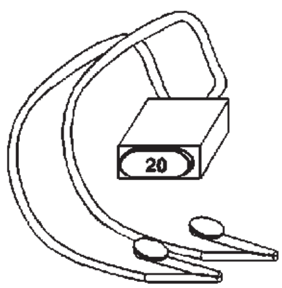
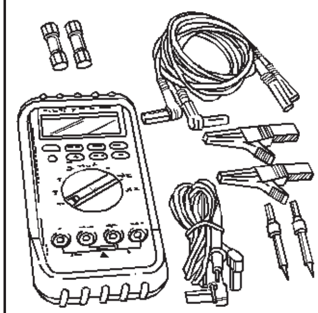
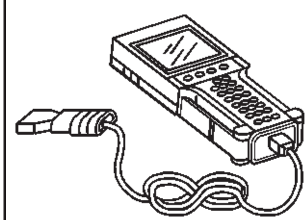
Illustration	Tool Number/ Description
 11799	J 35616 Connector Adapter Test Kit
 1025	J 36169-A Fused Jumper Wire

Illustration	Tool Number/ Description
 3430	J 39200 Digital Multi-Meter
 39438	Tech 2 Scan Tool

Section 5

Brakes

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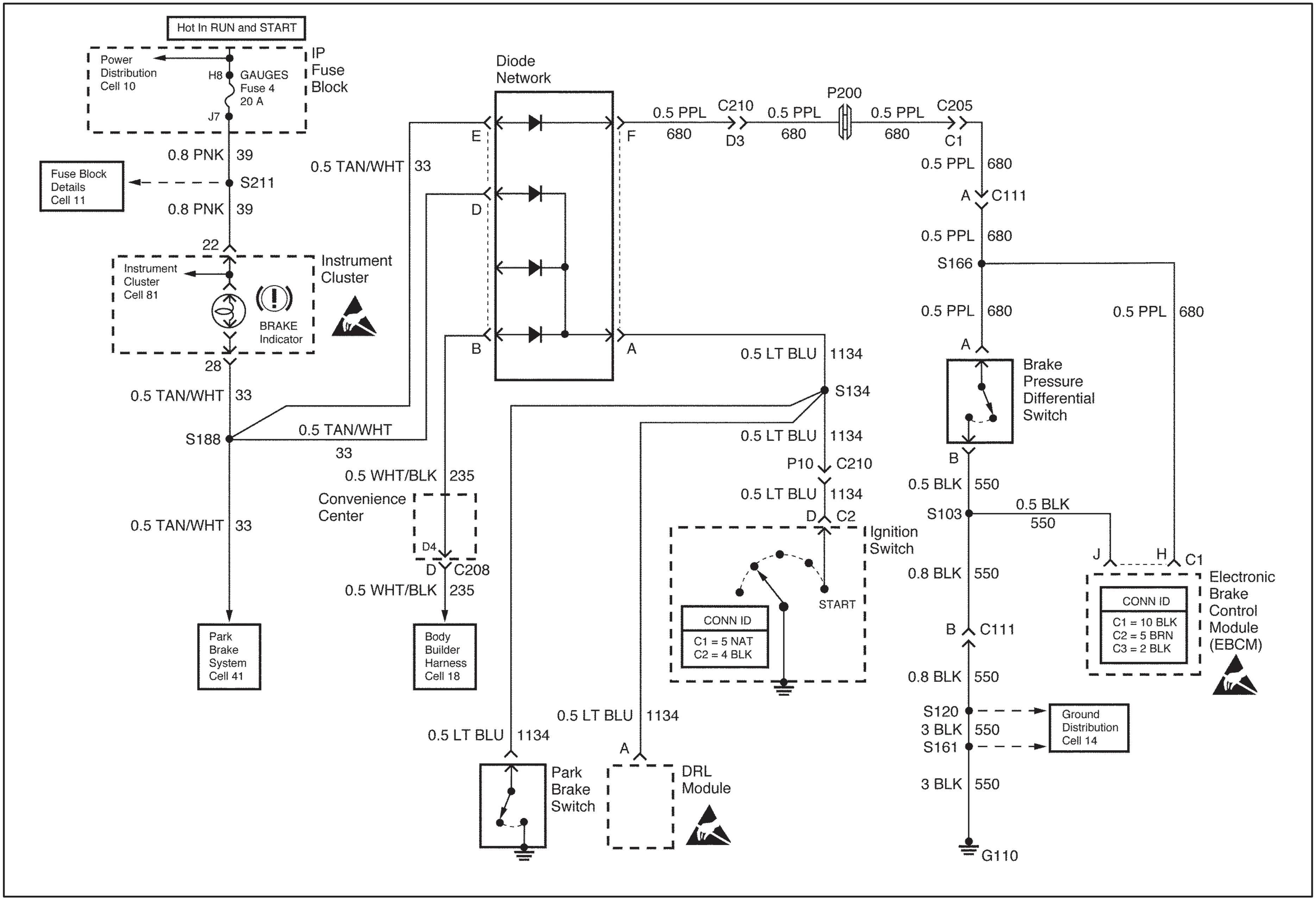
Hydraulic Brakes

Schematic and Routing Diagrams

Hydraulic Brakes Schematic Icons

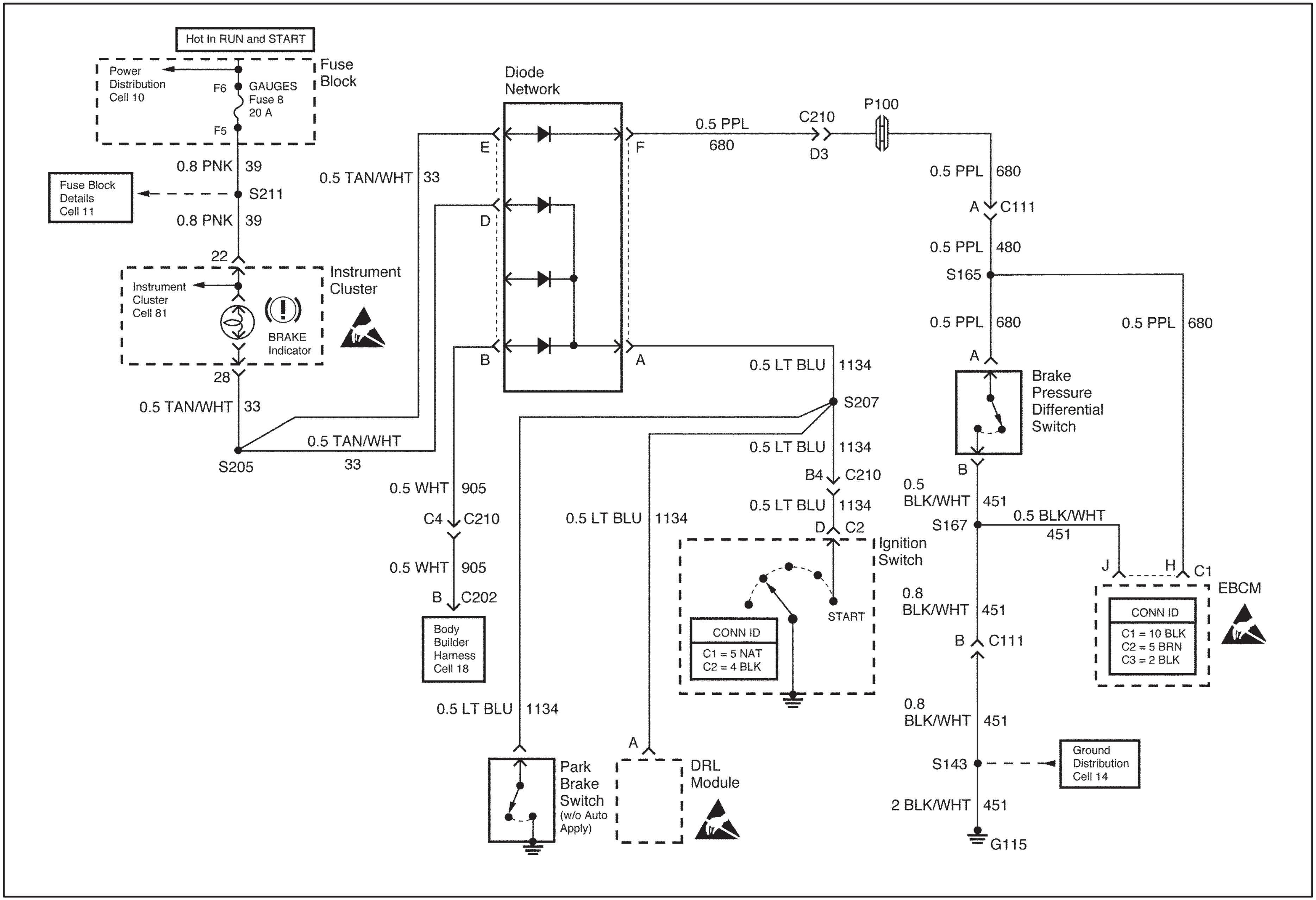
Icon	Icon Definition
 19384	Refer to *ESD Notice* in Cautions and Notices in the WCC Service Manual.

Brake Warning System Schematics (P32 Motorhome) (Cell 41) (L18)



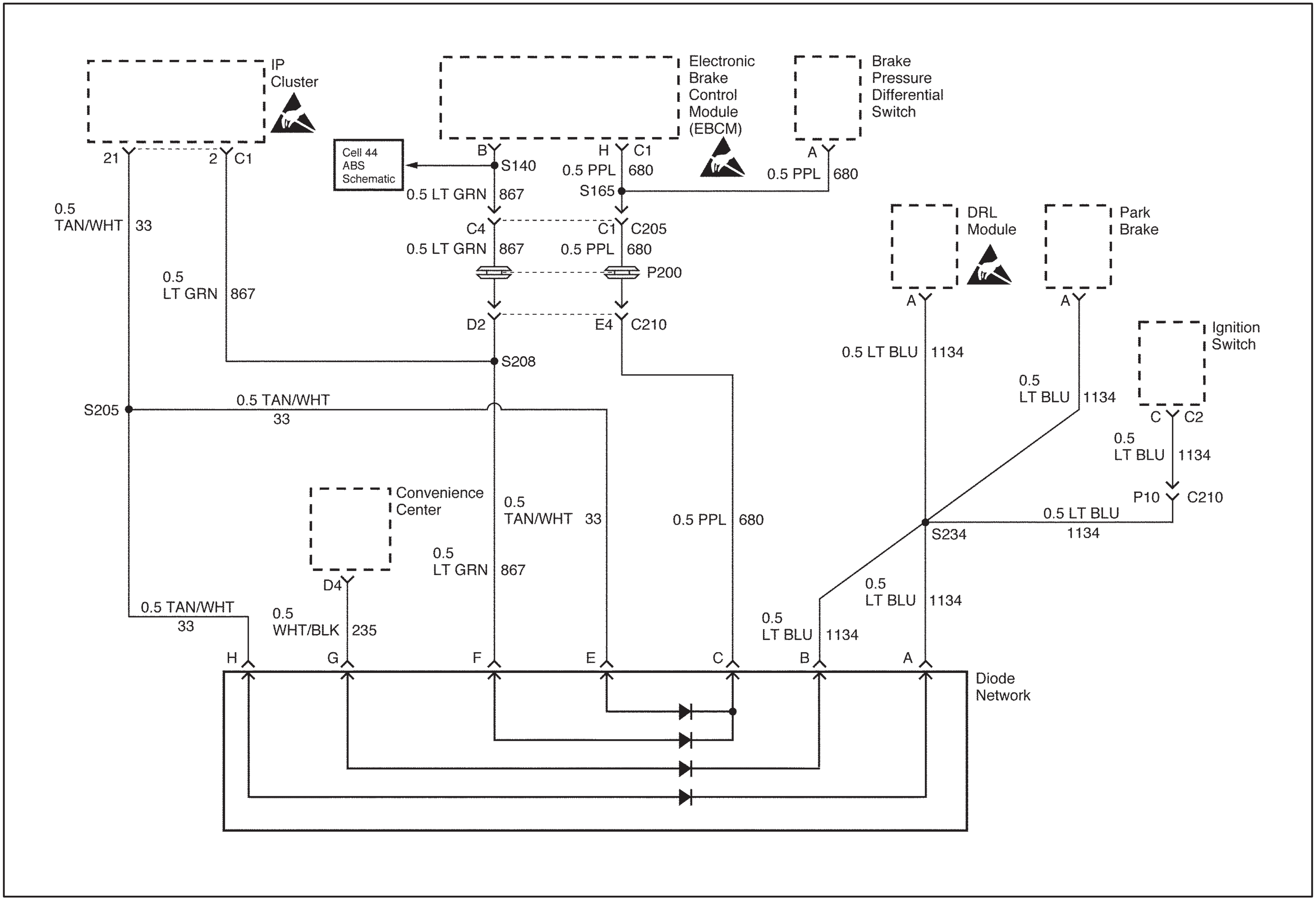
77551005

Brake Warning System Schematics (P32 Motorhome) (Cell 41) (L31)



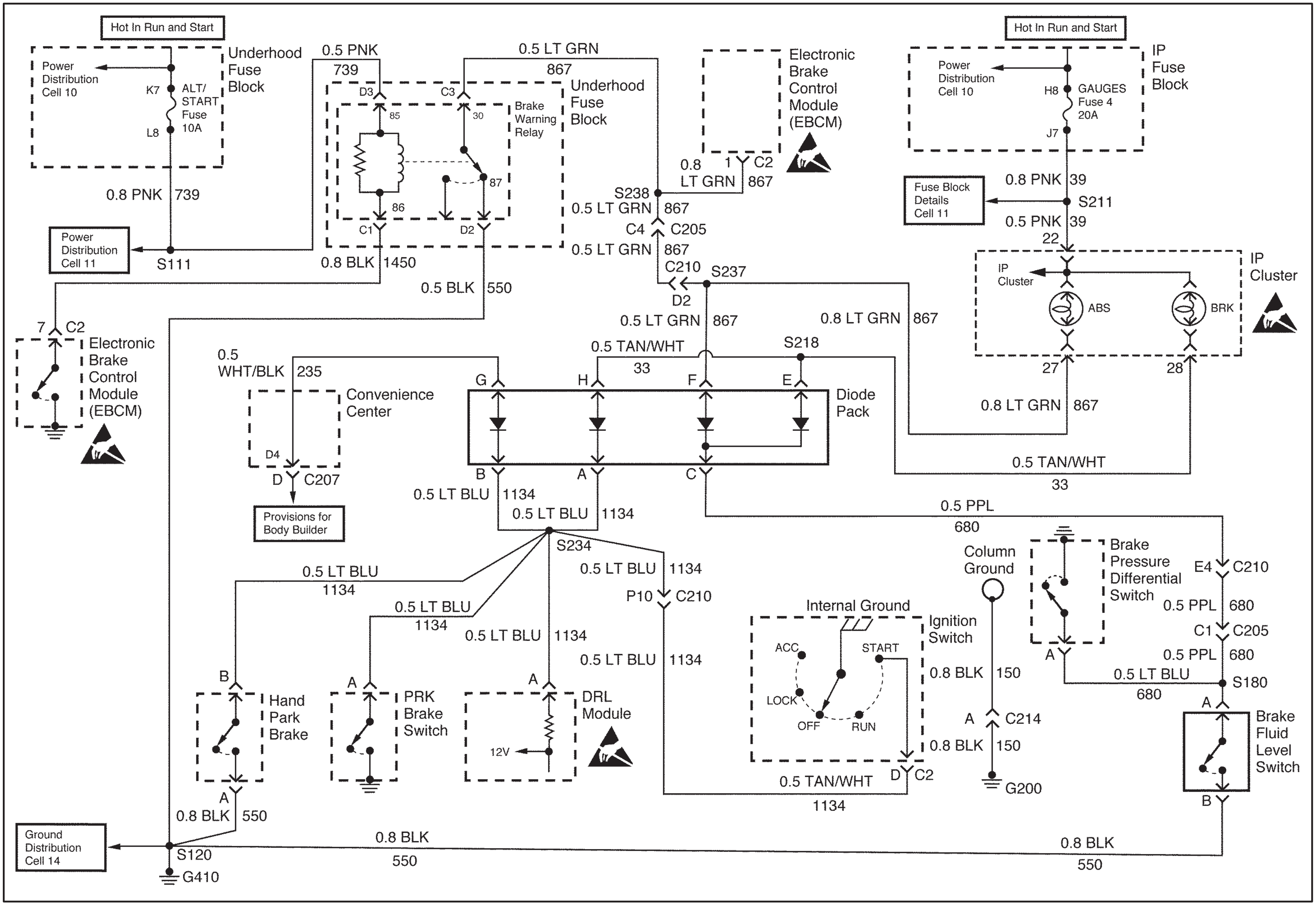
77555005

Brake Warning System Schematics (P42 Commercial) (Cell 41: Diode Network) (L4B)

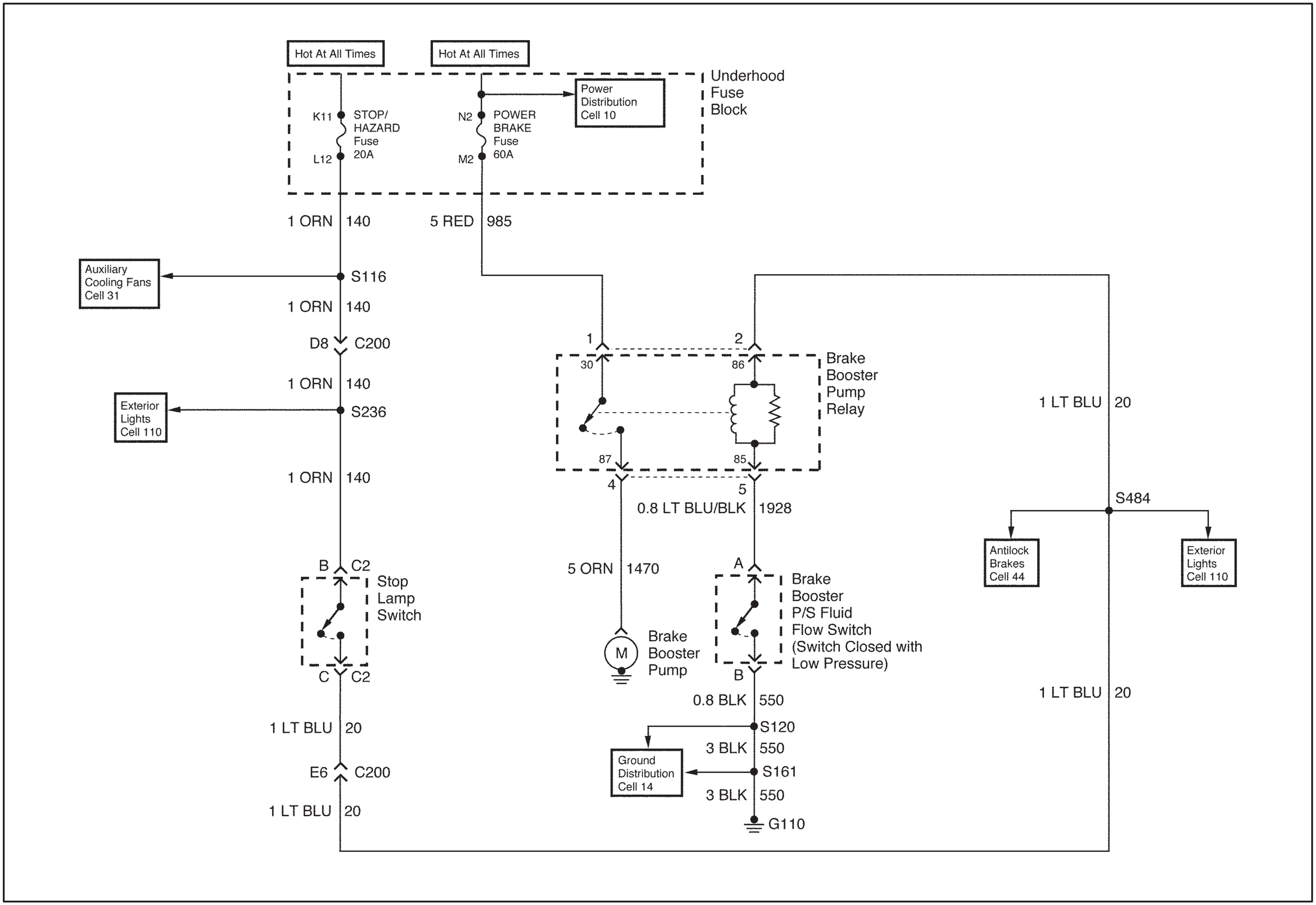


77555010

Brake Warning System Schematics (P52 Commercial) (Cell 41) (L18)



Brake Warning System Schematics (P52 Commercial) (Cell 44: Brake Booster Pump) (L18)



77555014

Section 5

Brakes

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Park Brake

Specifications

Fastener Tightening Specifications

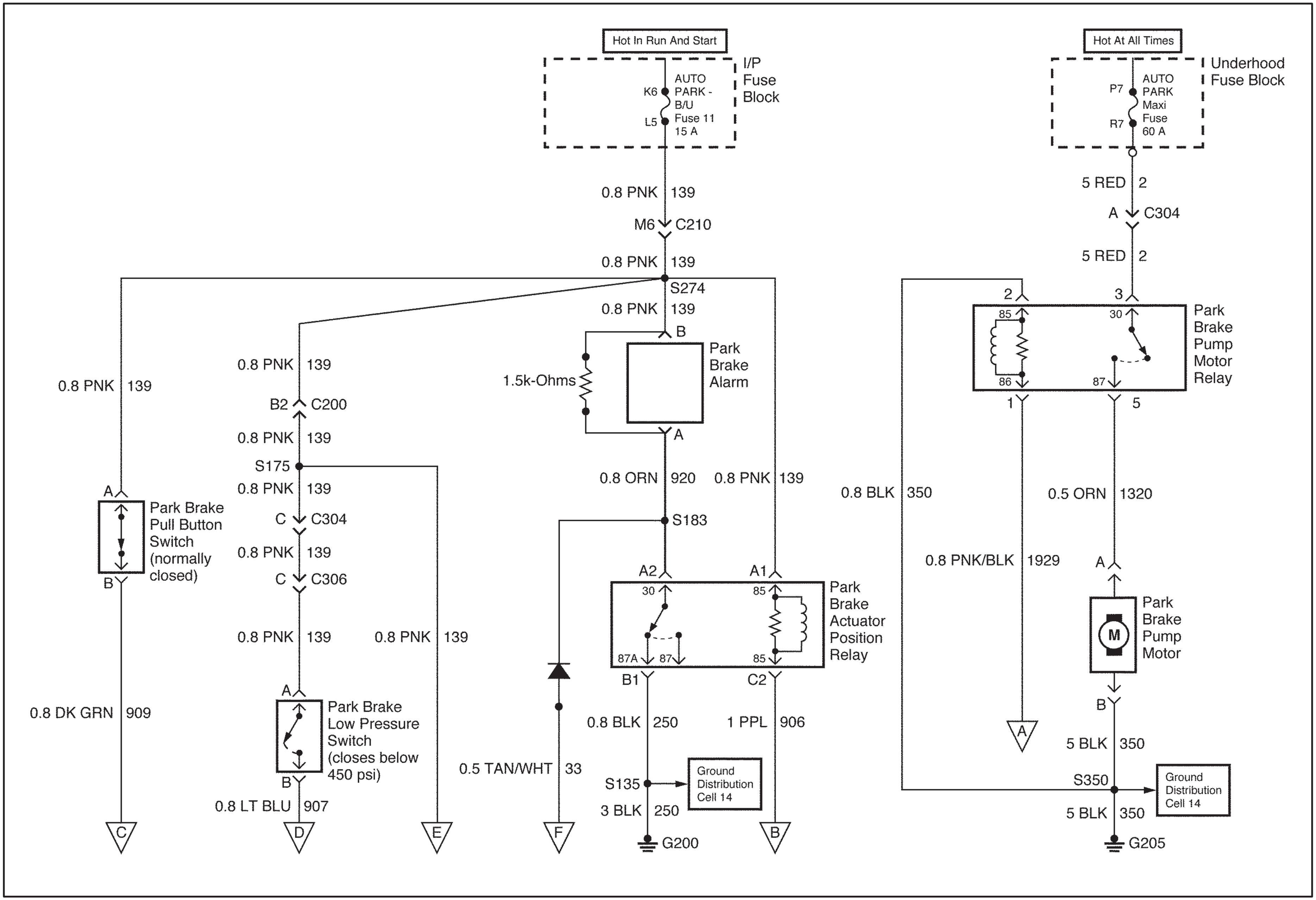
Application	Specification	
	Metric	English
Access Panel Fasteners	12 N·m	106 lb in
Actuator Bolts	40 N·m	30 lb ft
Actuator Mounting Bolts	108 N·m	80 lb ft
Anchor Pin Mounting Nut	200 N·m	148 lb ft
Backing Plate Bolts	41 N·m	30 lb ft
Cable Adjuster Jamb Nut	45 N·m	33 lb ft
Cable Bracket Mounting Bolt	10 N·m	89 lb in
Cable Retainer Clip Bolts	17 N·m	13 lb ft
Cable Clip Nuts	12 N·m	106 lb in
Hydraulic Pipe Fittings	16 N·m	12 lb ft
Parking Brake Cable-to-Frame Clip Bolt	10 N·m	7.5 lb ft
Parking Brake Drum and Yoke Assembly Mounting Bolt	110 N·m	81 lb ft
Parking Brake Lever Mounting Nuts	30 N·m	22 lb ft
Parking Brake Pedal-to-Cowl Mounting Nuts	22 N·m	16 lb ft
Parking Brake Pressure Indicator Switch	12 N·m	106 lb in
Parking Brake Pull Switch Mounting Nut	3 N·m	27 lb in
Parking Brake Pump Assembly Mounting Bolts	37 N·m	27 lb ft
Parking Brake Pressure (Pump Motor) Switch	12 N·m	106 lb in
Parking Brake Rear Axle Bracket Bolt	31 N·m	23 lb ft
Parking Brake Solenoid Valve Mounting Nuts	13 N·m	115 lb in
Propeller Shaft Parking Brake Adjusting Nut	40 N·m	30 lb ft
Propeller Shaft Parking Brake Drum-to-Yoke Bolt	40 N·m	30 lb ft
Propeller Shaft Parking Brake Cable Clip to Frame	17 N·m	13 lb ft
Propeller Shaft Parking Brake Cable to Clip to Dash	12 N·m	107 lb in
Propeller Shaft Parking Brake Cable Clip to Transmission	27 N·m	20 lb ft
Right Rear Parking Brake Cable Clip Bolt to Rear Axle Bracket	31 N·m	23 lb ft

Schematic and Routing Diagrams

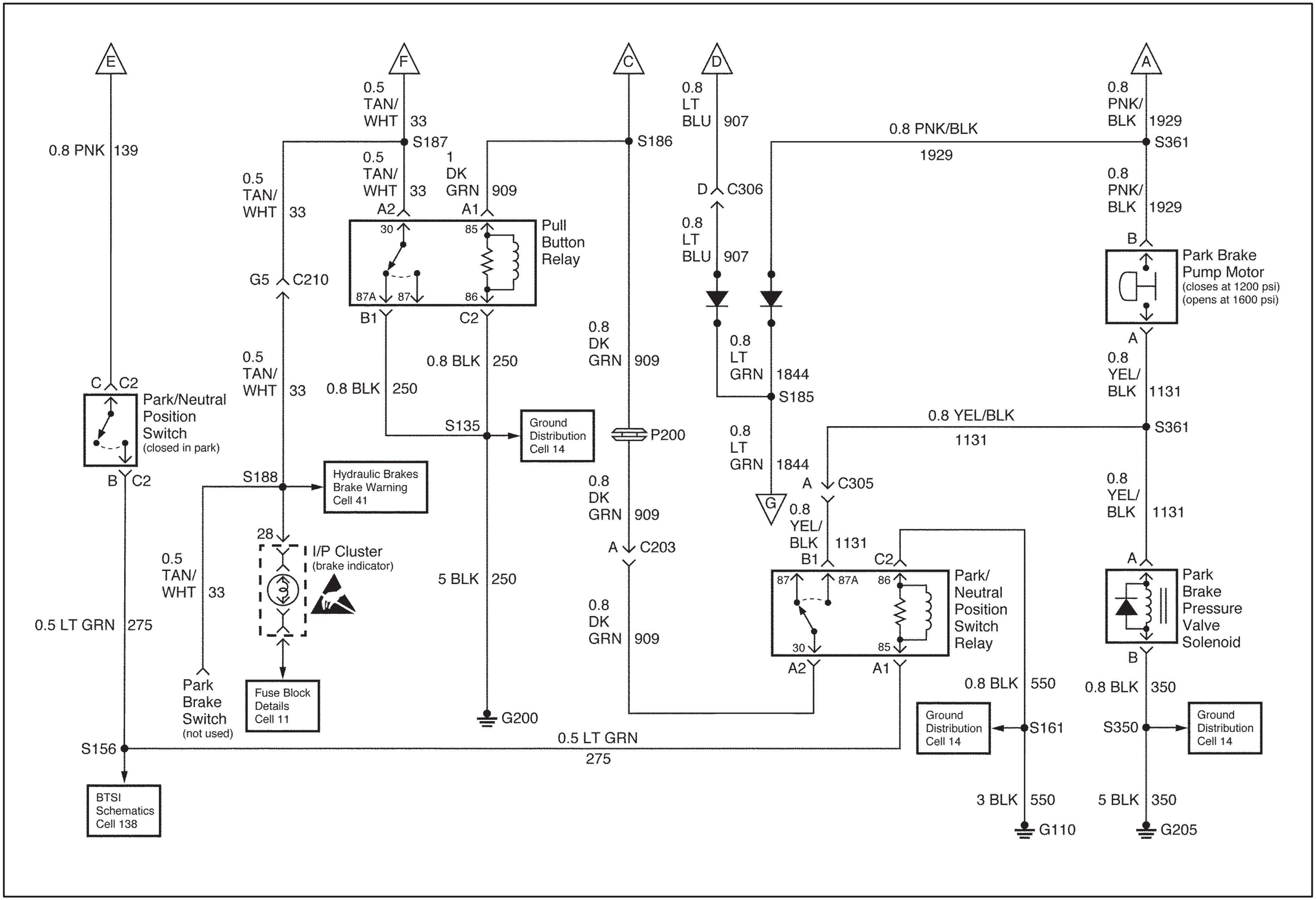
Park Brake System Schematic Icons

Icon	Icon Definition
 19384	Refer to *ESD Notice* in Cautions and Notices.

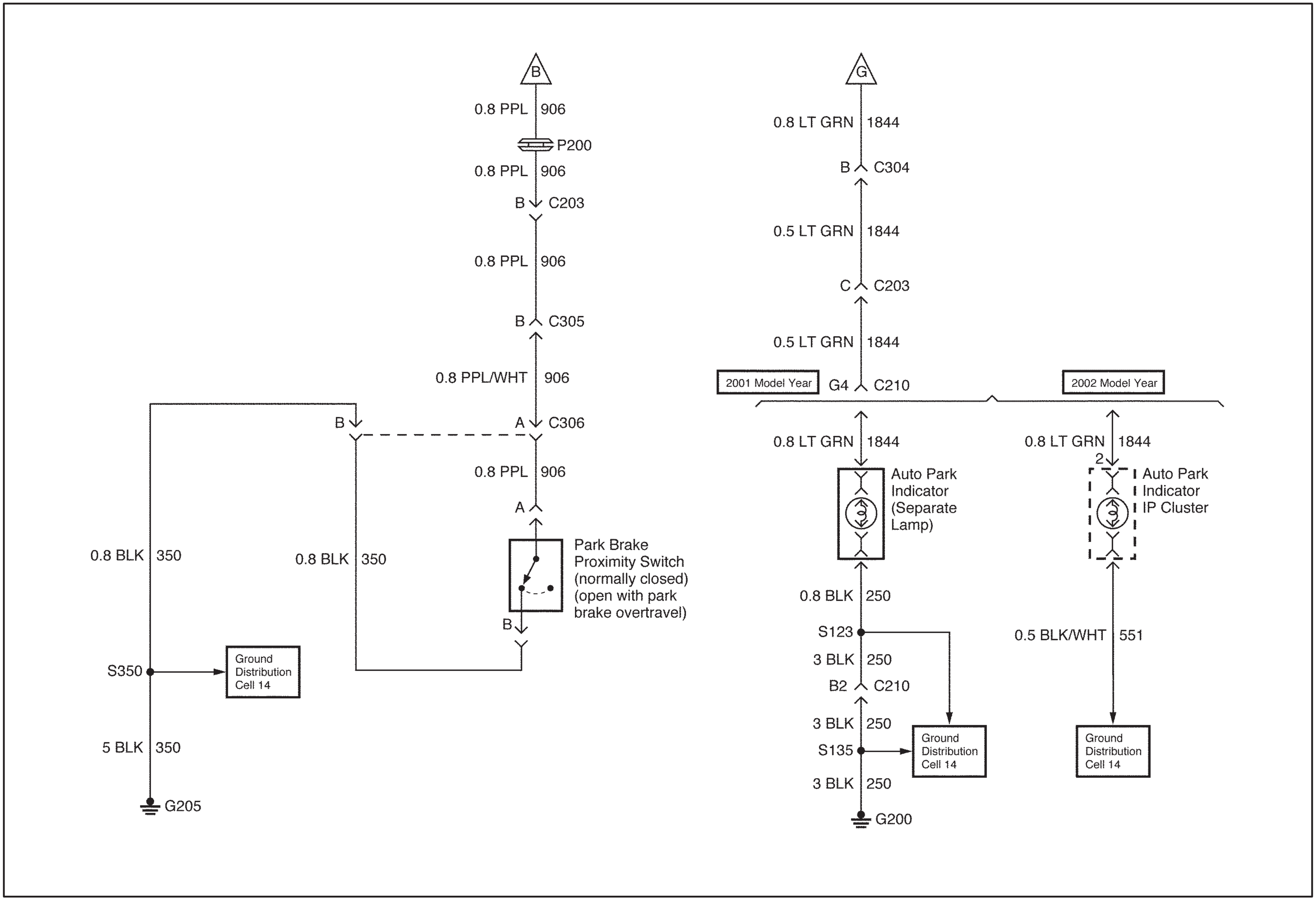
Park Brake System Schematics (P32 Motorhome) (Cell 41: Power, Pump Motor, Park Brake Control, Alarm) (L18)



Park Brake System Schematics (P32 Motorhome) (Cell 41: Pump Motor, Park Brake Controls, Brake Indicator) (L18)



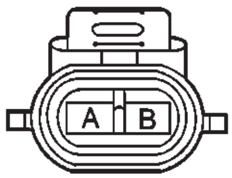
Park Brake System Schematics (P32 Motorhome) (Cell 41: Park Brake Alarm Control, Brake Indicator) (L18)



Visual Identification

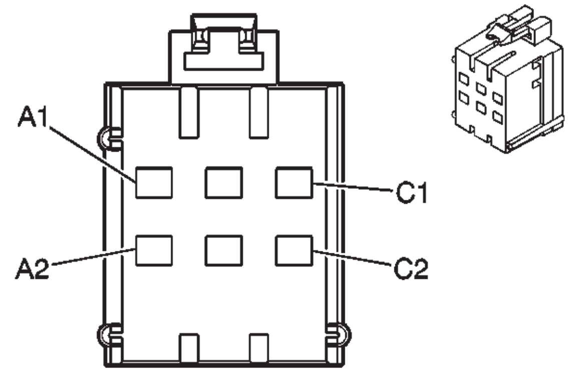
Park Brake Connector End Views (P32 Motorhome) (L18)

Park Brake Pressure Valve Solenoid



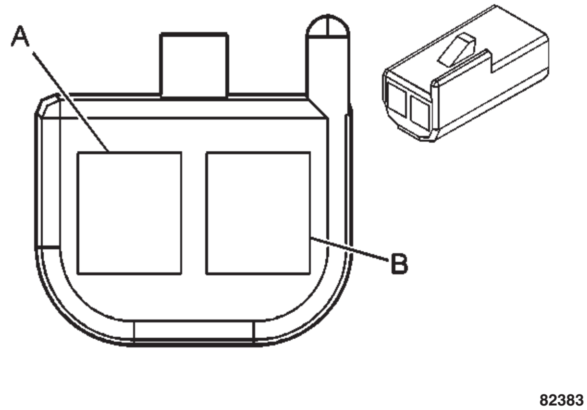
Connector Part Information	• 12052641 • 2 Way F Metri-Pack 150 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	YEL/BLK	1131	Auto Apply Park Brake Switch Signal
B	BLK	350	Ground

Park Brake Pull Button Relay



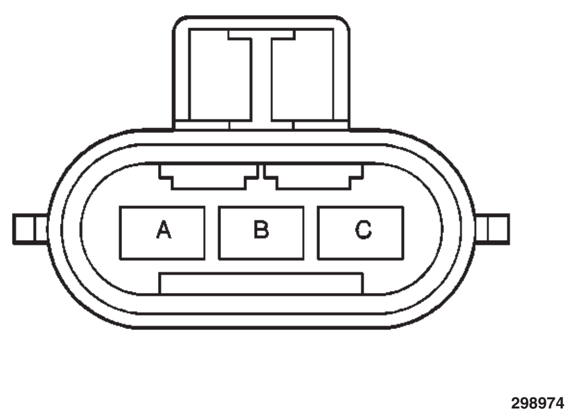
Connector Part Information	• 12110541 • 6 Way F Metri-Pack 280 Series, Flexlock (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A1	DK/GRN	909	Output to PNP Relay and Park Brake Pull Button Switch
A2	TAN/WHT	33	Brake Warning Indicator Lamp Output w/o DRL
A2 (Z49)	LT BLU	1134	Park Brake Switch Signal w/DRL
B1	BLK	250	Ground
B2-C1	—	—	Not Used
C2	BLK	250	Ground

Park Brake Pull Button Switch



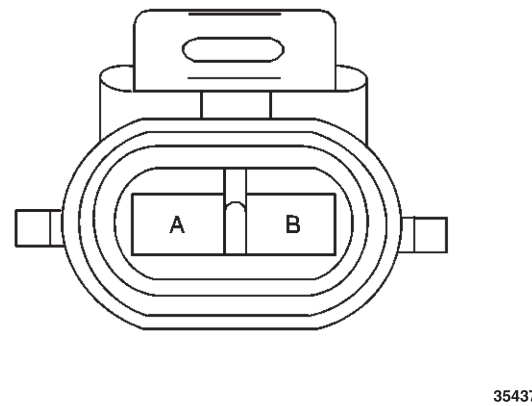
Connector Part Information	• 12047662 • 2 Way F Metri-Pack 150 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PNK	539	Fuse Output-Ignition
B	DK GRN	909	Output to PNP Relay and Park Brake Pull Button Switch

Park Brake Pump Motor



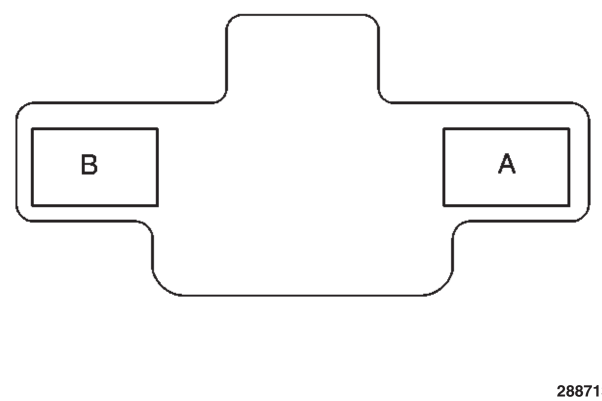
Connector Part Information	• 12124685 • 3 Way F Metri-Pack 630 Series Sealed (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	ORN	1320	Power Brake Booster Pump Motor Feed
B	BLK	350	Ground
C	—	—	Not Used

Park Brake Proximity Switch



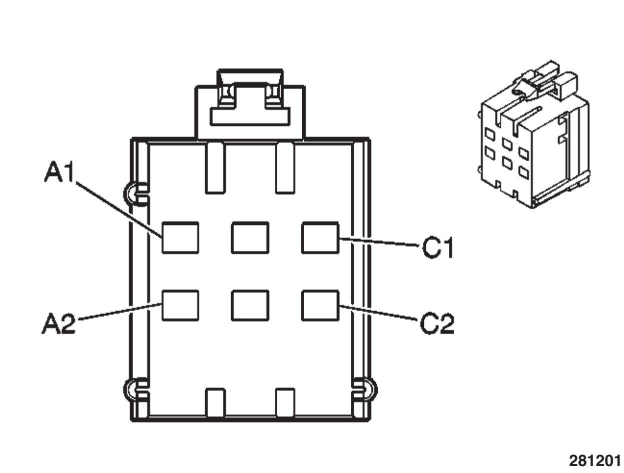
Connector Part Information	• 12052644 • 2 Way F Metri-Pack 150 Series (GRY)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PPL	906	Park Brake Proximity Switch
B	BLK	350	Ground

Park Brake Alarm



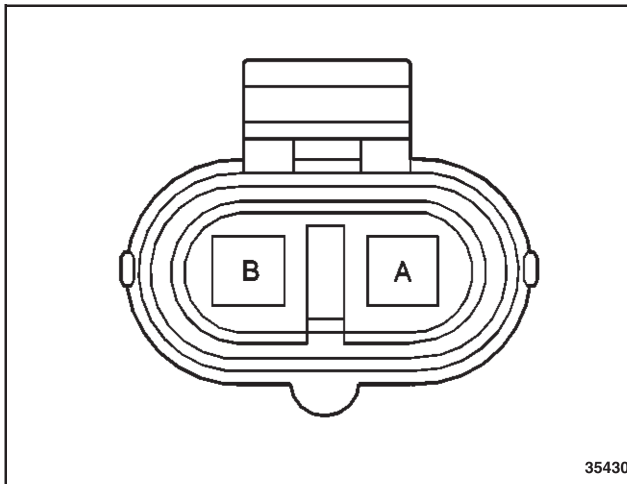
Connector Part Information	• 08905825 • 2 Way F 56 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	ORN	920	Park Brake Alarm
B	PNK	539	Fuse Output-Ignition

Park Brake Actuator Position Relay



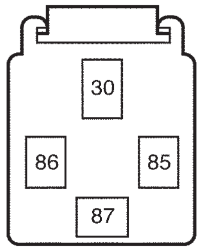
Connector Part Information	• 12110541 • 6 Way F Metri-Pack 280 Series, Flexlock (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A1	PNK	539	Fuse Output-Ignition
A2	ORN	920	Park Brake Alarm
B1	BLK	250	Ground
B2-C1	—	—	Not Used
C2	PPL	906	Park Brake Proximity Switch

Park Brake Low Pressure Switch



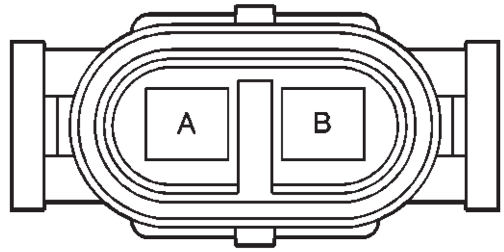
Connector Part Information	• 12020599 • 2 Way F Metri-Pack 280 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PNK	539	Fuse Output-Ignition 1-Type III Fuse
B	LT BLU	907	Diode to AUTO PARK Indicator Lamp

Park Brake Pump Motor Relay



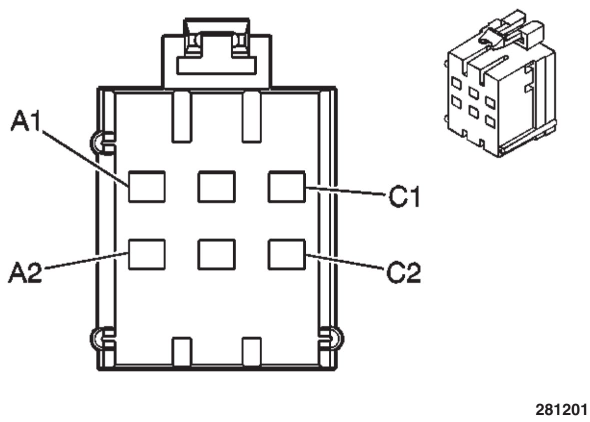
Connector Part Information	• 12124169 • 4 Way F Metri-Pack Mixed Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
86	PNK/BLK	1929	Park Brake Pump Motor Relay Output-Coil
85	BLK	350	Ground
30	RED	2	Fuse Output-Battery
87	ORN	1320	Power Brake Booster Pump Motor Feed

Park Brake Pump Motor Switch



Connector Part Information	• 12124819 • 2 Way F Metri-Pack 280 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	YEL/BLK	1131	Auto Apply Park Brake Switch Signal
B	PNK/BLK	1929	Park Brake Pump Motor Relay Output-Coil

Park Neutral Position Switch Relay



Connector Part Information	• 12110541 • 6 Way F Metri-Pack 280 Series, Flexlock (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A1	LT GRN	275	Park Neutral Position Switch Input
A2	DK GRN	909	Park Brake Pull Button Input
B1	YEL/BLK	1131	Park Neutral Position Switch Relay Output
B2-C1	—	—	Not Used
C2	BLK	550	Relay Ground

Diagnostic Information and Procedures

Park Brake System Check (Process) (P32 Motorhome) (L18)

Notice: Use care when probing terminals to measure voltage and resistance values. The Digital Multimeter (DMM) probe can damage the connector terminal and cause a poor connection. A damaged terminal condition is very hard to diagnose.

Important: The amount of time it takes for the parking brake to release will vary based on the temperature and battery voltage. In extreme cold weather, it can take up to 15 seconds to release the parking brake. This is normal system operation.

Before beginning diagnosis on the Electric/Auto park brake system, you need a detailed description of when the condition occurred from the owner. This information can be useful in duplicating the condition. Always begin diagnosis with a visual inspection of all connectors, wiring, wire routing and retention, and system components. Many times a disconnected or loose connector, blown fuse, open circuit breaker, corroded terminal, or miss-routed wire is the cause of a malfunction. If you need additional information on wiring conditions, repair procedures or electrical component location, refer to *Park Brake Will Not Release* or *Park Brake Pump Motor Runs All of the Time*.

Refer to *Electric/Auto Park System Description* or *Electric/Auto Park System Operation* for description and operation of the Electric/Auto Parking Brake.

Park Brake Indicator Always On

Checks	Action
DEFINITION: The AUTO PARK light stays on all the time or comes on frequently while driving.	
Confirm that the parking brake is fully released if the AUTO PARK indicator stays on.	Turn the rear wheels and check for drag. If the park brake is not fully releasing, refer to *Park Brake Will Not Release*.
Check for a short in the light circuit	Repair and/or replace the light circuit.
The AUTO PARK light comes on at intervals less than 15 minutes while driving, and the duration becomes shorter, leading to constant pump operation.	• Refer to *Park Brake Pump Motor Runs All of the Time*. Inspect for a system leak, the solenoid valve failed open, or the motor pressure switch failed closed. • Replace the faulty solenoid valve, the pressure switch, or repair the leak.
The pump is constantly running.	Refer to *Park Brake Pump Motor Runs All of the Time*.

PARK BRAKE Indicator Lamp Does Not Light

Check Circuits for the following conditions:

- A wire may be broken (or partially broken) inside the insulation. This could cause a system malfunction but appear good in a continuity test or a voltage check with a system disconnected. If possible, test the circuit for a voltage drop when the system is under load.
- Examine any aftermarket electronic equipment for proper installation. Refer to *Troubleshooting.*

AUTO PARK Indicator Lamp Does Not Light

Step	Action	Value(s)	Yes	No
1	Turn the ignition to ON. Does the AUTO PARK lamp illuminate?	—	Go to *Step 2*	Go to *Step 3*
2	Refer to the instructions above for dealing with an intermittent problem. Is the repair complete?	—	System OK	—
3	Move the shift lever to NEUTRAL. Does the AUTO PARK lamp illuminate?	—	Go to *Step 4*	Go to *Step 9*
4	1. Disconnect the pull button switch. 2. Use a DMM *J 39200* to measure voltage between the connector terminal A and ground. Does the DMM indicate the specified voltage?	11–14 v	Go to *Step 6*	Go to *Step 5*
5	Repair the open in CKT 539 (PNK) between terminal A of the pull button switch and splice S274. Is the repair complete?	—	System OK	—
6	Use a DMM *J 39200* to measure resistance between terminal A and terminal B of the park brake low pressure switch. Does the DMM indicate the specified resistance?	Less than 2 Ω	Go to *Step 8*	Go to *Step 7*
7	Replace the park brake low pressure switch. Is the repair complete?	—	System OK	—
8	Repair the open between terminal B of the park brake low pressure switch and splice S185. This includes the following components: • CKT 907 (LT BLU) between terminal B of the park brake low pressure switch and diode D300 • Diode D300 • CKT 1844 (LT GRN) between diode D300 and splice S185 Is the repair complete?	—	System OK	—
9	Use a DMM *J 39200* to backprobe between terminal 2 of the I/P cluster connector and ground. Does the DMM indicate the specified voltage?	11–14 v	Go to *Step 10*	Go to *Step 11*
10	Replace the AUTO PARK lamp. Is the repair complete?	—	System OK	—
11	Repair the open in CKT 1844 (LT GRN) between splice S185 and AUTO PARK indicator lamp socket. Is the repair complete?	—	System OK	—

Park Brake Pump Motor Runs All of the Time

Step	Action	Value(s)	Yes	No
1	1. Set the ignition to LOCK. 2. Have an assistant check the pump Is the park brake pump motor running?	—	Go to *Step 2*	Go to *Step 7*
2	Look at the instrument cluster. Is the AUTO PARK lamp illuminated?	—	Go to *Step 3*	Go to *Step 4*
3	Repair the short to voltage in one of the following areas: • Between the park brake pump motor switch and splice S184 • Between S184 and the diode splice • Between S184 and the pump motor relay Is the repair complete?	—	System OK	—
4	Disconnect the pump motor relay. Is the pump still running?	—	Go to *Step 5*	Go to *Step 6*
5	Repair the short to B+ in CKT 1320 (ORN) wire between the park brake pump motor relay and the park brake pump motor. Is the repair complete?	—	System OK	—
6	Replace the park brake pump motor relay. Refer to *Park Brake Pressure Relay Replacement* in the WCC Service Manual. Is the repair complete?	—	System OK	—
7	1. Make sure that the pull button switch is pushed in. 2. Make sure that the transmission range (TR) selector is in Park. 3. Turn the ignition to RUN. Is the pump running?	—	Go to *Step 3*	Go to *Step 8*
8	Check the hydraulic fluid reservoir of the park brake pump. Is the reservoir empty?	—	Go to *Step 9*	Go to *Step 13*
9	1. Fill the pump reservoir with Dextron III. Refer to *Checking and Adding Park Brake Fluid* in the WCC Service Manual. 2. With the ignition in RUN, move the TR selector out of Park. Is there a visible leak when the pump is running?	—	Go to *Step 10*	Go to *Step 11*
10	Repair the leak found as required. Is the repair complete?	—	System OK	—
11	Check the reservoir. Is it empty again?	—	Go to *Step 12*	Go to *Step 13*
12	Replace the actuator assembly. Refer to *Park Brake Actuator Replacement* in the WCC Service Manual. Is the repair complete?	—	System OK	—
13	Disconnect the pump motor switch. Is the pump still running?	—	Go to *Step 3*	Go to *Step 14*
14	Locate and replace the failed hydraulic component. • The pump motor switch may not be opening at 1560 +/– 142 psi • The pressure valve solenoid may be leaking through too much to allow a high enough pressure to open the pump motor switch • The pump may not be generating enough pressure to open the switch Is the repair complete?	—	System OK	—

Park Brake Will Not Hold

Step	Action	Value(s)	Yes	No
1	1. Set the ignition to LOCK. Is the park brake released?	—	Go to *Step 2*	Go to *Step 7*
2	Look at the instrument cluster. Is the BRAKE lamp illuminated?	—	Go to *Step 3*	Go to *Step 4*
3	1. Check for a mechanical problem in one of the following areas: • The park brake cable. Refer to *Park Brake Cable Inspection* in the WCC Service Manual. • The park brake shoes. Refer to *Park Brake Shoe Inspection* in the WCC Service Manual. 2. Adjust, repair, or replace components as required. Is the repair complete?	—	System OK	—
4	Disconnect the pump motor switch. Does the park brake apply?	—	Go to *Step 5*	Go to *Step 6*
5	Repair the short to B+ in CKT 1131 (YEL/BLK). Is the repair complete?	—	System OK	—
6	Find and repair the mechanical problem in the brake, cable, or linkage. Is the repair complete?	—	System OK	—
7	1. Turn the ignition to RUN. 2. Make sure that the transmission range (TR) selector is in Park. 3. Pull the pull button switch. Does the park brake apply?	—	Go to *Step 8*	Go to *Step 9*
8	1. Find the problem in one of the following areas: • Failed PNP relay • Failed PNP switch • Open in one of the following circuits: – CKT 539 (PNK) between splice S274 and the PNP switch – CKT 275 (LT GRN) between the PNP switch and the PNP relay – CKT 550 (BLK) between the PNP relay and splice S161. 2. Repair, or replace components as required. Is the repair complete?	—	System OK	—
9	Find and repair the short to switched ignition in CKT 1131 (YEL/BLK). Is the repair complete?	—	System OK	—

Park Brake Will Not Release

Step	Action	Value(s)	Yes	No
1	***Caution: Chock the wheels to prevent the vehicle from moving. Failure to chock the wheels can cause personal injury when the electrical system is repaired.*** 1. Turn the ignition to RUN. 2. Observe the instrument cluster. Is the AUTO PARK park lamp illuminated?	—	Go to *Step 2*	Go to *Step 6*
2	1. Continue to observe the AUTO PARK lamp. 2. Move the transmission range (TR) selector out of the PARK position. Does the AUTO PARK lamp turn off after a few seconds?	—	Go to *Step 3*	Go to *Step 12*
3	1. Position yourself where you can see the park brake mechanism. 2. Have an assistant move the transmission range selector between Park and Neutral with the ignition in RUN. Does the mechanism move at all as the brake is applied and released?	—	Go to *Step 4*	Go to *Step 5*
4	Examine the parking brake for a mechanical problem that is preventing its release and repair as required. Is the repair complete?	—	System OK	—
5	Replace the park brake actuator. Refer to *Park Brake Actuator Replacement* in the WCC Service Manual. Is the repair complete?	—	System OK	—
6	1. Turn the ignition switch to LOCK. 2. Inspect the TURN/B/U fuse 10. Has the fuse blown?	—	Go to *Step 8*	Go to *Step 7*
7	Locate and repair the open in CKT 539 (PNK) between TURN/B/U fuse 10 (fuse block terminal J5) and splice S226. Is the repair complete?	—	System OK	—
8	1. Replace the TURN/B/U fuse 10. 2. Turn the ignition to RUN. Does the fuse blow again?	—	Go to *Step 9*	Go to *Step 10*

Park Brake Will Not Release (cont'd)

Step	Action	Value(s)	Yes	No
9	1. Locate the short to ground in one of the following locations: • CKT 539 (PNK) from the TURN/B/U fuse 10 (fuse block terminal J5) to splice S226. – from S226 to the park brake alarm – from S226 to the park brake actuator position relay – from S226 to terminal M6 of C210 • From terminal M6 of C210 – from S274 to the pull button switch – from S274 to the park/neutral position and backup lamps switch – from S274 to the park brake pressure indicator switch • CKT 909 (DK GRN) from the pull button switch to splice S186 – from S186 to the park/neutral position switch relay – from S186 to the park brake pull button relay • CKT 275 (LT GRN) from terminal B, connector C2 of the park/neutral position and backup lamps switch to splice S156 – from S156 to the park/neutral position switch relay – from S186 to the BTSI relay 2. Repair as required. Is the repair complete?	—	System OK	—
10	Move the TR selector out of Park. Does the park brake release normally?	—	System OK	Go to *Step 11*
11	Check TURN/B/U fuse 10. Did the fuse blow again?	—	Go to *Step 12*	Go to *Step 13*
12	1. Locate the short to ground in one of the following locations: • CKT 1131 (YEL/BLK) from the park/neutral position switch relay to splice S361. – from S361 to the pressure valve solenoid – from S361 to the pump motor switch • The pressure valve solenoid • The pump motor switch • CKT 1929 (PNK/BLK) from the pump motor switch to splice S184. – from S184 to splice S301 at diode D301 – from S184 to the pump motor relay • The pump motor relay 2. Repair as required. Is the repair complete?	—	System OK	—

Park Brake Will Not Release (cont'd)

Step	Action	Value(s)	Yes	No
13	1. Return the TR selector to Park. 2. Examine the park brake pump hydraulic fluid reservoir. Is the fluid level low?	—	Go to *Step 14*	Go to *Step 16*
14	1. Fill the reservoir to the proper level with Dextron III transmission fluid. Refer to *Checking and Adding Park Brake Fluid* in the WCC Service Manual. 2. Examine the hydraulic components for signs of a leak. Is there any indication of a hydraulic leak?	—	Go to *Step 15*	Go to *Step 16*
15	Repair the park brake hydraulic system as required. Is the repair complete?	—	System OK	—
16	1. Position yourself near the hydraulic pump. 2. Have an assistant move the TR selector out of Park with the ignition in RUN. Does the pump motor operate?	—	Go to *Step 17*	Go to *Step 20*
17	Examine the system for any indication of a leak under pressure. Is there a leak?	—	Go to *Step 15*	Go to *Step 18*
18	Check the functioning of the system. Does the park brake release properly?	—	System OK	Go to *Step 19*
19	1. Examine the following components for a problem: • An open in CKT 1131 (YEL/BLK) from S361 to terminal A of the pressure valve solenoid • An open in CKT 350 (BLK) from S350 to terminal B of the pressure valve solenoid • A malfunction of the pressure valve solenoid 2. Repair, or replace components as required. Is the repair complete?	Less than 1 Ω	System OK	—
20	1. Move the TR selector to Park. 2. Disconnect the park brake pump motor. 3. Use a *J 39200* to check for continuity to ground from connector terminal B, CKT 350 (BLK). Is there continuity?	—	Go to *Step 22*	Go to *Step 21*
21	Repair CKT 350 (BLK) between pump motor connector terminal B to G205. Is the repair complete?	—	System OK	—

Park Brake Will Not Release (cont'd)

Step	Action	Value(s)	Yes	No
22	1. Connect the *J 39200* between the terminals of the pump motor connector. 2. Set the meter for DC volts. 3. Move the TR selector out of Park with the ignition in RUN. Does the DVM indicate the specified voltage?	11–14 v	Go to *Step 23*	Go to *Step 24*
23	Replace the park brake pump. Is the repair complete?	—	System OK	—
24	1. Move the TR selector to Park. 2. Turn the ignition switch to LOCK. 3. Remove the pump motor relay connector from the relay. 4. Use a *J 39200* to check for continuity in CKT 1320 (ORN) between the relay socket terminal 87 and the pump motor connector terminal A. Is the resistance within the specified limit?	Less than 1 Ω	Go to *Step 26*	Go to *Step 25*
25	Repair the open in CKT 1320 (ORN). Is the repair complete?	—	System OK	—
26	Replace the park brake pump motor relay. Is the repair complete?	11–14 v	Go to *Step 28*	Go to *Step 27*
27	Repair the open in CKT 2 (RED). Is the repair complete?	—	System OK	—
28	1. Turn the ignition switch to RUN. 2. Move the TR selector out of Park. 3. Use a *J 39200* to measure voltage in CKT 1929 (PNK/BLK) between the pump motor relay socket terminal 86 and ground. Is the voltage within the specified limits?	11–14 v	Go to *Step 29*	Go to *Step 32*
29	Use a *J 39200* to check for continuity in CKT 350 (BLK) between the pump motor relay terminal 85 and ground G205. Is the resistance within the specified limit?	Less than 1 Ω	Go to *Step 30*	Go to *Step 31*
30	Replace the pump motor relay. Is the repair complete?	—	System OK	—
31	Repair the open in CKT 350 (BLK). Is the repair complete?	—	System OK	—
32	1. Disconnect the pump motor switch CKT 1929 (PNK/BLK) and CKT 1131 (YEL/BLK). 2. Use a *J 39200* to measure voltage between the pump motor switch connector terminal A (YEL/BLK) and ground with the ignition in RUN and the TR selector out of Park. Is the voltage within the specified limits?	11–14 v	Go to *Step 33*	Go to *Step 36*
33	Use a *J 39200* to measure resistance between the pump motor switch terminals. Is the resistance within the specified limit?	Less than 1 Ω	Go to *Step 34*	Go to *Step 35*
34	1. Locate the open in CKT 1929 (PNK/BLK) between the pump motor switch and the pump motor relay. 2. Repair the open as required. Is the repair complete?	—	System OK	—
35	Replace the pump motor switch. Is the repair complete?	—	System OK	—

Park Brake Will Not Release (cont'd)

Step	Action	Value(s)	Yes	No
36	With the ignition in RUN and the TR selector out of Park, measure voltage between terminal A of connector C305 and ground. Is the voltage within the specified limits?	11–14 v	Go to *Step 37*	Go to *Step 38*
37	Locate the open in CKT 1131 (YEL/BLK) between terminal A of connector C305 and the pump motor switch terminal A. Is the repair complete?	—	System OK	—
38	1. Remove the park/neutral position switch relay from its socket. 2. With the ignition in RUN, use a *J 39200* to measure voltage between terminal 30 of the relay socket and ground. Is the voltage within the specified limits?	11–14 v	Go to *Step 40*	Go to *Step 39*
39	1. Locate the open in one of the following areas: • CKT 909 (DK GRN) between the park/neutral position switch relay terminal 30 and park brake pull button switch • CKT 539 (PNK) between the pull button switch and splice S274 • Check the pull button switch for proper functioning 2. Repair the open or replace the switch as required. Is the repair complete?	—	System OK	—
40	Use a *J 39200* to measure resistance between terminal 30 and terminal 87A of the park/neutral position switch relay. Is the resistance within the specified limit?	Less than 1 Ω	Go to *Step 42*	Go to *Step 41*
41	Replace the park/neutral position switch relay. Is the repair complete?	—	System OK	—
42	With the ignition in RUN and the TR selector out of Park, use a *J 39200* to measure voltage between the park/neutral position switch relay terminal 85 and ground. Is the voltage within the specified limits?	11–14 v	Go to *Step 44*	Go to *Step 43*
43	Locate and repair the open in CKT 1131 (YEL/BLK) between the park/neutral position switch relay terminal 87A and terminal A of C305. Is the repair complete?	—	System OK	—
44	1. Disconnect connector C1 (7 GRY) from the park/neutral position and backup lamps switch. 2. With the ignition in RUN and the TR selector out of Park, use a *J 39200* to measure voltage between terminal B of connector C1 and ground. Is the voltage within the specified limits?	11–14 v	Go to *Step 46*	Go to *Step 45*
45	Replace the park/neutral position and backup lamps switch. Is the repair complete?	—	System OK	—
46	1. Locate the short to B+ in CKT 275 (LT GRN) in one of the following areas: • Terminal B of the park/neutral position and backup lamps switch and park/neutral position switch relay terminal 85. • Splice S156 and the BTSI relay terminal 85 • Splice S156 and the upfitter connector 2. Repair as required. Is the repair complete?	—	System OK	—

Repair Instructions

Park Brake System Repair

Refer to *Park Brake Repair Instructions* in the WCC Service Manual.

Description and Operation

Electric/Auto Park System Description (P32 Motorhome) (L18)

Auto Apply Actuator System

The parking brake is applied by an actuator which uses a strong spring to pull on the cable and apply the brake. The brake is released by a hydraulic cylinder which pushes a piston against the actuator spring to remove tension from the cable. Hydraulic pressure for this release is supplied by an electric pump which is turned on by having the ignition ON and the transmission range selector moved out of PARK. Shifting the selector into PARK, turning the ignition to OFF, or pulling the pull button switch will shut off power for the release mechanism, allowing the actuator to apply the parking brake.

Pull Button Switch

There is provision for applying the parking brake manually when the transmission is not in PARK. Pulling out the pull button switch will turn off the brake release system and apply the brake.

AUTO PARK and BRAKE Lamp

The AUTO PARK indicator lamp on the instrument cluster turns on when the parking brake is applied or when the pump is running. The BRAKE indicator turns on when the pull button switch is applied or when the actuator is in an overtravel condition. In case of an actuator overtravel, the parking brake alarm will also sound.

Electric/Auto Park System Operation

Release the Parking Brake

To release the electric/auto park brake, turn the ignition switch to ON and move the transmission range (TR) shift lever from the PARK position. This opens a section of the park/neutral position and backup lamps switch. That allows relay contacts to close providing power to the release circuit.

Apply the Parking Brake

Apply the parking brake by one of three methods:

- Pull the shift lever back into the PARK position
- Pull the pull button switch
- Turn the ignition to OFF

Any of these actions de-energize the parking brake release system which allows the actuator to apply the parking brake.

Warning/Indicator Lamp Operation

The AUTO PARK indicator lamp turns on when the system pressure is less than 3 100 kPa (450 psi) or when the electric/hydraulic pump motor is running because the pump motor switch is closed. The pressure pump motor switch and the pressure indicator switch supply B+ to the circuit for lamp operation. The hydraulic pressure involved in releasing the parking brake causes the switches to open the circuit and turns the lamp off. The lamp will light briefly each time the pump runs for pressure maintenance.

Electric/Auto Park Circuit Description

The electric/auto parking brake system controls the propeller shaft-mounted parking brake. It consists of the following components.

- Pump motor switch
- Pump
- Solenoid valve
- Actuator assembly
- Park/Neutral position switch
- Pump motor relay
- Pressure indicator switch
- Actuator position switch

This section covers the diagnostic and service procedures for the system components. For service information on the propeller shaft parking brake, refer to *Park Brake Cable Service/Adjustment (Electric Auto Park Brake)* in the WCC Service Manual.

Basic Knowledge Required

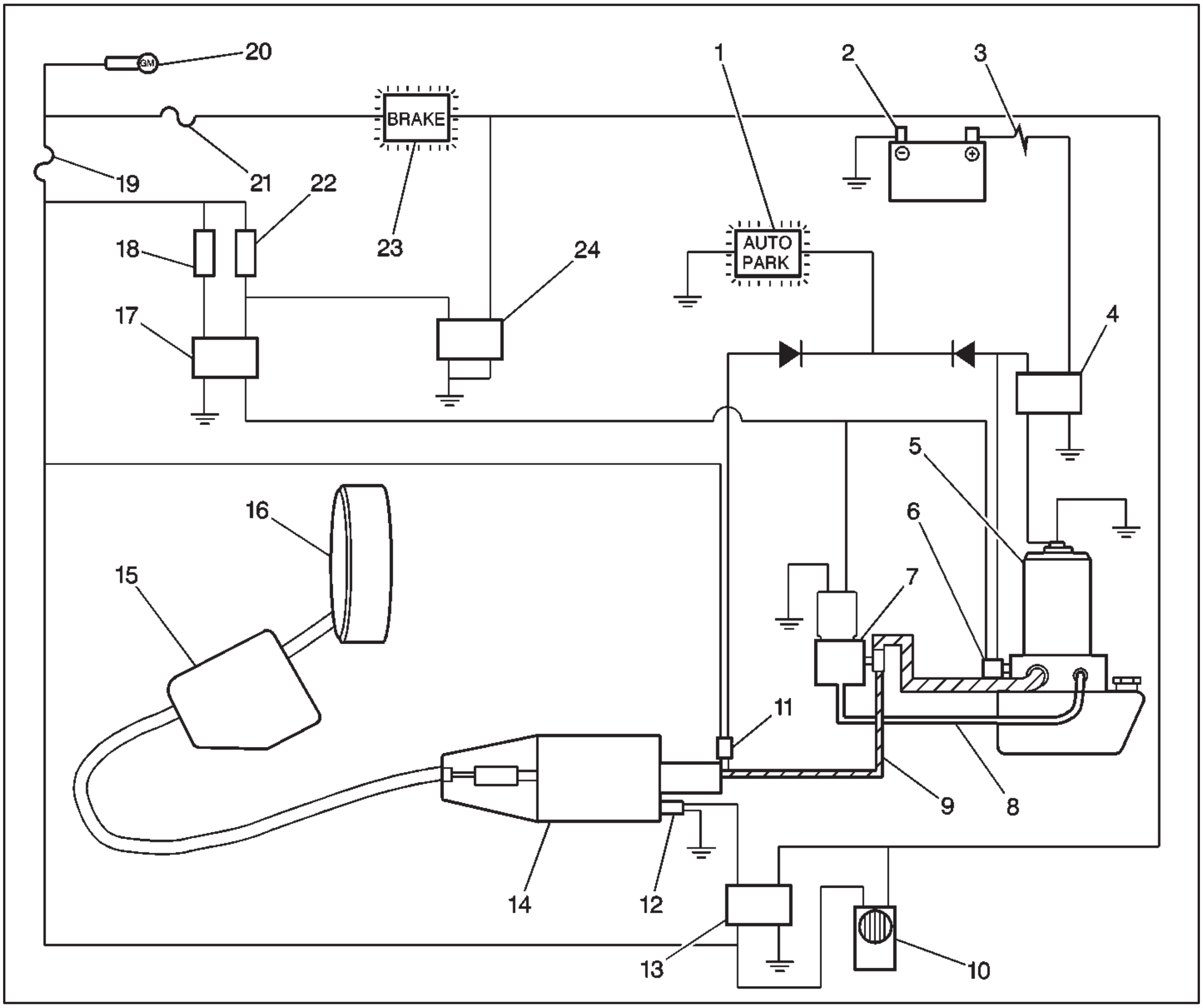
Before attempting to diagnose the electric/auto park brake system, you must have a good understanding of electric and hydraulic system basics. Without this basic knowledge, you will find it difficult to diagnose this system.

Some electrical basics, basic troubleshooting procedures and hints, and the use of circuit testing tools are discussed in Electrical Diagnosis.

Pump Motor Switch

The pump motor switch mounts on to the parking brake pump assembly housing. It is a hydraulic pressure switch that operates within a certain pressure range turning the pump motor on and off. The switch closes when the system pressure is below 8 300 kPa (1,200 psi) and opens when the system pressure reaches approximately 11 000 kPa (1,600 psi). The switch operates the pump motor by applying B+ to the coil (control side) of the relay switch. This also applies B+ to the AUTO PARK indicator lamp which lights whenever the pump relay is energized.

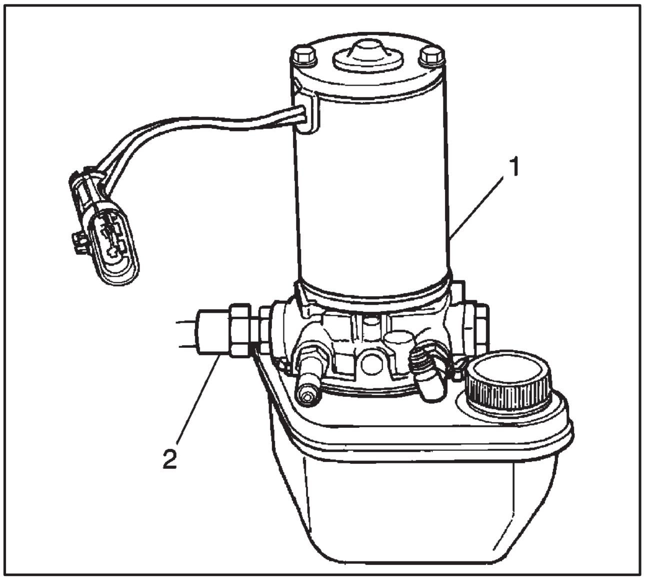
Electric/Auto Parking Brake Components (P32 Motorhome) (L18)



Legend

- (1) AUTO PARK Indicator Lamp
- (2) Battery
- (3) Fusible Link
- (4) Pump Motor Relay
- (5) Pump and Reservoir
- (6) Pump Motor Switch
- (7) Solenoid Valve
- (8) Hydraulic Return Pipe (Low Pressure)
- (9) Hydraulic Supply Pipe (High Pressure)
- (10) Parking Brake Alarm
- (11) Park Brake Low Pressure Switch
- (12) Park Brake Proximity Switch
- (13) Alarm Relay
- (14) Actuator Assembly
- (15) Differential Lever
- (16) Parking Brake
- (17) Park/Neutral Position Switch Relay
- (18) Park/Neutral Position and Backup Lamps Switch
- (19) Turn/Backup Fuse 10
- (20) Ignition Switch
- (21) GAUGES Fuse 8
- (22) Pull Button Switch
- (23) Brake Indicator Lamp
- (24) Pull Button Relay

Parking Brake Pump Assembly



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Legend

(1) Parking Brake Pump Assembly
(2) Pressure Maintenance Switch

The parking brake pump assembly is located in a component box on the passenger's side of the vehicle. The component box is on the inside of the right frame rail behind the transmission. It consists of an electric pump and fluid reservoir. The pump provides fluid pressure to release the brake. A pressure relief valve in the pump limits system pressure to 12 400 kPa (1,800 psi).

Parking Brake Solenoid Valve

The parking brake solenoid valve is located in the component box on the underside of the vehicle. The valve regulates fluid return to the pump reservoir. The parking brake is released by turning on the hydraulic pump and closing the solenoid valve to hold the pressure in the system. The parking brake is applied by turning off the power, which stops pump operation and opens the valve to allow the fluid to return to the pump reservoir.

Actuator Assembly

Caution: Do not disassemble the actuator. Always service the actuator as a unit. The actuator contains a large spring under tension. Disassembling the actuator allows the spring to expand with great force, which can result in personal injury.

The actuator is located underneath the vehicle in front of the component box. The actuator is a spring-loaded device that operates the parking brake cable. A large spring inside the actuator applies the parking brake. The brake is released by applying hydraulic fluid pressure against a piston. When that pressure is great enough, the piston overcomes spring tension and pushes against the actuator to release the parking brake.

Park/Neutral Position Switch

The park/neutral position (PNP) switch is located on the left side of the transmission housing. One portion of this switch is normally open, closed in PARK. This operates a normally closed relay that supplies power to the park brake release mechanism when that relay coil is not energized. By placing the range selector in PARK, the PNP switch applies voltage to the relay coil which opens the contacts and removes voltage from the release system resulting in application of the parking brake. Moving the selector out of PARK de-energizes the relay which switches power on for the release mechanism to release the park brake.

Pump Motor Relay

The parking brake pump motor relay is located in the component box underneath the vehicle. The relay coil receives B+ from the pump motor switch closing the contacts to complete the feed circuit to the pump motor. When the relay coil is energized, the AUTO PARK indicator is lighted.

Park Brake Low Pressure Switch

The park brake low pressure switch is a hydraulic ON/OFF switch located in the hydraulic fitting at the end of the actuator release cylinder underneath the vehicle. The switch is mounted in the park brake hydraulic system and controls B+ to the AUTO PARK lamp. The switch closes when the system pressure is below 3 100 kPa (450 psi) and turns on the light when the ignition is ON.

Park Brake Proximity Switch (Alarm Circuit)

This is a switch mounted beside the relay cylinder on the end of the actuator housing. This switch opens in an actuator overtravel condition, causing the alarm relay to de-energize and complete ground for the park brake alarm and the diode network. That sounds the alarm and lights the BRAKE indicator lamp. Except for an electrical malfunction, this alarm will be active only when the parking brake is applied and indicates the need for adjustment of the cable or service of the park brake linings.

Section 5

Brakes

Sub-Section 5.5 – Antilock Brake System

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Antilock Brake System Connector End Views (P52 Commercial) (L18) . . . . (S2) 5.5-27

BLANK

Antilock Brake System

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Combination Valve to BPMV	16 N·m	12 lb ft
EBCM Bracket Mounting Bolts	36 N·m	28 lb ft
EBCM to BPMV	5 N·m	44 lb in
EHCU to Bracket	9 N·m	7 lb ft
EHCU Crossmember Bolts	36 N·m	28 lb ft
Front Brake Line to Combination Valve	24 N·m	18 lb ft
Front Wheel Speed Sensor Mounting Bolts	26 N·m	19 lb ft
Hydraulic Lines to Tube Adapters	30 N·m	22 lb ft
Rear Brake Line to Combination Valve	24 N·m	18 lb ft
Splash Shield Mounting Bolts	11 N·m	9 lb ft
Tube Adapters to BPMV	31 N·m	23 lb ft
Wheel Speed Sensor Harness Clip to Shock Tower	11 N·m	9 lb ft

ABS Diagnostic Specifications

WSS Temperature vs. Sensor Resistance

°C	°F	Ohms
Temperature vs Resistance Values (Approximate)		
–40 to 4	–40 to 40	1575 to 2420
5 to 43	41 to 110	1980 to 2800
44 to 93	111 to 200	2250 to 3280
94 to 150	201 to 302	2750 to 3850

Service Parts Group Numbers

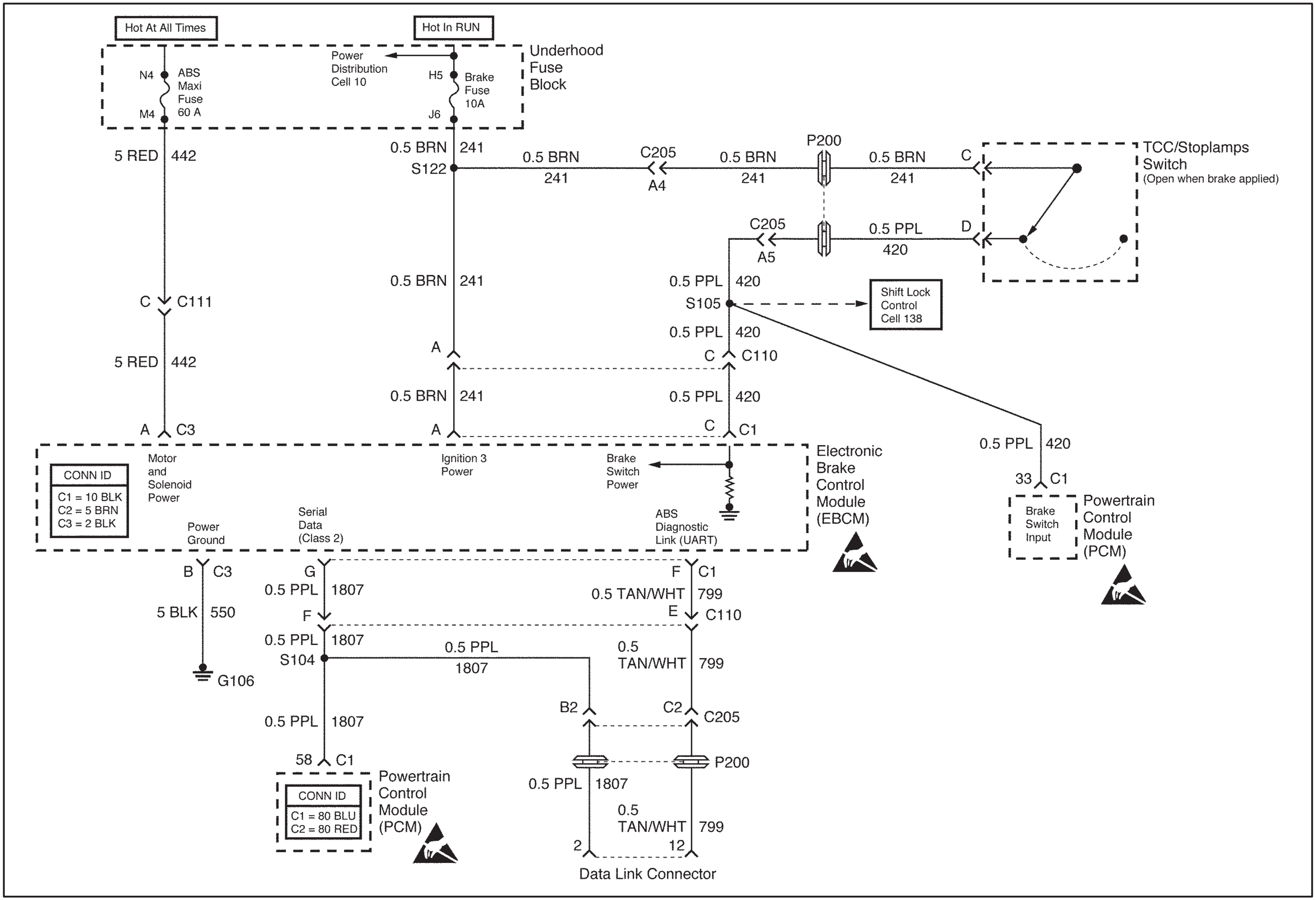
Application	Service Parts Group Number
Brake Pressure Modulator Valve	4.730
Electronic Brake Control Module	4.720
Stoplamp Switch	2.447
Wheel Speed Sensor	4.710

Schematic and Routing Diagrams

Antilock Brake System Schematic Icons

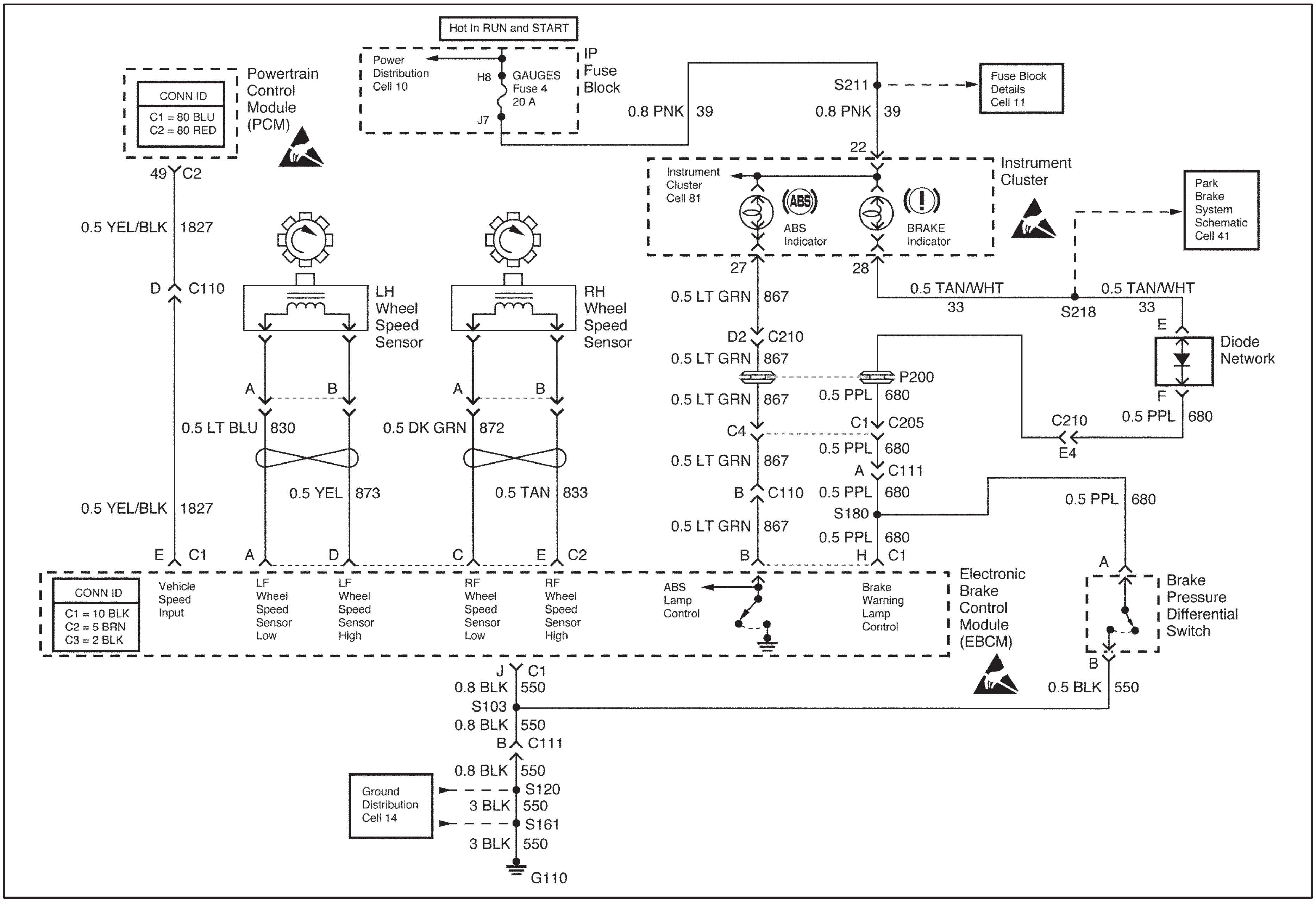
Icon	Icon Definition
 19384	Refer to *ESD Notice* in Cautions and Notices in the WCC Service Manual.
 296880	**Important:** The wheel speed sensor (WSS) pigtail has female terminals. The ABS harness has female terminals. A Delphi© coupling with male terminals (P/N 12146445) is used to make the two harnesses. Be sure to check the connectors at both ends of this coupling during a visual diagnostic inspection of these circuits.
 296880	**Important:** Twisted-pair wires provide an effective “shield” that helps protect sensitive electronic components from electrical interference. Depending on application, twisted-pair wires are used on wiring harnesses connecting the following components: electronic brake control module (EBCM) wheel speed sensor (WSS). In order to prevent electrical interference from degrading the performance of the connected components, you must maintain the proper specification when making any repairs to the twisted-pair wires shown: • The wires must be twisted a minimum of nine (9) turns per 30.5 cm (12 in) as measured anywhere along the length of the wires. • The outside diameter of the twisted wires must not exceed 6.0 mm (0.236 in). Refer to *Splicing Twisted or Shielded Cable* in Wiring Systems.

Antilock Brake System Schematics (P32 Motorhome) (Cell 44: Gas, ABS, Power and Grounding, DLC Output) (L18)



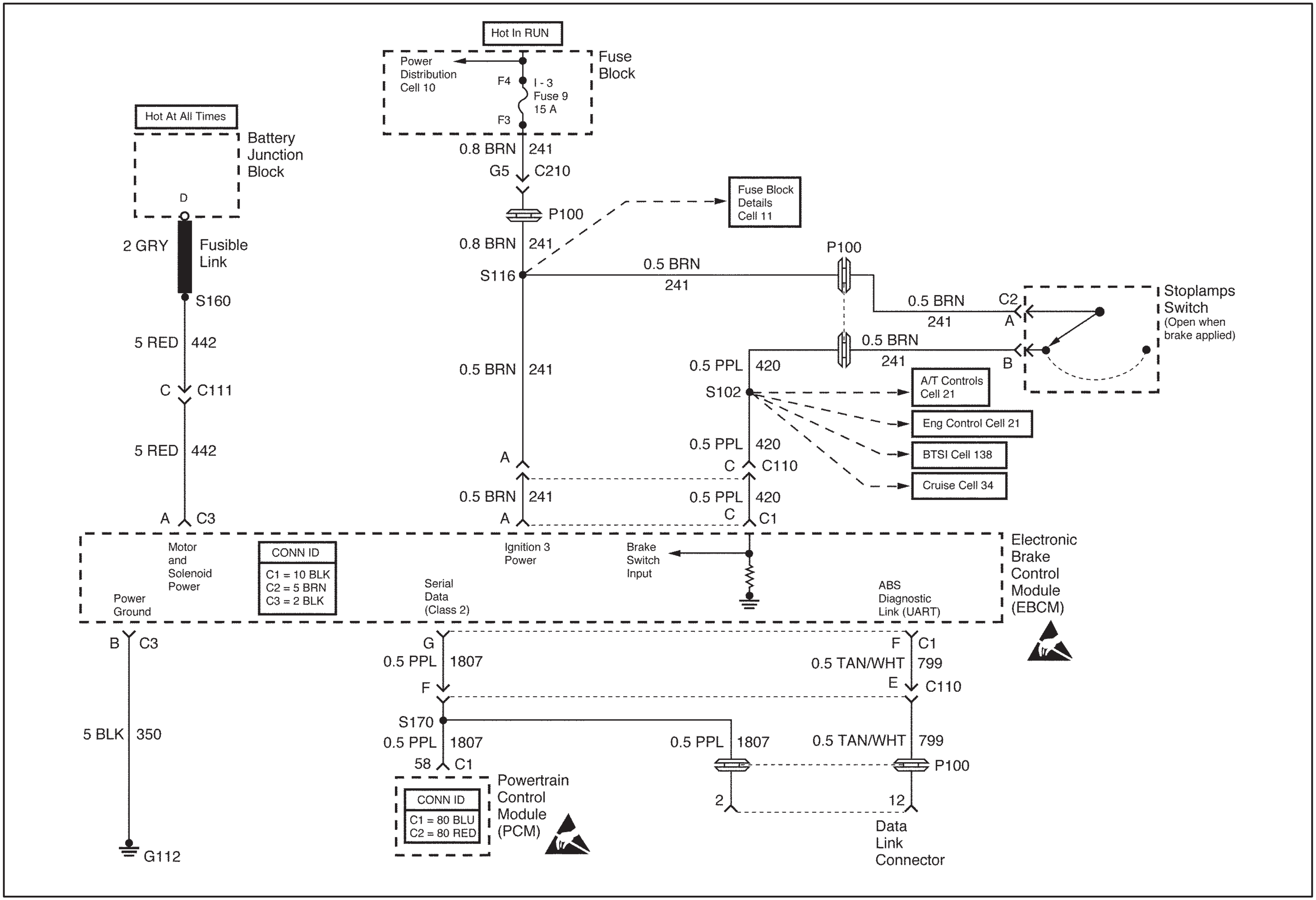
77555001

Antilock Brake System Schematics (P32 Motorhome) (Cell 44: ABS Inputs and Outputs) (L18)



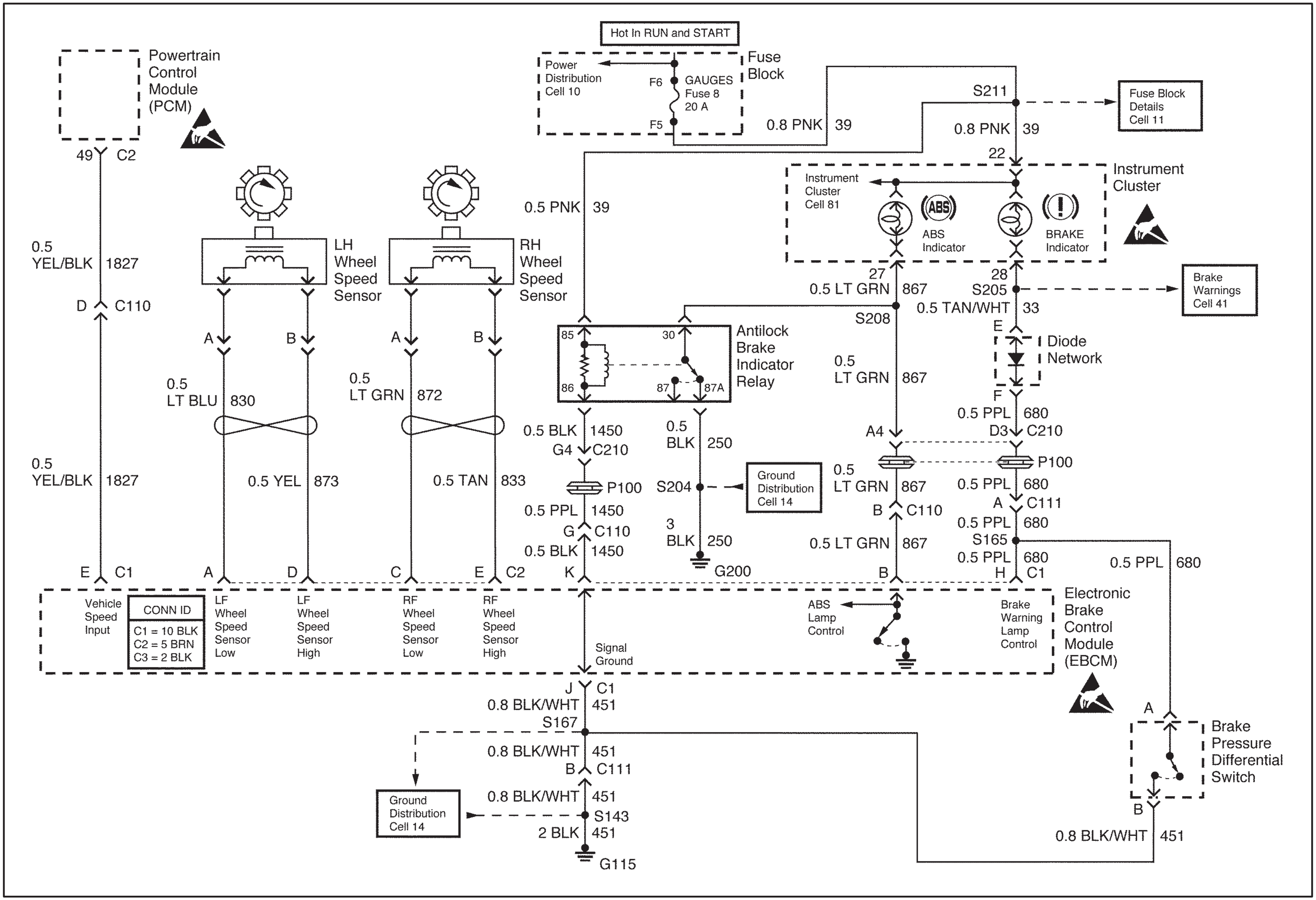
77555002

Antilock Brake System Schematics (P32 Motorhome) (Cell 44: Gas, ABS Power and Grounding, DLC Output) (L31)

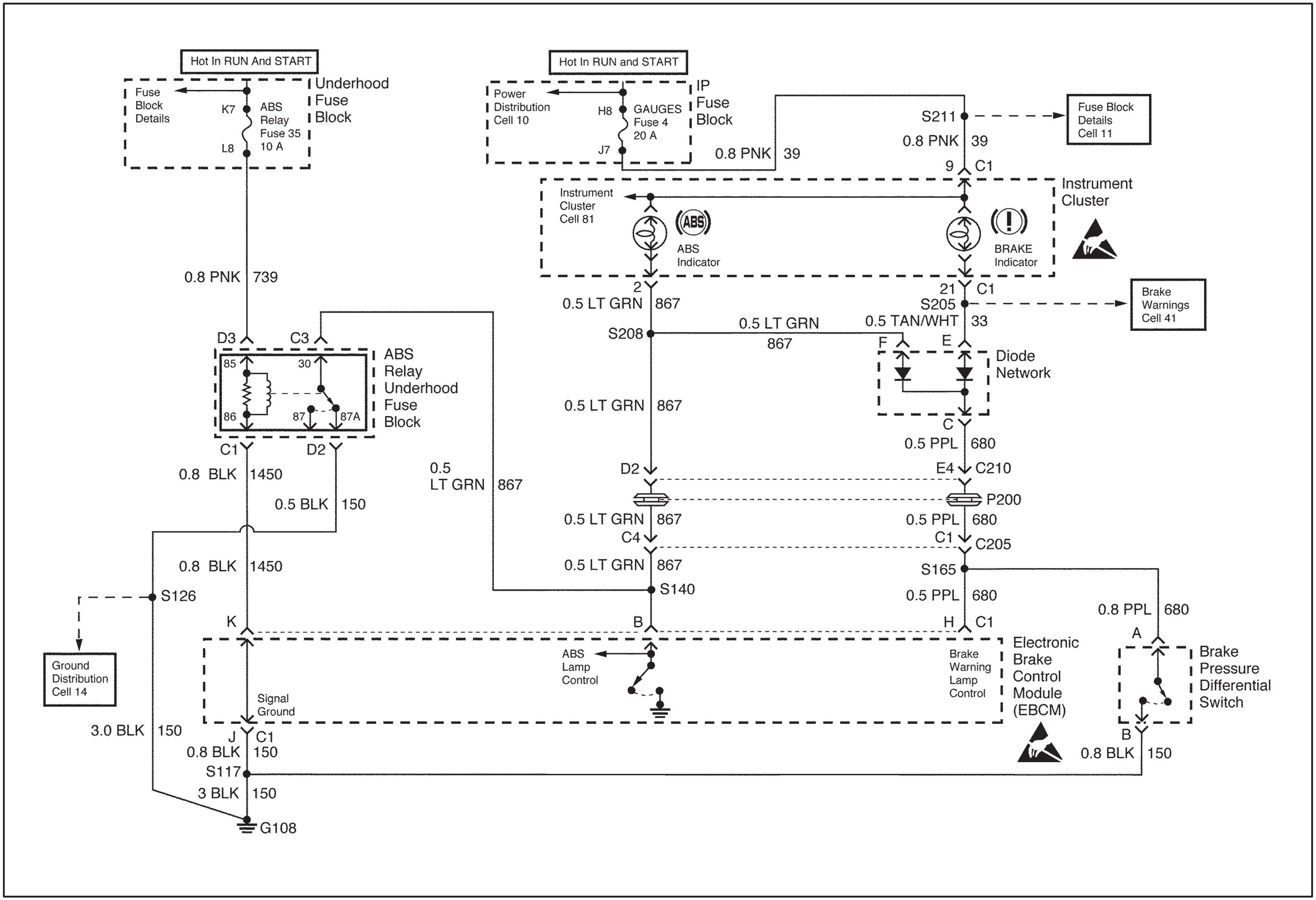


77555003

Antilock Brake System Schematics (P32 Motorhome) (Cell 44: ABS Inputs and Outputs) (L31)

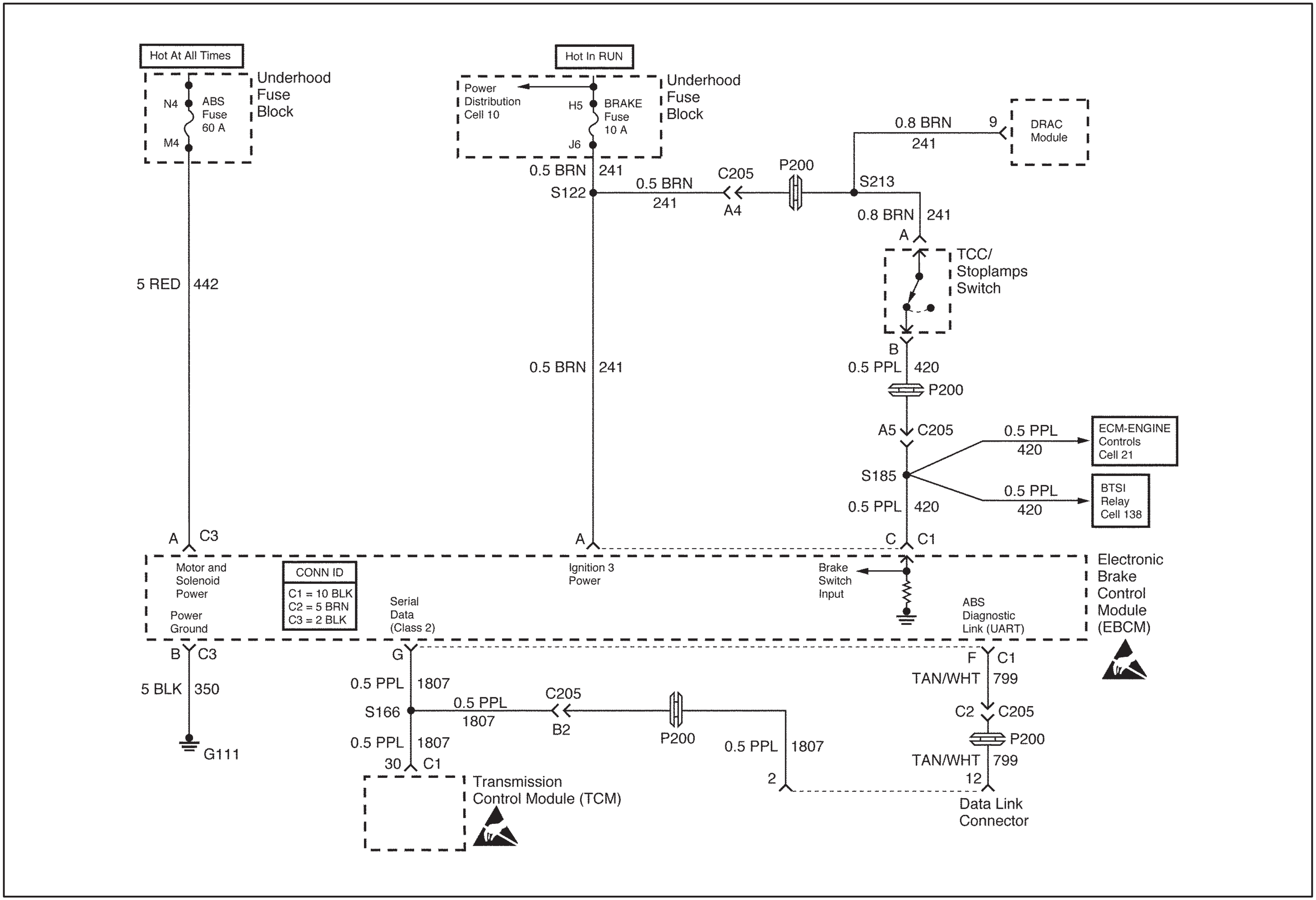


Antilock Brake System Schematics (P42 Commercial) (Cell 44: ABS Inputs and Indicators) (L4B)



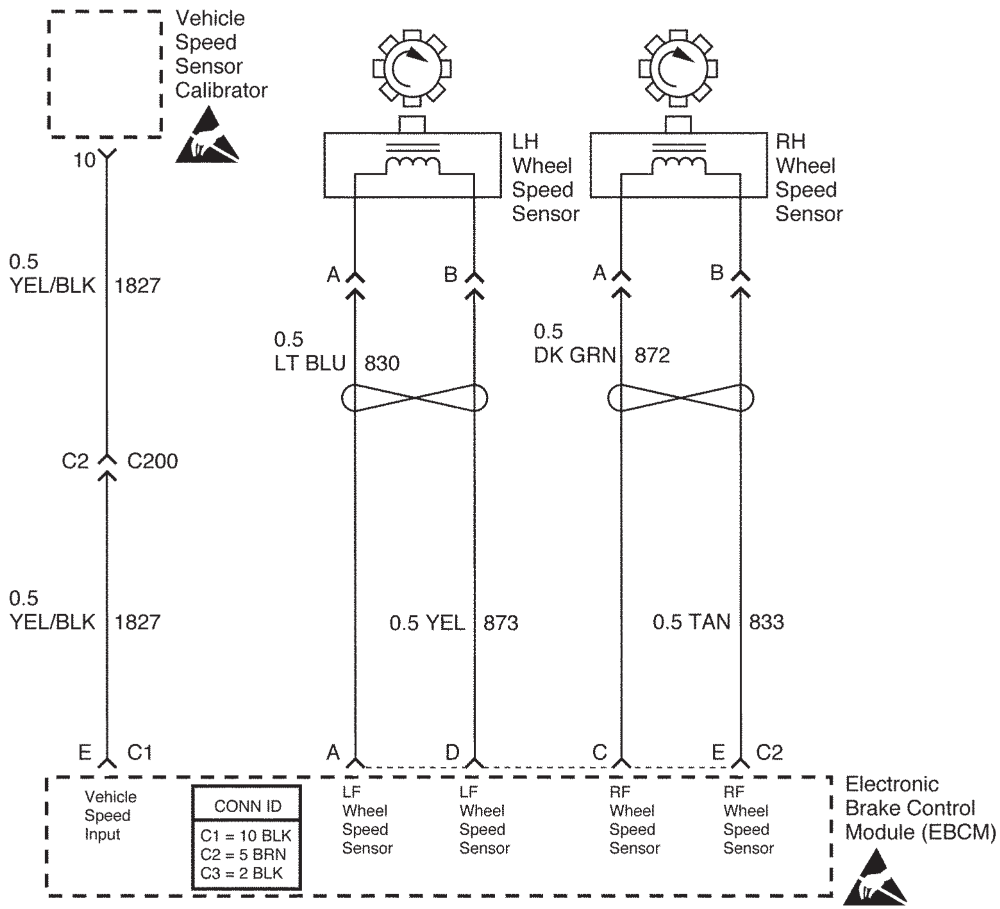
77555006

Antilock Brake System Schematics (P42 Commercial) (Cell 44: ABS Power and Grounding, DLC Output) (L4B)



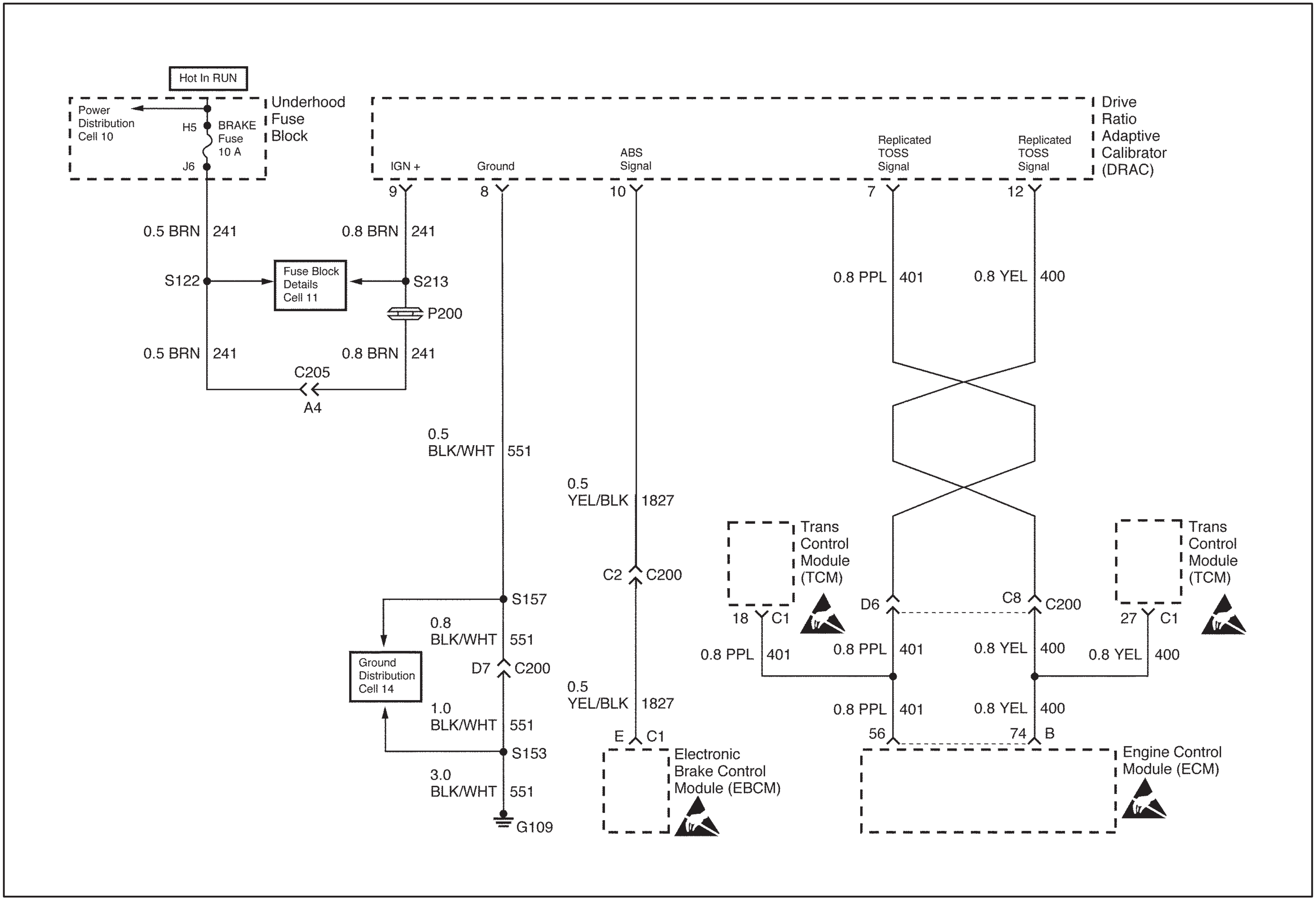
77555007

Antilock Brake System Schematics (P42 Commercial) (Cell 44: Speed Inputs) (L4B)

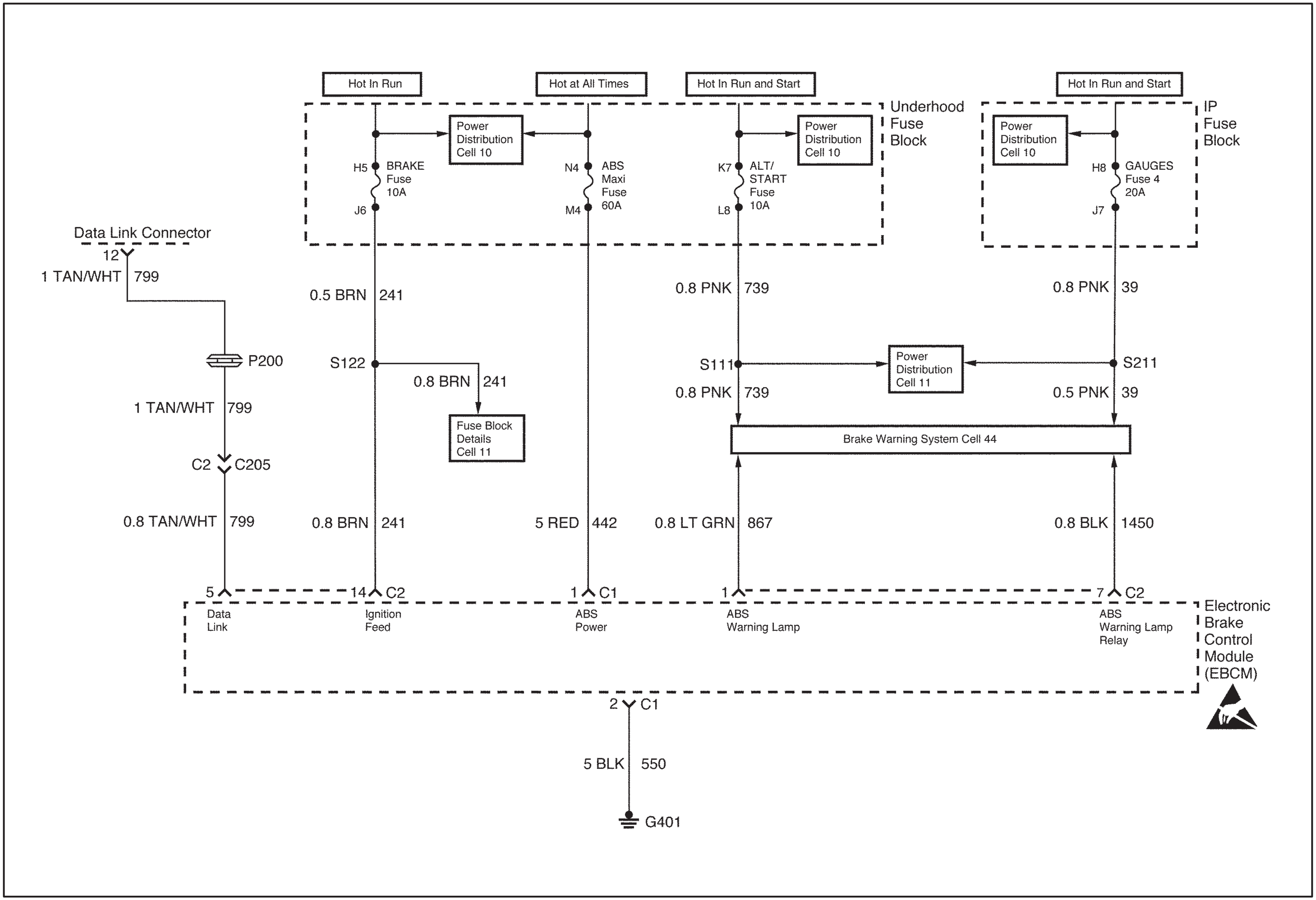


77555008

Antilock Brake System Schematics (P42 Commercial) (Cell 44: DRAC Module) (L4B)

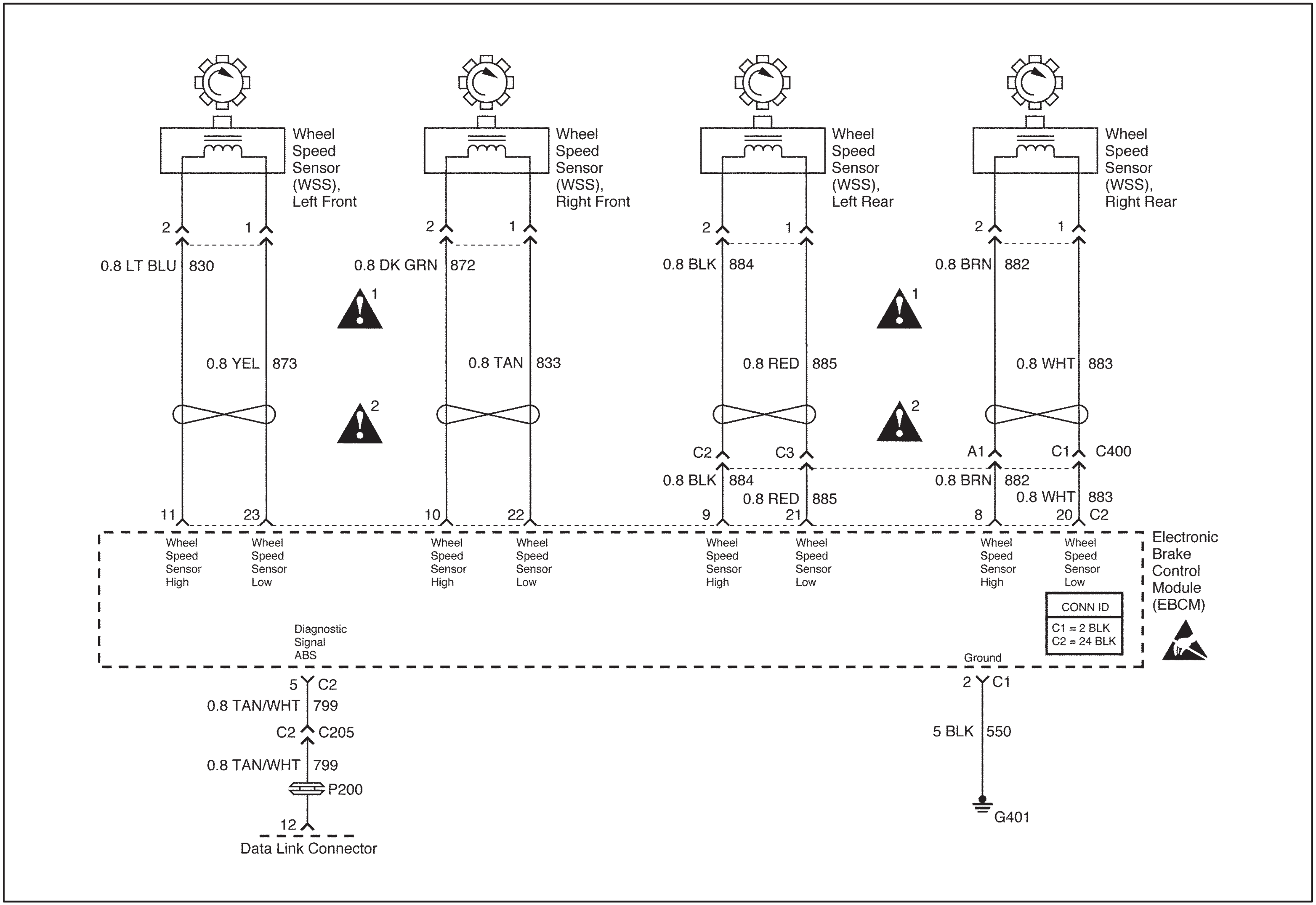


Antilock Brake System Schematics (P52 Commercial) (Cell 44: ABS Power and Grounding) (L18)



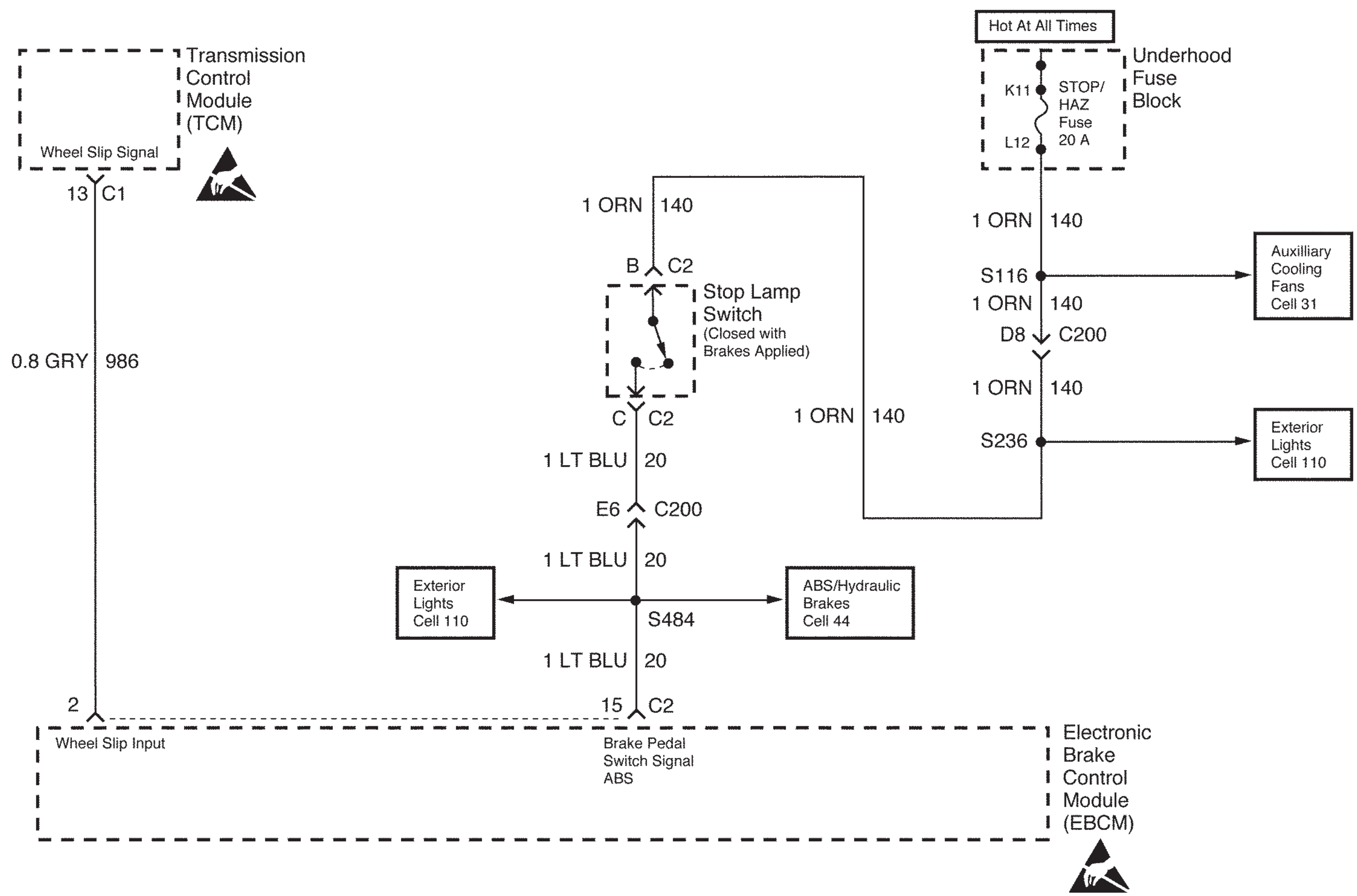
WRK55001

Antilock Brake System Schematics (P52 Commercial) (Cell 44: DLC, EBCM, EBCM Grounds and Wheel Speed Sensors) (L18)



77555011

Antilock Brake System Schematics (P52 Commercial) (Cell 44: Transmission Control Module and Stop Lamp Switch) (L18)

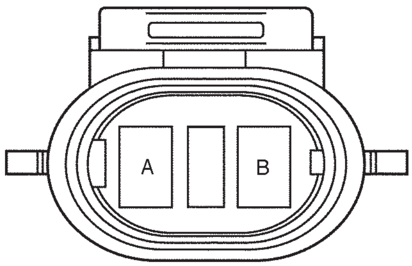


77555012

Visual Identification

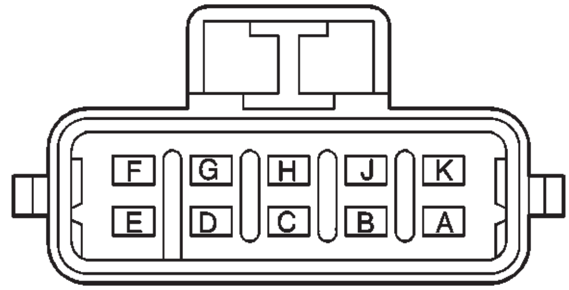
Antilock Brake System Connector End Views (P32 Motorhome) (L18)

Brake Pressure Differential Switch



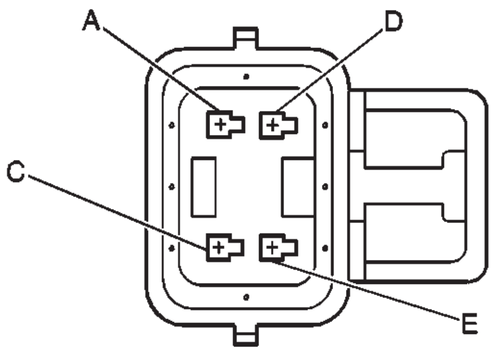
Connector Part Information		• 12052646 • 2 Way F Metri-Pack 150 Series (WHT)	
Pin	Wire Color	Circuit No.	Function
A	PPL	680	ABS Pressure Differential Sensor Signal
B	BLK	550	Ground

Electronic Brake Control Module (EBCM) Connector C1



Connector Part Information		• 12065425 • 10 Way F Metri-Pack 150 Series (BLK)	
Pin	Wire Color	Circuit No.	Function
A	BRN	241	Fuse Output-Ignition 3
B	LT GRN	867	ABS Failure Indicator Lamp Output
C	PPL	420	Brake Pedal Switch Input
D	—	—	Not Used
E	YEL/BLK	1827	Vehicle Speed Input Signal
F	TAN/WHT	799	Diagnostic Signal-ABS
G	PPL	1807	Serial Data Signal-Class 2
H	PPL	680	ABS Brake Pressure Differential Sensor Signal
J	BLK	550	Ground
K	—	—	Not Used

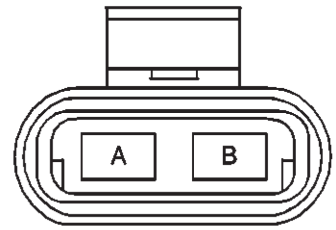
EBCM Connector C2



68766

Connector Part Information	• 12124662 • 5 Way F Metri-Pack 150 Series (BRN)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	830	Wheel Speed Return-Left Front
B	—	—	Not Used
C	DK GRN	872	Wheel Speed Return-Right Front
D	YEL	873	Wheel Speed Signal-Left Front
E	TAN	833	Wheel Speed Signal-Right Front

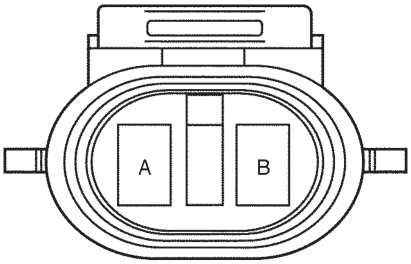
EBCM Connector C3



62489

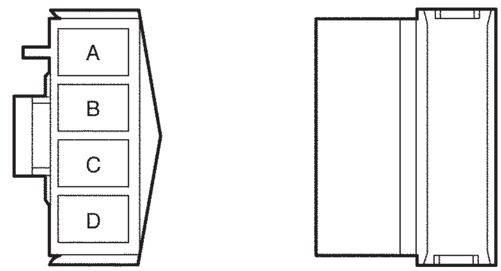
Connector Part Information	• 12085030 • 2 Way F 630 Series P2S (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	RED	442	Fuse Output-Battery
B	BLK	550	Ground

Wheel Speed Sensors



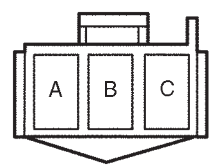
Connector Part Information	• 12052641 • 2 Way F Metri-Pack 150 Series, Sealed (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
Left Front			
A	LT BLU	830	Wheel Speed Sensor Return
B	YEL	873	Wheel Speed Sensor Signal
Right Front			
A	DK GRN	872	Wheel Speed Sensor Return
B	TAN	833	Wheel Speed Sensor Signal

Stop Lamp Switch C1



Connector Part Information	• 12033706 • 4 Way F Metri-Pack 280 Series (BLU)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	—	—	Not Used
B	—	—	Not Used
C	BRN	241	Ignition Positive Feed
D	PPL	420	Stop Lamp Signal

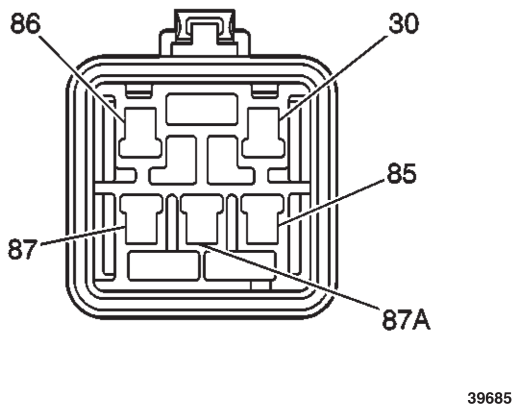
Stop Lamp Switch C2



Connector Part Information	• 12033699 • 3 Way F Metri-Pack Mixed Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	WHT	17	Stop Lamp Output
B	ORN	240	Switch Feed
C	LT BLU	20	CHMSL Output

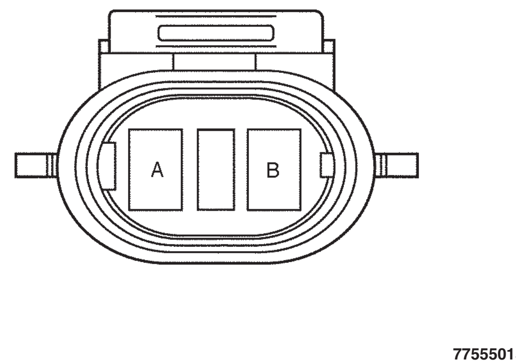
Antilock Brake System Connector End Views (P32 Motorhome) (L31)

Antilock Brake Indicator Relay



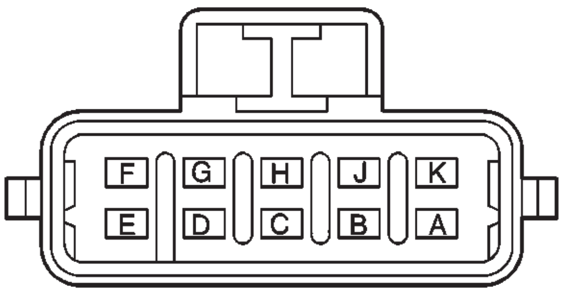
Connector Part Information	• 12110539 • 5 Way F Metri-Pack 280 Series, Flexlock (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
30	LT GRN	867	ABS Failure Indicator Lamp Output
85	PNK	39	Fuse Output-Ignition 1-Type III Fuse
86	BLK	1450	Ground
87	—	—	Not Used
87A	BLK	250	Ground

Brake Pressure Differential Switch



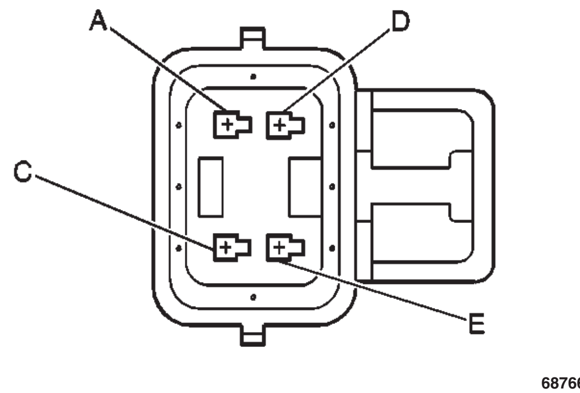
Connector Part Information	• 12052646 • 2 Way F Metri-Pack 150 Series (WHT)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PPL	680	ABS Pressure Differential Sensor Signal
B	BLK	450	Ground

Electronic Brake Control Module (EBCM) Connector C1



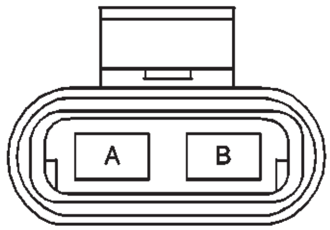
Connector Part Information	• 12065425 • 10 Way F Metri-Pack 150 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BRN	241	Fuse Output-Ignition 3-Type III Fuse
B	LT GRN	867	ABS Failure Indicator Lamp Output
C	PPL	420	Brake Pedal Switch Input
D	—	—	Not Used
E	YEL/BLK	1827	Output Shaft Speed-128,000 Pulses Per Mile
F	TAN/WHT	799	Diagnostic Signal-ABS-UART
G	PPL	1807	Serial Data Signal-Class B-10,400 BAUD-Primary
H	PPL	680	ABS Brake Pressure Differential Sensor Signal
J	BLK	450	Ground
K	BLK	1450	Ground

EBCM Connector C2



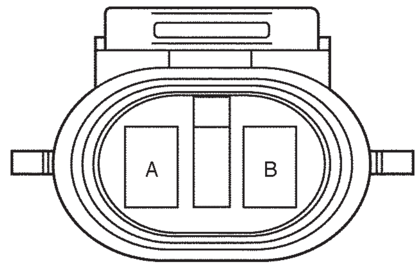
Connector Part Information	• 12124662 • 5 Way F Metri-Pack 150 Series (BRN)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	830	Wheel Speed Return-Left Front
B	—	—	Not Used
C	DK GRN	872	Wheel Speed Return-Right Front
D	YEL	873	Wheel Speed Signal-Left Front
E	TAN	833	Wheel Speed Signal-Right Front

EBCM Connector C3



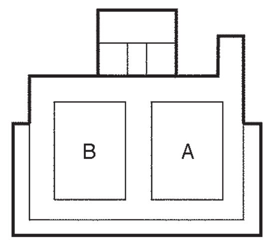
Connector Part Information	• 12085030 • 2 Way F Metri-Pack 630 Series P2S (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	RED	442	Fuse Output-Battery-Type II Fuse
B	BLK	350	Ground

Wheel Speed Sensors



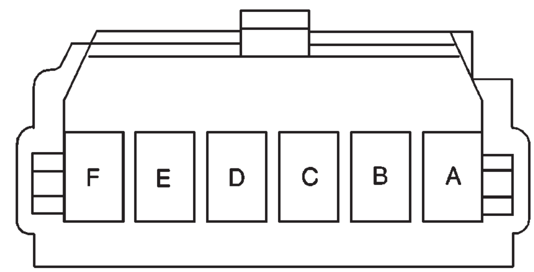
Connector Part Information	• 12052641 • 2 Way F Metri-Pack 150 Series, Sealed (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
Left Front			
A	LT BLU	830	Wheel Speed Sensor Return
B	YEL	873	Wheel Speed Sensor Signal
Right Front			
A	LT GRN	872	Wheel Speed Sensor Return
B	TAN	833	Wheel Speed Sensor Signal

Stop Lamp Switch C2



Connector Part Information	• 12015197 • 2 Way F Metri-Pack 280 Series (BLU)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BRN	241	Ignition Positive Feed
B	PPL	420	Stop Lamp Switch Signal

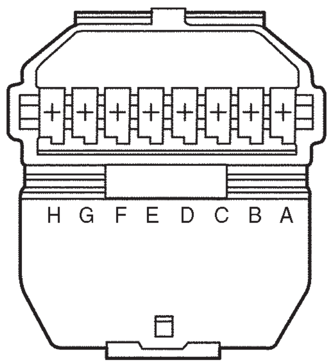
Diode Network



Connector Part Information	• 12040549 • 6 Way Printed Circuit Edgeboard Series Standard (GRY)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	1134	Park Brake Switch Signal
B	WHT	905	Body Builder Harness
C	—	—	Not Used
D (DRL)	TAN/WHT	33	Brake Warning Indicator Lamp Output
E	TAN/WHT	33	Brake Warning Indicator Lamp Output
F	PPL	680	ABS Pressure Differential Sensor Signal

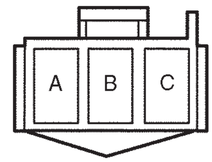
Antilock Brake System Connector End Views (P42 Commercial) (L4B)

Diode Network



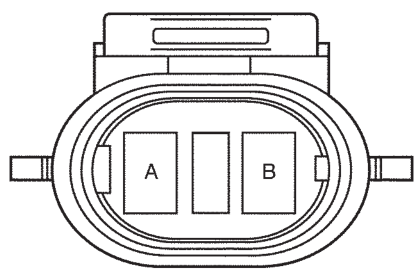
Connector Part Information	• 12015308 • 8 Way F Edgeboard Series, Standard (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	1134	Park Brake Input
B	LT BLU	1134	Park Brake Input
C	PPL	680	Brake Fluid Level Input
D	—	—	Not Used
E	TAN/WHT	33	Brake Lamp Control
F	LT GRN	867	ABS Lamp Control
G	WHT/BLK	235	Body Builder
H	TAN/WHT	33	Brake Lamp Control

Stop Lamp Switch C2



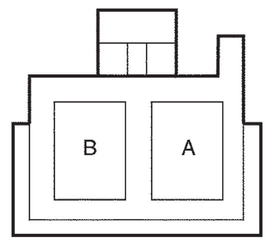
Connector Part Information	• 12033699 • 3 Way F Metri-Pack Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	WHT	17	Stop Lamp Output
B	ORN	140	Switch Feed
C	LT BLU	20	CHMSL Output

Brake Pressure Differential Switch



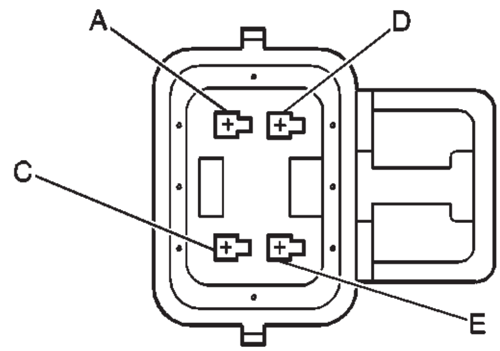
Connector Part Information	• 15324284 • 2 Way F Metri-Pack 150 Series (NAT)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PPL	680	Pressure Signal
B	BLK	150	Ground

Stop Lamp Switch C1



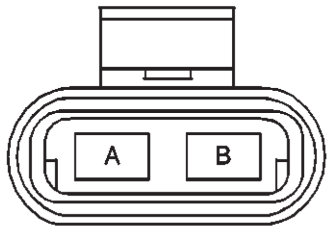
Connector Part Information	• 12015197 • 2 Way F Metri-Pack 280 Series (BLU)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BRN	241	Ignition Positive Feed
B	PPL	420	Stop Lamp Switch Signal

EBCM Connector C2



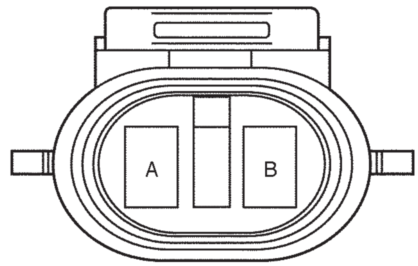
Connector Part Information	• 12124662 • 5 Way F Metri-Pack 150 Series (BRN)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	830	Wheel Speed Return-Left Front
B	—	—	Not Used
C	DK GRN	872	Wheel Speed Return-Right Front
D	YEL	873	Wheel Speed Signal-Left Front
E	TAN	833	Wheel Speed Signal-Right Front

EBCM Connector C3



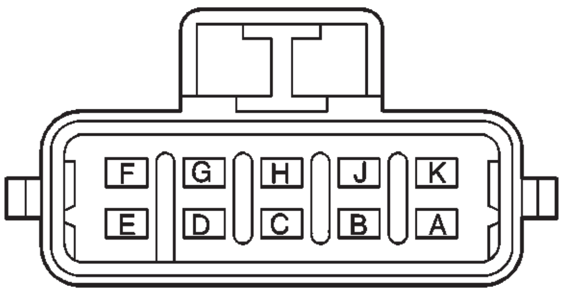
Connector Part Information	• 12085030 • 2 Way F 630 Series P2S (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	RED	442	Fuse Output-Battery-Type II Fuse
B	BLK	350	Ground

Wheel Speed Sensors



Connector Part Information	• 12052641 • 2 Way F Metri-Pack 150 Series, Sealed (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
Left Front			
A	LT BLU	830	Wheel Speed Sensor Return
B	YEL	873	Wheel Speed Sensor Signal
Right Front			
A	DK GRN	872	Wheel Speed Sensor Return
B	TAN	833	Wheel Speed Sensor Signal

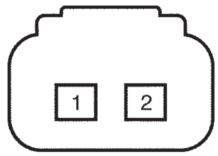
Electronic Brake Control Module (EBCM) Connector C1



Connector Part Information	• 12065425 • 10 Way F Metri-Pack 150 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BRN	241	Fuse Output-Ignition 3-Type III Fuse
B	LT GRN	867	ABS Failure Indicator Lamp Output
C	PPL	420	Brake Pedal Switch Input
D	—	—	Not Used
E	YEL/BLK	1827	Output Shaft Speed-128,000 Pulses Per Mile
F	TAN/WHT	799	Diagnostic Signal-ABS UART
G	PPL	1807	Serial Data Signal-Class B-10,400 BAUD-Primary
H	PPL	680	ABS Brake Pressure Differential Sensor Signal
J	BLK	150	Ground
K	BLK	1450	Ground

Antilock Brake System Connector End Views (P52 Commercial) (L18)

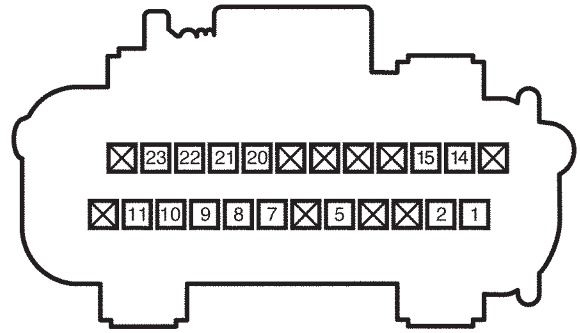
Electronic Brake Control Module (EBCM) Connector C1



77555025

Connector Part Information	• 12162896 • 2 Way (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
1	RED	442	Pump Motor Power Feed
2	BLK	550	Ground

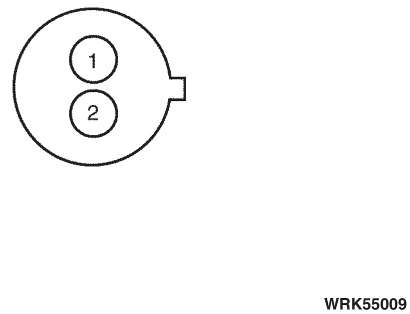
Electronic Brake Control Module (EBCM) Connector C2



77555026

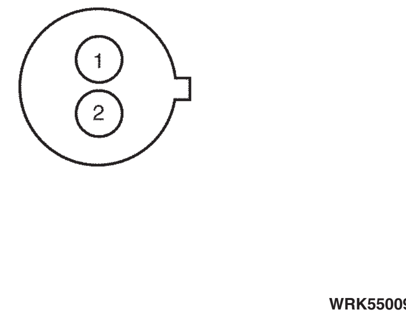
Connector Part Information	• 12162898 • 24 Way (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
1	LT GRN	867	ABS Indicator Lamp Control
2	GRY	986	Wheel Slip Signal Output
3	—	—	Not Used
4	—	—	Not Used
5	TAN/WHT	799	Serial Data Communication
6	—	—	Not Used
7	BLK	1450	ABS Warning Lamp Relay
8	BRN	882	Right Rear Wheel Speed Sensor High
9	BLK	884	Left Rear Wheel Speed Sensor High
10	DK GRN	872	Right Front Wheel Speed Sensor High
11	LT BLU	830	Left Front Wheel Speed Sensor High
12	—	—	Not Used
13	—	—	Not Used
14	BRN	241	Switched Ignition Feed Input
15	LT BLU	20	Stop Lamp Switch Input (Brake Switch)
16	—	—	Not Used
17	—	—	Not Used
18	—	—	Not Used
19	—	—	Not Used
20	WHT	883	Right Rear Wheel Speed Sensor Low
21	RED	885	Left Rear Wheel Speed Sensor Low
22	TAN	833	Right Front Wheel Speed Sensor Low
23	YEL	873	Left Rear Wheel Speed Sensor Low
24	—	—	Not Used

Wheel Speed Sensor (WSS) Left Rear



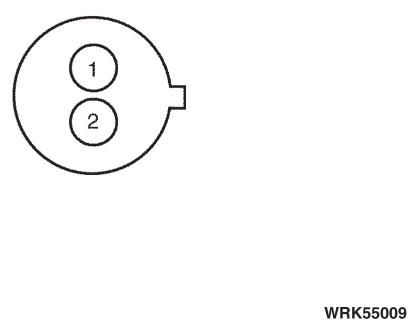
Connector Part Information	• 15339791		
Pin	**Wire Color**	**Circuit No.**	**Function**
1	RED	885	Wheel Speed Sensor Return Left Rear
2	BLK	884	Wheel Speed Sensor Signal Left Rear

Wheel Speed Sensor (WSS) Right Front



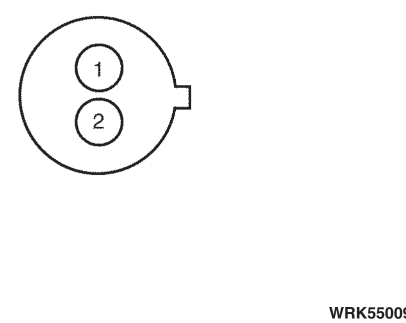
Connector Part Information	• 15339791		
Pin	**Wire Color**	**Circuit No.**	**Function**
1	DK GRN	872	Wheel Speed Sensor Signal Right Front
2	TAN	833	Wheel Speed Sensor Return Right Front

Wheel Speed Sensor (WSS) Left Front



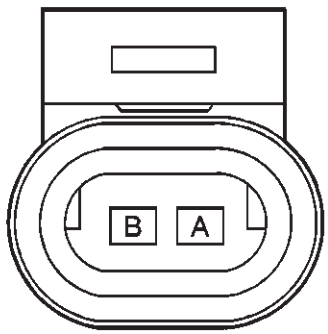
Connector Part Information	• 15339791		
Pin	**Wire Color**	**Circuit No.**	**Function**
1	YEL	873	Wheel Speed Sensor Return Left Front
2	LT BLU	830	Wheel Speed Sensor Signal Left Front

Wheel Speed Sensor (WSS) Right Rear



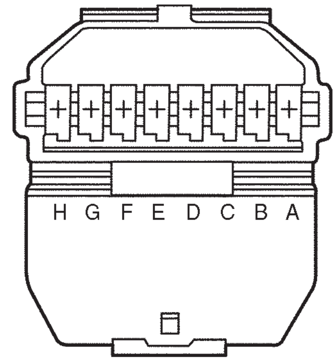
Connector Part Information	• 15339791		
Pin	**Wire Color**	**Circuit No.**	**Function**
1	WHT	883	Wheel Speed Sensor Return Right Rear
2	BRN	882	Wheel Speed Sensor Signal Right Rear

Brake Fluid Level Switch



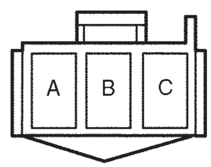
Connector Part Information	• 12162194 • 2 Way F Metri-Pack 150 Series, Sealed (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PPL	680	Brake Fluid Level Switch Output Brake Warning Indicator Lamp
B	BLK	550	Ground

Diode Network



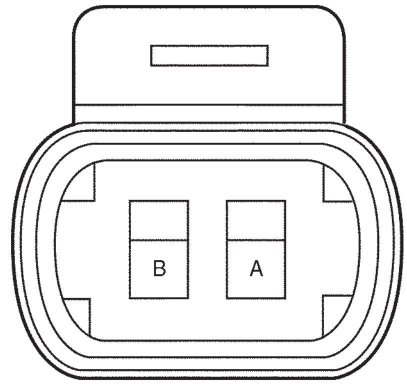
Connector Part Information	• 12015308 • 8 Way F Edgeboard Series, Standard (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	1134	Park Brake Input
B	LT BLU	1134	Park Brake Input
C	PPL	680	Brake Fluid Level Input
D	—	—	Not Used
E	TAN/WHT	33	Brake Lamp Control
F	LT GRN	867	ABS Lamp Control
G	WHT/BLK	235	Body Builder
H	TAN/WHT	33	Brake Lamp Control

Stop Lamp Switch C2



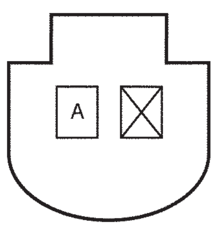
Connector Part Information	• 12033699 • 3 Way Metri-Pack Mixed Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	WHT	17	Stop Lamp Output
B	ORN	140	Switch Feed
C	LT BLU	20	CHMSL Output

Hydrobooster P/S Fluid Flow Switch



Connector Part Information	• 12162196 • 2-Way F Metri-Pack 150.2 Series (GRY)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU/BLK	1928	Brake Booster Pump Relay Control
B	BLK	550	Ground

Pressure Differential Switch



Connector Part Information	• 15398879 • 2 Way F Insert Molded Style (NAT)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	680	Pressure Signal
B	—	—	Not Used